Orleans Mutual Water Company Water Treatment System Upgrade

Public Review Draft

Initial Study/Mitigated Negative Declaration

July 2024

Prepared for:

State Water Resources Control Board
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ACRONYMS AND ABBREVIATIONS

APN	Assessor's Parcel Number
BACT	Best Available Control Technology
BMP	Best Management Practices
CAAQS	California ambient air quality standards
CalEEMod	California Emissions Estimator Model
CAL FIRE	California Department of Fire and Forestry
Caltrans	California Department of Transportation
Cal/OSHA	California Division of Occupational Safety and Health
Cal OES	California Governor's Office of Emergency Services
CARB	California Air Resources Board
CBC	California Building Code
CCAA	California Clean Air Act
CCR	California Code of Regulations
CDC	California Department of Conservation
CDFW	California Department of Fish and Wildlife
CESA	California Endangered Species Act
CEQA	California Environmental Quality Act
CF	Conservation Floodway
Cfs	cubic feet per second
CGS	California Geologic Survey
CH_4	methane
CIWMB	California Integrated Waste Management Board
CMU	concrete masonry unit
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalents
CRHR	California Register of Historical Resources
CWA	Clean Water Act
CWPP	Community Wildfire Protection Plan
dB	decibels
bcf/year	billion cubic feet per year
DDW	Division of Drinking water
District	Klamath-Trinity Joint Unified School District
DPM	diesel particulate matter
DTSC	Department of Toxic Substances Control
EIR	Environmental Impact Report

ACRONYMS AND ABBREVIATIONS (cont.)

EPA	Environmental Protection Agency
ESWTR	Enhanced Surface Water Treatment Rules
FAR	floor area ratio
FER	fault evaluation reports
FESA	Federal Endangered Species Act
FMMP	Farmland Mapping and Monitoring Program
Ft	foot
GHG	greenhouse gases
GLO	General Land Office
Gpm	gallons per minute
GWh	gigawatt hours
GWP	global warming potential
HFC	hydrofluorocarbons
IPCC	Intergovernmental Panel on Climate Change
ISMND	Initial Study Mitigated Negative Declaration
ISP	internet service provider
kVA	kilovolt-amps
kWh	kilowatt hour
Ldn	day-night average sound level
LRA	Local Responsibility Area
MBTA	Migratory Bird Treaty Act
MDD	maximum day demand
MLD	Most Likely Descendant
MMRP	Mitigation Monitoring and Reporting Program
MT	metric tons
NAAQS	national ambient air quality standards
NAGPRA	Native American Graves Protection and Repatriation Act
NAHC	Native American Heritage Commission
NCAB	North Coast Air Basin
NCUAQMD	North Coast Unified Air Quality Management District
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOx	nitrogen oxides
NO_2	nitrogen dioxide
NPDES	National Pollution Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSR	New Source Review

ACRONYMS AND ABBREVIATIONS (cont.)

NWI	National Wetland Inventory
NWIC	Northwest Information Center
O_3	ozone
OHP	Office of Historic Preservation
OMWC	Orleans Mutual Water Company
OSHA	Occupational Safety and Health Administration
PFC	perfluorocarbons
PG&E	Pacific Gas & Electric
PI	Plasticity Index
PM_{10}	coarse particulate matter
$PM_{2.5}$	fine particulate matter
PRC	Public Resources Code
PSD	Prevention of Significant Deterioration
RE 1-5	Residential Estates, 1-5 acre minimum
ROGs	reactive organic gases
RWQCB	Regional Water Quality Control Board
SAA	Streambed Alteration Agreement
SB	Senate Bill
Sf	square foot
SF_6	sulfur hexafluoride
SLF	Sacred Lands File
SMARA	State Surface Mining and Reclamation Act of 1975
SO_2	sulfur dioxide
SR	State Route
SRA	State Responsibility Area
SRF	State Revolving Fund
SWPPP	Stormwater Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TAC	Toxic Air Contaminant
TPZ	Timber Production Zone
U	Unclassified
USACE	United States Army Corps of Engineers
USCB	United States Census Bureau
USFWS	United States Fish and Wildlife Service
VFD	Variable Frequency Devices
VMT	Vehicles miles traveled
WTP	water treatment plant

INITIAL STUDY INFORMATION SHEET

1.	Project title:	Orleans Mutual Water Company Water Treatment System Upgrade Project
2.	Lead agency name and address:	State Water Resources Control Board 1001 I St, Sacramento, CA 95814
3.	Contact person and phone number:	Abbygayle Guevara, Environmental Scientist (916)319-0180
4.	Project location:	The project is located in the unincorporated community of Orleans in Humboldt County, CA, 95546.
5.	General plan designation:	Conservation Floodway (CF), Residential Estates, 1-5 acre minimum (RE1-5)
6.	Zoning:	Unclassified (U)

7. Description of project:

The Orleans Mutual Water Company Water Treatment System Upgrade Project (Project) is proposing to improve and replace an existing water distribution system that currently serves 34 residential connections in the unincorporated community of Orleans. The Project would demolish an existing in-line filtration plant and replace it with a new surface, direct-filtration water treatment plant (WTP). The Project would construct a new water treatment building with a backwash reclaim tank. A proposed generator and propane tank would be located adjacent to the water treatment building. The existing in-line filtration plant would be replaced due to age, deteriorating condition, outdated composition of the existing system, lack of system redundancy, and insufficient reserves to support fire response flows. The Project would also demolish an existing redwood raw water tank and replace it with a new bolted steel water storage tank.

8. Surrounding land uses and setting:

The Project site is located directly off Camp Creek Road in the unincorporated community of Orleans in Humboldt County. The Project site is located approximately 1.1 miles west of downtown Orleans, CA. The Project would be located on Assessor's Parcel Number (APN) 529-141-037, which is approximately 3.34-acres and owned by the Karuk Tribe. The proposed Project site would be located on the northern side of California State Route 96 (SR 96) and would be accessed via an existing path directly off Camp Creek Road. The Project site is bordered by Six Rivers National Forest, Crawford Creek, Camp Creek, Klamath River, SR 96, and single-family homes.

The Project site is generally flat, although there is a steep upwards slope to the north of the Project site. The elevation within the Project site ranges from 560 to 640-feet(ft) above mean sea level (amsl). Crawford Creek flows through a steeply walled ravine located west of the Project site. Two ponds, totaling approximately 0.06-acre, are located in the Project area; however, they will not be impacted from the proposed Project.

1.0 INTRODUCTION

This Initial Study Mitigated Negative Declaration (ISMND) addresses the proposed upgrade to an existing water treatment system by the Project applicant, Orleans Mutual Water Company (OMWC). The property is located within the unincorporated area of Orleans in Humboldt County (County). The Initial Study has been prepared to satisfy the requirements of the California Environmental Quality Act (CEQA; Public Resources Code Section 21000 et seq.) and the CEQA Guidelines (14 California Code of Regulations [CCR] 15000 et seq.). CEQA requires that all State and local government agencies consider the environmental consequences of projects over which they have discretionary authority before they approve or implement those projects.

The Initial Study is a public document used by the decision-making Lead Agency to determine whether a project may have a significant effect on the environment. The Project is proposed by the OMWC and has applied for funding with the State Water Resources Control Board (SWRCB) under the State Revolving Fund (SRF) Program. In the case of the proposed Project, the SWRCB is the Lead Agency and will use the Initial Study to determine whether the proposed Project may have a significant effect on the environment.

This Initial Study relies on CEQA Guidelines Sections 15064 in its determination of the significance of the environmental impacts. Per Section 15064, the finding as to whether a project may have one or more significant impacts shall be based on substantial evidence in the record, and that controversy alone, without substantial evidence of a significant impact, does not trigger the need for an Environmental Impact Report (EIR).

2.0 PROJECT BACKGROUND

The OMWC owns and operates a surface water diversion off Crawford Creek, a redwood raw water storage tank, an in-line filtration plant, and a water distribution system, all within Humboldt County. The diversion from Crawford Creek is located on United States Forest Service (USFS) land and the redwood raw storage tank and water treatment plant are located on a parcel owned by the Karuk Tribe.

On November 15, 2013, the California Department of Public Health (now the SWRCB Division of Drinking Water, or DDW) issued a letter to OMWC noting that the State had adopted Environmental Protection Agency's (EPA) Enhanced Surface Water Treatment Rules (ESWTR). Under these new rules, in-line filtration is not an approved filtration technology and grandfathering in older in-line systems is no longer allowed. The DDW then required OMWC to either: (1) demonstrate that the existing filter system can comply with the new rules; (2) upgrade the filter system to direct filtration; or (3) replace the filter system with an approved filtration technology. On August 29, 2016, the DDW issued an inspection letter to OMWC noting several deficiencies that must be addressed, most notably for: (1) compliance with the ESWTR as described above; (2) implementation of operational measures or improvements to reduce filter loading rate during peak demands to three gallons per minute per square foot (gpm/sf) or less; and (3) inadequate disinfection.

Due to these operational deficiencies along with the advanced age, deteriorating condition, outdated composition, lack of system redundancy, and insufficient reserves to support fire response flows, a new water treatment system would be required to replace the existing system almost in its entirety. The proposed improvements to this Project would include a new surface, direct-filtration water treatment plant (WTP). The Project would construct a new water treatment building and would install a new backwash reclaim tank and a steel water storage tank. The goal of the proposed water treatment system is to reliably produce water with acceptable turbidity levels using SWRCB approved filtration and disinfection technologies. The goal of the new water storage tank is to provide water storage equal to the maximum daily demand (MDD) while providing system redundancy and calculated fire flow. The OMWC has applied for financial assistance for the Project, through the California SWRCB Drinking Water State Revolving Fund (DWSRF) and would include the planning and design for an upgraded surface, direct-filtration WTP to comply with current Federal and State requirements.

2.1. Water Rights

Water rights for the division off Crawford Creek were originally permitted in 1965 and held by the subdivision developer under Permit No. 14952. In 2015, the Karuk Tribe applied for and took ownership as the Primary Owner of the water right (effective 12/2/2015). The water right states that the amount of water diverted from the creek is limited to the amount beneficially used for the stated purposes and would not exceed:

> Eleven-hundredths (0.11) cubic foot per second, to be diverted from June 1 to October 31 of each year for irrigation and domestic purposes. So long as there is no interference with other water rights, junior, as well as senior, licensee may increase his rate of diversion to a maximum of 0.67 cubic foot per second; provided that the total quantity diverted in any 30-day period does not exceed seven acre-feet. The maximum amount diverted under this license shall not exceed 35 acre-feet per year.

Per the water right, the peak diversion rate is 0.11 cubic feet per second (cfs), or 49 gallons per minute (gpm), although the diversion rate may increase to as high as 0.67 cfs, or 300 gpm. According to water production records, and as noted in the letters from DDW, the peak diversion rate of 49 gpm has been exceeded several times in the past 10 years. Additionally, the maximum diversion of 35 acre-feet per year (11.4 million gallons per year) was exceeded in 2010, 2014, 2015 and 2017.

3.0 PROJECT SETTING

3.1. Project Location

The Project site is located directly off Camp Creek Road in the unincorporated community of Orleans in Humboldt County (County). The Project site is located approximately 1.1-miles west of downtown Orleans, CA. The Project would be located on Assessor's Parcel Number (APN) 529-141-037, which is approximately 3.34-acres and owned by the Karuk Tribe. The proposed Project site would be located on the northern side of California State Route 96 (SR 96) and would be accessed via an existing path directly off Camp Creek Road. The Project site is bordered by Six Rivers National Forest, Crawford Creek, Camp Creek, Klamath River, SR 96, Marble Mountain Wilderness Area, and single-family homes. Neighboring land uses are summarized in Table 1. The Project site is located within the U.S. Geological Survey 7.5-minute *Orleans*, CA topographic quadrangle Township 11 North, Range 5 East, Section 36. Refer to Figure 1 for a vicinity graphic of the Project site and Figure 2 for an aerial map of the Project site depicting existing infrastructure/proposed improvements. (Note: all Figures are located in Appendix A).

Table 1
NEIGHBORING LAND USES

DIRECTION	LAND USE
North	Six Rivers National Forest, densely wooded land
East	Single-family homes, Camp Creek, wooded land
South	Single-family homes, SR 96, Klamath River, wooded land
West	Crawford Creek, Six Rivers National Forest, densely wooded land

3.2. Environmental Setting

The Project site is generally flat, although there is a steep upwards slope to the north of the site. The elevation within the Project site ranges from 560 to 640 feet (ft) above mean sea level (amsl). Crawford Creek flows through a steeply walled ravine located west of the Project site. Two ponds, totaling 0.06-acre, are located in the Project area; however, they will not be impacted by the proposed Project. The ponds are remnant tailing ponds from historic hydraulic mining and are likely not hydrologically connected to the surrounding area. A drainage ditch containing seepage from the ponds is located approximately 40-ft east of the proposed steel water tank location. This ditch is also the result of historic hydrologic mining in the area and is not a natural feature. The ditch would not be impacted by the proposed Project.

The General Plan land use designations for the project are Conservation Floodway (CF), and Residential Estates, 1-5 acre minimum (RE1-5). The zoning code for the property is Unclassified (U) (Humboldt County 2017). Land uses surrounding the Project site include U.S. Forest Service Land and residential land.

4.0 PROJECT DESCRIPTION

The Project is proposing to improve and replace an existing water distribution system that currently serves 34 residential connections in the unincorporated area of Orleans. The Project would demolish an existing in-line filtration plant and replace it with a new surface, direct-filtration WTP. The Project would construct a new water treatment building with a backwash reclaim tank. A proposed generator and propane tank would be located adjacent to the water treatment building. The existing in-line filtration plant would be replaced due to age, deteriorating condition, outdated composition of the existing system, lack of system redundancy, and insufficient reserves to support fire response flows. The Project would also demolish an existing redwood raw water tank and replace it with a new bolted steel water storage tank. Implementation of the proposed Project would increase water storage capacity and/or operational capability of the overall system. The proposed improvements have been sized to provide for system redundancy and calculated fire flows without additional residential service connections that are non-growth inducing. All components of the Project are described in more detail below. Refer to Figure 3 for a Site Plan of the proposed Project.

4.1. Water Treatment Building

A new 468-square foot (sf) concrete masonry unit (CMU) block building would be constructed to house the booster pumps and raw meter pumps, coagulant pump, sodium hypochlorite pump, backwash reclaim pump, pressure tank, controls, and analyzers for the treatment system, which was mutually agreed upon by the Karuk Tribe and OMWC. The interior of the building would be separated into a treatment room and a chemical room. Two pressure filter tanks and an emergency eyewash and shower would be directly connected to the exterior of the water treatment building. Additionally, a proposed generator and propane tank would be located adjacent to the new water treatment building.

An emergency raw water bypass connection would be provided near the new water treatment building to allow the WTP to be bypassed in the event of an emergency. This connection would consist of a buried 6-inch gate valve on the raw water pipeline and two buried 6-inch gate valves on the potable water pipeline, with a removable section of exposed piping between the valves.

The new treatment system would comply with the EPA’s Enhanced Surface Water Treatment Rules for treatment system design and operation and would include the following processes: coagulation, flocculation, pressure filtration, and disinfection (chlorination) as described below.

Coagulation

Two 5-gallon samples of the Crawford Creek source water were collected on November 7, 2020, by OMWC and sent to DDW for jar testing (Waterworks Engineers 2021). Jar tests were performed with each coagulant at different dosages, flash mixing times and flocculation times. Based on the results of the jar tests, both coagulants performed equally well, resulting in filtered turbidity down to 0.08 and ultraviolet absorption reduction as high as 62.5-percent.

The coagulation storage and feed system would be similar to the existing system and would include a metering pump drawing from a small batch tank that contains the coagulant. The coagulant would be stored in a 15-gallon container in the water treatment building to allow the coagulant and water to be routinely added for the correct dilution, if required. The metering pump would be mounted on or adjacent to the tank and would be automatically controlled to flow paced directly from the plant's effluent flowmeter. An on-the-shelf metering pump would be provided for redundancy.

Flocculation

In-pipe flocculation allows the coagulated particles to come into contact with one another to form larger particles, or "floc," without any equipment with moving parts or controls. For this Project, a 6-inch pipeline flocculator would be installed 115-ft upstream of the water treatment building.

Pressure Filtration

Filtration would be accomplished with three new 3.5-ft diameter vertical multimedia pressure filters operated in parallel to replace the two existing 3-ft diameter filters. Each filter would have a surface area of 9.6-sf. The filters would be installed in the new water treatment building to protect against freezing and vandalism.

Disinfection (chlorination)

Disinfection would be accomplished by injecting sodium hypochlorite into the water following filtration and prior to booster pumping which would effectively mix the chemical with the filtered water. Chlorinated water would be conveyed by the booster pump to the new storage tank via a new 330-ft long PVC pipeline which would provide approximately 1 minute of effective contact time. The sodium hypochlorite storage and feed system would include a 15-gallon tank and solenoid operated diaphragm metering pump. The tank would be sealed and vented to the outside of the new water treatment building to minimize issues with off gassing of chlorine which would result in corrosion inside the building.

4.2. Backwash Reclaim Tank

Backwash waste flows from the filters would be conveyed to a new bolted steel backwash reclaim tank adjacent to the new water treatment building. The backwash reclaim tank would have a 14,312-gallon nominal capacity and 10,750-gallon usable capacity. Solids would settle to the bottom of the tank and, after a preset settling time, the clear water at the top of the tank would be pumped to the treatment system within the water treatment building. A floating suction strainer and flexible hose in the backwash tank would be used to draw water off the top of the water column and conveyed via a backwash recycle pump (located in the treatment building) back to the treatment process. The bottom 3-ft of the tank would be reserved for solids accumulation. A valve at the bottom of the tank would allow the tank to be periodically drained into a small catch basin with an air gap, from which a septic hauler can remove the solids and haul them away for disposal. Sample taps on the side of the tank would allow the operator to gauge the depth of solids in the tank and determine when solids removal is necessary. An on-the-shelf pump would be provided for redundancy.

4.3. Water Storage Tank

As mentioned above, the Project would demolish an existing redwood raw water tank and replace it with a new bolted steel water storage tank. The goal of the new storage system is to provide water storage equal to the MDD flow plus fire storage volume. With an MDD of 70,300 gallons and a fire storage volume of 60,000 gallons, the total proposed capacity of the new storage tank would be 130,300 gallons. The MDD storage would be reasonable as the OMWC reported maximum daily rates of 60,000-gallons in 2007 through 2012, and no significant increase in housing units has since occurred.

The tank would be supported by a reinforced concrete ring wall foundation and constructed in the same vicinity as the existing redwood water storage tank. The maximum operating water level in the tank would be similar to that of the existing redwood tank and would be able to serve the community water via gravity. The tank would have a top manway with an interior ladder for access and inspection. An exterior ladder would be provided with anti-climb features to prevent unauthorized access to the top of the tank. A side manway would be provided for access for maintenance.

4.4. Booster Pumping

Chlorinated water would be pumped to the new water storage tank via two new 1 horsepower (HP) booster pumps. The pumps would be controlled by Variable Frequency Devices (VFD) that would allow the speed to be adjusted to set the desired pumping rate. The pumps would be manually rotated at regular intervals to exercise the pumps and result in even runtimes on each pump. The booster pumps would be located within the water treatment building.

4.5. Instrumentation and Controls

An XIO web-based control system is recommended to monitor, control, and log the operation of the new water treatment system and provide remote access to the facility for monitoring purposes. The control system would have the ability to shut the treatment process down when raw water turbidity is high, to allow the system to use stored water, and to “ride out the storm” in order minimize the solids loading the filters and ensure turbidity requirements are met. Alarms would be sent out via the control system (by text, telephone, email, or a combination thereof).

4.6. Ancillary Systems

HVAC

A small electric heater would be installed in the water treatment building to keep the interior temperature above freezing. A small exhaust fan would be provided adjacent to the sodium hypochlorite system to vent any chlorine gases to the outside to prevent interior corrosion.

Communications

An internet connection would be provided at the new water treatment building for monitoring the new treatment equipment. It is anticipated that a local internet service provider (ISP) is available and capable of providing this service to the site.

Electrical Service

A new underground electrical service from Pacific Gas and Electric (PG&E) would be provided to the site, via the existing path off Camp Creek Road. A new pole or pad mount transformer would be provided to support the new water treatment system.

Generator and Propane Tank

A generator and propane tank would be located adjacent to the new water treatment building and backwash reclaim tank. The generator would run approximately five minutes per week for testing and maintenance purposes.

4.7. Fire Hydrant, Subsurface Piping, and Fencing

A new fire hydrant would be installed at the entrance of the existing path, directly off Camp Creek Road, which would lead to the proposed water treatment building.

Existing subsurface piping would be demolished and/or abandoned. New subsurface piping would tie into the existing distribution system piping located throughout the parcel in order to serve the new water treatment system.

The new 468-sf water treatment building, backwash reclaim tank, generator and propane tank would be protected by a 6-ft tall chain link fence with barbed wire. A 12-ft wide chain link double leaf gate would be installed to allow limited personnel access to the water treatment building and backwash reclaim tank.

4.8. Access Roads

The existing, unimproved dirt road leading to the water treatment building would be widened to create a 12-ft wide road with a 14-ft wide unobstructed clearance (2-ft on each side of the driveway). The path leading to the water treatment building would begin on the edge of Camp Creek Road (a paved roadway). Additionally, the Project would recontour the existing unimproved dirt road from the new water treatment building to the new water storage tank site after installation of all buried utilities.

4.9. Construction Phasing

The existing in-line filtration plant would remain online and operational until the new surface, direct-filtration WTP is completed and fully tested. At that time, the redwood water storage tank would be demolished, and the new water storage tank constructed in its place. The new booster pumps would provide filtered, chlorinated water directly to the distribution system (similar to operation of the existing system). From the time the redwood tank is demolished to the time the new storage tank is brought online is estimated to be between 1 and 2 months. During this time, bottled water may be brought in for customers for potable purposes.

5.0 ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED

The Project could potentially result in one or more of the following significant environmental effects; however, proposed mitigation measures will reduce effects to less than significant:

☐ Aesthetics	☐ Agriculture and Forestry Resources	☐ Air Quality
☒ Biological Resources	☒ Cultural Resources	☐ Energy
☒ Geology and Soils	☐ Greenhouse Gas Emissions	☐ Hazards and Hazardous Materials
☐ Hydrology and Water Quality	☐ Land Use and Planning	☐ Mineral Resources
☒ Noise	☐ Population and Housing	☐ Public Services
☐ Recreation	☐ Transportation	☒ Tribal Cultural Resources
☐ Utilities and Service Systems	☐ Wildfire	☒ Mandatory Findings of Significance

6.0 DETERMINATION

On the basis of this initial evaluation:

☐	I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.
☒	I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.
☐	I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.
☐	I find that the proposed project MAY have a “potentially significant impact” or “potentially significant unless mitigated” impact on the environment, but at least one effect I) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.
☐	I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

Signature | Date

Printed Name | For

7.0 ENVIRONMENTAL INITIAL STUDY CHECKLIST

The lead agency has defined the column headings in the environmental checklist as follows:

A. "Potentially Significant Impact" is appropriate if there is substantial evidence that an effect may be significant. If there are one or more "Potentially Significant Impact" entries when the determination is made, an EIR is required.

B. "Less Than Significant with Mitigation Incorporated" applies where the inclusion of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less Than Significant Impact." All mitigation measures are described, including a brief explanation of how the measures reduce the effect to a less than significant level. Mitigation measures from earlier analyses may be cross-referenced.

C. "Less Than Significant Impact" applies where the project does not create an impact that exceeds a stated significance threshold.

D. "No Impact" applies where a project does not create an impact in that category. "No Impact" answers do not require an explanation if they are adequately supported by the information sources cited by the lead agency which show that the impact simply does not apply to projects like the one involved (e.g., the project falls outside a fault rupture zone). A "No Impact" answer should be explained where it is based on project-specific factors as well as general standards (e.g., the project would not expose sensitive receptors to pollutants, based on a project specific screening analysis).

The explanation of each issue identifies the significance criteria or threshold used to evaluate each question; and the mitigation measure identified, if any, to reduce the impact to less than significance. Earlier analyses may be used where, pursuant to the tiering, program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR or negative declaration [CEQA Guidelines Section 15063(c)(3)(D)]. Where appropriate, the discussion identifies the following:

a) Earlier Analyses Used. Identifies where earlier analyses are available for review.

b) Impacts Adequately Addressed. Identifies which effects from the checklist were within the scope of and adequately analyzed in an earlier document pursuant to applicable legal standards, and states whether such effects were addressed by mitigation measures based on the earlier analysis.

c) Mitigation Measures. For effects that are "Less Than Significant with Mitigation Incorporated," describes the mitigation measures which were incorporated or refined from the earlier document and the extent to which they address site-specific conditions for the project.

I. AESTHETICS

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Except as provided in Public Resources Code Section 21099, would the project:				
a) Have a substantial adverse effect on a scenic vista?	☐	☐	☒	☐
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐	☒	☐
c) Substantially degrade the existing visual character or quality of public views of the site and its surroundings? (Public views are those that are experienced from publicly accessible vantage point). If the project is in an urbanized area, would the project conflict with applicable zoning and other regulations governing scenic quality?	☐	☐	☒	☐
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?	☐	☐	☒	☐

Environmental Setting

Humboldt County is an area of diverse visual character, including timberland, range, mountains, rolling hills, and streams. The Project site is located in the unincorporated community of Orleans. The Project is located to the north of Klamath River, to the east of Crawford Creek, and to the west of Camp Creek. The Project site would be located along Camp Creek Road and would be accessed by SR 96. According to the California Department of Transportation (Caltrans), SR 96 is considered an eligible State Scenic Highway (Caltrans 2022). However, no officially designated State Scenic or County Scenic highways in Humboldt County exist near the Project site. Views along both sides of SR 96 include heavily forested hillsides, along with grass and brush closer to the highway.

Evaluation

a) Have a substantial adverse effect on a scenic vista?

Less than significant impact. A scenic vista is defined as a viewpoint that provides expansive views of a highly valued landscape (such as an area with remarkable scenery or a resource that is indigenous to the area) for the benefit of the general public. There are no officially designated scenic vistas in the Project area, and the Project site would not be visible from SR 96 due to heavily forested vegetation. As mentioned above, SR 96 is considered an eligible State Scenic Highway, although it is not officially designated. Given the lack of officially designated scenic vistas, and the lack of visibility of the Project from SR 96, impacts would be less than significant.

b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a State scenic highway?

Less than significant impact. Though there are no currently designated scenic highways in the Project area, SR 96 is considered eligible, as described above. The proposed Project would not damage rock outcroppings, historic buildings, or other scenic resources in the Project area. However, some brush removal may be required along access roads and work areas to ensure access and safe working conditions. Such work would be isolated in nature and not visible from SR 96 given the topography of the area and the obscuring vegetation that generally exists along both highways. Therefore, any potential impacts would be less than significant.

c) In non-urbanized areas, substantially degrade the existing visual character or quality of public views of the site and its surroundings? (Public views are those that are experienced from publicly accessible vantage point). If the project is in an urbanized area, would the project conflict with applicable zoning and other regulations governing scenic quality?

Less than significant impact. Sensitive viewer groups typically include residents, recreationists, and motorists. The Project site is heavily forested; however, the proposed areas for development are cleared with minimal trees and vegetation from previous disturbance. The new water treatment building and backwash reclaim tank would be located on a relatively flat area that has been previously disturbed by past mining activities. The new water treatment building would be located southwest of the existing in-line filtration plant. The new storage tank would be located within the same vicinity as the existing redwood storage tank, which is within a previously excavated area for water storage tanks.

The existing, unimproved dirt road leading to the water treatment building would be widened to create a 12-ft wide road with a 14-ft wide unobstructed clearance (2-ft on each side of the driveway). The path leading to the water treatment building would begin on the edge of Camp Creek Road (a paved roadway). Additionally, the Project would recontour the existing unimproved dirt road from the new water treatment building to the new water storage tank site after installation of all buried utilities. Construction and operation of the proposed Project would be mainly obscured from public view by the topography and dense vegetation of the area. Therefore, any impacts would be less than significant.

d) Create a new source of substantial light or glare that would adversely affect day or nighttime views in the area?

Less than significant impact. The Project would demolish an existing in-line filtration plant and replace it with a new surface, direct-filtration WTP. The Project would construct a new water treatment building with a backwash reclaim tank. The Project would also demolish an existing redwood raw water tank and replace it with a new bolted steel water storage tank. Additionally, a new fire hydrant would be installed at the entrance of the path leading to the proposed water treatment building, directly off Camp Creek Road. Existing subsurface piping would be demolished and/or abandoned. New subsurface piping would tie into the existing distribution system piping located throughout the parcel in order to serve the new water treatment system. Lighting requirements are expected to remain remotely the same as the Project is upgrading an existing water distribution system. However, new exterior lighting would be located on the new water treatment building. The use of such lighting would be minimized to the extent possible and only the minimum lighting needed to provide security and occasional nighttime maintenance and service would be used. All lighting would be shielded and downward facing to reduce glare and light pollution to the extent practicable. Therefore, any impacts would be less than significant.

II. AGRICULTURE AND FORESTRY RESOURCES

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☒	☐
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	☐	☐	☐	☒
c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code Section 12220(g)), timberland (as defined by Public Resources Code Section 4526), or timberland zoned Timberland Production (as defined by Government Code Section 51104(g))?	☐	☐	☒	☐
d) Result in the loss of forest land or conversion of forest land to non-forest use?	☐	☐	☐	☒
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non- forest use?	☐	☐	☒	☐

Environmental Setting

The Farmland Mapping and Monitoring Program (FMMP) of the California Department of Conservation (CDC) has not yet mapped farmland in Humboldt County (CDC 2022a). Accordingly, Humboldt County does not display data for the California Important Farmland Finder (CDC 2022b). However, it is noted on the Humboldt County Web GIS that the Project parcel is not located on Farmland of Statewide Importance or Prime Farmland if irrigated.

As a means of agricultural land preservation, the State Legislature enacted the California Land Conservation Act of 1965 commonly called the “Williamson Act.” Under the Act, property owners may enter into contracts with their county to keep their lands in agricultural production for a minimum of 10 years in exchange for property tax relief. Lands covered by Williamson Act contracts are assessed based on their agricultural value instead of their potential market value under non-agricultural uses and are known as “Agricultural Preserves.” According to Humboldt County Web GIS mapping there are no portions of the Project area that are under Williamson Act contract.

The Z’berg-Warren-Keene-Collier Forest Taxation Reform Action 1979 requires counties to provide for the zoning of land used for growing and harvesting timber as timberland preserve. No portion of the Project site is zoned Timber Production Zone, and no timber activities are currently taking place at the site. Land uses surrounding the Project area are mainly residential and public land used for timber extraction, primarily the Six Rivers National Forest.

Evaluation

a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?

Less than significant impact. As previously mentioned, Humboldt County is not included in the FMMP. However, based on the Humboldt County Web GIS, the parcel is not located on Farmland of Statewide Importance or Prime Farmland. Additionally, based on the Humboldt County Web GIS, the Project parcel is not under the Williamson Act Contract. As the Project would not convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance to a non-agricultural use, impacts would be less than significant.

b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?

No impact. As stated above, no portions of the Project site are under a Williamson Act contract. The Project is zoned Unclassified (U) and would not conflict with any authorized use or current land use. Therefore, there would be no impact.

c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code Section 12220(g)), timberland (as defined by Public Resources Code Section 4526), or timberland zoned Timberland Production (as defined by Government Code Section 51104(g))?

Less than significant impact. The Project parcel is not zoned as Timber Production Zone (TPZ). No aspect of the proposed Project would interfere with the required characteristics of TPZ nor with the ability to grow trees now or in the future. All proposed construction would occur within the existing water treatment plant footprint or within previously disturbed land and would not require any tree removal. The proposed Project does not require a rezone, and any impact would be less than significant.

d) Result in the loss of forest land or conversion of forest land to non-forest use?

No impact. No portion of the Project site is zoned TPZ, and no removal of trees is proposed. The new water treatment building would be located on a relatively flat area, southwest of the existing in-line filtration plant, which has been heavily disturbed by past mining activities. The new steel water storage tank would take the place of the existing redwood storage tank, which is within a previously excavated area for future tanks. Therefore, no impact would occur.

e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use?

Less than significant impact. Improvements related to the proposed Project would take place within or adjacent to the existing footprint of disturbance or within previously disturbed areas. The new water treatment building would be located on a relatively flat area, southwest of the existing in-line filtration plant, which has been heavily disturbed by past mining activities. The new steel storage tank would take the place of the existing redwood storage tank, which is within a previously excavated area for future tanks. The improvements would not conflict with any existing, planned, or ongoing agriculture, timber growing, or harvesting. Based on the Humboldt County Web GIS, the parcel is not located on Farmland of Statewide Importance or Prime Farmland. Therefore, the Project would not lead to the conversion of farmland to non-agricultural use or forest land to non-forest use in the surrounding Project area. Any impact would be less than significant.

III. AIR QUALITY

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Where available, the significance criteria established by the applicable air quality management district or air pollution control district may be relied upon to make the following determinations. Would the project:				
a) Conflict with or obstruct implementation of the applicable air quality plan?	☐	☐	☒	☐
b) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard?	☐	☐	☒	☐
c) Expose sensitive receptors to substantial pollutant concentrations?	☐	☐	☒	☐
d) Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people?	☐	☐	☒	☐

The California Emissions Estimator Model (CalEEMod) version 2022.1.0 was used to quantify Project-generated construction and operations emissions. The model output sheets are included in Appendix B to this Initial Study.

Environmental Setting

Criteria pollutants are defined and regulated by State and federal law as a risk to the health and welfare of the public and are categorized into primary and secondary pollutants. Primary air pollutants are those that are emitted directly from sources including: carbon monoxide (CO); reactive organic gases (ROGs); nitrogen oxides (NO_X); sulfur dioxide (SO_2); coarse particulate matter (PM_{10}); fine particulate matter ($PM_{2.5}$); and lead. Of these primary pollutants, CO, SO_2, PM_{10}, $PM_{2.5}$, and lead are criteria pollutants. ROGs and NO_X are criteria pollutant precursors and go on to form secondary criteria pollutants through chemical and photochemical reactions in the atmosphere. The principal secondary criteria pollutants are ozone (O_3) and nitrogen dioxide (NO_2).

Ambient air quality is described in terms of compliance with State and national standards, and the levels of air pollutant concentrations considered safe, to protect the public health and welfare. These standards are designed to protect people most sensitive to respiratory distress, such as asthmatics, the elderly, very young children, people already weakened by other disease or illness, and persons engaged in strenuous work or exercise. The USEPA has established national ambient air quality standards (NAAQS) for criteria pollutants. As permitted by the Clean Air Act, California has adopted the more stringent California ambient air quality standards (CAAQS) and expanded the number of regulated air pollutant constituents.

The Project site is in Humboldt County, which lies within the North Coast Air Basin (NCAB). The NCAB extends for 250 miles from Sonoma County in the south to the Oregon border. The climate of NCAB is influenced by two major topographic units: the Klamath Mountains and the Coast Range provinces. The climate is moderate with the predominant weather factor being moist air masses from the ocean. Average annual rainfall in the area is approximately 50 to 60 inches with the majority falling between October and April. The predominant wind direction is from the northwest during summer months and from the southwest during winter storm events.

Project activities which result in air pollutant emissions are subject to the authority of the North Coast Unified Air Quality Management District (NCUAQMD) and the California Air Resources Board (CARB). Humboldt County is listed as "attainment" or "unclassified" for all the federal and State ambient air quality standards except for the State 24-hour PM_{10} standard.

In determining whether a project has potentially significant air quality impact on the environment, agencies often apply their local air district's thresholds of significance to project impacts in the review process. The NCUAQMD has not formally adopted thresholds for determining the significance of a project's emissions under CEQA. The Best Available Control Technology (BACT) emissions rate limits for stationary sources as defined and listed in the NCUAQMD Rule and Regulations, Rule 110 – New Source Review (NSR) and Prevention of Significant Deterioration (PSD), Section 5.1 – BACT (pages 8-9)[1], are informative as screening level thresholds. Project construction or operational emissions which do not exceed the NCUAQMD Rule 110 BACT maximum daily emissions limits, shown in Table 2, would not be expected to result in a new exceedance of air quality standards, or exacerbate an existing exceedance of air quality standards.

Table 2
SCREENING LEVEL THRESHOLDS FOR PROJECT EMISSIONS

Pollutant	Screening Threshold (pounds per day)
NO_X	50
ROG	50
PM_{10}	80
$PM_{2.5}$	50
CO	500
SO_X	80

Source: NCUAQMD Rule 110
NO_X = nitrogen oxides; ROG = reactive organic gases; PM_{10} = particulate matter 10 microns or less in diameter; $PM_{2.5}$ = particulate matter 2.5 microns or less in diameter; CO = carbon monoxide; SO_X = sulfur oxides

The nearest sensitive receptors to the proposed generator would be single-family residences approximately 350-ft to the southeast. The nearest sensitive receptors to the proposed new water storage tank would be single-family residences approximately 500-ft to the southeast.

1 North Coast Unified Air Quality Management District. 2021. District Rules and Regulations. Available at: http://www.ncuaqmd.org/index.php?page=rules.regulations. Accessed 2/17/21.

Evaluation

a) Conflict with or obstruct implementation of the applicable air quality plan?

Less than significant impact. A potentially significant impact to air quality would occur if the Project would conflict with or obstruct the implementation of the applicable air quality management or attainment plan.

The California Clean Air Act (CCAA) requires the NCUAQMD to achieve and maintain State ambient air quality standards for PM_{10} by the earliest practicable date. The NCUAQMD prepared the Particulate Matter Attainment Plan, Draft Report, in May 1995. This report includes a description of the planning area (North Coast Unified Air District), an emissions inventory, general attainment goals, and a listing of cost-effective control strategies. The NCUAQMD's attainment plan established goals to reduce PM_{10} emissions and eliminate the number of days in which standards are exceeded. The plan includes three areas of recommended control strategies to meet these goals: (1) transportation, (2) land use, and (3) burning. Control measures for these areas are included in the Attainment Plan. The Project design incorporates control measures identified in the PM_{10} Attainment Plan appropriate to this type of Project, such as:

1) The Project would be located on a site with an existing in-line filtration plant and water distribution system. As the Project would consist of updating existing infrastructure and maintaining current employment levels and hours, vehicle miles traveled are not anticipated to increase.

2) The Project would apply water in construction areas to control dust. Paved and gravel access roads would control dust.

3) The Project involves upgrading an existing water distribution system. The intensity of use, built footprint, and amount of water delivered would not change significantly from existing conditions. Land use would not change, and no other uses of the land would be impaired. Particulate emissions from the proposed Project would be appropriate for its General Plan Designations.

4) The proposed Project's operation does not include any burning and would not employ wood stoves for heat or burn piles to dispose of biomass.

Therefore, the proposed Project would not conflict with or obstruct implementation of the NCUAQMD Attainment Plan for PM_{10}, and the impact would be less than significant.

b) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non- attainment under an applicable federal or State ambient air quality standard?

Less than significant impact. Air quality standards within the NCUAQMD are set for emissions that may include, but are not limited to visible emissions, particulate matter, and fugitive dust. Pursuant to Air Quality Regulation 1, Chapter IV, Rule 400 – *General Limitations*, a person shall not discharge from any source whatsoever such quantities of air contaminants or other material which cause injury, detriment, nuisance or annoyance to any considerable number of persons or to the public, endanger the comfort, repose, health or safety of any such persons or the public, or have a natural tendency to cause injury or damage to business or property. Visible emissions include emissions that are visible to the naked eye, such as smoke from a fire. The proposed Project involves upgrading an existing water distribution system. No activities resulting in visible emissions, including intentional fire/burn, would be associated with the Project.

The CalEEMod version 2022.1.0 was used to quantify Project-generated construction and operations emissions. The model output sheets are included in Appendix B.

Construction

The proposed Project would demolish an existing in-line filtration plant and replace it with a new surface, direct-filtration WTP. The Project would construct a new water treatment building with a backwash reclaim tank and would construct a new steel water storage tank. Project construction emissions sources would include exhaust emissions from off-road equipment use, emissions related to on-road vehicles (e.g., construction worker vehicles, vendor delivery vehicles, and material haul trucks). Emissions from construction equipment would occur for a limited period, and the equipment would be maintained to meet current emissions standards as required by CARB and the NCUAQMD. Construction would include approximately 2 weeks of site preparation, approximately 2 weeks of demolition, approximately 2 weeks of grading, approximately 3 weeks of underground infrastructure and utilities, and approximately 6 months of physical building construction. The full buildout of the proposed Project would be completed in less than one year.

The Project has the potential to generate particulate matter (dust) during construction activities. All activities at the Project site are required to meet NCUAQMD Air Quality standards, including Regulation 1, which prohibits nuisance dust generation and is enforceable by the District.

The Project has the potential to generate particulate matter (dust) during construction activities. All activities at the Project site are required to meet NCUAQMD Air Quality standards, including Regulation 1, which prohibits nuisance dust generation and is enforceable by the NCUAQMD.[2] Rule 104 states that:

1. No person shall allow handling, transporting, or open storage of materials in such a manner which allows or may allow unnecessary amounts of particulate matter to become airborne

2. Reasonable precautions shall be taken to prevent particulate matter from becoming airborne, including, but not limited to, the following provisions:

    a. Covering open bodied trucks when used for transporting materials likely to give rise to airborne dust.

    b. Installation and use of hoods, fans, and fabric filters to enclose and vent the handling of dusty materials. Containment methods can be employed during sandblasting and other similar operations.

    c. Conduct agricultural practices in such a manner as to minimize the creation of airborne dust.

[2] North Coast Unified Air Quality Management District. 2015. 2015. General Provisions, Permits & Prohibitions. Adopted July 9, 2015.

d. The use of water or chemicals for control of dust in the demolition of existing buildings or structures, construction operations, the grading of roads or the clearing of land.

e. The application of asphalt, oil, water or suitable chemicals on dirt roads, materials stockpiles, and other surfaces which can give rise to airborne dusts.

f. The paving of roadways and their maintenance in a clean condition.

g. The prompt removal of earth or other track out material from paved streets onto which earth or other material has been transported by trucking or earth-moving equipment, erosion by water, or other means.

The Project would comply with NCUAQMD regulations, minimizing fugitive dust emissions.

The Project's estimated construction emissions of criteria pollutants are shown below in Table 3. As shown in Table 3, Project construction emissions would not exceed the NCUAQMD screening level thresholds.

Table 3
CONSTRUCTION CRITERIA POLLUTANT EMISSIONS (POUNDS PER DAY)

	ROG	NO_X	CO	SO_X	PM_{10}	$PM_{2.5}$
Maximum Daily Emissions	0.65	5.13	6.77	0.01	1.85	0.32
Screening Threshold	50	50	500	80	80	50
Exceed Threshold?	*No*	*No*	*No*	*No*	*No*	*No*

Source: CalEEMod Output (Appendix B); Thresholds: NCUAQMD Rule 110.
ROG = reactive organic gases; NO_X = nitrogen oxides; CO = carbon monoxide; SO_X = sulfur oxides; PM_{10} = particulate matter 10 microns or less in diameter; $PM_{2.5}$ = particulate matter 2.5 microns or less in diameter.

Operation

The current level of employment, trips, hours, and equipment use (i.e., those under existing conditions) would be maintained with existing conditions as the proposed Project would upgrade the existing water treatment system. The operation of the Project would include a new stationary source of emissions: a proposed backup generator located adjacent to the water treatment plant. Specific details of the generator were not available at the time of this analysis. A conservative (high) estimate of generator size would be an electrical rating in the 100 kilovolt-amps (kVA) to 150 kVA range with a 250-horsepower engine. The generator could be diesel powered or propane powered. A diesel-powered generator was assumed because diesel generators generally have higher emissions than similar sized propane generators. The generator would only operate for about 5 minutes per week for testing and maintenance purposes. As shown in Table 4, Project operational emissions would not exceed the screening level thresholds.

Table 4
OPERATION CRITERIA POLLUTANT EMISSIONS (POUNDS PER DAY)

	ROG	NO_X	CO	SO_X	PM_{10}	$PM_{2.5}$
Maximum Daily Emissions	0.08	0.11	0.10	<0.01	0.01	0.01
Screening Threshold	50	50	500	80	80	50
Exceed Threshold?	*No*	*No*	*No*	*No*	*No*	*No*

Source: CalEEMod Output (Appendix B); Thresholds: NCUAQMD Rule 110.

ROG = reactive organic gases; NO_X = nitrogen oxides; CO = carbon monoxide; SO_X = sulfur oxides; PM_{10} = particulate matter 10 microns or less in diameter; $PM_{2.5}$ = particulate matter 2.5 microns or less in diameter.

Therefore, the Project would not violate any air quality standard or contribute substantially to an existing or projected air quality violation. Additionally, the Project would not result in a cumulatively considerable net increase of any criteria pollutant for which the Project region is non-attainment under an applicable federal or State ambient air quality standard. Impacts would be less than significant, and no mitigation would be necessary.

c) Expose sensitive receptors to substantial pollutant concentrations?

Less than significant impact. Sensitive receptors (e.g., children, senior citizens, and acutely or chronically ill people) are more susceptible to the effect of air pollution than the general population. Land uses that are considered sensitive receptors typically include residences, schools, parks, childcare centers, hospitals, convalescent homes, and retirement homes. The closest sensitive receptors to the proposed generator are single-family residences located approximately 350-ft southeast.

The NCUAQMD currently enforces dust emissions according to the CA Health and Safety Code (Section 41701) which limits visible dust emissions that exceed 40 percent density to a maximum of three minutes in any one-hour period. NCUAQMD District Rule 104 states that "*reasonable precautions shall be taken to prevent particulate matter from becoming airborne*." As described in the impact b) discussion, above, the Project would incorporate fugitive best management practices in accordance with NCAUQMD Rule 110. Due to the limited activity that would occur, the rapid dissipation of the dust, and the distance to and low density of residences near the Project site, Project construction or operation would not result in substantial localized fugitive dust concentrations.

Diesel-powered construction equipment used on the Project site would result in emissions of the Toxic Air Contaminant (TAC) diesel particulate matter (DPM). The dose (of TAC) to which receptors are exposed is the primary factor used to determine health risk. Dose is a function of the concentration of a substance in the environment and the duration of exposure a person has with the substance; a longer exposure period to a fixed quantity of emissions would result in higher health risks. Construction equipment used for the proposed Project, excluding the steel water tank and WTP construction, would include: An excavator, a front loader, and a dump truck. The three pieces of construction equipment would only be used for 9 weeks, and the entire buildout of the Project would take less than one year. Due to the short and temporary nature of Project construction activity which would require heavy diesel-powered contract equipment use, and due to the limited number of diesel-power equipment anticipated to be use on the Project site, construction of the Project would not expose sensitive receptors to substantial DPM concentrations.

For operations, the Project proposes to install a backup generator that would only operate for about five minutes per week for testing and maintenance purposes. If the generator were to be diesel powered (as conservatively assumed in the modeling), the generator would be a source of DPM emissions. Based on the CalEEMod results (included in Appendix B) the generator would produce less than 1 pound per year of exhaust PM_{10} (exhaust PM_{10} is equivalent to DPM). Therefore, based on the small amount of DPM emissions and the limited generator operating hours, the operation of the Project would not expose sensitive receptors to substantial DPM concentrations.

Therefore, the construction or operation of the Project would not expose sensitive receptors to substantial pollutant concentrations. Impacts would be less than significant, and no mitigation would be necessary.

d) Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people?

Less than significant impact. Odors during the construction phase would consist primarily of diesel truck fumes; however, these impacts would be temporary and less than significant. New sources of odors from operations would be limited to diesel fumes from the backup generator and would be limited to short periods of maintenance and testing. The nearest sensitive receptors to the backup generator are single-family residences located approximately 350-ft southeast. Therefore, the proposed Project would not result in other emissions (such as those leading to odors) affecting a substantial number of people. Impacts would be less than significant, and no mitigation would be necessary.

IV. BIOLOGICAL RESOURCES

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service?	☐	☒	☐	☐
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the California Department of Fish and Wildlife or US Fish and Wildlife Service?	☐	☐	☐	☒
c) Have a substantial adverse effect on State or federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☐	☐	☐	☒
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☐	☐	☒	☐
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☒	☐
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or State habitat conservation plan?	☐	☐	☒	☐

A Biological Resources Evaluation was prepared for this Project by HELIX Environmental Planning, Inc. (HELIX 2021) and is included as Appendix C to this Initial Study. The discussion of biological resources in this section is based on the results of that evaluation.

Environmental Setting

Reconnaissance Survey

A biological reconnaissance survey was conducted on June 1, 2022, by HELIX Biologist Stephanie McLaughlin, M.S. between 1000 and 1330 hours. The Study Area was systematically surveyed on foot to ensure total search coverage. The Study Area is defined as the entire 3.34-acre parcel. All plant and animal species observed on-site during the surveys were recorded (Attachment E in Appendix C), and all biological communities occurring on-site were characterized. Following the field survey, the potential for each species identified in the database query to occur within the Study Area was determined based on the site survey, soils, habitats present within the Study Area, and species-specific information (Attachment D in Appendix C).

Habitat Types/Vegetation Communities

There are four habitat types/vegetation communities on the site: developed, ruderal/disturbed, Douglas fir-tanoak forest, and pond.

Developed

Developed habitat covers 2.13-acres of the Study Area and includes existing facilities and access roads as well as the shoulders of Placer Drive. These areas are disturbed and are dominated by a mix of native and non-native species, with ornamental species frequently planted in the residential area. Species observed in this community include California poppy (*Eschscholzia californica*), English ivy (*Hedera helix*), cape dandelion (*Arctotheca calendula*), and greenleaf manzanita (*Arctostaphylos patula*).

Ruderal/Disturbed

Ruderal/disturbed habitat covers 0.98-acre of the Study Area and occurs along the dirt access road. This habitat type occurs in areas that are heavily disturbed by past or ongoing human activities but retain a soil substrate. Ruderal/disturbed areas may be sparsely to densely vegetated, but do not support a recognizable community or species assemblage. Vegetative cover is usually herbaceous and dominated by a wide variety of weedy non-native species or a few ruderal native species. Dominant shrubs species within this community include poison oak (*Toxicodendron diversilobum*), Himalayan blackberry (*Rubus armeniacus*), French broom (*Genista monspessulana*), and greenleaf manzanita. Herbaceous species consist of flat pea (*Lathyrus sylvestris*), medusahead grass (*Elymus caput-medusae*), wild oats (*Avena fatua*), and ripgut brome (*Bromus diandrus*).

Douglas Fir-Tanoak Forest

Douglas fir – tanoak forest habitat is found in the vicinity of the redwood water storage tank and covers 0.17-acre of the Study Area. This habitat is a tall intermittent to continuous, mixed needle-leaved evergreen forest in stands dominated by Douglas fir (*Pseudotsuga menziesii*) and tanoak (*Notholithocarpus densiflorus*), and interspersed with Pacific madrone (*Arbutus menziesii*), bigleaf maple (*Acer macrophyllum*), and black oak (*Quercus kelloggii*). This habitat type is frequently found on stream terraces, slopes, and ridges of all aspects. The understory ranges from sparse with dense leaf litter and small woody debris, to an intermittent shrub and herbaceous layer, which includes California huckleberry (*Vaccinium ovatum*), Etruscan honeysuckle (*Lonicera etrusca*), western sword fem (*Polystichum munitum*), and remote sedge (*Carex remota*). Due to the age of the redwood water storage tank, there is some seepage from the tank onto the soil surface, creating a moist environment without producing any aquatic features.

Ponds

Two ponds, totaling 0.06-acre, are located in the Study Area. The ponds are remnant tailing ponds from historic hydraulic mining and are likely not hydrologically connected to the surrounding area. Vegetation surrounding the ponds include white alder (*Alnus rhombifolia*), red willow (*Salix laevigata*), and Himalayan blackberry.

Special Status Species Evaluation

For the purposes of this report, special-status species are those that fall into one or more of the following categories, including those:

- listed as endangered or threatened under the Federal Endangered Species Act (FESA; including candidates and species proposed for listing);
- listed as endangered or threatened under the California Endangered Species Act (CESA; including candidates and species proposed for listing);
- designated as rare, protected, or fully protected pursuant to California Fish and Game Code;
- designated a Species of Special Concern (SSC) by the CDFW;
- considered by CDFW to be a Watch List species with potential to become an SSC;
- defined as rare or endangered under Section 15380 of the California Environmental Quality Act (CEQA); or,
- Having a California Rare Plant Rank (CRPR) of 1A, 1B, 2A, 2B, or 3.

In order to evaluate special-status species and/or their habitats with the potential to occur in the Study Area and/or be impacted by the proposed Project, HELIX obtained lists of special-status species known to occur and/or having the potential to occur in the Study Area and vicinity from the U.S. Fish and Wildlife Service (USFWS; USFWS 2022), the California Native Plant Society (CNPS; CNPS 2022), and the California Natural Diversity Database (CNDDB; CDFW 2022). Attachment C (Appendix C) includes these lists of special status plant and animal species occurring in the Project region. A total of 27 regionally occurring special-status plant species and 26 regionally occurring special-status wildlife species were identified during the database queries and desktop review and are evaluated in Attachment D (Appendix C).

Special Status Plant Species

A total of 27 regionally occurring special-status plant species were identified during the database searches and desktop review. The Study Area does not provide habitat for the majority of the regionally occurring special-status plant species, which are associated with aquatic habitats such as seeps, marsh, lakes, rivers, vernal pools, and freshwater wetlands which do not occur within the Study Area. The majority of the remaining species are associated with grasslands, dunes, prairie, old-growth forest, chaparral, montane forest, cismontane woodlands, scrub, and ridgeline habitat.

However, based on the results of the desktop review and biological reconnaissance survey, the site provides suitable habitat for three special-status plant species: coast fawn lily (*Erythronium revolutum*), white-flowered rein orchid (*Piperia candida*) and Marble Mountain campion (*Silene marmorensis*). These species are discussed below. Special-status species determined to have no potential to occur on the Study Area or that are not expected to occur in the Study Area and be impacted by the proposed Project (Attachment D) are not discussed further in this report.

<u>Coast Fawn Lily</u>
Federal status – none
State status – none
Other status – CRPR 2B.2 (rare, threatened, or endangered in California; more common elsewhere)

Species Description
Coast fawn lily is a perennial bulbiferous herb found on mesic soils and streambanks in bogs and fens, broadleaf upland forest, and North Coast coniferous forest from 0 - 1600 meters above mean sea level. Coast fawn lily blooms between March and July (occasionally August). Associated species include Douglas fir, tanoak, and Pacific madrone (CNPS 2022).

Survey History
Focused surveys were not conducted for coast fawn lily; however, the biological reconnaissance survey was conducted during the blooming period for this species and coast fawn lily was not observed in the Study Area. The nearest extant occurrence is 6.2-miles east of the Study Area along the Salmon River Trail in an area with Douglas fir and tanoak (CDFW 2022).

Habitat Suitability
Suitable habitat for coast fawn lily is present in the Douglas fir-tanoak forest habitat in the Study Area, especially in the areas surrounding the redwood water storage tank.

<u>White-flowered Rein Orchid</u>
Federal status – none
State status – none
Other status – CRPR 1B.2 (rare, threatened, or endangered in California and elsewhere)

Species Description
White-flowered rein orchid is a perennial herb that occurs in broadleaved upland forests, lower montane coniferous forests, and North Coast coniferous forests, sometimes on serpentinite. This species is found in forest duff, on mossy banks, rock outcrops, and muskeg at elevations ranging from 30 to 1,310-meters above mean sea level. White-flowered rein orchid blooms between May and September (sometimes March) (CNPS 2022).

Survey History
Focused surveys were not conducted for white-flowered rein orchid; however, the biological reconnaissance survey was conducted during the blooming period for this species and white-flowered rein orchid was not observed in the Study Area. The nearest extant occurrence is 6.5-miles west of the Study Area in Douglas fir forest (CDFW 2022).

Habitat Suitability
Suitable habitat for white-flowered rein orchid is present in the Douglas fir-tanoak forest habitat in the Study Area.

<u>Marble Mountain Campion</u>
Federal status – none
State status – none
Other status – CRPR 1B.2 (rare, threatened, or endangered in California and elsewhere)

Species Description
Marble Mountain campion is a perennial herb found in broadleaf upland forests, chaparral, cismontane woodlands, and lower montane coniferous forests from 170 to 1,250-meters elevation. Marble Mountain campion blooms between June and August (CNPS 2022).

Survey History
Focused surveys were not conducted for Marble Mountain campion; however, the biological reconnaissance survey was conducted during the blooming period for this species and Marble Mountain campion was not observed in the Study Area. The nearest extant occurrence is 6.2 miles east of the Study Area along the Salmon River Trail in an area with Douglas fir and tanoak (CDFW 2022).

Habitat Suitability
Suitable habitat for Marble Mountain campion is present in the Douglas fir-tanoak forest habitat in the Study Area.

Special Status Wildlife Species
A total of 26 regionally occurring special-status wildlife species were identified during the database searches and desktop review. The Study Area does not provide habitat for the majority of the regionally occurring special-status wildlife species, which are associated with aquatic habitats such as lakes, ponds, rivers, vernal pools, and freshwater wetlands which do not occur within the Study Area. The majority of the remaining species are associated with tree groves, old-growth forest, woodlands, riparian, beach, and cliff habitat, or have specific food species or elevation requirements that were not found in the Study Area.

The site provides suitable habitat for three special-status wildlife species: bald eagle (Haliaeetus leucocephalus), osprey (Pandion haliaetus), and northern spotted owl (Strix occidentalis caurina), as well as habitat for other migratory birds and raptors. These species are discussed briefly below. In addition, although there is no suitable habitat within the Study Area for marbled murrelet (Brachyramphus marmoratus) or Pacific marten (Martes caurina). However, these two species are discussed due to the presence of designated Critical Habitat for these species in the Study Area. The remaining special status species determined to have no potential to occur in the Study Area or that are not expected to occur in the Study Area and be impacted by the proposed Project (Attachment D) are not discussed further in this report.

<u>Bald Eagle</u>
Federal status –Delisted
State status – Endangered
Other – CDFW Fully Protected

Species Description
Bald eagles require large bodies of water with an abundant fish population. This species also feeds on fish, carrion, small mammals, and waterfowl. In California, the nests are usually located within one mile of permanent water. Nests are most often situated in large, old growth, or dominant live trees with open branchwork such as ponderosa pine. The nests are usually placed 16-61 meters (50 to 200 feet) above ground in trees with a commanding view of the area (Zeiner et al. 1990).

Survey History
The bald eagle was not observed in the Study Area during the biological survey. The nearest extant occurrence of bald eagle is 0.6-mile south of the Study Area along the Klamath River (CDFW 2022).

Habitat Suitability
Suitable nesting for bald eagle is present in the Study Area and suitable foraging habitat is present adjacent to the Study Area. The Klamath River, located 0.2-mile south of the Study Area, provides suitable foraging habitat for bald eagles and the species may nest within trees in the Study Area.

<u>Osprey</u>
Federal status – none
State status – None
Other – CDFW Watch List

Species Description
Osprey breed in Northern California from the Cascade Ranges southward to Lake Tahoe, and along the coast south to Marin County. They prey primarily on fish but also predate small mammals, birds, reptiles, and invertebrates. Foraging areas include open, clear waters of rivers, lakes, reservoirs, bays, estuaries, and surf zones. Nesting habitat for osprey include large trees, snags, and dead-topped trees in open forest habitats for cover and nesting (Zeiner et al. 1988-1990).

Survey History
Osprey was not observed in the Study Area during the biological survey. The nearest extant occurrence is 2.4-miles southwest of the Study Area along the Klamath River dominated by Douglas fir and tanoak (CDFW 2022).

Habitat Suitability
Suitable nesting habitat for osprey is present in the Study Area and suitable foraging habitat for osprey is present along the Klamath River, located 0.2-mile south of the Study Area. Therefore, the species could potentially nest within the Study Area.

<u>Northern Spotted Owl</u>
Federal status – Threatened
State status – Threatened
Other – CDFW Watch List

Species Description
Northern spotted owl is found from southwestern British Columbia down through the western half of Washington, Oregon and northern California south at least to Marin County. In California, it occurs in the Klamath Ranges, Cascade Range, and North Coast Ranges. Spotted owls have also been observed in the Santa Cruz Mountains in San Mateo and Santa Cruz counties, but the status of those populations is poorly known, and it is uncertain whether those birds are northern spotted owl or California spotted owl (*Strix occidentalis occidentalis*). Northern spotted owl prefers late-stage and old-growth forests characterized by a dense, multilayered, multi-species canopy with large overstory trees and varied understory. Forest types it has been observed in include Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), grand fir (*Abies grandis*), white fir (*Abies concolor*), ponderosa pine (*Pinus ponderosa*), Shasta red fir (*Abies magnifica* var. *shastensis*), mixed evergreen, mixed conifer hardwood, redwood (*Sequoia sempervirens*), Bishop pine (*Pinus muricata*), and. mixed evergreen deciduous forest. These forests typically are characterized by a high incidence of large trees with various deformities (large cavities, broken tops, mistletoe infections, and other evidence of decadence); large snags; large accumulations of fallen trees and other woody debris on the ground; and sufficient open space below the canopy for spotted owls to fly.

Although it is dependent on old-growth and late-successional forests, there is research that suggests that a mosaic of late-successional forest habitat interspersed with other seral stages may be superior to large, homogeneous expanses of older forest as habitat for the species, at least in areas where woodrats are a major component of the species' diet. Low- to moderate-severity wildfire may enhance habitat for the species by increasing habitat heterogeneity. Diet is variable dependent upon prey availability, but northern flying squirrel (*Glaucomys sabrinus*) (mainly in in Washington and Oregon) and dusky-footed woodrat (*Neotoma fuscipes*) (mainly in the Oregon Klamath Ranges and California) dominate the diet both in terms of biomass and quantity. Spotted owl territories tend to be larger where flying squirrels are the primary prey and smaller where wood rats are the primary prey. Other prey occasionally taken include deer mice, (*Peromyscus* spp.), tree voles (*Arborimus* spp.), red-backed voles (*Myodes* spp.), gophers (Geomyidae), snowshoe hare (*Lepus americanus*), bushy-tailed wood rats (*Neotoma cinerea*), birds, and insects. Prey is generally taken using a sit-and-wait technique from a single perch each night. Spotted owl pairs begin forming in February and are typically maintained until the death of one of the partners. Spotted owl uses existing nests, often of corvids, or platforms created by broken treetops or limbs. A clutch of three to four eggs is laid from late March (occasionally as early as mid-March) to mid-April and incubated by the female for approximately 30 days. Young are brooded by the female for eight to 10 days while the male provides food. The flightless young leave the nest at approximately 35 days after hatching, and receive decreasing parental care at least until September, or until they become independent around November.

Survey History

Northern spotted owl was not observed in the Study Area during the biological survey; however, this species is typically only detected during protocol call surveys. The nearest occurrence of Northern spotted owl is within 0.45-mile of the Study Area with a second occurrence within 0.9-mile. There are six occurrences of northern spotted owl within one mile of the Study Area and 424 occurrences of the species within 5-miles (CDFW 2022). At least five northern spotted owl activity centers are located within approximately 2-miles of the Study Area.

Habitat Suitability

Suitable nesting habitat for northern spotted owl is present adjacent to the Study Area but not within the Study Area boundary. The Klamath River located 0.2-mile south of the Study Area, provides suitable foraging and nesting habitat for northern spotted owl. Given the proximity of the Study area to suitable nesting habitat, the species may forage in the Study Area. The Study Area is surrounded by northern spotted owl Critical Habitat on all sides, although the Study Area itself is not within the Critical Habitat boundaries, it is within 1.1-mile of Critical Habitat at its nearest point.

<u>Marbled Murrelet</u>

Federal status – Threatened
State status – Endangered
Other status – None

Species Description

This species is pelagic, except during its nesting season where it will use old-growth, multi-layered canopied forests up to 50-miles inland from the coast. When nesting trees are not present, this species will nest on the ground or amongst rocks. In California, nesting typically occurs in coastal redwood forest or Douglas fir forests (USFWS 1997).

Survey History

No marbled murrelet or potential nest sites for this species were observed in the Study Area during the biological reconnaissance survey. The nearest reported occurrence of marbled murrelet in the CNDDB is approximately 22.4-miles southwest of the site along Redwood Creek within Redwood National Park.

Habitat Suitability

The Douglas fir-tanoak forest in the Study Area does not provide suitable nesting habitat for marbled murrelet. The Study Area lacks dense, mature, multi-layer old growth forest and is disturbed. The eastern portion of the Study Area, along Placer Drive, overlaps designated Critical Habitat for this species; however, the site lacks the primary constituent elements of critical habitat including old growth trees with the presence of deformities and/or large branches to use as a nesting platform. This portion of the Study Area associated with the designated Critical Habitat consists of developed habitat.

<u>Pacific Marten</u>
Federal status – Threatened
State status – Endangered
Other status – CDFW Species of Special Concern

Species Description
Pacific marten are found in coniferous and mixed conifer forests with more than 40% canopy closure typically from 1,350 to 3,200-meters above mean sea level (amsl) and require old growth forests that consist primarily of fir and lodgepole pines with cavities for nesting and denning (Zielinski 2014). The species will also den under logs in the snow and form snow tunnels. Pacific marten are active year round, and typically avoid open areas with no canopy cover, but will forage in meadows, riparian areas and along streams (Zielinski 2014). When traveling, marten typically move along ridgetops and are capable of traveling up to 15-miles in a single night while foraging (Zeiner et al. 1990).

Survey History
No Pacific marten or potential den sites for this species were observed in the Study Area during the biological reconnaissance survey. The nearest reported occurrence of Pacific marten is approximately 1.4-miles north of the Study Area from 1972 from the vicinity of Slide Gulch (CDFW 2022).

Habitat Suitability
The Douglas fir - tanoak forest in the Study Area does not provide suitable denning habitat for Pacific marten. The Study Area lacks dense, mature, multi-layer old growth forest and is disturbed. The very northwestern portion of the Study Area, encompassing much of the proposed water treatment and storage features of the Project, overlaps designated Critical Habitat for this species; however, the site lacks the primary constituent elements of critical habitat including old growth trees with the presence of cavities to use as a den site.

Migratory Birds and Raptors
Migratory and non-game birds are protected during the nesting season by the federal Migratory Bird Treaty Act (MBTA) and California Fish and Game Codes. The Study Area and immediate vicinity provides nesting and foraging habitat for a variety of native birds common to urbanized areas, such as mourning dove (*Zenaida macroura*), house finch (*Haemorhous mexicanus*), and California towhee (*Melozone crissalis*). Nests were not observed during surveys; however, a variety of migratory birds have the potential to nest in and adjacent to the site, in trees, shrubs and on the ground in vegetation.

Project activities such as clearing and grubbing during the avian breeding season (February 1 through August 31) could result in injury or mortality of eggs and chicks directly through destruction or indirectly through forced nest abandonment due to noise and other disturbance. Destruction of active nests, eggs, and/or chicks would be a violation of the MBTA and Fish and Game Codes and a significant impact.

Sensitive Natural Communities
Natural communities are defined by one or more characteristic plant species, and the species communities in the majority of the Study Area are not considered characteristic of a sensitive natural community. Due to the disturbed nature of the Study Area and vicinity, there are no terrestrial sensitive natural communities in the Study Area.

Aquatic Resources

The ponds and ditch are the only aquatic resources in the Study Area, they are remnants of historic hydraulic mining in the area and are likely not hydrologically connected to other aquatic resources in the area. The Project has been designed to avoid direct impacts to aquatic resources. The ponds and ditch will not be developed as part of the proposed Project and there will be no direct impacts to aquatic resources (i.e., no placement of temporary or permanent fill within aquatic resources).

Regulatory Setting

Policies, regulations, and plans pertaining to the protection of biological resources on the Project site are summarized in the following subsections.

Federal Requirements

Federal Endangered Species Act

The U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) enforce the provisions stipulated within the Federal Endangered Species Act of 1973 (FESA; 16 USC 1531 et seq.). Species identified as federally threatened or endangered (50 CFR 17.11, and 17.12) are protected from take, defined as direct or indirect harm, unless a Section 10 permit is granted to an entity other than a federal agency or a Biological Opinion with incidental take provisions is rendered to a federal lead agency via a FESA Act Section 7 consultation. Pursuant to the requirements of FESA, an agency reviewing a proposed project within its jurisdiction must determine whether any federally listed species may be present in the study area and determine whether the proposed project will jeopardize the continued existence of or result in the destruction or adverse modification of critical habitat of such species (16 USC 1536 (a)[3], [4]). Other federal agencies designate species of concern (species that have the potential to become listed), which are evaluated during environmental review under the National Environmental Policy Act (NEPA) or CEQA although they are not otherwise protected under FESA.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) of 1918 established federal responsibilities for the protection of nearly all species of birds, their eggs, and nests. The Migratory Bird Treaty Reform Act of 2004 further defined species protected under the act and excluded all non-native species. Section 16 U.S.C. 703–712 of the Act states “unless and except as permitted by regulations, it shall be unlawful at any time, by any means or in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture, or kill” a migratory bird. A migratory bird is any species or family of birds that live, reproduce, or migrate within or across international borders at some point during their annual life cycle. Currently, there are 836 migratory birds protected nationwide by the MBTA, of which 58 are legal to hunt. The US Court of Appeals for the 9th Circuit (with jurisdiction over California) has ruled that the MBTA does not prohibit incidental take (952 F 2d 297 – Court of Appeals, 9th Circuit 1991).

Clean Water Act

Any person, firm, or agency planning to alter or work in waters of the US, including the discharge of dredged or fill material, must first obtain authorization from the US Army Corps of Engineers (USACE) under the Clean Water Act (CWA; 33 USC 1344). Permits, licenses, variances, or similar authorization may also be required by other federal, State, and local statutes. Section 10 of the Rivers and Harbors Act prohibits the obstruction or alteration of navigable waters of the US without a permit from USACE (33 USC 403).

Waters of the U.S. include certain wetlands; wetlands are defined in 33 CFR Part 328 as:

> those areas that are inundated or saturated by surface or ground water at a frequency and duration to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

Section 401 of the CWA requires that an applicant for a federal license or permit that allows activities resulting in a discharge to waters of the US also obtain a State certification that the discharge complies with all applicable water quality standards, limitations, and restrictions. The Regional Water Quality Control Board (RWQCB) administers the certification program in California and no license or permit may be issued until certification has been granted.

Section 402 establishes a permitting system for the discharge of any pollutant (except dredged or fill material) into waters of the US.

Section 404 establishes a permit program administered by USACE that regulates the discharge of dredged or fill material into waters of the U.S. (including wetlands). Implementing regulations by USACE are found at 33 CFR Parts 320-332. The Section 404 (b)(1) Guidelines were developed by the USEPA in conjunction with USACE (40 CFR Part 230), allowing the discharge of dredged or fill material for non-water dependent uses into special aquatic sites only if there is no practicable alternative that would have less adverse impacts.

State Requirements

California Endangered Species Act
The California Endangered Species Act (CESA) (California Fish and Game Code Sections 2050 to 2097) is similar to the FESA. The California Fish and Game Commission is responsible for maintaining lists of threatened and endangered species under CESA. CESA prohibits the take of listed and candidate (petitioned to be listed) species. “Take” under California law means to hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (California Fish and Game Code, Section 86). The California Department of Fish and Wildlife (CDFW) can authorize take of a State-listed species under Section 2081 of the California Fish and Game Code if the take is incidental to an otherwise lawful activity, the impacts are minimized and fully mitigated, funding is ensured to implement and monitor mitigation measures, and CDFW determines that issuance would not jeopardize the continued existence of the species. A CESA permit must be obtained if a project will result in the “take” of listed species, either during construction or over the life of the project. For species listed under both FESA and CESA requiring a Biological Opinion under Section 7 of the FESA, CDFW may also authorize impacts to CESA species by issuing a Consistency Determination under Section 2080.1 of the Fish and Game Code.

California Code of Regulations Title 14 and California Fish and Game Code
The official listing of endangered and threatened animals and plants is contained in the California Code of Regulations Title 14 §670.5. A State candidate species is one that the California Fish and Game Code has formally noticed as being under review by CDFW to include in the State list pursuant to Sections 2074.2 and 2075.5 of the California Fish and Game Code.

Legal protection is also provided for wildlife species in California that are identified as “fully protected animals.” These species are protected under Sections 3511 (birds), 4700 (mammals), 5050 (reptiles and amphibians), and 5515 (fish) of the California Fish and Game Code. These statutes prohibit take or possession of fully protected species at any time. CDFW is unable to authorize incidental take of fully protected species unless any such take authorization is issued in conjunction with the approval of a

Natural Community Conservation Plan that covers the fully protected species (California Fish and Game Code Section 2835).

California Environmental Quality Act

Under the California Environmental Quality Act of 1970 (CEQA; Public Resources Code Section 21000 et seq.), lead agencies analyze whether projects would have a substantial adverse effect on a candidate, sensitive, or special-status species (Public Resources Code Section 21001(c)). These “special-status” species generally include those listed under FESA and CESA, and species that are not currently protected by statute or regulation, but would be considered rare, threatened, or endangered under the criteria included CEQA Guidelines Section 15380. Therefore, species that are considered rare are addressed under CEQA regardless of whether they are afforded protection through any other statute or regulation. The California Native Plant Society (CNPS) inventories the native flora of California and ranks species according to rarity; plants ranked as 1A, 1B, 2A, 2B, and 3 are generally considered special-status species under CEQA. [3]

Although threatened and endangered species are protected by specific federal and State statutes, CEQA Guidelines Section 15380(d) provides that a species not listed on the federal or State list of protected species may be considered rare if it can be shown to meet certain specified criteria. These criteria have been modeled after the definition in FESA and the section of the California Fish and Game Code dealing with rare or endangered plants and animals. Section 15380(d) allows a public agency to undertake a review to determine if a significant effect on species that have not yet been listed by either the USFWS or CDFW (i.e., candidate species) would occur.

California Native Plant Protection Act

The California Native Plant Protection Act of 1977 (California Fish and Game Code Sections 1900-1913) empowers the Fish and Game Commission to list native plant species, subspecies, or varieties as endangered or rare following a public hearing. To the extent that the location of such plants is known, CDFW must notify property owners that a listed plant is known to occur on their property. Where a property owner has been so notified by CDFW, the owner must notify CDFW at least 10 days in advance of any change in land use (other than changing from one agricultural use to another), in order that CDFW may salvage listed plants that would otherwise be destroyed. Currently, 64 taxa of native plants have been listed as rare under the act.

Nesting Birds

California Fish and Game Code Subsections 3503 and 3800 prohibit the possession, take, or needless destruction of birds, their nests, and eggs, and the salvage of dead nongame birds. California Fish and Game Code Subsection 3503.5 protects all birds in the order of Accipitriformes, Falconiformes, and Strigiformes (birds of prey). Fish and Game Code Subsection 3513 states that it is unlawful to take or possess any migratory nongame bird as designated in the Migratory Bird Treaty Act or any part of such migratory nongame bird except as provided by rules and regulations adopted by the Secretary of the Interior under provisions of the MBTA. The Attorney General of California has released an opinion that the Fish and Game Code prohibits incidental take.

Porter Cologne Act

The Porter-Cologne Water Quality Control Act (Porter-Cologne Act, Water Code Section 13000 et seq.) is California’s statutory authority for the protection of water quality in conjunction with the federal CWA. The Porter-Cologne Act requires the State Water Resources Control Board (SWRCB) and RWQCBs under

[3] The California Rare Plant Rank system can be found online at https://www.cnps.org/rare-plants

the CWA to adopt and periodically update water quality control plans, or basin plans. Basin plans are plans in which beneficial uses, water quality objectives, and implementation programs are established for each of the nine regions in California. The Porter-Cologne Act also requires dischargers of pollutants or dredged or fill material to notify the RWQCBs of such activities by filing Reports of Waste Discharge and authorizes the SWRCB and RWQCBs to issue and enforce waste discharge requirements, National Pollution Discharge Elimination System (NPDES) permits, Section 401 water quality certifications, or other approvals. The RWQCB will assert jurisdiction over any waters of the State, including wetlands, regardless of whether or not the feature qualifies as waters of the U.S.

California Fish and Game Code Section 1602 – Lake and Streambed Alteration Program
Diversions or obstructions of the natural flow of, or substantial changes or use of material from the bed, channel, or bank of any river, stream, or lake in California that supports wildlife resources are subject to regulation by CDFW, pursuant to Section 1602 of the California Fish and Game Code. The CDFW requires notification prior to commencement of any such activities, and a Streambed Alteration Agreement (SAA) pursuant to Fish and Game Code Sections 1601-1603, if the activity may substantially adversely affect an existing fish or wildlife resource. A lake under CDFW jurisdiction is defined as "a permanent natural body of water of any size or an artificially impounded body of water of at least one acre, isolated from the sea, and having an area of open water of sufficient depth and permanency to prevent complete coverage by rooted aquatic plants" (CCR Vol. 18 Title 14, Section 1562.1). Streambeds within CDFW jurisdiction are based on the definition of a stream as "a body of water that flows at least periodically or intermittently through a bed or channel having banks and supporting fish or other aquatic life" (CCR Vol. 18 Title 14, Section 1.72).

Evaluation

a) Have a substantial adverse effect, directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies or regulations, or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service?

Less than significant impact with mitigation. Of the sensitive species known or thought to utilize the region around Orleans, the species determined to potentially utilize the site for suitable habitat include the coast fawn lily, white-flowered rein orchid, marble mountain campion, bald eagle, osprey, northern spotted owl, marbled murrelet, pacific marten, and other migratory birds and raptors. These organisms are discussed individually below.

Coast Fawn Lily

Although coast fawn lily is not known to occur in the Study Area there is a potential that it could occur due to the presence of suitable habitat. If this plant species were to occur in the Study Area, Project activities would have the potential to result in adverse impacts. Adverse impacts could occur if mechanical equipment or workers directly crushed, trampled, or uprooted sensitive plants and indirect impacts could occur through soil compaction, alteration of hydrology, and increased erosion and sedimentation resulting from ground disturbance. Implementation of Mitigation Measure BIO-01 would reduce potential impacts to this species to less than significant.

Mitigation Measure BIO-01: Avoid Impacts to Special Status Plants

Prior to any construction-related ground disturbance occurring in areas of suitable habitat for special status plants, focused surveys shall be completed to determine the presence or absence of these species in the Study Area. The surveys shall be floristic in nature and shall be seasonally timed to coincide with the blooming period of these species (March to July; coast fawn lily), (May to September; white flowered rein orchid) and (June and August; Marble Mountain campion). If special-status species are not found during the focused surveys, then no further action is required.

- If special-status plants are documented on the site, a report shall be submitted to CNDDB to document the status of the species on the site. If the Project is designed to avoid impacts to special-status plant individuals and habitat, no further mitigation for these species would be necessary.

- If special-status plants are documented on the site and Project impacts to these species are anticipated, consultation with CDFW shall be conducted to develop a mitigation strategy. The proponent shall notify CDFW, providing a complete description of the location, size, and condition of the occurrence, and the extent of proposed direct and indirect impacts to it. The Project proponent shall comply with any mitigation requirements imposed by CDFW. Mitigation requirements could include but are not limited to, development of a plan to relocate the special-status plants (seed) to a suitable location outside of the impact area and monitoring the relocated population to demonstrate transplant success or preservation of this species or its habitat at an on or off-site location.

White-flowered Rein Orchid

Although white-flowered rein orchid is not known to occur in the Study Area, there is a potential that it could occur due to the presence of suitable habitat. If this plant species were to occur in the Study Area, Project activities would have the potential to result in adverse impacts. Adverse impacts could occur if mechanical equipment or workers directly crushed, trampled, or uprooted sensitive plants and indirect impacts could occur through soil compaction, alteration of hydrology, and increased erosion and sedimentation resulting from ground disturbance. Implementation of Mitigation Measure BIO-01 would reduce potential impacts to this species to less than significant.

Marble Mountain Campion

Although Marble Mountain campion is not known to occur in the Study Area there is a potential that it could occur due to the presence of suitable habitat. If this plant species were to occur in the Study Area, Project activities would have the potential to result in adverse impacts. Adverse impacts could occur if mechanical equipment or workers directly crushed, trampled, or uprooted sensitive plants and indirect impacts could occur through soil compaction, alteration of hydrology, and increased erosion and sedimentation resulting from ground disturbance. Implementation of Mitigation Measure BIO-01 would reduce potential impacts to this species to less than significant.

Bald Eagle

If bald eagles were to nest within or adjacent to the site prior to construction, impacts to nesting could occur through noise, vibration, and the presence of construction equipment and personnel. Project activities such as clearing and grubbing, grading or other earthwork, or tree removal during the breeding season (February 1 through August 31) could result in injury or mortality of eggs and chicks directly through nest destruction or indirectly through forced nest abandonment due to noise and other disturbance. This would be a potentially significant impact. Implementation of Mitigation Measure BIO-02 would reduce potential impacts to this species to less than significant.

Mitigation Measure BIO-02: Avoid Impacts to Nesting and Migratory Birds

If ground disturbance including vegetation clearing and grubbing activities commence during the avian breeding season (February 1 through August 31), a qualified biologist should conduct a pre-construction nesting bird survey no more than 14 days prior to initiation of Project activities and again immediately prior to construction. The survey area should include suitable raptor nesting habitat within 500 feet of the Project boundary (inaccessible areas outside of the survey area can be surveyed from the site or from public roads using binoculars or spotting scopes). Pre-construction surveys are not required in areas where Project activities have been continuous since prior to February 1, as determined by a qualified biologist. Areas that have been inactive for more than 14 days during the avian breeding season should be re-surveyed prior to resumption of Project activities. If no active nests are identified, no further mitigation is required. If active nests are identified, the following measure should be implemented:

- A suitable nest buffer depending on species and surrounding land uses shall be established by a qualified biologist around active nests and no construction activities within the buffer shall be allowed until a qualified biologist has determined that the nest is no longer active (i.e., the nestlings have fledged and are no longer reliant on the nest, or the nest has failed). Encroachment into the buffer may occur at the discretion of a qualified biologist. Any encroachment into the buffer shall be monitored by a qualified biologist to determine whether nesting birds are being impacted.

Specifically, surveys for bald and golden eagle nests shall be conducted within 2 miles of any construction areas supporting suitable nesting habitat and important eagle roost sites and foraging areas. Surveys shall be conducted in accordance with the USFWS Interim Golden Eagle Inventory and Monitoring Protocols, and CDFW's Bald Eagle Breeding Survey Instructions, or current guidance.

If an active eagle's nest is found, project disturbance shall not occur within 0.5 mile of the active nest site during the breeding season (December 30 through July 1) or any disturbance if that action is shown to disturb the nesting birds. The 0.5 mile no disturbance buffer shall be maintained throughout the breeding season or until the young have fledged and are no longer dependent upon the nest or parental care for survival.

Osprey

If osprey were to nest within or adjacent to the site prior to construction, impacts to nesting could occur through noise, vibration, and the presence of construction equipment and personnel. Project activities such as clearing and grubbing, grading or other earthwork, or tree removal during the breeding season (February 1 through August 31) could result in injury or mortality of eggs and chicks directly through destruction or indirectly through forced nest abandonment due to noise and other disturbance. This would be a potentially significant impact. Implementation of Mitigation Measure BIO-02 would reduce potential impacts to this species to less than significant.

Northern Spotted Owl

If a northern spotted owl were to nest adjacent to the site prior to construction, impacts to nesting could occur through noise, vibration, and the presence of construction equipment and personnel. Project activities such as clearing and grubbing, grading or other earthwork, or tree removal during the breeding season (February 1 through August 31) could result in forced nest abandonment due to noise and other disturbance to adjacent nesting habitat. This would be a potentially significant impact. Implementation of Mitigation Measure BIO-02 would reduce potential impacts to this species to less than significant.

Marbled Murrelet

No impacts to marbled murrelet or suitable habitat for this species are anticipated as a result of the proposed Project. Suitable nesting habitat is not present in or adjacent to the Study Area. Preconstruction surveys will be conducted for migratory birds and raptors. If marbled murrelet is observed, coordination will be conducted with USFWS and CDFW to determine the appropriate nest buffer based on the location of the nest and the type of construction activity occurring within proximity to the nest. Implementation of Mitigation Measure BIO-02 would reduce potential impacts to this species to less than significant.

Pacific Marten

No impacts to Pacific marten or suitable habitat for this species are anticipated as a result of the proposed Project. Suitable denning habitat is not present in or adjacent to the Study Area. No direct impacts to Pacific marten or potential habitat in the Study Area would be anticipated as a result of the proposed Project as Pacific marten would not be expected to be present within the Project footprint and there is no suitable habitat for this species in the Project footprint.

Migratory Birds and Raptors

Project activities such as clearing and grubbing during the avian breeding season (February 1 through August 31) could result in injury or mortality of eggs and chicks directly through destruction or indirectly through forced nest abandonment due to noise and other disturbance. Destruction of active nests, eggs, and/or chicks would be a violation of the MBTA and Fish and Game Codes and a significant impact. Implementation of Mitigation Measure BIO-02 would reduce potential impacts to this species to less than significant.

b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies or regulations, or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service?

No impact. No riparian habitat or other sensitive natural communities were identified during the biological reconnaissance survey. There would be no impact on riparian habitat or other sensitive natural communities.

c) Have a substantial adverse effect on State or federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?

No impact. The ponds and ditch are the only aquatic resources in the Project area and would not be developed as part of the proposed Project. Therefore, there would be no direct impact to aquatic resources.

d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?

Less than significant impact. The proposed Project would replace an existing in-line filtration plant with a new surface, direct-filtration WTP. The Project would construct a new water treatment building and a backwash reclaim tank. A proposed generator and propane tank would be located adjacent to the water treatment building. The Project would also demolish an existing redwood storage tank and construct a new steel water storage tank. The Project would install a new fire hydrant at the entrance of the path leading to the proposed water treatment building, directly off Camp Creek Road. New fencing around the water treatment building, backwash reclaim tank, generator, and propane tank would be installed. Existing subsurface piping would be demolished and/or abandoned. New subsurface piping would tie into the existing distribution system piping located throughout the parcel in order to serve the new water treatment system.

The number of disturbed areas would not substantially increase, and new infrastructure would not differ substantially from that which currently exists. The new water treatment building would be located in a previously disturbed area and the new water storage tank would be located within the same vicinity as the existing redwood tank. Though construction activities may temporarily increase the amount of noise, movement, and other disturbance within portions of the Project site, these impacts would be short term and temporary, and would abate once construction is completed. Thus, wildlife use of, and movement through, the site would not be substantially changed, and any impacts would be less than significant.

e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?

Less than significant impact. No removal of live trees is proposed as part of this Project. The Project would include upgrading existing infrastructure and would remain largely within or adjacent to the existing footprint of disturbance. The Project would not conflict with any local policies or ordinances protecting biological resources, and any impacts would be less than significant.

f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or State habitat conservation plan?

Less than significant impact. The proposed Project would not alter or disturb a significant amount of habitat and would focus disturbance mostly on existing footprints. Intensity of use would be maintained around current levels. The Project would not conflict with an adopted local, regional, or State habitat conservation plan, and any impact would be less than significant.

V. CULTURAL RESOURCES

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource pursuant to §15064.5?	☐	☒	☐	☐
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?	☐	☒	☐	☐
c) Disturb any human remains, including those interred outside of dedicated cemeteries?	☐	☒	☐	☐

A Cultural Resource Assessment Letter was prepared for this Project by HELIX Environmental Planning, Inc. (HELIX 2024). The cultural report is not appended to this document due to its confidential nature. This assessment, which addresses both archaeological and architectural resources, is based on the results of an archival records search, Native American coordination, and a pedestrian survey of the Project site.

Environmental Setting

Archival Records Search

On June 27, 2022, HELIX conducted an archival records search in support of the proposed Project at the Northwest Information Center (NWIC) located at Sonoma State University. The records search addressed all portions of the Area of Potential Effects (APE) and a 0.25-mile radius around the APE (hereafter referred to as the study area). Sources of information examined through this records search included previous survey and cultural resources files; the National Register of Historic Places (NRHP); the California Register of Historical Resources (CRHR); the Office of Historic Preservation (OHP) Archaeological Determinations of Eligibility; the OHP Directory of Properties in the Historic Property Data File; historical topographic maps; and historical aerial photographs.

Regulatory Setting

Relevant Federal Regulations

National Register of Historic Places

The NRHP was established by the NHPA as "an authoritative guide to be used by federal, state, and local governments, private groups, and citizens to identify the Nation's cultural resources and to indicate what properties should be considered for protection from destruction or impairment" (36 CFR 60.2).

The NRHP recognizes properties that are significant at the national, state, and local levels. To be eligible for listing in the NRHP, a resource must be significant in American history, architecture, archaeology, engineering, or culture. Districts, sites, buildings, structures, and objects of potential significance must also possess integrity of location, design, setting, materials, workmanship, feeling, and association. A property is eligible for the NRHP if it is significant under one or more of the following criteria:

- Criterion A: It is associated with events that have made a significant contribution to the broad patterns of our history.
- Criterion B: It is associated with the lives of persons who are significant in our past.
- Criterion C: It embodies the distinctive characteristics of a type, period, or method of construction; represents the work of a master; possesses high artistic values; or represents a significant and distinguishable entity whose components may lack individual distinction.
- Criterion D: It has yielded, or may be likely to yield, information important in prehistory or history (36 CFR 60.4).

Cemeteries, birthplaces, graves of historic figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, and properties that are primarily commemorative in nature are not considered eligible for the NRHP unless they satisfy certain conditions. In general, a resource must be at least 50 years old to be considered for the NRHP, unless it satisfies a standard of exceptional importance.

State Regulations

California Environmental Quality Act
Pursuant to CEQA, a historical resource is a resource listed in, or eligible for listing in, the NRHP or the California Register of Historical Resources (CRHR). In addition, resources included in a local register of historic resources, or identified as significant in a local survey conducted in accordance with state guidelines, are also considered historic resources under CEQA, unless a preponderance of the facts demonstrates otherwise. According to CEQA, the fact that a resource is not listed in, or determined eligible for listing in, the CRHR, or is not included in a local register or survey, shall not preclude a Lead Agency, as defined by CEQA, from determining that the resource may be a historic resource as defined in California Public Resources Code (PRC) Section 5024.1.7.

CEQA applies to archaeological resources when (1) the historic or prehistoric archaeological resource satisfies the definition of a historical resource, or (2) the historic or prehistoric archaeological resource satisfies the definition of a “unique archaeological resource.” A unique archaeological resource is an archaeological artifact, object, or site that has a high probability of meeting any of the following criteria (PRC § 21083.2(g)):

1. The archaeological resource contains information needed to answer important scientific research questions and there is a demonstrable public interest in that information.
2. The archaeological resource has a special and particular quality such as being the oldest of its type or the best available example of its type.
3. The archaeological resource is directly associated with a scientifically recognized important prehistoric or historic event or person.

California Register of Historical Resources
The CRHR is “an authoritative guide in California to be used by state and local agencies, private groups, and citizens to identify the state’s historical resources and to indicate what properties are to be protected, to the extent prudent and feasible, from substantial adverse change” (PRC § 5024.1(a)). Certain properties, including those listed in or formally determined eligible for listing in the NRHP and

California Historical Landmarks (CHL) numbered 770 and higher, are automatically included in the CRHR. Other properties recognized under the California Points of Historical Interest program, identified as significant in historic resources surveys, or designated by local landmarks programs may be nominated for inclusion in the CRHR.

A resource, either an individual property or a contributor to a historic district, may be listed in the CRHR if the State Historical Resources Commission determines that it meets one or more of the following criteria, which are modeled on NRHP criteria (PRC § 5024.1(c)):

- Criterion 1: It is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage.
- Criterion 2: It is associated with the lives of persons important in our past.
- Criterion 3: It embodies the distinctive characteristics of a type, period, region, or method of construction; represents the work of an important creative individual; or possesses high artistic values.
- Criterion 4: It has yielded, or may be likely to yield, information important in history or prehistory.

Resources nominated to the CRHR must retain enough of their historic character or appearance to be recognizable as historic resources and to convey the reasons for their significance. It is possible that a resource whose integrity does not satisfy NRHP criteria may still be eligible for listing in the CRHR. A resource that has lost its historic character or appearance may still have sufficient integrity for the CRHR if, under Criterion 4, it maintains the potential to yield significant scientific or historical information or specific data. Resources that have achieved significance within the past 50 years also may be eligible for inclusion in the CRHR, provided that enough time has lapsed to obtain a scholarly perspective on the events or individuals associated with the resource.

Native American Heritage Commission

Section 5097.91 of the PRC established the Native American Heritage Commission (NAHC), whose duties include the inventory of places of religious or social significance to Native Americans and the identification of known graves and cemeteries of Native Americans on private lands. Under Section 5097.9 of the PRC, a State policy of noninterference with the free expression or exercise of Native American religion was articulated along with a prohibition of severe or irreparable damage to Native American sanctified cemeteries, places of worship, religious or ceremonial sites, or sacred shrines located on public property. Section 5097.98 of the PRC specifies a protocol to be followed when the NAHC receives notification of a discovery of Native American human remains from a county coroner.

Government Code Sections 6254(r) and 6254.10

These sections of the California Public Records Act were enacted to protect archaeological sites from unauthorized excavation, looting, or vandalism. Section 6254(r) explicitly authorizes public agencies to withhold information from the public relating to "Native American graves, cemeteries, and sacred places maintained by the Native American Heritage Commission." Section 6254.10 specifically exempts from disclosure requests for "records that relate to archaeological site information and reports, maintained by, or in the possession of the Department of Parks and Recreation, the State Historical Resources Commission, the State Lands Commission, the Native

American Heritage Commission, another state agency, or a local agency, including the records that the agency obtains through a consultation process between a Native American tribe and a state or local agency.”

Health and Safety Code, Sections 7050 and 7052
Health and Safety Code, Section 7050.5 declares that, in the event of the discovery of human remains outside of a dedicated cemetery, all ground disturbance must cease and the county coroner must be notified. Section 7052 establishes a felony penalty for mutilating, disinterring, or otherwise disturbing human remains, except by relatives.

Penal Code, Section 622.5
Section 622.5 of the Penal Code provides misdemeanor penalties for injuring or destroying objects of historic or archaeological interest located on public or private lands, but specifically excludes the landowner.

Previous Studies

The records search revealed that five cultural resource studies have been previously conducted within the Project’s APE.

Table 5
PREVIOUS STUDIES CONDUCTED WITHIN THE APE

Report	Year	Author(s)	Title	Affiliation
S-000193	1975	Roop, William G	Orleans-Red Cap Bridge Project	Archaeological Resource Service
S-015886	1994	Roscoe, James	Cultural Resource Inventory for the Proposed Fish Rehabilitation Project on Camp Creek, Orleans, California	N/A
S-024552	2000	Vaughan, Trudy	Confidential Archaeological Addendum for Timer Operations on Non-Federal Lands in California, Camp Creek THP, 1-00-406 HUM (California Department of Forestry)	Coyote & Fox Enterprises
S-038865	2011	Leach-Palm, Laura, Pat Mikkelsen, Libby Seil, Darla Rice, Bryan Larson, Joseph Freeman, and Julia Costello	Cultural Resources Inventory of Caltrans District 1 Rural Conventional Highways in Del Norte, Humboldt, Mendocino and Lake Counties, Contract NO. 01A1056, Expenditure Authorization No. 01-453608	Far Western Anthropological Research Group, JRP Historical Consulting LLC, and Foothill Resources Ltd.
S-053155	2019	Cardiff, Darrell	Historic Property Survey Report, Three Humboldt Bridges Seismic Retrofit Project, Camp Creek Bridge (04-0066), HUM-96, PM 37.25, Willow Creek Bridge (04-01235), HUM-96, PM 0.24, G Street Overcrossing (04-0243) HUM-101, PM 86.77, EA 01-0A120, E-FIS Project Number 0113000109	California Department of Transportation

Previously Recorded Cultural Resources

The records search also determined that there are three previously recorded cultural resources located within the APE (Table 6).

Table 6
PREVIOUSLY DOCUMENTED RESOURCES WITHIN THE APE

Primary	Trinomial	Year	Author(s)	Description
P-12-001386	CA-HUM-001042H	1997	Vaughan, T.	Historic Era – Oak Ridge & Salstrom Placers, also known as Delaney #1, includes privies, dumps, trash scatters, water conveyances including flume, ditches, and sluiceway cuts, and machinery
P-12-003123	N/A	1978	Burke, R. E.	Prehistoric/Protohistoric Era – Karuk Panamenik World Renewal Ceremony District
P-12-003719	N/A	1978	Burke, R.E.	Prehistoric/Protohistoric Era – Kusnachanimnam, a sacred/medicine place which is a contributing feature of the Karuk Panmenik World Renewal Ceremony District

- **P-12-001386** (CA-HUM-001042H): First recorded in 1997 by T. Vaughan during a cultural resource study associated with the Camp Creek Timber Harvest Plan, this resource, known as the Oak Ridge & Salstrom Placers and or as Delaney #1, is comprised of the remains of a series of water ditches, a wooden flume, and mining tailings, from the region's historic mining period (spanning from the 1840s through the mid-20th century). These remains are associated with the Salstrom family and the mining operations in the area. Jonas Salstrom acquired land in the area in 1876 and developed a mining and sawmilling operation in the vicinity. Hydraulic operations of the Salstrom Mine are thought to have taken place between 1908 and 1910. While this archaeological site has not been formally evaluated for eligibility for inclusion into the NRHP or CRHR, the official site record on file with the NWIC suggests that the site has the potential to reveal additional data regarding mining practices of the late 19th and early 20th centuries. This resource will be treated as a historical resource for the purposes of this Project.

  P-12-003123: First recorded in 1978 by R. E. Burke, this resource is the Karuk Panamenik World Renewal Ceremony District. Within this district Karuk Native Americans performed the sacred White Deerskin Dance or World Renewal Ceremony, which was the most important event of the community's late 19th and early 20th century religious system. Many Karuk are reported to have considered the World Renewal Ceremony as the focal point for the entire culture, and absolutely essential for the well-being of the universe. The religious leaders who performed the Ceremony were the most wealthy and influential men and women in the Karuk culture. Often these were upper class men, who were generally *Yash-arara* (rich men), whose names, exploits and families have been remembered for generations. There were also fatawenan (priests) who know the sacred rites for the ceremonies. The study of this site has revealed important information regarding Karuk culture and history. As a result of this district's association with events that have made a significant pattern of our history, its association with the lives of persons significant to our past, and the fact that it has yielded information important in American prehistory, this district was determined eligible for listing in the NRHP under Criteria A, B, and D on April 3, 1978.

- **P-12-003719:** First recorded in 1978 by R. E. Burke, this resource is a sacred medicine place, known as Kusnachanimnam. Within this location priests are thought to have made fire and smoked tobacco as an offering for the World Renewal Ceremony. As a result, this site is understood to be a contributing element to the NRHP listed Karuk Panamenik World Renewal Ceremony District (P-12-003123).

Additional Sources of Information

Historic maps covering the Project vicinity including a 1914 Map of Humboldt County by J. N. Lentell, an Atlas of Humboldt County California from 1921, and General Land Office (GLO) Maps from 1883, 1936, and 1982 were examined to find information on prehistoric and historic uses of the Project area. GLO maps from 1936 show the Project vicinity as divided into several mining plots including the “Oak Ridge Placer,” the “Salstrom and Co’s Placer,” the “Graham & Co. Placer,” the Haines Placer,” and the “Petersen Placer” but no other details regarding the placement of structures, water conveyances, or mines is apparent on either of these maps. Historic aerial photographs (1947, 1973, 1983, 2005, 2009, 2010, 2012, 2014, 2016, and 2018) were examined to provide an understanding of the APE’s historic land use (NETR Online 2022). Historic aerials of the study area revealed that sometime between 1947 and 1973 the Project vicinity was cleared and made ready for the development of houses in between and along the loop formed by Placer Drive and Camp Creek Road. By 1983, there are several residences adjacent to these roads and development of the area appears to have continued until 1998, when the Project vicinity appears to have taken on its current character as a moderately populated residential neighborhood. No evidence of prehistoric activity or occupation, or historic period activity or occupation (beyond the fact that the Project vicinity was divided in placer mining areas during the early to mid-20th century, and that residences adjacent to the APE, which are not anticipated to be impacted by Project activities, were built between 1973 and 1983 was revealed through HELIX’s historic map and aerial photograph analysis.

Native American Outreach

On June 9, 2022, HELIX requested that the NAHC conduct a search of their Sacred Lands File (SLF) for the presence of Native American sacred sites or human remains in the vicinity of the proposed Project area. HELIX received a response from NAHC on August 30, 2022 which reported that the SLF search results were negative. The NAHC recommended that HELIX contact representative from 20 Native American Tribes who may have knowledge of cultural resources within the Project vicinity. The recommended points of contact are as follows:

- Erika Cooper, Tribal Historic Preservation Officer, Bear River Band of Rohnerville Rancheria
- Edward “Gusto” Bowie, Cultural Liaison, Bear River Band of Rohnerville Rancheria
- Josefina Cortez, Chairwoman, Bear River Band of Rohnerville Rancheria
- Virgil Moorehead, Chairperson, Big Lagoon Rancheria
- Claudia Brundin, Chairperson, Blue Lake Rancheria
- Janet Eidsness, Tribal Historic Preservation Officer, Blue Lake Rancheria
- Jacob Pounds, Assistant Tribal Historic Preservation Officer, Blue Lake Rancheria
- Garth Sundberg, Chairperson, Cher-Ae Heights Indian Community of the Trinidad Rancheria
- Keduescha Lara-Colegrove, Tribal Historic Preservation Officer, Hoopa Valley Tribe
- Byron Nelson, Chairperson, Hoopa Valley Tribe
- Alex Watts-Tobin, Tribal Historic Preservation Officer, Karuk Tribe
- Russell Attebery, Chairperson, Karuk Tribe
- James Russ, President, Round Valley Reservation/Covelo Indian Community

- Sami Jo Difuntorum, Cultural Resource Coordinator, Shasta Indian Nation
- Roy Hall, Chairperson, Shasta Nation
- Paul Ammon, Chairperson, Tsnungwe Council
- Ted Hernandez, Chairperson, Wiyot Tribe
- Rosie Clayburn, Tribal Historic Preservation Officer, Yurok Tribe
- Joe James, Chairperson, Yurok Tribe
- NAGPRA Office of the Yurok Tribe

On September 19, 2022, HELIX sent a letter to each of the tribal representatives listed above to request any information they may possess regarding cultural resources in the vicinity of the APE. No responses were received to HELIX's initial outreach. Consultation between the SWRCB and the Karuk Tribe is discussed further in in Section 7.XVIII. *Tribal Cultural Resources* of this Initial Study.

Fieldwork

Intensive Pedestrian Survey

On June 1, 2022, HELIX Staff Archaeologist Jentin Joe conducted a pedestrian survey of the proposed Project area to characterize any prehistoric or historic-era archaeological resources located on the surface of the APE. During the survey the ground surface of the APE was examined for the presence of historic-era artifacts (e.g., metal, glass, ceramics), prehistoric artifacts (e.g., flaked stone tools, tool-making debris), and other features that might represent human activity that took place more than 50 years ago. Representative photographs were taken during the survey.

During the survey HELIX staff encountered a sloped topography in the south and east portions of the APE, which follow Camp Creek Road and Placer Drive through residential neighborhoods. While the APE itself proved to be relatively clear and maintained, vegetation just outside the bounds of the APE proved to be dense, including tall grasses, manzanita, and blackberry bushes.

In the northwest portion of the APE the surveying archaeologist encountered a steep incline up to an older redwood water tank which appears to be more than 45 years old. The redwood water tank sits on top of a concrete pad. According to the Project engineer, there is also a buried concrete pad adjacent to the one visible underneath the water tank, though the past purpose of this pad is unclear, and the currently proposed undertaking is not anticipated to make use of this second pad. As a result of its age, additional efforts were made to record features from the redwood water tank on the appropriate California State Parks DPR forms.

Soils visible within the northwestern portion of the survey area consist of a gravelly sandy loam, with occasional exposed bedrock outcrops. It is clear that previous hydraulic mining and excavation during the early 1900s has greatly changed the native soils in the area, as there is now back fill and installed gravel/cement roads within the APE. HELIX's survey also encountered a drainage to the northwest of the Project area which runs down to the nearby Crawford Creek. According to the Project engineer, this drainage was partially created by the runoff of hydraulic mining in the Project vicinity.

NRHP/CRHR Evaluation of the OMWC Redwood Tank

The results of this Cultural Resources Assessment resulted in the identification of one new cultural resource within the Project's APE, a redwood water tank, given the temporary field name "OMWC Redwood Tank," located within the northwest portion of the APE. To determine if this resource should be identified as a historical resource, HELIX evaluated the OMWC Redwood Tank against the criteria of eligibility for listing in the NRHP or CRHR which are described in the Regulatory Framework sections above. Each NRHP/CRHR criterion is addressed individually below.

Criterion A/1. The Redwood Tank does not qualify as a historic property or historical resource under Criterion A/1 (association with events that have made a significant contribution to the broad patterns of our history). The redwood tank was built circa 1965 to support the development of a residential subdivision on Camp Creek Road and Placer Drive. Although one home existed prior to the subdivision, the majority of homes on these roads were built in 1965 according to real estate listings. The developer, Delaney, had obtained water rights through a permit in 1965. The Orleans Mutual Water Company was incorporated later in 1981. The redwood tank serves 34 residential connections. Neither the subdivision nor the redwood tank have played any major role in the overall development history of the area, and did not substantially shape local, state, or national history. Likewise, there is no evidence to suggest that the redwood tank is associated with events that have made a significant contribution to the broad patterns of our history.

Criterion B/2. The redwood tank does not qualify as a historic property or historical resource under Criterion B/2 (association with the lives of significant persons in our past). Research did not identify the engineering firm or builder used by Delaney for the design and development of the water conveyance system. No information about the developer was found in the historical record. Therefore, there is no evidence to suggest that construction or operation of the redwood tank is associated with any person considered important in history.

Criterion C/3. The redwood tank does not qualify as a historic property or historical resource under Criterion C/3 (embodiment of the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction). The OMWC Redwood Tank was built circa 1965 as part of a small residential subdivision developed by Delaney. Pressure for the hasty development of settlements began with the California Gold Rush in 1849. Water was needed to support those settlements. The most readily available and significant source of material for building both shelter and water storage was the massive and numerous redwood trees. Through the end of the 1800s and early 1900s, redwood water tanks were built throughout the state and are ubiquitous in Northern California. The generic materials used in their construction have no unique or distinguishing characteristics or features. Furthermore, by the 1960s and 1970s, many water storage facilities were being built of metal rather than the outdated and less efficient wood planks. No evidence of the engineering firm or builder has been identified, so there is no indication that the redwood tank is associated with a master. Therefore, the redwood tank does not embody distinctive characteristics of a type, period, or method of construction, does not possess significant and distinguishable design elements or high artistic values, and does not represent the work of a master.

Criterion D/4. The redwood tank does not qualify as a historic property or historical resource under Criterion D/4 (has yielded or may be likely to yield, information important in history or prehistory). Generic in materials and construction, the redwood tank does not have the potential to add to our understanding of local, state, or national history.

Therefore, the SWRCB finds that the redwood tank is not a historical resource.

Evaluation

Three historical resources were identified within the APE: the NRHP listed Karuk Panamenik World Renewal Ceremony District (P-12-003123), Kusnachanimnam a sacred medicine place and contributor to the aforementioned district (P-12-003719), and the remains of the Oak Ridge and Salstrom Placer mining site and water conveyances (Site P-12-001386, CA-HUM-001042H, also known as Delany #1). The study found that:

a) Cause a substantial adverse change in the significance of a historical resource pursuant to §15064.5?

Less than significant impact with mitigation. Although there are three known resources within the APE, none of these resources would be adversely impacted by the proposed Project. Mitigation Measures CUL-01 through CUL-04 described below would further ensure that significant impacts would be avoided. With implementation of Mitigation Measure CUL-01 through CUL-04, the impact would be less than significant.

b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?

Less than significant impact with mitigation. Although there are three known resources within the APE, none of these resources would be adversely impacted by the proposed Project. Mitigation Measures CUL-01 through CUL-04 described below would further ensure that significant impacts would be avoided. With implementation of Mitigation Measure CUL-01 through CUL-04, the impact would be less than significant.

c) Disturb any human remains, including those interred outside of dedicated cemeteries?

Less than significant impact with mitigation. Although there is no evidence to suggest the presence of human remains, their discovery is a possibility during the Project. Mitigation Measures CUL-01 through CUL-04 described below would ensure that significant impacts would be avoided. With implementation of Mitigation Measure CUL-01 through CUL-04, the impact would be less than significant.

Mitigation Measure CUL-01: Cultural Resource Monitoring During Ground Disturbing Activities

Due to the presence of numerous prehistoric and historic-era cultural resources h within the APE, a qualified archaeologist that meets the Secretary of the Interior's Professional Qualification Standards for prehistoric and historical archaeology shall be retained to conduct Cultural Resource Monitoring during initial ground disturbing activities associated with the Project (including but not limited to grubbing, grading, shearing, and excavation). The on-site archaeologist shall then be able to examine newly exposed soils for cultural remains and or changes in colors in exposed soils that might indicate the presence of archaeological materials. The Cultural Resource Monitor will also ensure that construction activities will not adversely impact any known features of the three historical resources described above. This Cultural Resource Monitor shall have "stop work" authority in the event that they believe they have encountered cultural materials or if the Project has impacted archaeological features associated with the three historical resources described above. The SWRCB will be notified and consulted immediately if cultural materials are encountered or if impacts to archaeological features occur. The Cultural Resource Monitor shall take daily notes and photographs documenting the construction activities observed and any cultural resources that are encountered. At the conclusion of the Project, the Cultural Resource Monitor shall also provide a final monitoring report which summarizes the construction activities observed and any cultural concerns that were noted during the construction effort.

Mitigation Measure CUL-02: Native American Monitoring During Ground Disturbing Activities

Due to the presence of the NRHP listed Karuk Panamenik Ceremonial District and the contributing element of this district within the APE, , a qualified Native American Monitor from the Karuk Tribe shall be retained to conduct monitoring during initial ground disturbing activities associated with the Project (including but not limited to grubbing, grading, shearing, and excavation). This Native American Monitor would then be able to examine newly exposed soils for cultural remains and or changes in colors in exposed soils that might indicate the presence of archaeological materials or other culturally sensitive materials. This Monitor shall have “stop work” authority in the event that they believe they have encountered cultural or otherwise sensitive materials and shall take daily notes and photographs documenting the construction activities observed and any cultural resources that are encountered. At the conclusion of the Project, this Monitor shall also provide a final monitoring report which summarizes the construction activities observed and any cultural concerns that were noted during the construction effort.

Mitigation Measure CUL-03: Unanticipated Discoveries

In the event that cultural resources are exposed during any future ground-disturbing activities, construction activities shall be halted in the immediate vicinity of the discovery. If the site cannot be avoided during the remainder of construction, an archaeologist who meets the Secretary of the Interior’s Professional Qualifications Standards shall then be retained to evaluate the find’s significance under CRHR criteria. The SWRCB will be consulted regarding the evaluation. If the discovery proves to be significant, additional work, such as data recovery excavation, may be warranted and shall be discussed in consultation with the SWRCB.

Mitigation Measure CUL-04: Treatment of Human Remains

If human remains are identified, the specific procedures outlined by the NAHC, in accordance with Section 7050.5 of the California Health and Safety Code and Section 5097.98 of the Public Resources Code would be followed.

1. All excavation activities within 60-feet of the remains shall immediately stop, and the area shall be protected with flagging or by posting a monitor or construction worker to ensure that no additional disturbance occurs.

2. The construction manager or their authorized representative shall contact the County Coroner and the State Water Resources Control Board.

3. The coroner shall have two working days to examine the remains after being notified in accordance with HSC 7050.5. If the coroner determines that the remains are Native American and are not subject to the coroner’s authority, the coroner shall notify NAHC of the discovery within 24 hours.

4. NAHC shall immediately notify the Most Likely Descendant (MLD), who shall have 48 hours after being granted access to the location of the remains to inspect them and make recommendations for treatment of them. Work shall be suspended in the area of the find until

the landowner, in consultation with the MLD and the State Water Resources Control Board, approve the proposed treatment of human remains.

5. If the coroner determines that the human remains are neither subject to the coroner's authority nor of Native American origin, then the Cultural Resource Monitor, in consultation with the landowner and the State Water Resources Control Board, shall determine mitigation measures appropriate to the discovery.

VI. ENERGY

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation?	☐	☐	☒	☐
b) Conflict with or obstruct a State or local plan for renewable energy or energy efficiency?	☐	☐	☒	☐

Environmental Setting

California's electricity needs are satisfied by a variety of entities, including investor-owned utilities, publicly owned utilities, electric service providers and community choice aggregators. In 2020, the California power mix totaled 272,576 gigawatt hours (GWh). In-State generation accounted for 51 percent of the State's power mix. The remaining electricity came from out-of-State imports (CEC 2021a). Table 7 provides a summary of California's electricity sources as of 2020.

Table 7
CALIFORNIA ELECTRICITY SOURCES 2020

Fuel Type	Percent of California Power
Coal	2.74
Large Hydro	12.21
Natural Gas	37.06
Nuclear	9.33
Oil	0.01
Other (Petroleum Coke/Waste Heat)	0.19
Renewables	33.09

Source: CEC 2021a.

Natural gas provides the largest portion of the total in-State capacity and electricity generation in California, with nearly 45 percent of the natural gas burned in California used for electricity generation in a typical year. Much of the remainder is consumed in the residential, industrial, and commercial sectors for uses such as cooking, space heating, and as an alternative transportation fuel. In 2012, total natural gas demand in California for industrial, residential, commercial, and electric power generation was 2,313 billion cubic feet per year (bcf/year), up from 2,196 bcf/year in 2010 (CEC 2021b).

Transportation accounts for a major portion of California's energy budget. Automobiles and trucks consume gasoline and diesel fuel, which are nonrenewable energy products derived from crude oil. Gasoline is the most used transportation fuel in California, with 97 percent of all gasoline being consumed by light-duty cars, pickup trucks, and sport utility vehicles (SUV). In 2015, 15.1 billion gallons of gasoline were sold in California (CEC 2021c). Diesel fuel is the second most consumed fuel in California, used by heavy-duty trucks, delivery vehicles, buses, trains, ships, boats, and farm and construction equipment. In 2015, 4.2 billion gallons of diesel were sold in California (CEC 2021d).

Evaluation

a) Result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation?

b) Conflict with or obstruct a State or local plan for renewable energy or energy efficiency?

Less than significant impact. As discussed above, electricity used during normal operations is provided mainly by connections with PG&E. A backup generator would be installed adjacent to the new water treatment building. Specific details of the generator were not available at the time of this analysis. A conservative (high) estimate of generator size would be an electrical rating in the 100 kilovolt-amps (kVA) to 150 kVA range with a 250-horsepower engine. The generator could be diesel powered or propane powered. A diesel-powered generator was assumed because diesel generators generally have higher emissions than similar sized propane generators. The use of one backup generator would be limited to times of power outages and would run for about 5 minutes per week for testing and maintenance purposes. The only regular increase in power consumption would be a 3,300-kilowatt hour (kWh) net increase of electricity from 5 hours of annual use of the generator. There are no State or local plans for renewable energy or energy efficiency that apply to the proposed Project. Impacts would be less than significant for a) and b).

VII. GEOLOGY AND SOILS

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i. Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	☐	☒	☐	☐
ii. Strong seismic ground shaking?	☐	☐	☒	☐
iii. Seismic-related ground failure, including liquefaction?	☐	☐	☒	☐
iv. Landslides?	☐	☐	☒	☐
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☐	☐
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?	☐	☒	☐	☐
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property?	☐	☐	☒	☐
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?	☐	☐	☐	☒
f) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☒	☐	☐

A Preliminary Geotechnical Report was prepared by Bajada Geosciences, Inc. on September 2, 2022, and is included as Appendix D to this Initial Study.

Environmental Setting

Regional Geology

The Project site is located in the Klamath Mountains geomorphic/geologic province of California (Bajada Geosciences, Inc. 2022). The Klamath Mountains province extends from the northern end of the California Coast Ranges north into Oregon. It is bounded to the east by the Cascade Range province, to the south by the Coast Ranges and Great Valley provinces, to the west by the Pacific Ocean, and to the north by the Coast Ranges of Oregon.

The Klamath Mountains province is predominately composed of pre-Paleozoic and Paleozoic sedimentary, volcanic, intrusive, and metamorphic rocks that have been locally intruded by Mesozoic-age rocks (Bajada Geosciences, Inc. 2022). Rock materials within this province have been accreted during tectonic processes into differing terrains or differing ages. Five terrains of subjacent rock materials have been identified within the Klamath Mountains province: Western Jurassic belt, Western Paleozoic and Triassic belt, Central Metamorphic belt, Eastern Klamath belt, and Granitic rocks (Bajada Geosciences, Inc. 2022). The Project site is located within the Western Jurassic belt.

Site History

The topography of the Project area has been altered by historic placer mining of older alluvial deposits. Those materials were mined from where the existing and proposed WTPs are located, and south of where the proposed tank is located. In addition, the site was previously developed with the existing in-line filtration plant and water storage tank, and underground pipelines. Prior to construction of the existing tank, an older tank was present upslope and east of the existing tank.

Surface Conditions

The proposed water treatment building is located on a relative flat to a slightly undulatory area that has previously been graded during historical placer mining. The proposed water treatment building is located southwest of the existing in-line filtration plant. The site is covered with seasonal grasses, shrubs, and local trees. Elevations at the proposed Project site range from about 560 to 640-ft. Drainage occurs as sheet flow into the adjacent drainage, which discharges into the Klamath River.

The proposed water storage tank site is located in the mid-slope on a ridge that descends to the west and south of the proposed site. An unpaved access road ascends from the area where the proposed water treatment building is to be located. The area is covered by shrubs and surrounded by mature trees. The slope located south of the proposed tank is about 40 feet tall and inclined at about a 1:1 (horizontal to vertical) angle. The slope located west of the proposed water storage tank is about 55-ft tall and inclined at about a 1.1:1 angle. Drainage at the site occurs as sheet flows west into Crawford Creek, which discharges into the Klamath River.

Subsurface Conditions

Subsurface conditions were explored at selected locations at the site during the Geotechnical Report study. Metamorphic rock consisting of phyllite was encountered beneath the proposed water treatment building. Phyllite is anticipated to be present in the lower terrace area surrounding the proposed water treatment building. It consisted of dry, moderately to slightly weathered, weak, poorly indurated, slightly to moderately fractured rock with a platy, fissile texture.

Artificial fill and older alluvium were encountered beneath the proposed water storage tank site. These materials predominantly consist of sandy gravel with cobbles and boulders. The materials were moist to wet, dense to very dense, slightly cemented, fine to coarse grained, with abundant fine to coarse subrounded to rounded gravels and cobbles, and boulders up to at least 18 inches in largest dimension. In addition, an approximately 15- to 16-inch-thick concrete slab was encountered within the artificial fill materials underlying the proposed water storage tank site.

Soils

Based on the NRCS Web Soil Survey (NRCS 2022), the following soil map units are present on the site:

- Typic Xerofluvents-Riverwash association, 2 to 10 percent slopes
- Pits and Dumps

Typic Xerofluvents-Riverwash association, 2 to 10 percent slopes soils occur on base slopes, alluvial fans, and toeslopes and consists of sandy and gravelly alluvium. A typical profile for Typic Xerofluvents-Riverwash association is gravelly sandy loam from 0 to 10-inches and stratified extremely gravelly loamy sand to silt loam from 1 to 60 inches. The depth to water table Typic Xerofluvents-Riverwash association soils is greater than 80 inches. Typic Xerofluvents-Riverwash association soils are not the National Hydric Soils List for Humboldt County (NRCS 2015).

Pit and Dump soils occur on terraces, foot slopes and risers and consists of gravelly alluvium. A typical profile for Pit and Dump soil is very bouldery from 0 to 4-inches. The depth to water table for Pit and Dump soil is greater than 80-inches. Pit and Dump soils are not the National Hydric Soils List for Humboldt County (NRCS 2015).

Evaluation

a) Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:

  i. Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42?

Less than significant impact with mitigation. Seismically induced ground rupture is defined as the physical displacement of surface deposits in response to an earthquake's seismic waves. The magnitude and nature of fault rupture can vary for different faults or even along different strands of the same fault. Surface rupture can damage or collapse buildings, cause severe damage to roads and pavement structures, and cause failure of overhead and underground utilities.

There are no Alquist-Priolo Fault Zones within the Project area. For purposes of the Alquist-Priolo Act, an active fault is one that has ruptured in the last 11,000 years. The impact of surface rupture or other seismic-related movement at the Project site would be reduced as new construction Projects must comply with the California Building Code (CBC) requirements and have geotechnical reports prepared prior to obtaining grading or building permits from the Humboldt County Building Division. Although no Alquist Priolo Fault Zones are within the Project area, the Project would still comply with all recommendations outlined in the Geotechnical Report, as described in Mitigation Measure GEO-01. With implementation of Mitigation Measure GEO-01 and compliance with the CBC, impacts would be less than significant.

Mitigation Measure GEO-01: Recommendations in the Geotechnical Report

Prior to construction, the applicant shall implement all recommendations regarding geotechnical aspects of Project design and construction presented in the Geotechnical Report prepared by Bajada Geosciences, Inc. (Bajada Geosciences, Inc. 2022).

ii. Strong seismic ground shaking?

Less than significant impact. The State of California designates faults as Holocene-age or Pre-Holocene-age depending on the recency of movement that can be substantiated for a fault. The California Geologic Survey (CGS) evaluates the activity rating of a fault in fault evaluation reports (FER). FERs compile available geologic and seismologic data and evaluate if a fault should be zoned as Holocene-active, pre-Holocene, or age undetermined. If an FER evaluates a fault as Holocene-active, then it is typically incorporated into a Special Studies Zone in accordance with the Alquist-Priolo Earthquake Fault Zoning Act. Alquist-Priolo Special Studies Zones require site-specific evaluation of fault location for structures for human occupancy and require a habitable structure setback if the fault is found traversing a Project site.

No known faults have been mapped projecting through the Project site. The closest Holocene-active fault to the site is the Trinidad fault, located about 32 miles southwest of the Project. The proposed Project would be designed and constructed under the CBC criteria and would be designed in accordance with the seismic design criteria. As the Project is not located near known faults and would comply with CBC criteria, impacts related to seismic ground shaking are less than significant.

iii. Seismic-related ground failure, including liquefaction?

Less than significant impact. Liquefaction is a phenomenon whereby unconsolidated and/or near-saturated soils lose cohesion and are converted to a fluid state as a result of severe vibratory motion. The relatively rapid loss of soil shear strength during strong earthquake shaking results in temporary, fluid-like behavior of the soil. Soil liquefaction causes ground failure that can damage roads, pipelines, underground cables, and buildings with shallow foundations.

Lateral spreading is defined as lateral earth movement of liquefied soils, or soil riding on a liquefied soil layer, down slope toward an unsupported slope face, such as a creek bank, or an inclined slope face. In general, lateral spreading has been observed on low to moderate gradient slopes but has been noted on slopes inclined as flat as one degree. According to Bajada Geosciences (2022), dense to very dense sediments and cemented rock underlie the Project site and groundwater is not anticipated to be present within the upper 50-feet of the soil/rock column. Based on those two conditions, the potential for liquefaction to adversely impact the site is very low. As liquefaction and lateral spreading pose a very low risk of adversely affecting the Project site or proposed improvements, impacts are less than significant.

iv. Landslides?

Less than significant impact. The proposed water treatment building and backwash reclaim tank would be located in a relatively flat area but would be located adjacent to an incised drainage. No landslides, older, active, or incipient were observed in the vicinity of the proposed site. Therefore, natural landslides pose a low risk to the new surface, direct-filtration WTP site.

The proposed water storage tank would be located in mountainous terrain with descending slopes to the west and south and ascending slopes to the north and east. No landslides, older, active, or incipient were observed in the vicinity of the proposed site. Slope stability analyses were performed to evaluate the risks of slope instabilities. Results of the analyses indicated the existing slopes beneath the proposed water treatment building, backwash reclaim tank, and water storage tank were stable. As the proposed water treatment building, backwash reclaim tank, and water storage tank are located on stables slopes with low risks to natural landslides, impacts would be less than significant.

b) Result in substantial soil erosion or the loss of topsoil?

Less than significant impact. The proposed Project would replace an existing in-line filtration plant with a new surface, direct-filtration WTP. The Project would construct a new water treatment building and a backwash reclaim tank. The Project would also demolish an existing redwood storage tank and construct a new steel water storage tank. The new water treatment building would be located on a relatively flat area, southwest of the existing in-line filtration plant, which has been heavily disturbed by past mining activities. The new storage tank would take the place of the existing redwood storage tank, which is within a previously excavated area for future tanks. Soil disturbance would be limited to small areas for a short duration during construction.

Projects resulting in one or more acre of ground disturbance require a General Construction Activity Stormwater Permit and a NPDES permit from the SWRCB. Use of the permit requires the preparation of a Stormwater Pollution Prevention Plan (SWPPP) for approval by the SWRCB. The SWPPP would contain BMPs to control construction-related erosion and sedimentation and prevent damage to streams, watercourses, and aquatic habitat and reduce potential impacts to water quality during construction of the Project. With implementation of BMPs, impacts relating to soil erosion would be less than significant, and no mitigation is required.

c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?

Less than significant impact with mitigation. See a)iii for a discussion of liquefaction potential, and a)iv for a discussion of landslide potential. The proposed construction of the Project would comply with the CBC requirements and would comply with all recommendations outlined in the Geotechnical Report prepared by Bajada Geosciences, Inc, as outlined in Mitigation Measure GEO-01.

Three samples of near-surface soils were subjected to chemical analysis for assessment of corrosion and reactivity with concrete. The samples were tested for soluble sulfates and chlorides. The results indicated that where the proposed water treatment building would be located, the soils are estimated to be corrosive to severely corrosive to ferrous metals. Where the proposed tank and pipelines would be located, the soil is estimated to be mildly to moderately corrosive. With implementation of Mitigation Measure GEO-02, impacts to corrosivity would be less than significant.

Mitigation Measure GEO-02: Consult of Corrosion Expert

Prior to construction, the applicant shall consult a corrosion specialist to assess the soil at the proposed water treatment building and backwash reclaim tank and the soil at the proposed water storage tank. After the assessment of the soil on the Project site, corrosion protection measures prepared by the corrosion specialist shall be implemented to mitigate potential soil instability due to corrosion.

d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property?

Less than significant impact. There is a direct relationship between plasticity of a soil and the potential for expansive behavior, with expansive soil generally having a high plasticity. Thus, granular soils typically have a low potential to be expansive, whereas clay-rich soils can have a low to high potential to be expansive.

Atterberg limit testing was performed on two selected samples to estimate the plasticity of foundation soils (Bajada Geosciences, Inc. 2022). The results of that testing found that on-site soils have a Plasticity Index's (PI's) ranging from non-plastic to 4. PI's of less than 10 are correlated to soils having a very low potential for expansion (Bajada Geosciences, Inc. 2022). Based on the PI data obtained during the study, the existing site would have a very low expansion potential. As expansion potential is low, impacts would be less than significant.

e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?

No impact. The Project would not include the construction of any septic tanks or alternative wastewater disposal systems, the proposed Project deals only with water supply. Therefore, there would be no impact.

f) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?

Less than significant impact with mitigation. No previous surveys conducted in the Project area have identified the Project site as sensitive for paleontological resources or other geologically sensitive resources, nor have testing or ground disturbing activities performed to date uncovered any paleontological resources or geologically sensitive resources. While the likelihood encountering paleontological resources and other geologically sensitive resources is considered low, Project-related ground disturbing activities could affect the integrity of a previously unknown paleontological or other geologically sensitive resource, resulting in a substantial change in the significance of the resource. Therefore, the proposed Project could result in potentially significant impacts to paleontological resources. Implementation of Mitigation Measure GEO-03 would reduce potentially significant impacts to a less than significant level.

Mitigation Measure GEO-03: Identification of Paleontological Resource During Project Construction

In the event a paleontological or other geologically sensitive resources (such as fossils or fossil formations) are identified during any phase of Project construction, all excavations within 100-ft of the find shall be temporarily halted until the find is examined by a qualified paleontologist, in accordance with Society of Vertebrate Paleontology standards. The paleontologist shall notify the appropriate representative at Humboldt County who shall coordinate with the paleontologist as to any necessary investigation of the find. If the find is determined to be significant under CEQA, the County shall implement those measures which may include avoidance, preservation in place, or other appropriate measures, as outlined in Public Resources Code Section 21083.2.

VIII. GREENHOUSE GAS EMISSIONS

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	☐	☐	☒	☐
b) Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?	☐	☐	☒	☐

Environmental Setting

Global climate change refers to changes in average climatic conditions on Earth including temperature, wind patterns, precipitation, and storms. Global temperatures are moderated by atmospheric gases. These gases are commonly referred to as greenhouse gases (GHG) because they function like a greenhouse by letting sunlight in but preventing heat from escaping, thus warming the Earth's atmosphere.

GHGs are emitted by natural processes and human (anthropogenic) activities. Anthropogenic GHG emissions are primarily associated with the burning of fossil fuels during motorized transport; electricity generation; natural gas consumption; industrial activity; manufacturing; and other activities such as deforestation, agricultural activity, and solid waste decomposition.

The GHGs defined under California's AB 32, described below, include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), and sulfur hexafluoride (SF_6). Each GHG differs in its ability to absorb heat in the atmosphere based on the lifetime, or persistence, of the gas molecule in the atmosphere. Estimates of GHG emissions are commonly presented in carbon dioxide equivalents (CO_2e), which weigh each gas by its global warming potential (GWP). Expressing GHG emissions in CO_2e takes the contribution of all GHG emissions to the greenhouse effect and converts them to a single unit equivalent to the effect that would occur if only CO_2 were being emitted. GHG emissions quantities in this analysis are presented in metric tons (MT) of CO_2e. For consistency with United Nations Standards, modeling and reporting of GHGs in California and the US use the GWPs defined in the Intergovernmental Panel on Climate Change's (IPCC) Fourth Assessment Report.

GHG Reduction Regulations and Plans

Assembly Bill 32 – Global Warming Solution Act of 2006: The California Global Warming Solutions Act of 2006, widely known as AB 32, requires that CARB develop and enforce regulations for the reporting and verification of Statewide GHG emissions. CARB is directed by AB 32 to set a GHG emission limit, based on 1990 levels, to be achieved by 2020. The bill requires CARB to adopt rules and regulations in an open public process to achieve the maximum technologically feasible and cost-effective GHG emission reductions.

Senate Bill 32: Signed into law by Governor Brown on September 8, 2016, Senate Bill (SB) 32 (Amendments to the California Global Warming Solutions Action of 2006) extends California's GHG reduction programs beyond 2020. SB 32 amended the Health and Safety Code to include Section 38566, which contains language to authorize CARB to achieve a Statewide GHG emission reduction of at least 40 percent below 1990 levels by no later than December 31, 2030. SB 32 codified the targets established by EO B-30-15 for 2030, which set the next interim step in the State's continuing efforts to pursue the long-term target expressed in EO B-30-15 of 80 percent below 1990 emissions levels by 2050.

Assembly Bill 1279: Approved by Governor Newsom on September 16, 2022, AB 1279, The California Climate Crisis Act, declares the policy of the State to achieve net zero GHG emissions as soon as possible, but no later than 2045, and achieve and maintain net negative GHG emissions thereafter, and to ensure that by 2045, Statewide anthropogenic GHG emissions are reduced to at least 85 percent below the 1990 levels. AB 1279 anticipates achieving these policies through direct GHG emissions reductions, removal of CO2 from the atmosphere (carbon capture), and almost complete transition away from fossil fuels.

California Air Resources Board: The Scoping Plan is a strategy CARB develops and updates at least one every five years, as required by AB 32. It lays out the transformations needed across our society and economy to reduce emissions and reach our climate targets. The current 2022 Scoping Plan is the third update to the original plan that was adopted in 2008. The initial 2008 Scoping Plan laid out a path to achieve the AB 32 mandate of returning to 1990 levels of GHG emissions by 2020, a reduction of approximately 15 percent below business as usual. The 2008 Scoping Plan included a mix of incentives, regulations, and carbon pricing, laying out the portfolio approach to addressing climate change and clearly making the case for using multiple tools to meet California's GHG targets. The 2013 Scoping Plan assessed progress toward achieving the 2020 mandate and made the case for addressing short-lived climate pollutants (SLCPs). The 2017 Scoping Plan also assessed the progress toward achieving the 2020 limit and provided a technologically feasible and cost-effective path to achieving the SB 32 mandate of reducing GHGs by at least 40 percent below 1990 levels by 2030. On December 15, 2022, CARB approved the 2022 Scoping Plan for Achieving Carbon Neutrality (2022 Scoping Plan). The 2022 Scoping Plan lays out a path to achieve targets for carbon neutrality and reduce anthropogenic GHG emissions by 85 percent below 1990 levels no later than 2045, as directed by Assembly Bill 1279. The actions and outcomes in the plan will achieve significant reductions in fossil fuel combustion by deploying clean technologies and fuels; further reductions in SLCPs; support for sustainable development; increased action on natural and working lands to reduce emissions and sequester carbon; and the capture and storage of carbon (CARB 2022).

Humboldt County: The County of Humboldt completed a draft Climate Action Plan for their General Plan Update in January 2012 (Humboldt County 2012). The plan contained GHG reduction strategies designed to achieve the goal of limiting greenhouse gas emissions to 1990 emissions levels by 2020. The NCUAQMD and Humboldt County have not adopted any thresholds of significance for measuring the impact of GHG emissions generated by a proposed project.

Evaluation

a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?

Less than significant impact. The NCUAQMD and Humboldt County have not adopted any thresholds of significance for evaluating the impact of GHG emissions generated by a proposed Project. This section includes a discussion of potential GHG emissions impacts with an emphasis on Project features which would reduce GHG emissions.

Construction

Construction GHG emissions are generated by vehicle engine exhaust from construction equipment, on-road hauling trucks, vendor trips, and worker commuting trips. The proposed Project is relatively small, and construction would be short term (less than one year). All construction equipment and commercial trucks would be maintained to meet current emissions standards as required by CARB. As reported in the CalEEMod output (see Appendix B), construction of the proposed Project would produce 57.8 MT of CO_2e. Based on the small size of the Project and the short duration of construction activities (less than 1 year), impacts associated with GHG emissions generated from construction would be less than significant.

Operation

GHG emissions sources during operation would include vehicle use from workers, deliveries, and maintenance; solid waste generation; electricity use; and operation of the backup generator for maintenance and testing. Because the Project would upgrade an existing water distribution system, the current level of vehicle use and solid waste generation (i.e., those levels under existing conditions), and the GHG emission associated with those sources, would not increase with implementation of the Project.

The only new sources of GHG emissions for operation of the Project would be from the proposed generator, which would only operate for about 5 minutes per week for testing and maintenance purposes (about 5 hours per year), and from an increase in electrical power consumption of about 3,300-kWh per year. Power for the proposed Project would be provided mainly by existing PG&E connections. As reported in the CalEEMod output (seen Appendix B), operation of the proposed Project would produce 0.8 MT of CO_2e per year. To place this minimal amount of GHG emissions in context, the Sacramento Metropolitan Air Quality Management District has adopted a screening level of 1,100 MT CO_2e per year to determine the significance of land use development Project GHG emissions. Therefore, due to the minimal potential increase in GHG emissions, the proposed Project would not generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment.

b) Conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of greenhouse gases?

Less than significant impact. The proposed Project was evaluated against the following applicable plans, policies, and regulations:

Humboldt County Draft Climate Action Plan: The County's 2012 Draft Climate Action Plan contains strategies for reducing greenhouse gas emissions. This Project, as proposed, is consistent with the following GHG reduction strategies listed in the County of Humboldt Climate Action Plan:

a) *Foster land use intensity near, along with connectivity to, retail and employment centers and services to reduce vehicle miles traveled and increase the efficiency of delivery services through adoption and implementation of focused growth principles and policies.*

   The Project setting consists of a small rural community. The Project would help maintain community integrity and maintain the community as a desirable place to live by ensuring reliable access to clean and safe water and by providing additional protection from fire hazards. The workforce during construction is anticipated to live locally in southern Humboldt County and commute to and from the site. During operation, the same level of employment currently utilized to maintain the existing infrastructure would be required. Vehicle miles traveled would slightly increase during construction and return to baseline conditions following construction.

b) *Conserve natural lands for carbon sequestration.*

   The proposed improvements would be within or immediately adjacent to the existing footprint of the water distribution system or would be located within previously disturbed areas. No removal of live trees is proposed, and no conversion of timberland would occur. Installation of water supplies for firefighting would help to protect adjacent forested lands from wildfire threat.

c) *Reduce length and frequency of vehicle trips.*

   See response to strategy a), above.

d) *Promote the revitalization of communities in transition due to the decline of resource-based industries.*

   The Project would remediate existing issues with water quality and reliability and would provide additional fire protection in a wildland urban interface area. These improvements would enhance the quality of life and safety in the community of Orleans.

e) *Ensure that land use decisions conserve, enhance, and manage water resources on a sustainable basis to assure sufficient clean water for beneficial uses and future generations.*

The proposed Project would enhance the existing water treatment system. It would be sufficient to maintain existing demand sustainably and would improve the reliability and safety of the system.

Therefore, the proposed Project would not conflict with the Humboldt County Draft Climate Action Plan.

CARB Scoping Plan: As described above, the 2022 CARB Scoping Plan contains plans, policies, and measures to achieve State mandated targets to achieve carbon neutrality and reduce anthropogenic GHG emissions by 85 percent below 1990 levels no later than 2045. The Project would not result in long-term increases in vehicle miles traveled (VMT). The Project would result in a 3,300 kWh per year increase in electricity use. As required by Senate Bill 100, the 2022 Scoping Plan accounts for all retail electricity sold in California to be provided by zero-carbon sources. accordingly, the Project's electricity use would not result in GHG emissions after 2045. Therefore, the proposed Project would not conflict with the 2022 CARB Scoping Plan.

Therefore, the proposed Project would not conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases, and impacts would be less than significant.

IX. HAZARDS AND HAZARDOUS MATERIALS

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☒	☐
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	☐	☒	☐
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☐	☒
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☐	☒
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard or excessive noise for people residing or working in the project area?	☐	☐	☐	☒
f) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☒	☐
g) Expose people or structures, either directly or indirectly, to a significant risk of loss, injury or death involving wildland fires?	☐	☐	☒	☐

Environmental Setting

Hazardous materials and hazardous wastes are subject to extensive federal, State, and local regulations to protect public health and the environment. These regulations provide definitions of hazardous materials; establish reporting requirements; set guidelines for handling, storage, transport, and disposal of hazardous wastes; and require health and safety provisions for workers and the public. The major federal, State, and regional agencies enforcing these regulations are USEPA and the Occupational Safety and Health Administration (OSHA); California Department of Toxic Substances Control (DTSC); California Department of Industrial Relations, California Division of Occupational Safety and Health (Cal/OSHA); California Governor’s Office of Emergency Services (Cal OES); and North Coast Unified Air Quality Management District (NCUAQMD).

The site is not shown as containing hazardous materials or being involved in any cleanup or monitoring programs. The DTSC EnviroStor mapper indicated no cleanup or monitoring programs on the site or in the area (DTSC 2022). The State Water Resource Control Board Geotracker did not indicate the presence of a site in the vicinity of the Project (SWRCB 2022).

The nearest school in the District to the Project site is Orleans Elementary School, located at 38016 California 96, Orleans, CA 95556, approximately 1.4-miles east of the Project site. The next closest schools in the District are Captain John Continuation High School, located at 101 Loop Avenue, Hoopa, CA 95546, and Hoopa Valley High School, located at 11400 State Route 96, Hoopa, CA 95546, both approximately 25-miles southwest from the Project site.

The nearest airport to the site is the Hoopa Airport, located approximately 27-miles to the south. According to Humboldt County Web GIS data, the Project site is within a wildland Fire Hazard Severity Zones of “Very High” within a State Responsibility Area (SRA) (Humboldt County 2020).

Evaluation

a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?

b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?

Less than significant impact. The proposed Project would replace an existing in-line filtration plant with a new surface, direct-filtration WTP. The Project would construct a new water treatment building and a backwash reclaim tank. The Project would also replace an existing redwood tank with a new steel water storage tank. Hazardous materials associated with construction include fuels, lubricants, and paint. Hazardous materials associated with the proposed operation include propane, diesel, lubricants, paint, solvents, and sodium hypochlorite. Disinfection would be accomplished by injecting sodium hypochlorite into the water following filtration prior to booster pumping, which would effectively mix the chemical with the filtered water. The sodium hypochlorite storage and feed system would include a 15-gallon tank and solenoid operated diaphragm metering pump. The tank would be sealed and vented to the outside to minimize issues with off gassing of chlorine which would result in corrosion inside the water treatment building.

A small electric heater would be installed in the water treatment building to keep the interior temperature above freezing. Additionally, a small exhaust fan would be provided adjacent to the sodium hypochlorite system to vent any chlorine gases to the outside to prevent interior corrosion. An emergency eyewash and shower would be connected to the exterior of the water treatment building, as well. A generator and propane tank would be located adjacent to the new water treatment building and backwash reclaim tank. However, the generator would only run 5 minutes per week for testing and maintenance purposes.

All other potentially hazardous materials would be used occasionally and in small amounts as required for routine maintenance and cleaning. Employees responsible for the application of these products would be trained to handle, mix, apply and dispose of the products with the proper safety equipment in accordance with the manufacturer’s recommendations. Material Safety Data Sheets for any hazardous materials used onsite would be available for review by employees, visitors, and first responders.

Hazardous chemicals would be purchased from licensed vendors and transported/shipped to the Project site in accordance with all federal, State, and local regulations for the transport of hazardous materials.

With appropriate storage, handling, and application practices that comply with the requirements of Humboldt County, it is not anticipated that the use of these materials at the facility would not pose a significant hazard. Use of hazardous materials is not expected to change significantly relative to existing conditions. The proposed Project would not create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials, or through reasonably foreseeable accidental releases, and impacts would be less than significant for a) and b).

c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?

No impact. There are no schools located within one-quarter mile of the Project site. The nearest school in the District to the Project site is Orleans Elementary School, located at 38016 California 96, Orleans, CA 95556, approximately 1.4-miles east of the Project site. The next closest schools in the District are Captain John Continuation High School, located at 101 Loop Avenue, Hoopa, CA 95546, and Hoopa Valley High School, located at 11400 State Route 96, Hoopa, CA 95546, both approximately 25-miles southwest from the Project site. The proposed Project would not emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within 0.25-mile of an existing or proposed school. No impact would occur.

d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?

No impact. The Project site is not included on a list of hazardous materials sites reporting to the DTSC or SWRCB. Because there are no hazardous materials concerns currently at the Project site, implementation of the proposed Project would not create a significant hazard to the public or the environment as a result. No impact would occur.

e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard or excessive noise for people residing or working in the project area?

No impact. The Project site is not located within an airport land use plan area. The site is approximately 27.0 miles north of Hoopa Airport. Therefore, no impact would occur.

f) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?

Less than significant impact. The Project would comply with the requirements of the CBC and California Department of Fire and Forestry (CAL FIRE) regulations including those regarding emergency vehicle access, turnarounds, and defensible space. The Project site is located within the Mid-Klamath Wildfire Planning Unit. Evacuation routes would depend on the location of the community at risk and law enforcement recommendations based on fire behavior, wind patterns, traffic, and ingress of emergency vehicles. The determination for the locations of these sites is normally made by the Humboldt County Emergency Operations Center Incident Commander in cooperation with an incident Management Team (Humboldt County 2019). SR 96 would, in most cases, serve as the primary evacuation route. The proposed Project is accessed via Camp Creek Road, which is directly connected to the main primary evacuation route, SR 96. The Project would construct a new water treatment building, backwash reclaim tank, and water storage tank on the northern side of Camp Creek Road and would not limit ingress or egress of the Project area. The existing, unimproved dirt road leading to the water treatment building would be widened to create a 12-ft wide road with a 14-ft wide unobstructed clearance (2-ft on each side of the driveway). The path leading to the water treatment building would begin on the edge of Camp Creek Road (a paved roadway). Additionally, the Project would recontour the existing unimproved dirt road from the new water treatment building to the new water storage tank site after installation of all buried utilities. Therefore, the proposed Project would not substantially impair an adopted emergency response plan or emergency evacuation plan and impacts would be less than significant.

g) Expose people or structures, either directly or indirectly, to a significant risk of loss, injury or death involving wildland fires?

Less than significant impact. According to Humboldt County GIS data, the Project site is in a Fire Hazard Severity Zone of “Very High” and is located within the SRA. The proposed Project would comply with all CAL FIRE SRA requirements including those for emergency vehicle access, turnarounds, and defensible space. By adding a fire hydrant for fire suppression in an area where no hydrants currently exist, the Project would enhance the protection of existing residences, infrastructure, and wildlands. All proposed structure modifications would comply with County fire code requirements and access would follow requirements by CAL FIRE. The Project would maintain current levels of service, would not be growth inducing, and would not create any new residences or occupied structures in an area susceptible to wildfire. Impacts would be less than significant. See also the discussion of wildfire in Section 7.XXI. *Wildfire* of this Initial Study.

X. HYDROLOGY AND WATER QUALITY

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality?	☐	☐	☒	☐
b) Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?	☐	☐	☒	☐
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner which would:				
i. Result in substantial erosion or siltation on- or off-site?	☐	☐	☒	☐
ii. Substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off- site?	☐	☐	☒	☐
iii. Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional resources of polluted runoff?	☐	☐	☒	☐
iv. Impede or redirect flood flows?	☐	☐	☒	☐
d) In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation?	☐	☐	☒	☐
e) Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?	☐	☐	☒	☐

A Preliminary Engineering Report was prepared by Waterworks Engineers on January 14, 2021. The Preliminary Engineering Report is included as Appendix E to this Initial Study.

Environmental Setting

The proposed Project is located within the Camp Creek hydrologic unit (Hydrologic Unity Code (HUC)12: 180102090801). Waterways in the region of the Project area, including Crawford Creek and Camp Creek, flow into the Klamath River and eventually the Pacific Ocean. The Project site is bordered to the north and west by densely wooded land and the Six Rivers National Forest and Crawford Creek, to the south by SR 96, wooded land, and Klamath River, and to the east by wooded land and residential homes. National Wetland Inventory (NWI) mapping shows Crawford Creek and a tributary, classified as Riverine, run along the western boundary of the Project area. The proposed Project improvements would be located approximately 260-ft east of Crawford Creek, approximately 950-ft west of Camp Creek, and approximately 1,500- ft north of the Klamath River.

An existing small pond is located near the proposed water treatment building and backwash recycling tank. The pond is a result of historic hydrologic mining in the area and would not be impacted by the proposed Project. Additionally, a drainage ditch containing seepage from the pond is located approximately 40-ft to the east of the proposed tank location. The ditch is the result of historic hydrologic mining in the area and is not a natural ditch. The ditch would not be impacted by the proposed Project.

FEMA flood insurance rate maps were reviewed for the Project's proximity to a 100-year floodplain (FEMA 2022). The proposed Project is on FEMA panel #06023C0275F, effective 11/4/2016. The Project site is located in Zone D, which is an area where no analysis of flood hazards has been conducted. Zone D is used for areas where there are possible but undetermined flood hazards.

The Project is not located in an area with a sustainable groundwater management plan in place, as the Sustainable Groundwater Management Act only applies to groundwater basins designated as medium or high priority. Currently there is one medium-priority basin, the Eel River Valley groundwater basin, within Humboldt County (Humboldt County 2021). That basin is located over 40 air miles southwest of the Project site. Stormwater and wastewater drainage systems are not within the scope of this Project.

Evaluation

a) Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or ground water quality?

Less than significant impact. The Project would be limited to upgrading an existing water treatment system with a new surface, direct-filtration WTP. The Project would construct a new water treatment building, backwash reclaim tank and water storage tank within its existing footprint or within previously disturbed areas. A small pond is located near the new water treatment building and backwash reclaim tank. The pond is the result of historic hydrologic mining in the area and will not be impacted by the proposed Project. Currently, water from the storage tanks runs downhill to the in-line filtration plant through a pipeline. As part of the proposed Project, this pipeline would be abandoned and left in place. A drainage ditch containing seepage from the pond is located approximately 40-ft to the east of the proposed water storage tank location. This ditch is the result of historic hydrologic mining in the area and is not a natural feature. The ditch would not be impacted by the proposed Project.

The only grading proposed as part of the Project would include any minor alterations necessary to accommodate new or upgraded features. However, the proposed Project has the potential to temporarily degrade water quality due to increased erosion during Project construction as the proposed Project would require over one acre of grading on the Project site. Projects resulting in one or more acre of ground disturbance require a General Construction Activity Stormwater Permit and a NPDES permit from the SWRCB. Use of the permit requires the preparation of a SWPPP for approval by the SWRCB. The SWPPP would contain BMPs to control construction-related erosion and sedimentation and prevent damage to streams, watercourses, and aquatic habitat and reduce potential impacts to water quality during construction of the Project. The SWPPP submitted to the SWRCB with the NOI for the proposed Project must include a description of all post-construction stormwater management measures and a plan for long-term maintenance. The maintenance plan must be designed for a minimum of five years and must describe the procedures to ensure that the post-construction stormwater management measures are adequately maintained.

Post-construction measures are defined as structural and non-structural controls that detain, retain, or filter the release of pollutants to receiving water after final stabilization is attained. Non-structural controls are required unless the discharger demonstrates that non-structural controls are infeasible or that structural controls will produce greater reduction in water quality impacts. Nonstructural controls may include vegetated swales, soil quality enhancement, setbacks, buffers and/or rooftop and impervious surface disconnection. Nonstructural controls can be included as a landscape amenity.

Compliance with SWRCB permit conditions ensures that the Project would violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or groundwater quality, and impacts would be less than significant.

b) Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?

Less than significant impact. The proposed Project would not require groundwater supplies for construction or operation. The proposed Project would replace an existing in-line filtration plant with a new surface, direct-filtration WTP. The Project would construct a new water treatment building and a backwash reclaim tank. A proposed generator and propane tank would be located adjacent to the water treatment building. The Project would also demolish an existing redwood storage tank and construct a new steel water storage tank.

Bajada Geosciences, Inc conducted test pits to determine if groundwater was encountered (Bajada Geosciences Inc., 2022). A search of regional groundwater data did not identify any wells within 2,000-ft of the Project site. In addition, a search of the Geotracker database did not indicate the presence of subsurface exploration or data close to the Project site. Springs have not been mapped on U.S Geologic topographic maps in the Project region. Groundwater elevations at Project improvement locations will fluctuate over time. The depth to groundwater can vary throughout the year and from year to year. Intense and long duration precipitation or drought, modification of topography, and cultural land use changes can contribute to fluctuations in groundwater levels. Localized saturated conditions or perched groundwater conditions near the ground surface could be present during and following periods of heavy precipitation or if on-site sources contribute water. If groundwater is encountered during construction, it is the Contractor’s responsibility to install mitigation measures for adverse impacts caused by groundwater encountered in excavations.

The new water treatment building would be located on a relatively flat area, southwest of the existing in-line filtration plant, which is heavily disturbed by past mining activities. The new storage tank would take the place of the existing redwood storage tank, which is within a previously excavated area for future tanks. Soil disturbance would be limited to small areas for a short duration during construction. The Project would not include substantial increases in impervious surfaces that would limit natural groundwater recharge. The proposed Project would have a less than significant impact on groundwater supplies or groundwater recharge.

c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner which would:

    i. Result in substantial erosion or siltation on- or off-site?

    ii. Substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off- site?

    iii. Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional resources of polluted runoff?

Less than significant impact. The Project would be limited to upgrading infrastructure within its existing footprint or within previously disturbed areas. Soil disturbance would be limited to minimal areas for a short duration during construction. However, the Project would disturb over one acre of soil, so a SWPPP would be required. The SWPPP would contain BMPs to control construction-related erosion and sedimentation and prevent damage to streams, watercourses, and aquatic habitat and reduce potential impacts to water quality during construction of the Project. As the Project is upgrading existing infrastructure, the Project would not significantly increase impervious surfaces more than what currently exists.

The only grading proposed as part of the Project would include any minor alterations necessary to accommodate new or upgraded features, including the new water treatment building, backwash reclaim tank, and new storage tank. The proposed Project would not significantly alter drainage patterns and would not impede or redirect flood flows. It would not block or reroute any existing drainage or stream. Additionally, the Project would comply with post-construction measures in accordance with NPDES Construction General Permit to ensure the Project would not result in an increase in polluted runoff. Any impacts for points c) i. through c) iii. would be less than significant.

    iv. Impede or redirect flood flows?

Less than significant impact. The proposed Project improvements would be located approximately 260-ft east of Crawford Creek, approximately 950-ft west of Camp Creek, and approximately 1,500- ft north of the Klamath River. As there are no water courses near the proposed Project improvements and as the Project would implement the SWPPP and associated BMPs required under the Statewide Construction General Permit, the Project would not impede or redirect flood flows. Impacts would be less than significant.

d) In flood hazard, tsunami, or seiche zones, risk release of pollutants due to project inundation?

Less than significant impact. The Project is not in an area that is at risk from seiche or tsunamis. The Project is not located near a large body of water capable of producing a seiche or tsunami. The proposed Project is on FEMA panel #06023C0275F, effective 11/4/2016. The Project site is located in Zone D, which is an area where no analysis of flood hazards has been conducted. Zone D is used for areas where there are possible but undetermined flood hazards. In advance of a potential flood, staff would take steps necessary to protect the new water treatment building, but not limited to, placing sandbags, and removing chemicals from the area that may pose a risk if contacted by flood waters. Therefore, the proposed Project would not risk release of pollutants due to Project inundation from seiche, tsunami, or flood. Any impact would be less than significant.

e) Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?

Less than significant impact. The Project is located within the area covered by the North Coast Regional Water Quality Basin Plan and would not conflict with or obstruct its implementation (NCRWQCB 2023). Construction activities would feature standard BMPs, including temporary erosion and runoff control measures that minimize the potential for erosion and storm water runoff.

The Project is not located in an area with a sustainable groundwater management plan in place, as the Sustainable Groundwater Management Act only applies to groundwater basins designated as medium or high priority. Currently there is one medium-priority basin, the Eel River Valley groundwater basin, within Humboldt County (Humboldt County 2021). That basin is located over 40 air miles southwest of the Project site.

Bajada Geosciences, Inc. conducted test pits to determine if groundwater was encountered. A search of regional groundwater data did not identify any wells within 2,000-ft of the Project site. In addition, a search of the Geotracker database did not indicate the presence of subsurface exploration or data close to the Project site. Springs have not been mapped on U.S Geologic topographic maps in the Project region. Therefore, any impacts would be less than significant.

XI. LAND USE AND PLANNING

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Physically divide an established community?	☐	☐	☐	☒
b) Cause significant environmental impact due to a conflict with any land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☒	☐

Environmental Setting

The General Plan land use designations for the Project area are Conservation Floodway (CF), and Residential Estates, 1 to 5-acre minimum (RE 1-5).

The General Plan (Humboldt County 2017) designation of CF applies to the channels of river and streams, including the areas which carry normal flood waters or the area between existing or planned levees, dikes or other such flood control features, and in which agricultural and limited recreational uses may be desirable or permissible. The RE designation is used for lands adjacent to urban areas or rural communities with limited public services but suitable for single-family residential use. It is also intended as a transition from urban development to rural lands. This designation is commonly used in water-only service areas. The RE designation has a density range of 1 to 5-acres per unit with a maximum floor area ratio (FAR) or 0.20.

The Project area has a zoning designation of Unclassified (U). Land uses surrounding the Project site include U.S Forest Service Lands and residential land.

Section 314-8.1 states that all of the unincorporated areas of the County not otherwise zoned are designated as the Unclassified Zone. This area has not been sufficiently studied to justify precise zoning classifications. Principal permitted uses include one-family dwelling, general agriculture, rooming, and boarding of not more than two persons, and manufactured homes. All other uses not specified in the subsection, Principal Permitted Uses, may be permitted upon the granting of a Use Permit.

Evaluation

a) Physically divide an established community?

No impact. The proposed Project would replace an existing in-line filtration plant with a new surface, direct-filtration WTP. The Project would construct a new water treatment building with a backwash reclaim tank. A proposed generator and propane tank would be located adjacent to the water treatment building. The Project would demolish an existing redwood storage tank and construct a new water storage tank. Additionally, the Project would install a new fire hydrant at the entrance of the path leading to the proposed water treatment building, directly off Camp Creek Road. New fencing around the water treatment building, generator, propane tank, backwash reclaim tank would be installed.

Existing subsurface piping would be demolished and/or abandoned. New subsurface piping would tie into the existing distribution system piping located throughout the parcel in order to serve the new water treatment system.

The proposed Project would not divide the established community that is located within the vicinity of the Project along Camp Creek Road and Placer Drive. The water treatment system currently exists, and the proposed Project would include upgrades to the existing system. During temporary construction of the water storage tank, bottled water may be brought in for potable services. Property owners would be notified in advance of the shutdown. The proposed Project would not significantly expand the built footprint of the existing system, and therefore would not physically divide an established community. No impact would occur.

b) Cause significant environmental impact due to a conflict with any land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect?

Less than significant impact. The proposed Project would include updates to an existing water treatment system. The nature or intensity of use on any parcel would not change and built footprints would not significantly expand. Type and intensity of use would continue without significant change relative to existing conditions. Vegetation clearing would be limited to the minimum extent necessary to ensure site access and safety, and no removal of trees is proposed. Potential impacts would be less than significant, and no mitigation would be necessary.

XII. MINERAL RESOURCES

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the State?	☐	☐	☐	☒
b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?	☐	☐	☐	☒

Environmental Setting

Current mineral resource production in the County is primarily limited to sand, gravel, and rock extraction. The State Surface Mining and Reclamation Act of 1975 (SMARA) brought about a State policy for the reclamation of mined lands. According to the CA Department of Conservation's Mines Online, there are no SMARA parcels located in the Project area (CDC 2022c).

Evaluation

a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the State?

b) Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?

No Impact. According to SMARA Mines Online, the Project site is not located on a SMARA parcel. Therefore, the Project would not result in a loss of availability of mineral resources or recovery site delineated on a local general plan, specific plan, or any land use plan. There would be no impact.

XIII. NOISE

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project result in:				
a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☒	☐	☐
b) Generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☒	☐
c) For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☒	☐

Environmental Setting

The Project is located in unincorporated Orleans area in Humboldt County, approximately 1.1 miles west of downtown Orleans. The proposed Project site would sit on the northern side of SR 96 and would be accessed via an existing path directly off Camp Creek Road. The Project site is bordered to the north and west by densely wooded land, the Six Rivers National Forest, to the south by SR 96, wooded land, and Klamath River, and to the east by wooded land and residential homes.

OMWC currently owns and operates a surface water diversion off Crawford Creek, a redwood raw storage tank, an in-line infiltration plant, and a water distribution system. Two booster pumps run continuously to supply water to the distribution system and two pressure regulators are located in the distribution system. A small 12-volt battery backup system with inverter provides standby power for the plant controls and chemical pumps. No standby power is available for the booster pumps.

The predominant existing noise sources in the vicinity of the proposed Project site are vehicles on adjacent streets. Sensitive receptors, including residences, border the Project site to the southeast. The nearest sensitive receptors to the water treatment building and generator would be single-family residences approximately 350-ft to the southeast. The nearest sensitive receptors to the proposed new water storage tank would be single-family residences approximately 500-ft to the southeast.

Evaluation

a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?

Less than significant impact with mitigation. The noise standards in the Humboldt County General Plan are based on EPA recommendations. Section 3240 of the 2017 General Plan states: “The Environmental Protection Agency identifies 45 Day-Night average sound level (Ldn) indoors and 55 Ldn outdoors as the maximum level below which no effects on public health and welfare occur. Ldn is the Day-Night Noise Level. Ldn is the average sound level in decibels, excluding frequencies beyond the range of the human ear, during a 24-hour period with a 10 decibels (dB) weighting applied to nighttime sound levels. A standard construction wood frame house reduces noise transmission by 15dB. Since interior noise levels for residences are not to exceed 45dB, the maximum acceptable exterior noise level for residences is 60dB without any additional insulation being required. Of course, this would vary depending on the land use designation, adjacent uses, distance to noise source, and intervening topography, vegetation, and other buffers.” Since Ldn is a daily average, allowable noise levels can increase in relation to shorter periods of time. As stated in Section 3240, “Fences, landscaping, and noise insulation can be used to mitigate the hazards of excessive noise levels.”

The existing County noise standard utilizes an averaging mechanism (dBA Ldn) applicable to activities that generate sound sources averaged over a 24-hour period of time. This type of measurement is commonly used for measuring highway noise or industrial operations. A ten-decibel addition is added to noise levels occurring at nighttime – between 10:00 p.m. and 7:00 a.m. Utilizing a typical standard of 45 dBA Ldn interior noise level allows for a maximum of 60 dBA Ldn for ‘normally acceptable’ exterior levels.

Construction

Construction activities would result in a temporary increase in noise levels in the area. This noise increase would be short-term and would occur during daytime hours. The nearest sensitive receptors to any of the proposed Project improvements are single-family residences approximately 350-feet southeast from the new water treatment building. Mitigation Measure NOI-01 would be implemented during Project construction to reduce potential impacts from construction noise to a less than significant level. The proposed mitigation would limit construction hours and days and would require standard maintenance of tools and equipment to reduce noise levels. With implementation of the proposed mitigation, potentially significant impacts would be reduced to a level of less than significant.

Operation

The long-term operation of the Project is not expected to generate significant noise levels that would exceed the Humboldt County General Plan Noise Element standards. Operations would be consistent with the sorts of activities that occur under existing conditions, including deliveries, maintenance vehicle travel, routine maintenance, generator usage during power outages, and pump operation.

The proposed operation would include a small electric heater and a small exhaust fan located within the 468-sf water treatment building. The building would be supported by a reinforced slab foundation and the walls would be made of CMU block, supporting open web steel trusses with a metal roof to safeguard against wildfires. As the electric heater and exhaust fan would be located within the CMU block building, potential noise levels would be reduced.

A generator and propane tank would be located adjacent to the new water treatment building and backwash reclaim tank. However, the generator would only operate for about five minutes per week for testing and maintenance purposes. The nearest sensitive receptor to the generator would be single-family residences located approximately 350-ft to the southeast. As operation would be consistent with existing operations, impacts would be less than significant.

Therefore, with implementation of Mitigation Measure NOI-01, construction or operation of the proposed Project would not expose persons to or result in the generation of temporary or permanent noise levels in excess of standards established in the local general plan, noise ordinance, or applicable standard of other agencies. Impacts would be less than significant with mitigation.

Mitigation Measure NOI-01: Construction Related Noise

The following shall be implemented during construction activities:

- The operation of tools or equipment used in construction, drilling, repair, alternation, or demolition shall occur between the hours of 8 a.m. and 5 p.m. Monday through Friday, and between 9 a.m. and 5 p.m. on Saturdays.
- No heavy equipment related to construction activities shall be allowed on Sundays or holidays.
- All stationery and construction equipment shall be maintained in good working order and fitted with factor approved muffler systems.

b) Generation of excessive groundborne vibration or groundborne noise levels?

Less than significant impact. Generally, construction activities within 200-feet and pile driving within 468-feet of vibration sensitive use would be potentially disruptive to vibration-sensitive operations (Caltrans 2013). Land uses in which groundborne vibration could potentially interfere with operations or equipment, such as research, manufacturing, hospitals, and university research operations are considered “vibration sensitive” (Caltrans 2013).

All construction activities would be temporary and would not create long-term ground disturbing activities. Construction would include approximately two weeks of site preparation, approximately two weeks of demolition, approximately two weeks of grading, approximately three weeks of underground infrastructure and utilities, and approximately six months of physical building construction. The full buildout of the proposed Project would be completed in less than one year. There are no vibration sensitive land uses within 200-feet of the proposed Project. The nearest sensitive land use is single-family residences located approximately 350-ft southeast from the water treatment building. The operation of the Project would not involve the use of heavy machinery or ground disturbing activities that would result in excessive groundborne vibration or groundborne noise levels. A generator and propane tank would be located adjacent to the new water treatment building and backwash reclaim tank. However, the generator would only operate for about 5 minutes per week for testing and maintenance purposes. Therefore, the proposed Project would not expose persons to or generate excessive groundborne vibration or groundborne noise levels, and impacts would be less than significant.

c) For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?

Less than significant impact. The nearest airport to the Project site is Hoopa Airport, located approximately 26-miles to the south. At this distance, there would be no excessive noise levels related to the airport. As there are no private airstrips in the vicinity of the Project site, the proposed Project would not expose people working in the Project area to excessive noise levels. There would be no impact.

XIV. POPULATION AND HOUSING

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Induce substantial unplanned population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☒	☐
b) Displace substantial numbers of existing people or housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

Environmental Setting

Humboldt County is a rural county with a large land area and low population density. The US Census Bureau (USCB) estimates that the County's population was 136,373 in 2018, up from 134,794 in 2010 (USCB 2022). Orleans is not a Census Designated Place within Humboldt County.

Evaluation

a) Induce substantial unplanned population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?

Less than significant impact. Growth inducing impacts are generally caused by Projects that have a direct or indirect effect on economic growth, population growth, or when the Project taxes community service facilities which require upgrades beyond the existing remaining capacity. The proposed Project would upgrade the existing system by replacing an in-line filtration plant with a new surface, direct-filtration WTP. It is anticipated that the workforce for construction of the proposed Project would be drawn from the existing population in northern Humboldt County and that they would maintain in their current residences and commute to work. No long-term jobs are expected to be created as a result of this Project. The Project would not create new water service for a level of development beyond that which currently exists. Impacts would be less than significant.

b) Displace substantial numbers of existing people or housing, necessitating the construction of replacement housing elsewhere?

No impact. The proposed Project would upgrade an existing water treatment system. The Project would not induce any population growth, raise rents or property values significantly, or otherwise make housing prohibitive for current residents. During construction of the new storage tank, bottled water may be brought for potable purposes. Therefore, replacement housing would not be required. There would be no impact.

XV. PUBLIC SERVICES

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:				
a) Fire protection?	☐	☐	☒	☐
b) Police protection?	☐	☐	☐	☒
c) Schools?	☐	☐	☐	☒
d) Parks?	☐	☐	☐	☒
e) Other public facilities?	☐	☐	☐	☒

Environmental Setting

The Orleans Volunteer Fire Department is the nearest fire department (Humboldt County 2019). Their station is located at 38162 California 96, Orleans, CA 95556, located approximately 1.5-miles east of the Project site. The Project site is in an SRA served by CAL FIRE. The nearest CAL FIRE station is the CAL FIRE Elk Camp Forest Fire Station, located at Bald Hills at Johnson Road, Orick, CA, 95555, approximately 38-miles east via SR 96.

The nearest police station is the Humboldt County Sheriff Office, Willow Creek Station located approximately 36-miles to the south by California 96 at 80 Country Club Drive, Willow Creek, CA 95573. Deputies assigned to the Willow Creek Station provide law enforcement services to northeastern part of Humboldt County including Willow creek, Hoopa, Orleans, Redwood Valley and other surrounding communities and work in cooperation with the Hoopa Valley Tribal Police Department and California Highway Patrol. The Hoopa Valley Tribal Police Station is located at 12637 California 96, Hoopa, CA 95546, approximately 23-miles southwest of the Project site.

The Project site is in the Klamath-Trinity Joint Unified School District (District). The nearest school in the District to the Project site is Orleans Elementary School, located at 38016 California 96, Orleans, CA 95556, approximately 1.4-miles east of the Project site. The next closest schools in the District are Captain John Continuation High School, located at 101 Loop Avenue, Hoopa, CA 95546, and Hoopa Valley High School, located at 11400 State Route 96, Hoopa, CA 95546, both approximately 25-miles southwest from the Project site.

The Six Rivers National Forest surrounds the Project site and borders the Project parcel to the west and north. Project work would occur within the Project parcel and would not take place on State Park land.

The next nearest small park, Three Dollar Bar, is located approximately 9-miles northeast of the Project site. No other parks or recreational facilities are in the immediate vicinity of the Project.

Evaluation

a) Fire protection?

Less than significant impact. The proposed Project would replace an existing in-line filtration plant with a new surface, direct-filtration WTP. The Project would construct a new water treatment building, a backwash reclaim tank, and a new steel water storage tank. A generator and propane tank would be located adjacent to the water treatment building. A new fire hydrant would be installed at the entrance of the path leading to the proposed water treatment building, directly off Camp Creek Road. Existing subsurface piping would be demolished and/or abandoned. New subsurface piping would tie into the existing distribution system piping located throughout the parcel in order to serve the new water treatment system.

Though the risk of ignition may be slightly increased during construction, such elevated risk would be temporary and of short duration. No change in fire risk is projected post-construction relative to existing conditions. The site is located within an SRA served by CAL FIRE, with additional protection provided by the Orleans Volunteer Fire Department. Additionally, by adding a fire hydrant in an area where no hydrants currently exist, the Project would improve the capacity of existing agencies to fight fires in the Project site. All proposed structure modifications would comply with County fire code requirements and access would follow requirements by CAL FIRE. The Project would not create any long-term jobs and would not construct any large new facilities. Correspondingly, the Project would not result in the need for new or physically altered fire protection facilities. Impacts to fire protection services from the proposed Project would be less than significant, and no mitigation would be necessary.

b) Police protection?

No impact. The proposed Project would replace an existing in-line filtration plant with a new surface, direct-filtration WTP. The Project would construct a new water treatment building and a backwash reclaim tank. A generator and propane tank would be located adjacent to the water treatment building. Additionally, the Project would demolish an existing redwood storage tank and construct a new steel water storage tank. A new fire hydrant would be installed at the entrance of the path leading to the proposed water treatment building, directly off Camp Creek Road. Fencing would be installed around the new water treatment building, generator, propane tank, and backwash reclaim tank. Existing subsurface piping would be demolished and/or abandoned. New subsurface piping would tie into the existing distribution system piping located throughout the parcel in order to serve the new water treatment system. The Project would not result in an increase in population, criminal activity, or assets requiring any protection beyond existing levels. No impact would occur.

c) Schools?

No impact. The proposed Project is not expected to have any growth-inducing effects and would have no impact on schools within the District or with enrollment. The Project includes upgrading an existing water treatment system by replacing an in-line filtration plant with a new surface, direct-filtration WTP. No impact on schools would occur.

d) Parks?

No impact. As previously mentioned, the proposed Project would not directly or indirectly induce population growth and would not result in the need for new or expanded park and recreational facilities. Project work would occur within the Project parcel and would not take place on State Park land. The next nearest small park, Three Dollar Bar, is located approximately 9-miles northeast of the Project site. The proposed action would not negatively affect any existing recreation opportunities. No impact on park or recreational facilities would occur. See also the discussion on recreation in Section 7. XVII. *Recreation* of this Initial Study.

e) Other public facilities?

No impact. As previously mentioned, the proposed Project would not directly or indirectly induce population growth and would not result in an increased demand for other public facilities. No impact on demand for other public facilities would occur.

XVI. RECREATION

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	☒
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?	☐	☐	☐	☒

Environmental Setting

Recreational resources are addressed in the Humboldt County General Plan. Approximately 1.4-million of the County's 2.3-million acres are used for agricultural and timber production. More than 550,000-acres are protected open space, forests, and recreation areas. Within the county boundaries, there are four federal parks and beaches; 10 State parks; and 16 county parks and beaches, recreational areas, and reserves. There is also considerable National Forest land, as well as a number of city parks and open spaces owned by non-profit conservation groups. Redwood National Park, Six Rivers National Forest, Redwoods State Park, and King Range National Conservation Area are all significant, protected forests (Humboldt County 2017).

The Six Rivers National Forest surrounds the Project site and borders the Project parcel to the west and north. Project work would occur within the Project parcel and would not take place on State Park land. The next nearest small park, Three Dollar Bar, is located approximately 9-miles northeast of the Project site. No other parks or recreational facilities are in the immediate vicinity of the Project.

Evaluation

a) Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?

No impact. The Project would not induce population growth or otherwise result in an increased demand for existing recreational facilities. The Six Rivers National Forest exists in the vicinity of the Project site and borders the Project parcel to the west and north. Work for the Project would not occur on State park land, and it would not impact State park land or facilities. The next nearest small park, Three Dollar Bar, is located approximately 9-miles northeast of the Project site. Therefore, no impact would occur.

b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?

No impact. The proposed Project would not induce population growth or otherwise require the construction or expansion of recreational facilities. The Project includes upgrading an existing water distribution system by replacing an in-line filtration plant with a new surface, direct-filtration WTP. Further, the proposed Project does not include construction of recreational facilities. No impact would occur.

XVII. TRANSPORTATION

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Conflict with a program plan, ordinance or policy addressing the circulation system, including transit, roadway, bicycle and pedestrian facilities?	☐	☐	☒	☐
b) Would the project conflict or be inconsistent with CEQA Guidelines section 15064.3, subdivision (b)?	☐	☐	☒	☐
c) Substantially increase hazards due to a geometric design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☒	☐
d) Result in inadequate emergency access?	☐	☐	☒	☐

Environmental Setting

The Project is located in unincorporated Orleans area in Humboldt County, approximately 1.1-miles west of downtown Orleans. The proposed Project site would be located on the northern side of SR 96 and would be accessed via an existing path directly off Camp Creek Road. According to Caltrans, SR 96 is considered an eligible State Scenic Highway (Caltrans 2022). However, no officially designated State Scenic or County Scenic highways in Humboldt County exist near the Project site.

Evaluation

a) Conflict with a program plan, ordinance or policy addressing the circulation system, including transit, roadway, bicycle and pedestrian facilities?

Less than significant impact. Project construction would be accomplished by a small number of workers and would take place almost entirely along an existing path off Camp Creek Road. Construction of the Project would result in a temporary increase in construction traffic that would be minimal and for a short duration. Construction activities would be carried out on-site and would not result in substantial adverse effects or conflicts with the local roadway system. Construction would include approximately two weeks of site preparation, approximately 2 weeks of demolition, approximately two weeks of grading, approximately three weeks of underground infrastructure and utilities, and approximately six months of physical building construction. The full buildout of the proposed Project would be completed in less than one year.

The operation of the Project would not create any permanent new jobs or cause long-term changes in traffic volume or patterns. Therefore, the proposed Project would not conflict with a program plan, ordinance or policy addressing the circulation system, including transit, roadway, bicycle and pedestrian facilities, and impacts would be less than significant.

b) Would the project conflict or be inconsistent with CEQA Guidelines section 15064.3, subdivision (b)?

Less than significant impact. CEQA Guidelines Section 15064.3 requires that transportation impacts be analyzed based on vehicle miles traveled (VMT). If existing models or methods are not available to estimate the vehicle miles traveled for the particular Project being considered, a lead agency may analyze the Project's vehicle miles traveled qualitatively. Construction activities for the proposed Project would be relatively small in scale and short-term in nature and would not constitute a significant impact on vehicle miles travelled. The Project would not change vehicle miles travelled during Project operation relative to existing conditions. The Project would replace an existing in-line filtration plant with a new surface, direct-filtration WTP, and would replace an existing redwood storage tank with a new steel water storage tank. The present employees and their scheduled work hours would continue with the proposed Project and there would be no significant change in vehicle miles travelled. Impacts would be less than significant, and no mitigation would be required.

c) Substantially increase hazards due to a geometric design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?

Less than significant impact. The proposed Project would use an existing undeveloped path, directly off Camp Creek Road, to access the Project site. All portions of the Project site are accessible directly via SR 96 and Camp Creek Road. The existing, unimproved dirt road leading to the water treatment building would be widened to create a 12-ft wide road with a 14-ft wide unobstructed clearance (2-ft on each side of the driveway). The path leading to the water treatment building would begin on the edge of Camp Creek Road (a paved roadway). Additionally, the Project would recontour the existing unimproved dirt road from the new water treatment building to the water storage tank site after installation of all buried utilities. Any additional traffic generated by construction activities would be short term and temporary in nature. The proposed Project would not change the public road system in the area nor introduce permanent changes in traffic volume or composition. Therefore, the proposed Project would not substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersection) or incompatible uses (e.g., farm equipment). Potential impacts would be less than significant, and no mitigation would be necessary.

d) Result in inadequate emergency access?

Less than significant impact. All portions of the Project site are accessible via an existing path directly off Camp Creek Road, which is accessed by SR 96. The evacuation routes would depend on the location of the community at risk and law enforcement recommendations based on fire behavior, wind patterns, traffic, and ingress of emergency vehicles. The determination for the locations of these sites is normally made by the Humboldt County Emergency Operations Center Incident Commander in cooperation with an incident Management Team (Humboldt County 2019). SR 96 would, in most cases, serve as the primary evacuation route. The proposed Project is accessed via Camp Creek Road, which is adjacent to the main primary evacuation route, SR 96. The existing, unimproved dirt road leading to the water treatment building would be widened to create a 12-ft wide road with a 14-ft wide unobstructed clearance (2-ft on each side of the driveway). The path leading to the water treatment building would begin on the edge of Camp Creek Road (a paved roadway). Additionally, the Project would recontour the existing unimproved dirt road from the new water treatment building to the new water storage tank site after installation of all buried utilities. All access roads would provide sufficient access for emergency vehicles and opportunities for them to turn around. Therefore, potential impacts would be less than significant, and no mitigation would be necessary.

XVIII. TRIBAL CULTURAL RESOURCES

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code Section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:				
i. Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code Section 5020.1(k), or	☐	☒	☐	☐
ii. A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resources Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe.	☐	☒	☐	☐

Environmental Setting

On March 13, 2024, Project notification letters with invitations to consult on the Project were sent by email to representatives of the two tribes on the SWRCB Assembly Bill (AB) 52 list for Humboldt County: the Karuk Tribe and the Wiyot Tribe. Neither tribe responded within the 30-day response period.

However, because the Karuk Tribe owns land within the APE, the SWRCB conducted consultation with the Tribe. Various emails were exchanged, and one phone call occurred on April 16, 2024, between the SWRCB and the Karuk Tribe Tribal Historic Preservation Officer Alex Watts-Tobin. Dr. Watts-Tobin provided ethnographic information that was included in the Helix 2024 Cultural Resources Assessment. Dr. Watts-Tobin also agreed with the findings and mitigation measures proposed in that report and in this document.

Evaluation

a) Cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code Section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:

i. Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code Section 5020.1(k)?

Less than significant impact with mitigation. As described in Section 7.V. *Cultural Resources* of this Initial Study, two tribal cultural resources that are listed on the NRHP are located in the APE: the Karuk Panamenik World Renewal Ceremony District (P-12-003123) and its contributing feature, Kusnachanimnam, a sacred medicine place (P-12-003719). Mitigation measures CUL-01 through CUL-04 would reduce the potential impacts to less than significant.

ii. A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resources Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe?

Less than significant impact with mitigation. Ground-disturbing activities have the potential to result in the discovery of, or unanticipated damage to, archaeological contexts and human remains, and this possibility cannot be totally eliminated. Consequently, there is a potential for significant impacts on unanticipated TCRs. Implementation of Mitigation Measures CUL-01 through CUL-04 would reduce the potential impacts to less than significant.

XIX. UTILITIES AND SERVICE SYSTEMS

	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
Would the project:				
a) Require or result in the relocation or construction of new or expanded water, wastewater treatment or storm water drainage, electric power, natural gas, or telecommunications facilities, the construction or relocation of which could cause significant environmental effects?	☐	☐	☒	☐
b) Have sufficient water supplies available to serve the project and reasonably foreseeable future development during normal, dry and multiple dry years?	☐	☐	☒	☐
c) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	☐	☐	☒	☐
d) Generate solid waste in excess of State or local standards, or in excess of the capacity of local infrastructure, or otherwise impair the attainment of solid waste reduction goals?	☐	☐	☒	☐
e) Comply with federal, State, and local management and reduction statutes and regulations related to solid waste?	☐	☐	☒	☐

Environmental Setting

The existing Project area includes a surface water diversion off Crawford Creek, a 20,000-gallon redwood raw water storage tank, an in-line filtration plant, and a water distribution system. Two 2-HP booster pumps run continuously to supply water to the distribution system. Power for the in-line filtration plant is currently provided by PG&E. All existing water facilities are owned and operated by OMWC.

Evaluation

a) Require or result in the relocation or construction of new or expanded water, wastewater treatment or storm water drainage, electric power, natural gas, or telecommunications facilities, the construction or relocation of which could cause significant environmental effects?

Less than significant impact. The proposed Project would replace an existing in-line filtration plant with a new surface, direct-filtration WTP. The Project would construct a new water treatment building with a backwash reclaim tank. A generator and propane tank would be located adjacent to the water treatment building. The Project would also demolish an existing redwood storage tank and construct a new water storage tank. Additionally, the Project would install a new fire hydrant at the entrance of the path leading to the proposed water treatment building, directly off Camp Creek Road. New fencing around the water treatment building, generator, propane tank, and backwash reclaim tank would be installed. Existing subsurface piping would be demolished and/or abandoned. New subsurface piping would tie into the existing distribution system piping located throughout the parcel in order to serve the new water treatment system.

An internet connection would be provided at the new water treatment building for monitoring the new treatment equipment. It is anticipated that a local ISP is available and capable of providing this service to the site. A new underground electrical service from PG&E would be provided to the site, via the existing path off Camp Creek Road. A new pole or pad mount transformer would be provided to support the new system. A generator and propane tank would be located adjacent to the new water treatment building and backwash reclaim tank. The generator would only operate for about five minutes per week for testing and maintenance purposes. The proposed improvements have been sized to provide for system redundancy and calculated fire flows without additional residential service connections that are non-growth inducing.

The proposed Project would not require or result in the construction of new or expanded wastewater treatment or storm water drainage, natural gas, or telecommunications facilities that would cause significant environmental effects. The proposed improvements would be constructed within the same footprint of the existing facilities or would be constructed in previously disturbed areas. Impacts would be less than significant, and mitigation would not be necessary.

b) Have sufficient water supplies available to serve the project and reasonably foreseeable future development during normal, dry, and multiple dry years?

Less than significant impact. The Project would improve reliability of water access for the surrounding residents. The proposed Project would replace an existing in-line filtration plant with a new surface, direct-filtration WTP. The Project would construct a new water treatment building with a backwash reclaim tank. A generator and propane tank would be located adjacent to the water treatment building. The Project would also demolish an existing redwood storage tank and construct a new water storage tank. Additionally, the Project would install a new fire hydrant at the entrance of the path leading to the proposed water treatment building, directly off Camp Creek Road, and new fencing would be installed around the water treatment building, generator propane tank, and backwash reclaim tank.

The proposed Project would improve the condition of the existing water treatment system and the distribution infrastructure and would help improve the quality of water delivered to the residents. Implementation of the proposed Project would increase water storage capacity and/or operational capability of the overall system. The proposed improvements have been sized to provide for system redundancy and calculated fire flows without additional residential service connections that are non-growth inducing. The proposed Project would have sufficient water supplies available to serve the Project during normal, dry, and multiple dry years. Impacts would be less than significant.

c) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project’s projected demand in addition to the provider’s existing commitments?

Less than significant impact. The proposed Project would supply existing customers based on current levels of demand; the amount of water supplied and consumed would not significantly change relative to existing conditions. The Project would not increase the production of wastewater. Any impact would be less than significant.

d) Generate solid waste in excess of State or local standards, or in excess of the capacity of local infrastructure, or otherwise impair the attainment of solid waste reduction goals?

e) Comply with federal, State, and local management and reduction statutes and regulations related to solid waste?

Less than significant impact. The California Integrated Waste Management Act of 1989 (PRC Division 30), enacted through AB 939 and modified by subsequent legislation, required all California cities and counties to implement programs to divert waste from landfills (Public Resources Code Section 41780). Compliance with AB 939 is determined by the Department of Resources, Recycling, and Recovery (Cal Recycle), formerly known as the California Integrated Waste Management Board (CIWMB). Each county is required to prepare and submit an Integrated Waste Management Plan for expected solid waste generation within the county to the CIWMB. In 2012, the unincorporated area of Humboldt County met or exceeded the waste diversion mandate of 50 percent set by the Integrated Waste Management Act of 1989.

The proposed Project would comply with all federal, State, and local statutes related to solid waste, including AB 939. This would include compliance with the Humboldt Waste Management Authority's recycling, hazardous waste, and composting programs in the county to comply with AB 939. Solid waste from Humboldt County is largely transported to one of three out-of-area landfills for disposal: the Anderson Landfill in Shasta County; Dry Creek Landfill in Medford, Oregon; and Potrero Hills Landfill in Suisun City. The Anderson Landfill is not expected to close until 2036, Dry Creek is expected to remain open until 2099, and Potrero Hills until 2053. The proposed Project is not expected to generate significant amounts of solid waste during construction or operation due to its nature as a water treatment system. The proposed Project would have a less than significant impact regarding solid waste as discussed for subsections d) and e).

XX. WILDFIRE

		Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
If located in or near State responsibility areas or lands classified as very high fire hazard severity zones, would the project:					
a)	Substantially impair an adopted emergency response plan or emergency evacuation plan?	☐	☐	☒	☐
b)	Due to slope, prevailing winds, and other factors, exacerbate wildfire risks, and thereby expose project occupants to, pollutant concentrations from a wildfire or the uncontrolled spread of a wildfire?	☐	☐	☒	☐
c)	Require the installation or maintenance of associated infrastructure (such as roads, fuel breaks, emergency water sources, power lines or other utilities) that may exacerbate fire risk or that may result in temporary or ongoing impacts to the environment?	☐	☐	☒	☐
d)	Expose people or structures to significant risks, including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability, or drainage changes?	☐	☐	☒	☐

Environmental Setting

SB 1241 (2012) requires the legislative body of a city or county to adopt a comprehensive, long-term general plan that includes a safety element for the protection of the community from unreasonable risks associated with wildland and urban fires. The update of the safety element must address fire risks on land classified as SRA and on VHFHZ of Local Responsibility Area (LRA).

The Humboldt County General Plan section on Fire Hazards outlines policies that address and reduce fire risk in the County. Policies include improving subdivision design and building code conformance, increasing information exchange and education, and encouraging prescribed burning and native plant conservation (Humboldt County 2017). The Humboldt County Community Wildfire Protection Plan (CWPP) gives further guidelines on how these policies will be implemented; the Mid-Klamath Planning Unit Action Plan (Unit 3) is the portion of the CWPP that encompasses the Project area (Humboldt County 2019).

The entire Project area is located in the Mid-Klamath fire planning unit of Humboldt County. The Project site is within a “Very High” Fire Hazard Severity Zone in an SRA and is served by CAL FIRE (CAL FIRE 2022). The Orleans Volunteer Fire Department is the nearest fire department (Humboldt County 2019). Their station is located at 38162 California 96, Orleans, CA 95556, located approximately 1.5-miles east of the Project site. The Orleans Volunteer Fire Department responds to structural fires, wildland fire support, and medical and rescue services (Humboldt County 2019). CAL FIRE would provide an initial response to a wildfire on the Project site. The nearest CAL FIRE station is the CAL FIRE Elk Camp Forest

Fire Station, located at Bald Hills at Johnson Road, Orick, CA, 95555, approximately 38-miles east via SR 96.

Evaluation

a) Substantially impair an adopted emergency response plan or emergency evacuation plan?

Less than significant impact. The Project site is located within the Mid-Klamath Wildfire Planning Unit. Evacuation routes would depend on the location of the community at risk and law enforcement recommendations based on fire behavior, wind patterns, traffic, and ingress of emergency vehicles. The determination for the locations of these sites is normally made by the Humboldt County Emergency Operations Center Incident Commander in cooperation with an incident Management Team (Humboldt County 2019). SR 96 would, in most cases, serve as the primary evacuation route. The proposed Project is accessed via an existing path directly off Camp Creek Road, which is adjacent to the main primary evacuation route, SR 96. The Project would construct a new water treatment building, a new backwash reclaim tank, and a new steel water storage tank on the northern side of Camp Creek Road. All Project components would be constructed within the existing footprint of within previously disturbed areas and would not limit ingress or egress of the Project area. The existing, unimproved dirt road leading to the water treatment building would be widened to create a 12-ft wide road with a 14-ft wide unobstructed clearance (2-ft on each side of the driveway). The path leading to the water treatment building would begin on the edge of Camp Creek Road (a paved roadway). Additionally, the Project would recontour the existing unimproved dirt road from the new water treatment building to the water storage tank site after installation of all buried utilities.

Therefore, the proposed Project would not substantially impair an adopted emergency response plan or emergency evacuation plan and impacts would be less than significant.

b) Due to slope, prevailing winds, and other factors, exacerbate wildfire risks, and thereby expose project occupants to pollutant concentrations from a wildfire or the uncontrolled spread of a wildfire?

Less than significant impact. The Project is situated in and around a small rural community and located within a "Very High" Fire Hazard Severity Zone within a SRA. The proposed Project would replace an in-line filtration plant with a new surface, direct-filtration surface WTP. The Project would construct a new water treatment building, a backwash reclaim tank, and a new steel water storage tank. A generator and a propane tank would be located adjacent to the water treatment building. A new fire hydrant would be installed at the entrance of the path leading to the proposed water treatment building, directly off Camp Creek Road. Subsurface piping would also be demolished and/or abandoned and would tie into the existing distribution system piping. The Project would not induce growth nor involve the creation of new occupied structures within a wildfire hazard zone. By adding a fire hydrant in an area where no hydrants currently exist, the Project would enhance the protection of existing residences, infrastructure, and wildlands. All proposed structure modifications would comply with County fire code requirements and access would follow requirements by CAL FIRE. Impacts would be less than significant.

c) Require the installation or maintenance of associated infrastructure (such as roads, fuel breaks, emergency water sources, power lines or other utilities) that may exacerbate fire risk or that may result in temporary or ongoing impacts to the environment?

Less than significant impact. The Project site would be accessed via an existing path directly off Camp Creek Road. The existing, unimproved dirt road leading to the water treatment building would be widened to create a 12-ft wide road with a 14-ft wide unobstructed clearance (2-ft on each side of the driveway). The path leading to the water treatment building would begin on the edge of Camp Creek Road (a paved roadway). Additionally, the Project would recontour the existing unimproved dirt road from the new water treatment building to the water storage tank site after installation of all buried utilities.

The easement would enhance the road's function as a fuel break and may help to limit the spread of future wildfire in the area. The proposed Project would include the installation of a new fire hydrant at the entrance of the path leading to the proposed water treatment building. The fire hydrant and the proposed water storage tank would aid in the suppression of future wildfires and would protect homes and infrastructure. A new underground electrical service from Pacific Gas and Electric (PG&E) would be provided to the site, via the existing path off Camp Creek Road. A new pole or pad mount transformer would be provided to support the new system. A generator and propane tank would be located adjacent to the new water treatment building and backwash reclaim tank. The generator would only operate for about five minutes per week for testing and maintenance purposes. Project improvements, including the installation of the water treatment building, backwash reclaim tank, and water storage tank, would be done either within the same footprint, or within an area that has been heavily disturbed by mining activities.

During construction and operation of the proposed facility, the presence of humans and associated equipment may expose the area to increased risk of fire ignition. However, staff and contractors would follow all best management practices to reduce fire risk, including avoiding smoking in non-designated areas; using spark arrestors as warranted; maintaining equipment in its proper working order; ensuring that all loads are properly secured and no chains or metal drag; avoiding work that could potentially produce sparks during red flag warnings; and adhering to all requirements for burn permits. Fire suppression equipment, including fire extinguishers and hand tools, would be available onsite for the containment of small, incipient fires if it is safe for workers to do so and they have received proper training in the use of such tools. The Project would be required to comply with CAL FIRE SRA requirements during construction. Compliance with these requirements, along with the above measures, would reduce any impacts to less than significant.

d) Expose people or structures to significant risks, including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability, or drainage changes?

Less than significant impact. Based on FEMA flood maps, the Project site is located within Zone D, which is the resulting designation on the flood map, to indicate that while flood risk remains, the probability of that flood risk has not been quantified (FEMA 2022). The flood map is under 06023C0275F and has a location status of "not printed". However, the Project is only focused on upgrading existing infrastructure to maintain the existing level of service. It would not induce population growth nor introduce new facilities into the area beyond the level that currently exists. Additionally, the Project would not involve significant clearing of trees or brush, exposure of hillsides, or substantial changes to existing drainage patterns. Therefore, people or structures would not be susceptible to significant new risks involving downstream flooding as a result of runoff, post-fire slope instability or drainage changes.

The proposed water treatment building would be located on relatively flat land but located adjacent to an incised drainage. No landslides, older, active, or incipient were observed in the vicinity of the proposed site. Therefore, natural landslides pose a low risk to the proposed Project site. The proposed water storage tank is located in mountainous terrain with descending slopes to the west and south and ascending slopes to the north and east. No landslides, older, active, or incipient were observed in the vicinity of the proposed site. Slope stability analyses were performed by Bajada Geosciences, Inc. to evaluate the risks of slope instabilities. Results of the analyses indicated the existing slopes beneath the proposed water treatment building, and water storage tank were stable.

The proposed construction of the Project would comply with the CBC requirements and would follow all recommendations outlined in the geotechnical report (Bajada Geosciences, Inc. 2022). Therefore, the proposed Project would not expose people or structures to significant risks including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability, or drainage changes, and impacts would be less than significant.

XXI. MANDATORY FINDINGS OF SIGNIFICANCE

		Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact
a)	Does the project have the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, substantially reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	☐	☒	☐	☐
b)	Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of past, present and probable future projects)?	☐	☒	☐	☐
c)	Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☐	☒	☐

a) Does the project have the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, substantially reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?

Less than significant impact with mitigation. The preceding analysis indicates that the proposed Project has the potential to adversely affect biological and cultural resources. See sections 7.IV, 7.V, and 7.XVIII of this Initial Study for discussion of the proposed Project's potential impacts on these environmental issue areas. With implementation of the mitigation measures identified in those Sections, and compliance with County and State programs and requirements identified in this report, impacts would be reduced to a less than significant level. No significant or potentially significant impacts would remain.

b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of past, present and probable future projects)?

Less than significant impact with mitigation. While the Project would indirectly contribute to cumulative impacts associated with disturbance and infrastructure development in the region, these impacts have previously been evaluated by the County and considered in development of the County's General Plan as set forth in this Initial Study. Key areas of concern are discussed in detail below.

Evaluation of cumulative biological resource impacts: In order to evaluate special-status species and/or their habitats with the potential to occur in the Study Area and/or be impacted by the proposed Project, HELIX obtained lists of special-status species known to occur and/or having the potential to occur in the Study Area and vicinity from the U.S. Fish and Wildlife Service (USFWS; USFWS 2022), the California Native Plant Society (CNPS; CNPS 2022), and the California Natural Diversity Database (CNDDB; CDFW 2022). Additionally, a biological resources reconnaissance survey was conducted by HELIX Wildlife Biologist Stephanie McLaughlin, M.S. on June 1, 2022. Although no evidence of sensitive species was observed on the Project site, the Board recognizes that sensitive species may use the Project site and that they may be encountered during Project construction. With the implementation of **Mitigation Measures BIO-01 and BIO-02,** the impacts would be reduced to a less than significant level and potentially cumulative impacts would be avoided.

Evaluation of cumulative cultural resources impacts: A records search at the NWIC determined that 10 studies have been previously conducted within a 0.25-mile radius of the APE, and that five of these studies included the current APE as part of their study areas. The records search also determined that 11 additional cultural resources are located within 0.250mile of the APE. HELIX requested that the NAHC conduct a search of their SLF, and a written response received from the NAHC stated that results of the SLF search were negative; however, the NAHC's response also suggested the absence of specific site information in the SLF does not definitely indicate the absence of cultural resources. HELIX reached out to points of contact for 20 Native American Tribes and no response have been received. Additionally, HELIX inspected surveyable portions of the APE and determined the APE is understood to have a high cultural sensitivity. With implementation of **Mitigation Measures CUL-01, CUL-02, CUL-03, and CUL-04,** the impacts would be reduced to a less than significant level and potentially cumulative impacts would be avoided.

Evaluation of cumulative geology and soils impacts: A Preliminary Geotechnical Report was prepared by Bajada Geosciences, Inc. on September 2, 2022. It was indicated that although no Alquist Priolo Fault Zones are within the Project area, the Project would still comply with all recommendations outlined in the Geotechnical Report, as described in Mitigation Measure GEO-01. The Geotechnical Report noted that three samples of near-surface soils were subjected to chemical analysis for assessment of corrosion and reactivity with concrete. The results indicated that where the proposed water treatment building would be sited are estimated to be corrosive to severely corrosive to ferrous metals. Where the proposed tank and pipelines are located are estimated to be mildly to moderately corrosive. With implementation of Mitigation Measure GEO-02, impacts to corrosivity would be less than significant.

No previous surveys conducted in the Project area have identified the Project site as sensitive for paleontological resources or other geologically sensitive resources, nor have testing or ground disturbing activities performed to date uncovered any paleontological resources or geologically sensitive resources. While the likelihood encountering paleontological resources and other geologically sensitive resources is considered low, Project-related ground disturbing activities could affect the integrity of a previously unknown paleontological or other geologically sensitive resource, resulting in a substantial change in the significance of the resource. Implementation of Mitigation Measure GEO-03 would reduce potentially significant impacts to a less than significant level.

With implementation of **Mitigation Measure GEO-01**, **GEO-02**, and **GEO-03**, the impacts would be reduced to a less than significant level and potentially cumulative impacts would be avoided.

Evaluation of cumulative noise resource impacts: Construction of the proposed Project would result in a temporary increase in noise levels in the area. This noise increase would be short-term and would occur during daytime hours. The nearest sensitive receptors to any of the proposed Project improvements are single-family residences approximately 350-feet southeast from the new water treatment building. Mitigation Measure NOI-01 would be implemented during Project construction to reduce potential impacts from construction noise to a less than significant level. The proposed mitigation would limit construction hours and days and would require standard maintenance of tools and equipment to reduce noise levels. With implementation of **Mitigation Measure NOI-01**, the impacts would be reduced to a less than significant level and potentially cumulative impacts would be avoided.

c) Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?

Less than significant impact. Because of site conditions, existing County regulations, and regulation of potential environmental impacts by other agencies, the proposed Project would not have the potential to cause substantial adverse effects on human beings as demonstrated in the evaluation contained in this Initial Study. Therefore, impacts would be less than significant.

8.0 MITIGATION MONITORING AND REPORTING PROGRAM

A Mitigation Monitoring and Reporting Program (MMRP) has been prepared by the SWRCB per Section 15097 of the CEQA Guidelines and is presented in Appendix F.

9.0 PREPARERS

List of Preparers:

State Water Resources Control Board

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Lisa Machado, Senior Cultural Resources Officer

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Martin Rolph, Air Quality/Energy Specialist
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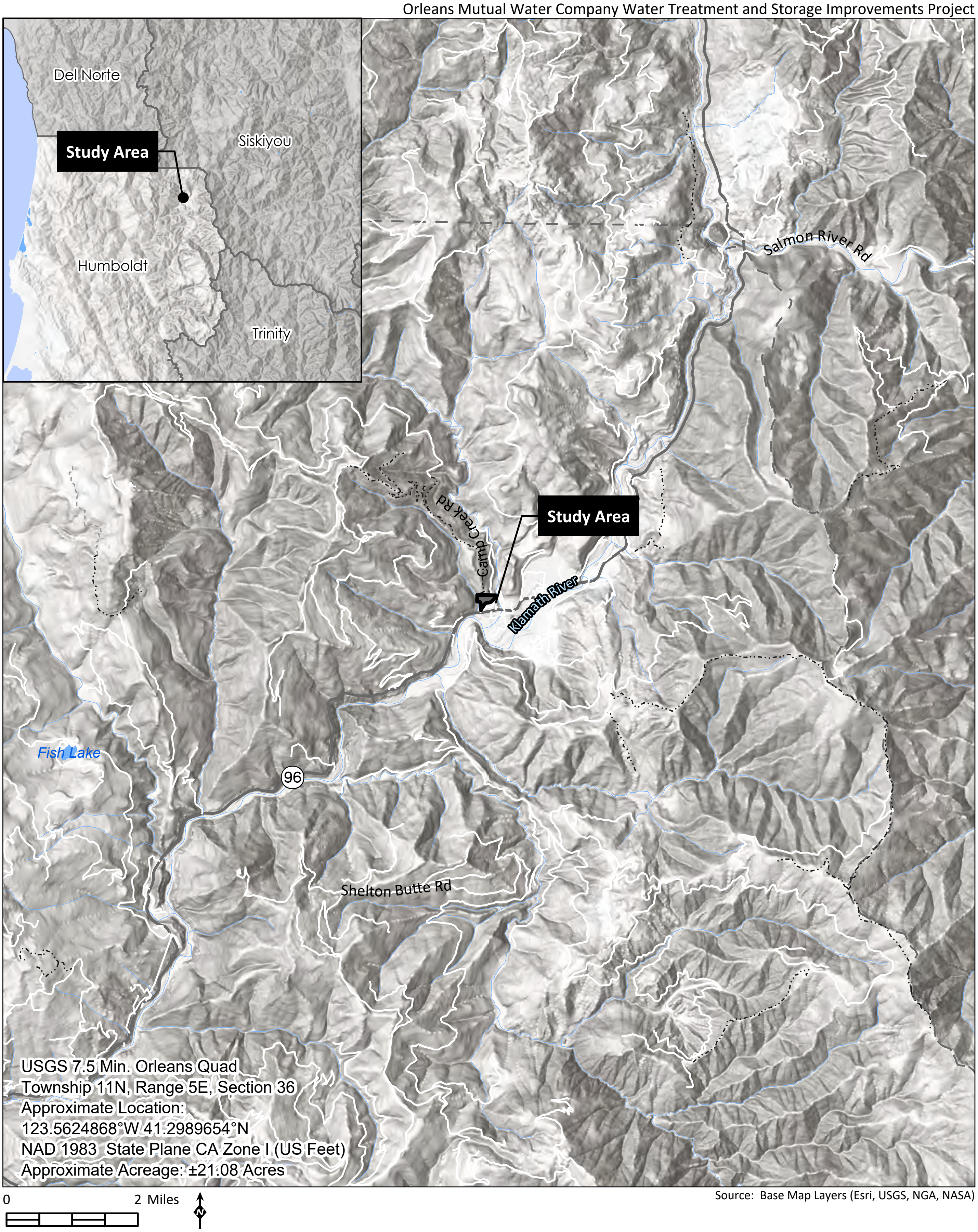
Appendix A

Figures

Orleans Mutual Water Company Water Treatment and Storage Improvements Project



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Source: Base Map Layers (Esri, USGS, NGA, NASA)

HELIX
Environmental Planning

Regional Location Map

Figure 1

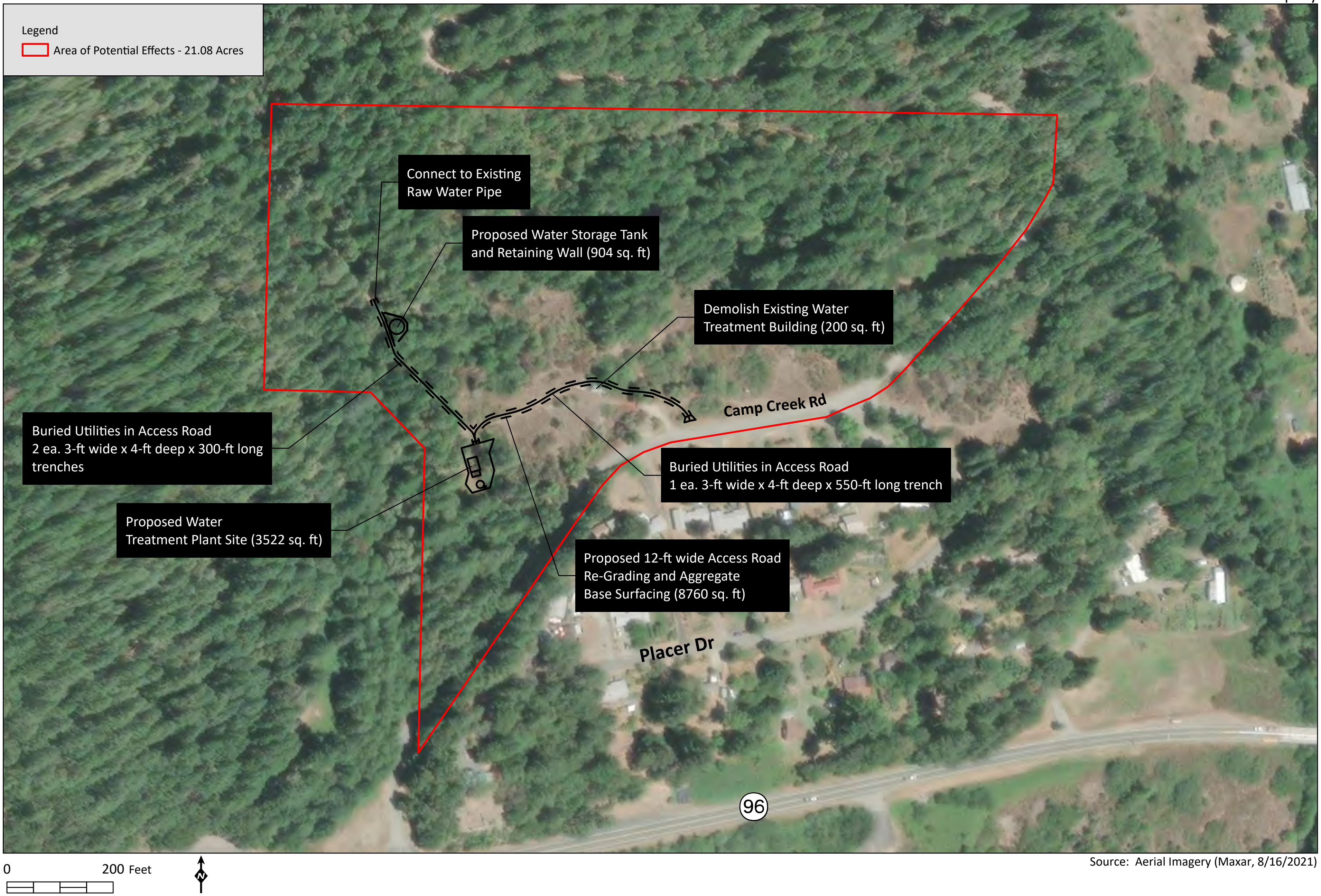
Project Name

Source: Aerial Imagery (Maxar, 8/16/2021)

HELIX Environmental Planning

Aerial Map

Figure 2



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Source: Aerial Imagery (Maxar, 8/16/2021)

HELIX Environmental Planning

Site Plan

Figure 3

Appendix B

CalEEMod Output

Orleans WTP Upgrade Detailed Report

Table of Contents

1. Basic Project Information

1.1. Basic Project Information

Data Field	Value
Project Name	Orleans WTP Upgrade
Lead Agency	State Water Resources Control Board
Land Use Scale	Project/site
Analysis Level for Defaults	County
Windspeed (m/s)	2.90
Precipitation (days)	21.6
Location	41.29842318876575, -123.56327353102273
County	Humboldt
City	Unincorporated
Air District	North Coast Unified APCD
Air Basin	North Coast
TAZ	109
EDFZ	2
Electric Utility	Pacific Gas & Electric Company
Gas Utility	Pacific Gas & Electric

1.2. Land Use Types

Land Use Subtype	Size	Unit	Lot Acreage	Building Area (sq ft)	Landscape Area (sq ft)	Special Landscape Area (sq ft)	Population	Description
General Light Industry	1.25	1000sqft	0.17	1,254	0.00	0.00	—	—
Other Non-Asphalt Surfaces	0.21	Acre	0.21	0.00	0.00	0.00	—	—

1.3. User-Selected Emission Reduction Measures by Emissions Sector

No measures selected

2. Emissions Summary

2.1. Construction Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.																	
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.77	0.65	5.13	6.77	0.01	0.23	0.33	0.56	0.21	0.04	0.25	—	1,426	1,426	0.06	0.02	1,434
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.45	0.38	3.30	4.53	0.01	0.13	1.72	1.85	0.12	0.19	0.32	—	1,098	1,098	0.03	0.07	1,121
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.17	0.15	1.20	1.39	< 0.005	0.05	0.08	0.13	0.05	0.01	0.06	—	347	347	0.01	0.01	349
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.03	0.03	0.22	0.25	< 0.005	0.01	0.01	0.02	0.01	< 0.005	0.01	—	57.5	57.5	< 0.005	< 0.005	57.8

2.2. Construction Emissions by Year, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year																	
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

2024	0.77	0.65	5.13	6.77	0.01	0.23	0.33	0.56	0.21	0.04	0.25	—	1,426	1,426	0.06	0.02	1,434
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2024	0.45	0.38	3.30	4.53	0.01	0.13	1.72	1.85	0.12	0.19	0.32	—	1,098	1,098	0.03	0.07	1,121
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2024	0.17	0.15	1.20	1.39	< 0.005	0.05	0.08	0.13	0.05	0.01	0.06	—	347	347	0.01	0.01	349
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2024	0.03	0.03	0.22	0.25	< 0.005	0.01	0.01	0.02	0.01	< 0.005	0.01	—	57.5	57.5	< 0.005	< 0.005	57.8

2.4. Operations Emissions Compared Against Thresholds

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Un/Mit.	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.05	0.08	0.11	0.10	< 0.005	0.01	0.00	0.01	0.01	0.00	0.01	0.00	22.8	22.8	< 0.005	< 0.005	22.9
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.05	0.08	0.11	0.10	< 0.005	0.01	0.00	0.01	0.01	0.00	0.01	0.00	22.8	22.8	< 0.005	< 0.005	22.9
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.01	0.04	0.02	0.01	< 0.005	< 0.005	0.00	< 0.005	< 0.005	0.00	< 0.005	0.00	4.72	4.72	< 0.005	< 0.005	4.75
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	< 0.005	0.01	< 0.005	< 0.005	< 0.005	< 0.005	0.00	< 0.005	< 0.005	0.00	< 0.005	0.00	0.78	0.78	< 0.005	< 0.005	0.79

2.5. Operations Emissions by Sector, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Sector																	
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mobile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Area	—	0.04	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Energy	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	1.84	1.84	< 0.005	< 0.005	1.86
Water	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Waste	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Refrig.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.00
Stationary	0.05	0.04	0.11	0.10	< 0.005	0.01	—	0.01	0.01	—	0.01	—	21.0	21.0	< 0.005	< 0.005	21.1
Total	0.05	0.08	0.11	0.10	< 0.005	0.01	0.00	0.01	0.01	0.00	0.01	0.00	22.8	22.8	< 0.005	< 0.005	22.9
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mobile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Area	—	0.04	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Energy	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	1.84	1.84	< 0.005	< 0.005	1.86
Water	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Waste	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Refrig.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.00
Stationary	0.05	0.04	0.11	0.10	< 0.005	0.01	—	0.01	0.01	—	0.01	—	21.0	21.0	< 0.005	< 0.005	21.1
Total	0.05	0.08	0.11	0.10	< 0.005	0.01	0.00	0.01	0.01	0.00	0.01	0.00	22.8	22.8	< 0.005	< 0.005	22.9
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Mobile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Area	—	0.04	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Energy	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	1.84	1.84	< 0.005	< 0.005	1.86
Water	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Waste	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Refrig.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.00
Stationary	0.01	0.01	0.02	0.01	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	2.88	2.88	< 0.005	< 0.005	2.88
Total	0.01	0.04	0.02	0.01	< 0.005	< 0.005	0.00	< 0.005	< 0.005	0.00	< 0.005	0.00	4.72	4.72	< 0.005	< 0.005	4.75
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mobile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Area	—	0.01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Energy	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.31	0.31	< 0.005	< 0.005	0.31
Water	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Waste	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Refrig.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.00
Stationary	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.48	0.48	< 0.005	< 0.005	0.48
Total	< 0.005	0.01	< 0.005	< 0.005	< 0.005	< 0.005	0.00	< 0.005	< 0.005	0.00	< 0.005	0.00	0.78	0.78	< 0.005	< 0.005	0.79

3. Construction Emissions Details

3.1. Demolition (2024) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Off-Road Equipment	0.40	0.34	2.66	4.15	0.01	0.13	—	0.13	0.12	—	0.12	—	643	643	0.03	0.01	645
Demolition	—	—	—	—	—	—	0.05	0.05	—	0.01	0.01	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01	0.01	0.07	0.11	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	17.6	17.6	< 0.005	< 0.005	17.7
Demolition	—	—	—	—	—	—	< 0.005	< 0.005	—	< 0.005	< 0.005	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	< 0.005	< 0.005	0.01	0.02	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	2.92	2.92	< 0.005	< 0.005	2.93
Demolition	—	—	—	—	—	—	< 0.005	< 0.005	—	< 0.005	< 0.005	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.03	0.03	0.03	0.26	0.00	0.00	< 0.005	< 0.005	0.00	0.00	0.00	—	35.8	35.8	< 0.005	< 0.005	36.5
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	< 0.005	0.06	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	44.2	44.2	< 0.005	0.01	46.3

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.01	0.00	0.00	< 0.005	< 0.005	0.00	0.00	0.00	—	0.98	0.98	< 0.005	< 0.005	1.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	1.21	1.21	< 0.005	< 0.005	1.27
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	0.00	0.00	—	0.16	0.16	< 0.005	< 0.005	0.17
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	0.20	0.20	< 0.005	< 0.005	0.21

3.3. Site Preparation (2024) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.40	0.34	2.66	4.15	0.01	0.13	—	0.13	0.12	—	0.12	—	643	643	0.03	0.01	645
Dust From Material Movement	—	—	—	—	—	—	< 0.005	< 0.005	—	< 0.005	< 0.005	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00

Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01	0.01	0.07	0.11	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	17.6	17.6	< 0.005	< 0.005	17.7
Dust From Material Movement	—	—	—	—	—	—	< 0.005	< 0.005	—	< 0.005	< 0.005	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	< 0.005	< 0.005	0.01	0.02	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	2.92	2.92	< 0.005	< 0.005	2.93
Dust From Material Movement	—	—	—	—	—	—	< 0.005	< 0.005	—	< 0.005	< 0.005	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.03	0.03	0.03	0.29	0.00	0.00	< 0.005	< 0.005	0.00	0.00	0.00	—	35.7	35.7	< 0.005	< 0.005	36.3
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	< 0.005	0.02	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	14.7	14.7	< 0.005	< 0.005	15.4
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.01	0.00	0.00	< 0.005	< 0.005	0.00	0.00	0.00	—	0.98	0.98	< 0.005	< 0.005	1.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00

Hauling	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	0.40	0.40	< 0.005	< 0.005	0.42
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	0.00	0.00	—	0.16	0.16	< 0.005	< 0.005	0.17
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	0.07	0.07	< 0.005	< 0.005	0.07

3.5. Grading (2024) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.40	0.34	2.66	4.15	0.01	0.13	—	0.13	0.12	—	0.12	—	643	643	0.03	0.01	645
Dust From Material Movement	—	—	—	—	—	—	< 0.005	< 0.005	—	< 0.005	< 0.005	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01	0.01	0.07	0.11	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	17.6	17.6	< 0.005	< 0.005	17.7
Dust From Material Movement	—	—	—	—	—	—	< 0.005	< 0.005	—	< 0.005	< 0.005	—	—	—	—	—	—

Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	< 0.005	< 0.005	0.01	0.02	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	2.92	2.92	< 0.005	< 0.005	2.93
Dust From Material Movement	—	—	—	—	—	—	< 0.005	< 0.005	—	< 0.005	< 0.005	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.03	0.03	0.03	0.29	0.00	0.00	< 0.005	< 0.005	0.00	0.00	0.00	—	35.7	35.7	< 0.005	< 0.005	36.3
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Hauling	0.01	0.01	0.61	0.09	0.01	0.01	0.03	0.04	0.01	0.01	0.02	—	420	420	< 0.005	0.07	440
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.01	0.00	0.00	< 0.005	< 0.005	0.00	0.00	0.00	—	0.98	0.98	< 0.005	< 0.005	1.00
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	< 0.005	0.02	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	11.5	11.5	< 0.005	< 0.005	12.1
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	0.00	0.00	—	0.16	0.16	< 0.005	< 0.005	0.17
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	1.90	1.90	< 0.005	< 0.005	2.00

3.7. Building Construction (2024) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.33	0.28	2.38	2.33	0.01	0.10	—	0.10	0.09	—	0.09	—	694	694	0.03	0.01	697
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.33	0.28	2.38	2.33	0.01	0.10	—	0.10	0.09	—	0.09	—	694	694	0.03	0.01	697
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.12	0.10	0.85	0.83	< 0.005	0.04	—	0.04	0.03	—	0.03	—	247	247	0.01	< 0.005	248
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.02	0.02	0.15	0.15	< 0.005	0.01	—	0.01	0.01	—	0.01	—	40.9	40.9	< 0.005	< 0.005	41.1
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.03	0.00	0.00	< 0.005	< 0.005	0.00	0.00	0.00	—	3.77	3.77	< 0.005	< 0.005	3.84
Vendor	< 0.005	< 0.005	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	4.88	4.88	< 0.005	< 0.005	5.11
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.03	0.00	0.00	< 0.005	< 0.005	0.00	0.00	0.00	—	3.77	3.77	< 0.005	< 0.005	3.82
Vendor	< 0.005	< 0.005	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	4.89	4.89	< 0.005	< 0.005	5.10
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.01	0.00	0.00	< 0.005	< 0.005	0.00	0.00	0.00	—	1.34	1.34	< 0.005	< 0.005	1.37
Vendor	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	1.74	1.74	< 0.005	< 0.005	1.82
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	0.00	0.00	—	0.22	0.22	< 0.005	< 0.005	0.23
Vendor	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	0.29	0.29	< 0.005	< 0.005	0.30
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00

3.9. Trenching (2024) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.40	0.34	2.66	4.15	0.01	0.13	—	0.13	0.12	—	0.12	—	643	643	0.03	0.01	645
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.02	0.01	0.11	0.17	< 0.005	0.01	—	0.01	< 0.005	—	< 0.005	—	26.4	26.4	< 0.005	< 0.005	26.5
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	< 0.005	< 0.005	0.02	0.03	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	4.37	4.37	< 0.005	< 0.005	4.39
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.03	0.03	0.03	0.29	0.00	0.00	< 0.005	< 0.005	0.00	0.00	0.00	—	35.7	35.7	< 0.005	< 0.005	36.3
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.01	0.00	0.00	< 0.005	< 0.005	0.00	0.00	0.00	—	1.47	1.47	< 0.005	< 0.005	1.50
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00

Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	0.00	0.00	—	0.24	0.24	< 0.005	< 0.005	0.25
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00

4. Operations Emissions Details

4.1. Mobile Emissions by Land Use

4.1.1. Unmitigated

Mobile source emissions results are presented in Sections 2.6. No further detailed breakdown of emissions is available.

4.2. Energy

4.2.1. Electricity Emissions By Land Use - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use																	
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Light Industry	—	—	—	—	—	—	—	—	—	—	—	—	1.84	1.84	< 0.005	< 0.005	1.86
Other Non-Asphalt Surfaces	—	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00
Total	—	—	—	—	—	—	—	—	—	—	—	—	1.84	1.84	< 0.005	< 0.005	1.86
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

General Light Industry	—	—	—	—	—	—	—	—	—	—	—	—	1.84	1.84	< 0.005	< 0.005	1.86
Other Non-Asphalt Surfaces	—	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00
Total	—	—	—	—	—	—	—	—	—	—	—	—	1.84	1.84	< 0.005	< 0.005	1.86
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Light Industry	—	—	—	—	—	—	—	—	—	—	—	—	0.31	0.31	< 0.005	< 0.005	0.31
Other Non-Asphalt Surfaces	—	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00
Total	—	—	—	—	—	—	—	—	—	—	—	—	0.31	0.31	< 0.005	< 0.005	0.31

4.2.3. Natural Gas Emissions By Land Use - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Light Industry	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	0.00
Other Non-Asphalt Surfaces	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

General Light Industry	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	0.00
Other Non-Asphalt Surfaces	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Light Industry	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	0.00
Other Non-Asphalt Surfaces	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	—	0.00	—	0.00	0.00	0.00	0.00	0.00

4.3. Area Emissions by Source

4.3.2. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Source	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Consumer Products	—	0.03	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Architectural Coatings	—	0.01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	0.04	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Consumer Products	—	0.03	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Architectural Coatings	—	0.01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	0.04	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Consumer Products	—	0.01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Architectural Coatings	—	< 0.005	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	0.01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.4. Water Emissions by Land Use

4.4.2. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use																	
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Light Industry	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Other Non-Asphalt Surfaces	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00

Total	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Light Industry	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Other Non-Asphalt Surfaces	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Total	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Light Industry	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Other Non-Asphalt Surfaces	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Total	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00

4.5. Waste Emissions by Land Use

4.5.2. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use																	
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Light Industry	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00

Other Non-Asphalt Surfaces	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Total	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Light Industry	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Other Non-Asphalt Surfaces	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Total	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Light Industry	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Other Non-Asphalt Surfaces	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00
Total	—	—	—	—	—	—	—	—	—	—	—	0.00	0.00	0.00	0.00	0.00	0.00

4.6. Refrigerant Emissions by Land Use

4.6.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use																	
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

General Light Industry	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.00
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Light Industry	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.00
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
General Light Industry	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.00
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.00

4.7. Offroad Emissions By Equipment Type

4.7.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Equipment Type																	
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.8. Stationary Emissions By Equipment Type

4.8.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Equipment Type	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Emergency Generator	0.05	0.04	0.11	0.10	< 0.005	0.01	—	0.01	0.01	—	0.01	—	21.0	21.0	< 0.005	< 0.005	21.1
Total	0.05	0.04	0.11	0.10	< 0.005	0.01	—	0.01	0.01	—	0.01	—	21.0	21.0	< 0.005	< 0.005	21.1
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Emergency Generator	0.05	0.04	0.11	0.10	< 0.005	0.01	—	0.01	0.01	—	0.01	—	21.0	21.0	< 0.005	< 0.005	21.1
Total	0.05	0.04	0.11	0.10	< 0.005	0.01	—	0.01	0.01	—	0.01	—	21.0	21.0	< 0.005	< 0.005	21.1
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Emergency Generator	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.48	0.48	< 0.005	< 0.005	0.48
Total	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.48	0.48	< 0.005	< 0.005	0.48

4.9. User Defined Emissions By Equipment Type

4.9.1. Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Equipment Type																	
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10. Soil Carbon Accumulation By Vegetation Type

4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Vegetation																	
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.2. Above and Belowground Carbon Accumulation by Land Use Type - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Land Use																	
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Species																	
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

5. Activity Data

5.1. Construction Schedule

Phase Name	Phase Type	Start Date	End Date	Days Per Week	Work Days per Phase	Phase Description
Demo Old Tank	Demolition	7/1/2024	7/12/2024	5.00	10.0	—
Site Preparation	Site Preparation	1/2/2024	1/15/2024	5.00	10.0	—
Grading	Grading	1/16/2024	1/29/2024	5.00	10.0	—

WTP and Tank Construtcion	Building Construction	2/20/2024	8/19/2024	5.00	130	—
Utilities and Water Meters	Trenching	1/30/2024	2/19/2024	5.00	15.0	—

5.2. Off-Road Equipment

5.2.1. Unmitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
WTP and Tank Construtcion	Cranes	Diesel	Average	1.00	2.00	367	0.29
WTP and Tank Construtcion	Forklifts	Diesel	Average	1.00	6.00	82.0	0.20
Demo Old Tank	Excavators	Diesel	Average	1.00	8.00	36.0	0.38
Demo Old Tank	Rubber Tired Loaders	Diesel	Average	1.00	8.00	150	0.36
Site Preparation	Excavators	Diesel	Average	1.00	8.00	36.0	0.38
Site Preparation	Rubber Tired Loaders	Diesel	Average	1.00	8.00	150	0.36
Grading	Excavators	Diesel	Average	1.00	8.00	36.0	0.38
Grading	Rubber Tired Loaders	Diesel	Average	1.00	8.00	150	0.36
WTP and Tank Construtcion	Off-Highway Trucks	Diesel	Average	1.00	2.00	376	0.38
Utilities and Water Meters	Excavators	Diesel	Average	1.00	8.00	36.0	0.38
Utilities and Water Meters	Rubber Tired Loaders	Diesel	Average	1.00	8.00	150	0.36

5.3. Construction Vehicles

5.3.1. Unmitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix

Site Preparation	—	—	—	—
Site Preparation	Worker	5.00	9.53	LDA,LDT1,LDT2
Site Preparation	Vendor	—	7.16	HHDT,MHDT
Site Preparation	Hauling	0.20	20.0	HHDT
Site Preparation	Onsite truck	—	—	HHDT
Grading	—	—	—	—
Grading	Worker	5.00	9.53	LDA,LDT1,LDT2
Grading	Vendor	—	7.16	HHDT,MHDT
Grading	Hauling	5.70	20.0	HHDT
Grading	Onsite truck	—	—	HHDT
WTP and Tank Construtcion	—	—	—	—
WTP and Tank Construtcion	Worker	0.53	9.53	LDA,LDT1,LDT2
WTP and Tank Construtcion	Vendor	0.21	7.16	HHDT,MHDT
WTP and Tank Construtcion	Hauling	0.00	20.0	HHDT
WTP and Tank Construtcion	Onsite truck	—	—	HHDT
Utilities and Water Meters	—	—	—	—
Utilities and Water Meters	Worker	5.00	9.53	LDA,LDT1,LDT2
Utilities and Water Meters	Vendor	—	7.16	HHDT,MHDT
Utilities and Water Meters	Hauling	0.00	20.0	HHDT
Utilities and Water Meters	Onsite truck	—	—	HHDT
Demo Old Tank	—	—	—	—
Demo Old Tank	Worker	5.00	9.53	LDA,LDT1,LDT2
Demo Old Tank	Vendor	—	7.16	HHDT,MHDT
Demo Old Tank	Hauling	0.60	20.0	HHDT
Demo Old Tank	Onsite truck	—	—	HHDT

5.4. Vehicles

5.4.1. Construction Vehicle Control Strategies

Control Strategies Applied	PM10 Reduction	PM2.5 Reduction
Water unpaved roads twice daily	55%	55%
Limit vehicle speeds on unpaved roads to 25 mph	44%	44%

5.5. Architectural Coatings

Phase Name	Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)

5.6. Dust Mitigation

5.6.1. Construction Earthmoving Activities

Phase Name	Material Imported (Cubic Yards)	Material Exported (Cubic Yards)	Acres Graded (acres)	Material Demolished (Ton of Debris)	Acres Paved (acres)
Demo Old Tank	0.00	0.00	0.00	23.0	—
Site Preparation	0.00	10.0	0.00	0.00	—
Grading	300	150	0.00	0.00	—

5.6.2. Construction Earthmoving Control Strategies

Control Strategies Applied	Frequency (per day)	PM10 Reduction	PM2.5 Reduction
Water Exposed Area	2	61%	61%

5.7. Construction Paving

Land Use	Area Paved (acres)	% Asphalt
General Light Industry	0.00	0%
Other Non-Asphalt Surfaces	0.21	0%

5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

Year	kWh per Year	CO2	CH4	N2O
2024	0.00	204	0.03	< 0.005

5.9. Operational Mobile Sources

5.9.1. Unmitigated

Land Use Type	Trips/Weekday	Trips/Saturday	Trips/Sunday	Trips/Year	VMT/Weekday	VMT/Saturday	VMT/Sunday	VMT/Year
Total all Land Uses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

5.10. Operational Area Sources

5.10.1. Hearths

5.10.1.1. Unmitigated

5.10.2. Architectural Coatings

Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)
0	0.00	1,881	0.00	549

5.10.3. Landscape Equipment

Equipment Type	Fuel Type	Number Per Day	Hours per Day	Hours per Year	Horsepower	Load Factor

5.11. Operational Energy Consumption

5.11.1. Unmitigated

Electricity (kWh/yr) and CO2 and CH4 and N2O and Natural Gas (kBTU/yr)

Land Use	Electricity (kWh/yr)	CO2	CH4	N2O	Natural Gas (kBTU/yr)
General Light Industry	3,300	204	0.0330	0.0040	0.00
Other Non-Asphalt Surfaces	0.00	204	0.0330	0.0040	0.00

5.12. Operational Water and Wastewater Consumption

5.12.1. Unmitigated

Land Use	Indoor Water (gal/year)	Outdoor Water (gal/year)
General Light Industry	0.00	0.00
Other Non-Asphalt Surfaces	0.00	0.00

5.13. Operational Waste Generation

5.13.1. Unmitigated

Land Use	Waste (ton/year)	Cogeneration (kWh/year)
General Light Industry	0.00	0.00
Other Non-Asphalt Surfaces	0.00	0.00

5.14. Operational Refrigeration and Air Conditioning Equipment

5.14.1. Unmitigated

Land Use Type	Equipment Type	Refrigerant	GWP	Quantity (kg)	Operations Leak Rate	Service Leak Rate	Times Serviced
General Light Industry	Other commercial A/C and heat pumps	R-410A	2,088	0.00	4.00	4.00	18.0

5.15. Operational Off-Road Equipment

5.15.1. Unmitigated

Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor

5.16. Stationary Sources

5.16.1. Emergency Generators and Fire Pumps

Equipment Type	Fuel Type	Number per Day	Hours per Day	Hours per Year	Horsepower	Load Factor
Emergency Generator	Diesel	1.00	0.10	5.00	250	0.73

5.16.2. Process Boilers

Equipment Type	Fuel Type	Number	Boiler Rating (MMBtu/hr)	Daily Heat Input (MMBtu/day)	Annual Heat Input (MMBtu/yr)

5.17. User Defined

Equipment Type	Fuel Type
—	—

5.18. Vegetation

5.18.1. Land Use Change

5.18.1.1. Unmitigated

Vegetation Land Use Type	Vegetation Soil Type	Initial Acres	Final Acres

5.18.1. Biomass Cover Type

5.18.1.1. Unmitigated

Biomass Cover Type	Initial Acres	Final Acres

5.18.2. Sequestration

5.18.2.1. Unmitigated

Tree Type	Number	Electricity Saved (kWh/year)	Natural Gas Saved (btu/year)

6. Climate Risk Detailed Report

6.1. Climate Risk Summary

Cal-Adapt midcentury 2040–2059 average projections for four hazards are reported below for your project location. These are under Representation Concentration Pathway (RCP) 8.5 which assumes GHG emissions will continue to rise strongly through 2050 and then plateau around 2100.

Climate Hazard	Result for Project Location	Unit
Temperature and Extreme Heat	14.5	annual days of extreme heat
Extreme Precipitation	22.8	annual days with precipitation above 20 mm
Sea Level Rise	0.00	meters of inundation depth
Wildfire	29.0	annual hectares burned

Temperature and Extreme Heat data are for grid cell in which your project are located. The projection is based on the 98th historical percentile of daily maximum/minimum temperatures from observed historical data (32 climate model ensemble from Cal-Adapt, 2040–2059 average under RCP 8.5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Extreme Precipitation data are for the grid cell in which your project are located. The threshold of 20 mm is equivalent to about ¾ an inch of rain, which would be light to moderate rainfall if received over a full day or heavy rain if received over a period of 2 to 4 hours. Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.
Sea Level Rise data are for the grid cell in which your project are located. The projections are from Radke et al. (2017), as reported in Cal-Adapt (2040–2059 average under RCP 8.5), and consider different increments of sea level rise coupled with extreme storm events. Users may select from four model simulations to view the range in potential inundation depth for the grid cell. The four simulations make different assumptions about expected rainfall and temperature are: Warmer/drier (HadGEM2-ES), Cooler/wetter (CNRM-CM5), Average conditions (CanESM2), Range of different rainfall and temperature possibilities (MIROC5). Each grid cell is 50 meters (m) by 50 m, or about 164 feet (ft) by 164 ft.
Wildfire data are for the grid cell in which your project are located. The projections are from UC Davis, as reported in Cal-Adapt (2040–2059 average under RCP 8.5), and consider historical data of climate, vegetation, population density, and large (> 400 ha) fire history. Users may select from four model simulations to view the range in potential wildfire probabilities for the grid cell. The four simulations make different assumptions about expected rainfall and temperature are: Warmer/drier (HadGEM2-ES), Cooler/wetter (CNRM-CM5), Average conditions (CanESM2), Range of different rainfall and temperature possibilities (MIROC5). Each grid cell is 6 kilometers (km) by 6 km, or 3.7 miles (mi) by 3.7 mi.

6.2. Initial Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	3	0	0	N/A
Sea Level Rise	N/A	N/A	N/A	N/A
Wildfire	1	0	0	N/A
Flooding	0	0	0	N/A
Drought	N/A	N/A	N/A	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.
The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores do not include implementation of climate risk reduction measures.

6.3. Adjusted Climate Risk Scores

Climate Hazard	Exposure Score	Sensitivity Score	Adaptive Capacity Score	Vulnerability Score
Temperature and Extreme Heat	N/A	N/A	N/A	N/A
Extreme Precipitation	3	1	1	3
Sea Level Rise	N/A	N/A	N/A	N/A
Wildfire	1	1	1	2
Flooding	1	1	1	2
Drought	N/A	N/A	N/A	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	N/A	N/A	N/A	N/A

The sensitivity score reflects the extent to which a project would be adversely affected by exposure to a climate hazard. Exposure is rated on a scale of 1 to 5, with a score of 5 representing the greatest exposure.

The adaptive capacity of a project refers to its ability to manage and reduce vulnerabilities from projected climate hazards. Adaptive capacity is rated on a scale of 1 to 5, with a score of 5 representing the greatest ability to adapt.
The overall vulnerability scores are calculated based on the potential impacts and adaptive capacity assessments for each hazard. Scores include implementation of climate risk reduction measures.

6.4. Climate Risk Reduction Measures

7. Health and Equity Details

7.1. CalEnviroScreen 4.0 Scores

The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Exposure Indicators	—
AQ-Ozone	13.7
AQ-PM	0.77
AQ-DPM	2.13
Drinking Water	54.6
Lead Risk Housing	53.3
Pesticides	11.9
Toxic Releases	3.80
Traffic	0.56
Effect Indicators	—
CleanUp Sites	25.6
Groundwater	52.0
Haz Waste Facilities/Generators	35.6
Impaired Water Bodies	66.7
Solid Waste	98.8
Sensitive Population	—
Asthma	47.6
Cardio-vascular	78.1

Low Birth Weights	15.4
Socioeconomic Factor Indicators	—
Education	28.1
Housing	47.1
Linguistic	0.51
Poverty	66.9
Unemployment	4.89

7.2. Healthy Places Index Scores

The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

Indicator	Result for Project Census Tract
Economic	—
Above Poverty	17.04093417
Employed	4.606698319
Median HI	10.43243937
Education	—
Bachelor's or higher	50.58385731
High school enrollment	100
Preschool enrollment	56.08879764
Transportation	—
Auto Access	40.90850764
Active commuting	33.23495445
Social	—
2-parent households	18.90157834
Voting	36.160657
Neighborhood	—
Alcohol availability	97.0101373

Park access	37.39253176
Retail density	1.385859104
Supermarket access	32.87565764
Tree canopy	99.80751957
Housing	—
Homeownership	53.79186449
Housing habitability	30.36058001
Low-inc homeowner severe housing cost burden	22.17374567
Low-inc renter severe housing cost burden	68.90799435
Uncrowded housing	49.1979982
Health Outcomes	—
Insured adults	21.67329655
Arthritis	0.0
Asthma ER Admissions	52.9
High Blood Pressure	0.0
Cancer (excluding skin)	0.0
Asthma	0.0
Coronary Heart Disease	0.0
Chronic Obstructive Pulmonary Disease	0.0
Diagnosed Diabetes	0.0
Life Expectancy at Birth	50.9
Cognitively Disabled	29.3
Physically Disabled	32.1
Heart Attack ER Admissions	51.6
Mental Health Not Good	0.0
Chronic Kidney Disease	0.0
Obesity	0.0

Pedestrian Injuries	91.7
Physical Health Not Good	0.0
Stroke	0.0
Health Risk Behaviors	—
Binge Drinking	0.0
Current Smoker	0.0
No Leisure Time for Physical Activity	0.0
Climate Change Exposures	—
Wildfire Risk	59.6
SLR Inundation Area	0.0
Children	31.0
Elderly	57.9
English Speaking	96.2
Foreign-born	1.2
Outdoor Workers	29.8
Climate Change Adaptive Capacity	—
Impervious Surface Cover	98.0
Traffic Density	0.7
Traffic Access	0.0
Other Indices	—
Hardship	64.0
Other Decision Support	—
2016 Voting	16.7

7.3. Overall Health & Equity Scores

Metric	Result for Project Census Tract
CalEnviroScreen 4.0 Score for Project Location (a)	25.0

Healthy Places Index Score for Project Location (b)	27.0
Project Located in a Designated Disadvantaged Community (Senate Bill 535)	No
Project Located in a Low-Income Community (Assembly Bill 1550)	Yes
Project Located in a Community Air Protection Program Community (Assembly Bill 617)	No

a: The maximum CalEnviroScreen score is 100. A high score (i.e., greater than 50) reflects a higher pollution burden compared to other census tracts in the state.
b: The maximum Health Places Index score is 100. A high score (i.e., greater than 50) reflects healthier community conditions compared to other census tracts in the state.

7.4. Health & Equity Measures

No Health & Equity Measures selected.

7.5. Evaluation Scorecard

Health & Equity Evaluation Scorecard not completed.

7.6. Health & Equity Custom Measures

No Health & Equity Custom Measures created.

8. User Changes to Default Data

Screen	Justification
Land Use	Lane use areas per project engineer. Industrial = Waste Treatment Plan and Water Storage Tank Other Non-Asphalt Surfaces = new access road and utility easement (not paved)
Construction: Construction Phases	Construction schedule per project engineer. All building and tank components to be pre-finished, no architectural coatings phase. Access road to be gravel, no paving.
Construction: Off-Road Equipment	Equipment per project engineer. Off-Highway Truck = concrete pumper.
Construction: On-Road Fugitive Dust	0.2 miles of each haul trip and vendor trip assumed to be on unpaved access road.
Operations: Architectural Coatings	No paved areas requiring coatings
Operations: Energy Use	3,300 kWh per year net increase in natural gas over existing WTP, per project engineer
Operations: Water and Waste Water	No change in water use over existing WTP
Operations: Solid Waste	No change in solid waste generation over existing WTP

Operations: Refrigerants	No A/C or heat pumps

Appendix C

Biological Resources Assessment

HELIX Environmental Planning, Inc.
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September 27, 2022 Project 04114.00013.001

Joe Riess, P.E.
Water Works Engineers
P.O. Box 3150
Weaverville, CA 96093

Subject: Biological Resources Assessment Report for Orleans Mutual Water Company, Water Treatment and Storage Improvements Project, Community of Orleans, Humboldt County, California

Dear Mr. Riess:

HELIX Environmental Planning, Inc. (HELIX) has prepared this biological resources assessment report for the proposed project located adjacent to Placer Drive (Study Area) in the unincorporated community of Orleans, Humboldt County, California. The proposed project includes the construction a new water treatment facility and storage improvements project on behalf of the Orleans Mutual Water Company (OMWC). The purpose of our biological resources assessment report was to evaluate the potential for regionally occurring special-status plant and animal species or other sensitive biological habitats to occur in the Study Area and/or be impacted by the proposed project. This letter report describes the methods and results of our biological resources assessment. All referenced figures are included in Attachment A.

PROJECT LOCATION AND DESCRIPTION

The Study Area is located along Placer Drive in the community of Orleans, off Highway 96 within an unincorporated area of Humboldt County (Figure 1). The Study Area is approximately 3.34 acres and is located within the U.S. Geological Survey 7.5 minute *Orleans, CA* topographic quadrangle Township 11 North, Range 5 East, Section 36. The approximate center of the Study Area is at latitude 41.298943 and longitude -123.561357, NAD 83 (Figures 1 and 2).

The OMWC provides potable water needs for approximately 34 residential services connections for the unincorporated community of Orleans. In support of these existing service connections, the OMWC owns and operates a surface water diversion off Crawford Creek, a 20,000-gallon redwood raw water storage tank, an in-line filtration plant, and a water distribution system. In 2013 the State Regional Water Quality Control Board determined that the OWMC's current facilities failed to support required filtration technology to meet water quality standards. Due to the age and deteriorating condition of the current system, a new water treatment system is required to replace the existing system almost in its entirety.

The proposed improvements included under this project include a new direct-filtration surface water treatment plant with backwash recycling, and new water storage tank, for each residential service connection (Figure 3). Specific project improvements include:

- Demolition of the existing 20,000-gallon redwood water storage tank and replacement with a bolted steel water storage tank with a 130,300-gallon usable capacity.

- Demolition of the existing water treatment plant building and equipment and replacement with new facilities/equipment (including 10,500-gallon usable capacity backwash recovery tank, backwash recycle pump, catch basin for solids removal, turbidity filters (3), booster pumps (2), static mixer/flocculator, coagulant tank, and sodium hypochlorite tank).

- Installation of chain link fence and other institutional controls around equipment and buildings.

- Demolition/replacement of subsurface piping.

- Installation of a fire hydrant.

Work may include felling of mature, native trees and/or minor trenching/grading for piping, foundations, and equipment.

METHODS

Background Research

Background research was conducted to inform and create target lists to focus the survey efforts. Accessible information in public databases pertaining to natural resources in the region of the Study Area were queried. The following site-specific published information was reviewed for this BRA:

- California Department of Fish and Wildlife (CDFW). 2022. California Natural Diversity Database (CNDDB); For Lonesome Ridge, Orleans, Bark Shanty Gulch, Somes Bar, Fish Lake, Orleans Mtn., Weitchpec, Hopkins Butte, and Salmon Mtn. USGS 7.5-minute series quadrangles, Sacramento, CA. Accessed [June 28, 2022];

- California Native Plant Society (CNPS). 2022. Inventory of Rare and Endangered Plants (online edition, v8-03 0.39) For: Lonesome Ridge, Orleans, Bark Shanty Gulch, Somes Bar, Fish Lake, Orleans Mtn., Weitchpec, Hopkins Butte, and Salmon Mtn. USGS 7.5-minute series quadrangles, Sacramento, CA. Accessed [June 28, 2022];

- U.S. Department of Agriculture (USDA), Natural Resource Conservation Service (NRCS). 2022. *Web Soil Survey*. Available at: http://websoilsurvey.sc.egov.usda.gov. [Accessed May 3, 2022];

- U.S. Fish and Wildlife Service (USFWS). 2022. Information for Planning and Consultation (IPaC). List of threatened and endangered species that may occur in your proposed project location and/or be affected by your proposed project. [Accessed June 28, 2022];

- National Wetlands Inventory (NWI); and

- U.S. Fish and Wildlife Critical Habitat Portal at: https://ecos.fws.gov/ecp/report/table/critical-habitat.html.

Special-Status Species Evaluation

Regulations pertaining to the protection of biological resources in the Study Area are summarized in Attachment B. For the purposes of this report, special-status species are those that fall into one or more of the following categories, including those:

- listed as endangered or threatened under the Federal Endangered Species Act (FESA; including candidates and species proposed for listing);
- listed as endangered or threatened under the California Endangered Species Act (CESA; including candidates and species proposed for listing);
- designated as rare, protected, or fully protected pursuant to California Fish and Game Code;
- designated a Species of Special Concern (SSC) by the CDFW;
- considered by CDFW to be a Watch List species with potential to become an SSC;
- defined as rare or endangered under Section 15380 of the California Environmental Quality Act (CEQA); or
- Having a California Rare Plant Rank (CRPR) of 1A, 1B, 2A, 2B, or 3.

In order to evaluate special-status species and/or their habitats with the potential to occur in the Study Area and/or be impacted by the proposed project, HELIX obtained lists of special-status species known to occur and/or having the potential to occur in the Study Area and vicinity from the U.S. Fish and Wildlife Service (USFWS; USFWS 2022), the California Native Plant Society (CNPS; CNPS 2022), and the California Natural Diversity Database (CNDDB; CDFW 2022). Attachment C includes these lists of special-status plant and animal species occurring in the project region. The potential for these regionally occurring special-status species to occur in the Study Area is analyzed in Attachment D.

Reconnaissance Survey

A biological reconnaissance survey was conducted on June 1, 2022, by HELIX Biologist Stephanie McLaughlin, M.S. between 1000 and 1330 hours. The Study Area was systematically surveyed on foot to ensure total search coverage. All plant and animal species observed on-site during the surveys were recorded (Attachment E), and all biological communities occurring on-site were characterized. Following the field survey, the potential for each species identified in the database query to occur within the Study Area was determined based on the site survey, soils, habitats present within the Study Area, and species-specific information, as shown in Attachment D.

RESULTS

Environmental Setting

The Study Area is located in a rural, unincorporated portion of Humboldt County. The Study Area is located on the east side of Orleans, north of Highway 96 and the Klamath River. The community of Orleans is surrounded by the Six Rivers National Forest and the Marble Mountain Wilderness Area. Land uses including and surrounding the Study Area are residential and public land used for timber extraction, primarily within the Six Rivers National Forest.

Study Area Conditions

The OMWC derives its water from a surface water diversion off Crawford Creek. The water is piped to and stored in a 20,000-gallon redwood raw water storage tank. The tank is constructed atop a concrete platform and is built into a small staging area on a hillside. Crawford Creek is located in a steeply sloped ravine, approximately 130 feet west of the tank. The tank is accessed from the south via a dirt road that connects to Placer Drive.

The water treatment plant (WTP) consists of an in-line filtration plant located in a small building. The site is accessed via the same dirt road that leads to the tank site. A small pond is located behind the WTP, this pond is the result of historic hydrologic mining in the area and will not be impacted by the proposed project. Currently, water from the storage tanks runs downhill to the WTP through a pipeline. As part of the proposed project, this pipeline will be abandoned and left in place.

A proposed new storage tank site is located in the western portion of the Study Area, along the same dirt road leading to the existing storage tank. The proposed tank location is generally flat and cleared of trees. A drainage ditch containing seepage from the pond is located approximately 40 feet to the east of proposed tank location, this ditch is the result of historic hydrologic mining in the area and is not a natural feature. The ditch will not be impacted by the proposed project.

Water is transported to OMWC customers via an underground water distribution main line located beneath Placer Drive.

Habitat Types/Vegetation Communities

There are four habitat types/vegetation communities on the site: developed, ruderal/disturbed, Douglas fir-tanoak forest, and pond. Habitats and land covers are depicted on Figure 6. A list of species observed during the biological reconnaissance survey is included in Attachment E. Representative site photographs are included as Attachment F.

Developed

Developed habitat covers 2.13 acres of the Study Area and includes existing facilities and access roads as well as the shoulders of Placer Drive. These areas are disturbed and are dominated by a mix of native and non-native species, with ornamental species frequently planted in the residential area. Species observed in this community include California poppy (*Eschscholzia californica*), English ivy (*Hedera helix*), cape dandelion (*Arctotheca calendula*), and greenleaf manzanita (*Arctostaphylos patula*).

Ruderal/Disturbed

Ruderal/disturbed habitat covers 0.98 acre of the Study Area and occurs along the dirt access road. This habitat type occurs in areas that are heavily disturbed by past or ongoing human activities but retain a soil substrate. Ruderal/disturbed areas may be sparsely to densely vegetated, but do not support a recognizable community or species assemblage. Vegetative cover is usually herbaceous and dominated by a wide variety of weedy non-native species or a few ruderal native species. Dominant shrubs species within this community include poison oak (*Toxicodendron diversilobum*), Himalayan blackberry (*Rubus armeniacus*), French broom (*Genista monspessulana*), and greenleaf manzanita. Herbaceous species consist of flat pea (*Lathyrus sylvestris*), medusahead grass (*Elymus caput-medusae*), wild oats (*Avena fatua*), and ripgut brome (*Bromus diandrus*).

Douglas fir - Tanoak Forest

Douglas fir – tanoak forest habitat is found in the vicinity of the redwood water storage tank and covers 0.17 acre of the Study Area. This habitat is a tall intermittent to continuous, mixed needle-leaved evergreen forest in stands dominated by Douglas fir (*Pseudotsuga menziesii*) and tanoak (*Notholithocarpus densiflorus*), and interspersed with Pacific madrone (*Arbutus menziesii*), bigleaf maple (*Acer macrophyllum*), and black oak (*Quercus kelloggii*). This habitat type is frequently found on stream terraces, slopes, and ridges of all aspects. The understory ranges from sparse with dense leaf litter and small woody debris, to an intermittent shrub and herbaceous layer, which includes California huckleberry (*Vaccinium ovatum*), Etruscan honeysuckle (*Lonicera etrusca*), western sword fem (*Polystichum munitum*), and remote sedge (*Carex remota*). Due to the age of the redwood water storage tank, there is some seepage from the tank onto the soil surface, creating a moist environment without producing any aquatic features

Pond

Two ponds, totaling 0.06 acre, are located in the Study Area. The ponds are remnant tailing ponds from historic hydraulic mining and are likely not hydrologically connected to the surrounding area. Vegetation surrounding the ponds include white alder (*Alnus rhombifolia*), red willow (*Salix laevigata*), and Himalayan blackberry.

Topography

The Study Area is generally flat with a steep upwards slope to the north. Elevation ranges from 500 to 525 feet above sea level. Crawford Creek flows through a steeply walled ravine located west of the Study Area.

Soils

The Study Area contains two soil mapping units (NRCS 2022): Typic Xerofluvents-Riverwash association, 2 to 10 percent slopes and Pits and Dumps (Figure 4).

Typic Xerofluvents-Riverwash association, 2 to 10 percent slopes soils occur on baseslopes, alluvial fans, and toeslopes and consists of sandy and gravelly alluvium. A typical profile for Typic Xerofluvents-Riverwash association is gravelly sandy loam from 0 to 10 inches and stratified extremely gravelly loamy sand to silt loam from 1 to 60 inches. The depth to water table Typic Xerofluvents-Riverwash association soils is greater than 80 inches. Typic Xerofluvents-Riverwash association soils are not the National Hydric Soils List for Humboldt County (NRCS 2015).

Pits and Dumps soils occur on terraces, footslopes and risers and consists of gravelly alluvium. A typical profile for Pits and Dumps soil is very bouldery from 0 to 4 inches. The depth to water table for Pits and Dumps soil is greater than 80 inches. Pits and Dumps soils are not the National Hydric Soils List for Humboldt County (NRCS 2015).

Hydrology

The Study Area is located within the Camp Creek hydrologic unit (HUC12: 180102090801). Waterways in the region of the Study Area, including Crawford Creek and Camp Creek flow into the Klamath River and eventually the Pacific Ocean.

National Wetland Inventory (NWI) mapping shows Crawford Creek and a tributary, classified as Riverine, runs along the western boundary of the Study Area (Figure 5).

Special-Status Species Evaluation

A total of 27 regionally occurring special-status plant species and 26 regionally occurring special-status wildlife species were identified during the database queries and desktop review and are evaluated in Attachment D.

Special-Status Plant Species

A total of 27 regionally occurring special-status plant species were identified during the database searches and desktop review. The Study Area does not provide habitat for the majority of the regionally-occurring special-status plant species, which are associated with aquatic habitats such as seeps, marsh, lakes, rivers, vernal pools, and freshwater wetlands which do not occur within the Study Area. The majority of the remaining species are associated with grasslands, dunes, prairie, old-growth forest, chaparral, montane forest, cismontane woodlands, scrub, and ridgeline habitat.

However, based on the results of the desktop review and biological reconnaissance survey, the site provides suitable habitat for three special-status plant species: coast fawn lily (*Erythronium revolutum*), white-flowered rein orchid (*Piperia candida*) and Marble Mountain campion (*Silene marmorensis*). These species are discussed below. Special-status species determined to have no potential to occur on the Study Area or that are not expected to occur in the Study Area and be impacted by the proposed project (Attachment D) are not discussed further in this report.

Coast Fawn Lily

Federal status – none
State status – none
Other status – CRPR 2B.2 (rare, threatened, or endangered in California; more common elsewhere)

Species Description

Coast fawn lily is a perennial bulbiferous herb found on mesic soils and streambanks in bogs and fens, broadleaf upland forest, and North Coast coniferous forest from 0 - 1600 meters above mean sea level. Coast fawn lily blooms between March and July (occasionally August). Associated species include Douglas fir, tanoak, and Pacific madrone (CNPS 2022).

Survey History

Focused surveys were not conducted for coast fawn lily; however, the biological reconnaissance survey was conducted during the blooming period for this species and coast fawn lily was not observed in the Study Area. The nearest extant occurrence is 6.2 miles east of the Study Area along the Salmon River Trail in an area with Douglas fir and tanoak (CDFW 2022).

Habitat Suitability

Suitable habitat for coast fawn lily is present in the Douglas fir-tanoak forest habitat in the Study Area, especially in the areas surrounding the redwood water storage tank.

Potential for Impacts

Although coast fawn lily is not known to occur in the Study Area there is a potential that it could occur due to the presence of suitable habitat. If this plant species were to occur in the Study Area, project activities would have the potential to result in adverse impacts. Adverse impacts could occur if mechanical equipment or workers directly crushed, trampled, or uprooted sensitive plants and indirect impacts could occur through soil compaction, alteration of hydrology, and increased erosion and sedimentation resulting from ground disturbance.

The recommended mitigation measures for special-status plants in the following section would reduce potential impacts to this species to less than significant.

White-flowered Rein Orchid

Federal status – none
State status – none
Other status – CRPR 1B.2 (rare, threatened, or endangered in California and elsewhere)

Species Description

White-flowered rein orchid is a perennial herb that occurs in broadleaved upland forests, lower montane coniferous forests, and North Coast coniferous forests, sometimes on serpentinite. This species is found in forest duff, on mossy banks, rock outcrops, and muskeg at elevations ranging from 30– 1,310 meters above mean sea level. White-flowered rein orchid blooms between May and September (sometimes March) (CNPS 2022).

Survey History

Focused surveys were not conducted for white-flowered rein orchid; however, the biological reconnaissance survey was conducted during the blooming period for this species and white-flowered rein orchid was not observed in the Study Area. The nearest extant occurrence is 6.5 miles west of the Study Area in Douglas fir forest (CDFW 2022).

Habitat Suitability

Suitable habitat for white-flowered rein orchid is present in the Douglas fir-tanoak forest habitat in the Study Area.

Potential for Impacts

Although white-flowered rein orchid is not known to occur in the Study Area, there is a potential that it could occur due to the presence of suitable habitat. If this plant species were to occur in the Study Area, project activities would have the potential to result in adverse impacts. Adverse impacts could occur if mechanical equipment or workers directly crushed, trampled, or uprooted sensitive plants and indirect impacts could occur through soil compaction, alteration of hydrology, and increased erosion and sedimentation resulting from ground disturbance.

The recommended mitigation measures for special-status plants in the following section would reduce potential impacts to this species to less than significant.

Marble Mountain Campion

Federal status – none
State status – none
Other status – CRPR 1B.2 (rare, threatened, or endangered in California and elsewhere)

Species Description

Marble Mountain campion is a perennial herb found in broadleaf upland forests, chaparral, cismontane woodlands, and lower montane coniferous forests from 170 – 1,250 meters elevation. Marble Mountain campion blooms between June and August (CNPS 2022).

Survey History

Focused surveys were not conducted for Marble Mountain campion; however, the biological reconnaissance survey was conducted during the blooming period for this species and Marble Mountain campion was not observed in the Study Area. The nearest extant occurrence is 6.2 miles east of the Study Area along the Salmon River Trail in an area with Douglas fir and tanoak (CDFW 2022).

Habitat Suitability

Suitable habitat for Marble Mountain campion is present in the Douglas fir-tanoak forest habitat in the Study Area.

Potential for Impacts

Although Marble Mountain campion is not known to occur in the Study Area there is a potential that it could occur due to the presence of suitable habitat. If this plant species were to occur in the Study Area, project activities would have the potential to result in adverse impacts. Adverse impacts could occur if mechanical equipment or workers directly crushed, trampled, or uprooted sensitive plants and indirect impacts could occur through soil compaction, alteration of hydrology, and increased erosion and sedimentation resulting from ground disturbance.

The recommended mitigation measures for special-status plants in the following section would reduce potential impacts to this species to less than significant.

Special-Status Wildlife Species

A total of 26 regionally occurring special-status wildlife species were identified during the database searches and desktop review. The Study Area does not provide habitat for the majority of the regionally-occurring special-status wildlife species, which are associated with aquatic habitats such as lakes, ponds, rivers, vernal pools, and freshwater wetlands which do not occur within the Study Area. The majority of the remaining species are associated with tree groves, old-growth forest, woodlands, riparian, beach, and cliff habitat, or have specific food species or elevation requirements that were not found in the Study Area.

The site provides suitable habitat for three special-status wildlife species: bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), and northern spotted owl (*Strix occidentalis caurina*), as well as habitat for other migratory birds and raptors. These species are discussed briefly below. In addition, although there is no suitable habitat within the Study Area for marbled murrelet (*Brachyramphus marmoratus*) or Pacific marten (*Martes caurina*). However, these two species are discussed due to the presence of designated Critical Habitat for these species in the Study Area. The remaining special-status species determined to have no potential to occur on the Study Area or that are not expected to occur in the Study Area and be impacted by the proposed project (Attachment D) are not discussed further in this report.

<u>Bald Eagle</u>

Federal status –Delisted
State status – Endangered
Other – CDFW Fully Protected

Species Description

Bald eagle requires large bodies of water with an abundant fish population. This species also feeds on fish, carrion, small mammals, and waterfowl. In California, the nests are usually located within one mile of permanent water. Nests are most often situated in large, old growth, or dominant live trees with open branchwork such as ponderosa pine. The nests are usually placed 16-61 meters (50 to 200 feet) above ground in trees with a commanding view of the area (Zeiner et al. 1990).

Survey History

Bald eagle was not observed in the Study Area during the biological survey. The nearest extant occurrence of bald eagle is 0.6 mile south of the Study Area along the Klamath River (CDFW 2022).

Habitat Suitability

Suitable nesting for bald eagle is present in the Study Area and suitable foraging habitat is present adjacent to the Study Area. The Klamath River, located 0.2 mile south of the Study Area, provides suitable foraging habitat for bald eagle and the species may nest within trees in the Study Area.

Potential for Impacts

If bald eagle were to nest within or adjacent to the site prior to construction, impacts to nesting could occur through noise, vibration, and the presence of construction equipment and personnel. Project activities such as clearing and grubbing, grading or other earthwork, or tree removal during the breeding season (February 1 through August 31) could result in injury or mortality of eggs and chicks directly through nest destruction or indirectly through forced nest abandonment due to noise and other disturbance. This would be a potentially significant impact.

The recommended mitigation measures for nesting migratory birds and raptors in the following section would reduce potential impacts to this species to less than significant.

Osprey

Federal status – none
State status – None
Other – CDFW Watch List

Species Description

Osprey breed in Northern California from the Cascade Ranges southward to Lake Tahoe, and along the coast south to Marin County. They prey primarily on fish but also predate small mammals, birds, reptiles, and invertebrates. Foraging areas include open, clear waters of rivers, lakes, reservoirs, bays, estuaries, and surf zones. Nesting habitat for osprey include large trees, snags, and dead-topped trees in open forest habitats for cover and nesting (Zeiner et al. 1988-1990).

Survey History

Osprey was not observed in the Study Area during the biological survey. The nearest extant occurrence is 2.4 miles southwest of the Study Area along the Klamath River dominated by Douglas fir and tanoak (CDFW 2022).

Habitat Suitability

Suitable nesting habitat for osprey is present in the Study Area and suitable foraging habitat for osprey is present along the Klamath River, located 0.2 mile south of the Study Area. Therefore, the species could potentially nest within the Study Area.

Potential for Impacts

If osprey were to nest within or adjacent to the site prior to construction, impacts to nesting could occur through noise, vibration, and the presence of construction equipment and personnel. Project activities such as clearing and grubbing, grading or other earthwork, or tree removal during the breeding season (February 1 through August 31) could result in injury or mortality of eggs and chicks directly through destruction or indirectly through forced nest abandonment due to noise and other disturbance. This would be a potentially significant impact.

The recommended mitigation measures for nesting migratory birds and raptors in the following section would reduce potential impacts to this species to less than significant.

Northern Spotted Owl

Federal status – Threatened
State status – Threatened
Other – CDFW Watch List

Species Description

Northern spotted owl is found from southwestern British Columbia down through the western half of Washington, Oregon and northern California south at least to Marin County. In California, it occurs in the Klamath Ranges, Cascade Range, and North Coast Ranges. Spotted owls have also been observed in the Santa Cruz Mountains in San Mateo and Santa Cruz counties, but the status of those populations is poorly known, and it is uncertain whether those birds are northern spotted owl or California spotted owl (*Strix occidentalis occidentalis*). Northern spotted owl prefers late-stage and old-growth forests characterized by a dense, multilayered, multi-species canopy with large overstory trees and varied understory. Forest types it has been observed in include Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), grand fir (*Abies grandis*), white fir (*Abies concolor*), ponderosa pine (*Pinus ponderosa*), Shasta red fir (*Abies magnifica* var. *shastensis*), mixed evergreen, mixed conifer hardwood, redwood (*Sequoia sempervirens*), Bishop pine (*Pinus muricata*), and. mixed evergreen deciduous forest. These forests typically are characterized by a high incidence of large trees with various deformities (large cavities, broken tops, mistletoe infections, and other evidence of decadence); large snags; large accumulations of fallen trees and other woody debris on the ground; and sufficient open space below the canopy for spotted owls to fly.

Although it is dependent on old-growth and late-successional forests, there is research that suggests that a mosaic of late-successional forest habitat interspersed with other seral stages may be superior to large, homogeneous expanses of older forest as habitat for the species, at least in areas where woodrats are a major component of the species' diet. Low- to moderate-severity wildfire may enhance habitat for the species by increasing habitat heterogeneity. Diet is variable dependent upon prey availability, but northern flying squirrel (*Glaucomys sabrinus*) (mainly in in Washington and Oregon) and dusky-footed woodrat (*Neotoma fuscipes*) (mainly in the Oregon Klamath Ranges and California) dominate the diet both in terms of biomass and quantity. Spotted owl territories tend to be larger where flying squirrels are the primary prey and smaller where wood rats are the primary prey. Other prey occasionally taken include deer mice, (*Peromyscus* spp.), tree voles (*Arborimus* spp.), red-backed voles (*Myodes* spp.), gophers (Geomyidae), snowshoe hare (*Lepus americanus*), bushy-tailed wood rats (*Neotoma cinerea*), birds, and insects. Prey is generally taken using a sit-and-wait technique from a single perch each night. Spotted owl pairs begin forming in February and are typically maintained until the death of one of the partners. Spotted owl uses existing nests, often of corvids, or platforms created by broken treetops or limbs. A clutch of three to four eggs is laid from late March (occasionally as early as mid-March) to mid-April and incubated by the female for approximately 30 days. Young are brooded by the female for eight to 10 days while the male provides food. The flightless young leave the nest at approximately 35 days after hatching, and receive decreasing parental care at least until September, or until they become independent around November.

Survey History

Northern spotted owl was not observed in the Study Area during the biological survey; however, this species is typically only detected during protocol call surveys. The nearest occurrence of Northern spotted owl is within 0.45 mile of the Study Area with a second occurrence within 0.9 mile. There are six occurrences of northern spotted owl within one mile of the Study Area and 424 occurrences of the species within 5 miles (CDFW 2022). At least five northern spotted owl activity centers are located within approximately 2 miles of the Study Area.

Habitat Suitability

Suitable nesting habitat for northern spotted owl is present adjacent to the Study Area but not within the Study Area boundary. The Klamath River located 0.2 miles south of the Study Area, provides suitable foraging and nesting habitat for northern spotted owl. Given the proximity of the Study area to suitable nesting habitat, the species may forage in the Study Area. The Study Area is surrounded by northern spotted owl Critical Habitat on all sides, although the Study Area itself is not within the Critical Habitat boundaries, it is within 1.1 mile of Critical Habitat at its nearest point.

Potential for Impacts

If northern spotted owl were to nest adjacent to the site prior to construction, impacts to nesting could occur through noise, vibration, and the presence of construction equipment and personnel. Project activities such as clearing and grubbing, grading or other earthwork, or tree removal during the breeding season (February 1 through August 31) could result in forced nest abandonment due to noise and other disturbance to adjacent nesting habitat. This would be a potentially significant impact.

The recommended mitigation measures for nesting migratory birds and raptors in the following section would reduce potential impacts to this species to less than significant.

<u>Marbled Murrelet</u>

Federal status – Threatened
State status – Endangered
Other status – None

Species Description

This species is pelagic, except during its nesting season where it will use old-growth, multi-layered canopied forests up to 50 miles inland from the coast. When nesting trees are not present, this species will nest on the ground or amongst rocks. In California, nesting typically occurs in coastal redwood forest or Douglas fir forests (USFWS 1997).

Survey History

No marbled murrelet or potential nest sites for this species were observed in the Study Area during the biological reconnaissance survey. The nearest reported occurrence of marbled murrelet in the CNDDB is approximately 22.4 miles southwest of the site along Redwood Creek within Redwood National Park.

Habitat Suitability

The Douglas fir-tanoak forest in the Study Area does not provide suitable nesting habitat for marbled murrelet. The Study Area lacks dense, mature, multi-layer old growth forest and is disturbed. The eastern portion of the Study Area, along Placer Drive, overlaps designated Critical Habitat for this species; however, the site lacks the primary constituent elements of critical habitat including old growth trees with the presence of deformities and/or large branches to use as a nesting platform. This portion of the Study Area associated with the designated Critical Habitat consists of developed habitat.

Potential for Impacts

No impacts to marbled murrelet or suitable habitat for this species are anticipated as a result of the proposed project. Suitable nesting habitat is not present in or adjacent to the Study Area. Pre-construction surveys will be conducted for migratory birds and raptors. If marbled murrelet is observed, coordination will be conducted with USFWS and CDFW to determine the appropriate nest buffer based on the location of the nest and the type of construction activity occurring within proximity to the nest.

The recommended mitigation measures for migratory birds and raptors in the following section would reduce potential impacts to this species to less than significant.

<u>Pacific Marten</u>

Federal status – Threatened
State status – Endangered
Other status – CDFW Species of Special Concern

Species Description

Pacific marten are found in coniferous and mixed conifer forests with more than 40% canopy closure typically from 1,350 – 3,200 m above mean sea level (amsl) and require old growth forests that consist primarily of fir and lodgepole pines with cavities for nesting and denning (Zielinski 2014). The species will also den under logs in the snow and form snow tunnels. Pacific marten are active year round, and typically avoid open areas with no canopy cover, but will forage in meadows, riparian areas and along streams (Zielinski 2014). When traveling, marten typically move along ridgetops and are capable of traveling up to 15 miles in a single night while foraging (Zeiner et al. 1990).

Survey History

No Pacific marten or potential den sites for this species were observed in the Study Area during the biological reconnaissance survey. The nearest reported occurrence of Pacific marten is approximately 1.4 miles north of the Study Area from 1972 from the vicinity of Slide Gulch (CDFW 2022).

Habitat Suitability

The Douglas fir - tanoak forest in the Study Area does not provide suitable denning habitat for Pacific marten. The Study Area lacks dense, mature, multi-layer old growth forest and is disturbed. The very northwestern portion of the Study Area, encompassing much of the proposed water treatment and storage features of the project, overlaps designated Critical Habitat for this species; however, the site lacks the primary constituent elements of critical habitat including old growth trees with the presence of cavities to use as a den site.

Potential for Impacts

No impacts to Pacific marten or suitable habitat for this species are anticipated as a result of the proposed project. Suitable denning habitat is not present in or adjacent to the Study Area. No direct impacts to Pacific marten or potential habitat in the Study Area would be anticipated as a result of the proposed project as Pacific marten would not be expected to be present within the project footprint and there is no suitable habitat for this species in the project footprint.

Migratory Birds and Raptors

As noted in Attachment B, migratory and non-game birds are protected during the nesting season by the federal Migratory Bird Treaty Act (MBTA) and California Fish and Game Codes. The Study Area and immediate vicinity provides nesting and foraging habitat for a variety of native birds common to urbanized areas, such as mourning dove (*Zenaida macroura*), house finch (*Haemorhous mexicanus*), and California towhee (*Melozone crissalis*). Nests were not observed during surveys; however, a variety of migratory birds have the potential to nest in and adjacent to the site, in trees, shrubs and on the ground in vegetation.

Project activities such as clearing and grubbing during the avian breeding season (February 1 through August 31) could result in injury or mortality of eggs and chicks directly through destruction or indirectly through forced nest abandonment due to noise and other disturbance. Destruction of active nests, eggs, and/or chicks would be a violation of the MBTA and Fish and Game Codes and a significant impact.

The recommended mitigation measures for nesting migratory birds and raptors in the following section would reduce potential impacts for nesting birds to less than significant

Sensitive Natural Communities

Natural communities are defined by one or more characteristic plant species, and the species communities in the majority of the Study Area are not considered characteristic of a sensitive natural community. Due to the disturbed nature of the Study Area and vicinity, there are no terrestrial sensitive natural communities in the Study Area.

Aquatic Resources

The ponds and ditch are the only aquatic resources in the Study Area, they are remnants of historic hydraulic mining in the area and are likely not hydrologically connected to other aquatic resources in the area. The project has been designed to avoid direct impacts to aquatic resources. The ponds and ditch will not be developed as part of the proposed project and there will be no direct impacts to aquatic resources (i.e., no placement of temporary or permanent fill within aquatic resources).

RECOMMENDED MITIGATION MEASURES

Special-Status Species

Special-Status Plants

Prior to any construction-related ground disturbance occurring in areas of suitable habitat for special-status plants, focused surveys shall be completed to determine the presence or absence of these species on the Study Area. The surveys shall be floristic in nature and shall be seasonally timed to coincide with the blooming period of these species (March to July; coast fawn lily), (May to September; white-flowered rein orchid) and (June and August; Marble Mountain campion). If special-status species are not found during the focused surveys, then no further action is required.

- If special-status plants are documented on the site, a report shall be submitted to CNDDB to document the status of the species on the site. If the project is designed to avoid impacts to special-status plant individuals and habitat, no further mitigation for these species would be necessary.

- If special-status plants are documented on the site and project impacts to these species are anticipated, consultation with CDFW shall be conducted to develop a mitigation strategy. The proponent shall notify CDFW, providing a complete description of the location, size, and condition of the occurrence, and the extent of proposed direct and indirect impacts to it. The project proponent shall comply with any mitigation requirements imposed by CDFW. Mitigation requirements could include but are not limited to, development of a plan to relocate the special-status plants (seed) to a suitable location outside of the impact area and monitoring the relocated population to demonstrate transplant success or preservation of this species or its habitat at an on or off-site location.

Bald Eagle, Osprey, Northern Spotted Owl, Other Raptors, and Migratory Birds

The Study Area and adjacent areas provide suitable nesting habitat for a variety of native birds including bald eagle, osprey, northern spotted owl, native songbirds, and other raptors. Removal of vegetation containing active nests would potentially result in destruction of eggs and/or chicks; noise, dust, and other anthropogenic stressors in the vicinity of an active nest could lead to forced nest abandonment and mortality of eggs and/or chicks. Needless destruction of eggs or chicks would be a violation of the MBTA and Fish and Game Codes. Pre-construction surveys should be conducted prior to project implementation during the typical nesting season to determine if nesting birds are present on or adjacent to the site, so that measures could be implemented if needed to avoid harming nesting birds.

The following mitigation is recommended to reduce potential project impacts to nesting birds:

- If ground disturbance including vegetation clearing and grubbing activities commence during the avian breeding season (February 1 through August 31), a qualified biologist should conduct a pre-construction nesting bird survey no more than 14 days prior to initiation of project activities and again immediately prior to construction. The survey area should include suitable raptor nesting habitat within 500 feet of the project boundary (inaccessible areas outside of the survey area can be surveyed from the site or from public roads using binoculars or spotting scopes). Pre-construction surveys are not required in areas where project activities have been continuous since prior to February 1, as determined by a qualified biologist. Areas that have been inactive for more than 14 days during the avian breeding season should be re-surveyed prior to resumption of project activities. If no active nests are identified, no further mitigation is required. If active nests are identified, the following measure should be implemented:
    - A suitable nest buffer depending on species and surrounding land uses should be established by a qualified biologist around active nests and no construction activities within the buffer should be allowed until a qualified biologist has determined that the nest is no longer active (i.e., the nestlings have fledged and are no longer reliant on the nest, or the nest has failed). Encroachment into the buffer may occur at the discretion of a qualified biologist. Any encroachment into the buffer should be monitored by a qualified biologist to determine whether nesting birds are being impacted.

Aquatic Resources

The ponds and ditch are the only aquatic resources in the Study Area and will not be developed as part of the proposed project. There will be no direct impacts to aquatic resources.

SUMMARY/CONCLUSIONS

Study Area Conditions

The Study Area is located along Placer Drive in the community of Orleans, off Highway 96 within an unincorporated area of Humboldt County. The Study Area is in a disturbed condition and supports no sensitive terrestrial biological resources. Biological communities in the Study Area consist of developed, ruderal/disturbed, ponds, and Douglas fir-tanoak forest.

Special-Status Species

The Study Area provides suitable habitat for three regionally-occurring special-status plant species: coast fawn lily, white-flowered rein orchid, and Marble Mountain campion. The Study Area provides suitable habitat for two regionally-occurring special-status animal species: bald eagle and osprey. Implementation of the recommended mitigation measures would reduce the potential for project impacts to these species to less than significant. The Study Area does not provide suitable habitat for any other regionally-occurring special-status plant or animal species.

Migratory Birds and Raptors

There is the potential for common native birds to nest in the Study Area or on adjacent properties where project activities could result in stress leading to nest failure. Implementation of the recommended mitigation measure for nesting bird surveys would reduce the potential for project impacts to nesting birds to less than significant.

Aquatic Resources

The ponds and ditch are the only aquatic resources in the Study Area and will not be developed as part of the proposed project. There will be no direct impacts to aquatic resources.

I appreciate the opportunity to assist you on this project. Feel free to contact me with any questions at (916) 365-8700.

Sincerely,

Stephanie McLaughlin, M.S.
Biologist

Attachments:

Attachment A: Figures
Attachment B: Regulatory Context
Attachment C: Database Query Results
Attachment D: Potential for Special-status Species to Occur in the Study Area
Attachment E: Plant and Wildlife Species Observed in the Study Area
Attachment F: Site Photos

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Appendix D

Preliminary Geotechnical Report

Draft Geotechnical Report

Orleans Water Treatment Plant
Orleans Community Services District
Orleans Area, Humboldt County, California

Submitted To:

Mr. Joe Riess, P.E.
WATER WORKS ENGINEERS
760 Cypress Avenue, Suite 201
Redding, California 96001

WATERWORKS ENGINEERS

Prepared by:
Bajada Geosciences, Inc.

September 2, 2022
Project No. 2201.0119

Bajada Geosciences, Inc.

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PLATES

APPENDICES

1 GENERAL

Bajada Geosciences, Inc. (BAJADA) is pleased to present this geotechnical report for the Orleans Community Services District (CSD) water treatment plant (WTP) improvements located in Humboldt County, California. BAJADA has prepared this report at the request of Water Works Engineers, LLC (WWE). The project location is shown on Plate 1 – Site Location Map. The following sections present our understanding of the project, the purpose of our study, and the geotechnical findings, conclusions, and recommendations for the project. Our services were performed in general accordance with our proposal dated January 13, 2021.

1.1 PROJECT UNDERSTANDING & LOCATION

We understand that the CSD is proposing to improve the existing WTP servicing a portion of the Orleans community. Those improvements consist of:

- The replacement of the existing water treatment building and facilities with a new structure and equipment;
- The replacement of an existing 30,000-gallon redwood tank with a new 130,000-gallon bolted steel storage tank. We understand that the tank dimensions will be about 34 feet in diameter and 25 feet tall; and
- Construction of new pipelines connecting the new WTP, tank, and existing distribution system.

The project is located on Assessor's Parcel Number 529-141-037. Latitude and longitude for the approximate center of the existing water treatment plant building are as follows:

- Latitude: 41° 17' 55.4" (41.298717°)
- Longitude: -123° 33' 44.1" (-123.562247°)

1.2 STUDY PURPOSE

The purpose of our geotechnical study was to explore and evaluate selected site surface and subsurface conditions to provide geotechnical engineering recommendations related to the design and construction of the proposed improvements, and to identify potential geologic hazards that could impact the project. Those tasks had the following purposes:

- To characterize geologic hazards that pose an adverse effect on the performance of the proposed improvements;
- To estimate settlement and allowable bearing values for proposed subgrade soils for use in designing the proposed structure foundations and slabs;
- To evaluate stability of the tank and slope located south and west of the proposed tank;

- To evaluate stability of the WTP and slope located to the east; and
- To develop geotechnical recommendations for the design and construction of the proposed project.

1.3 SCOPE OF SERVICES

Services performed for this study are in general conformance with the proposed scope of services presented in our January 13, 2021, proposal. Our scope of services included:

- Reconnaissance of the site surface conditions;
- Advancement of five exploratory test pits at selected locations shown on Plate 2 – Geotechnical Map. Exploration procedures and Logs of Test Pits are presented in Appendix A – Subsurface Exploration;
- Performance of laboratory testing on selected samples obtained during our field investigation. Laboratory test procedures and results of those tests are presented in Appendix B – Laboratory Testing;
- Performance of slope stability analyses to estimate static and pseudostatic stability of the proposed project. Methods used, and results of the stability evaluations are presented in Appendix C – Slope Stability Evaluations;
- Estimation of settlements for the proposed structures;
- Preparation of this report, which includes:
    - A description of the proposed project;
    - A summary of our field exploration and laboratory testing programs;
    - A description of site surface and subsurface conditions encountered during our field investigation;
    - 2019 California Building Code (CBC) and site-specific seismic design criteria;
    - A geotechnical map and three cross sections showing site geotechnical conditions, presented as Plate 2 and Plates 4.1 – 4.3, respectively;
    - Geotechnical recommendations for:
        - Site preparation, engineered fill, site drainage, and subgrades;
        - Suitability of on-site materials for use as engineered fill;
        - Construction of proposed slopes at the project site;
        - Foundation and slab-on-grade design;
        - Temporary excavations, shoring, and trench backfill;
        - Trench backfill and compaction recommendations; and
        - Lateral earth pressures for retaining wall design and construction.
    - Appendices that present a summary of our field investigation procedures and laboratory testing programs; and

- An appendix with slope stability analyses.

1.4 PREVIOUS WORK PERFORMED & REFERENCES REVIEWED

We know of no previous geotechnical studies that have been performed on the project site.

BAJADA reviewed historical aerial photographs of the project region to observe potential geomorphic indicators present on those aerial photographs that would assist us in our evaluation of past site uses (if any) and geologic hazards that might adversely affect the performance of the proposed improvements. Aerial photographs were reviewed from 1947, 1973, 1983, 1993, 2005, 2009, 2010, 2012, 2016, and 2018. In addition, topographic maps from 1954, 1961, 1968, 1979, 1991, 2001, 2012, 2015, and 2018 were reviewed as part of our study.

Additional documents were referred to during this study and are referenced in the text and cited in Section 10.0 of this report.

1.5 RELEVANT SITE HISTORY

The topography of the project area has been altered by historic placer mining of older alluvial deposits. Those materials were mined from where the existing and proposed WTPs are located and south of where the proposed tank is located.

In addition, the site was previous developed with the existing WTP and tank, and underground pipelines. Prior to construction of the existing tank, we understand that an older tank was present upslope and east of the existing tank. The concrete slab for the older tank was encountered in TP-3 during our subsurface exploration as shown on Plate 4.3 – Section C–C'.

2 FINDINGS

2.1 FIELD INVESTIGATION

BAJADA conducted investigations to evaluate selected subsurface soil and rock conditions at test pit locations and to obtain samples for laboratory testing. Our field investigation consisted of subsurface exploration through advancement of exploratory test pits. The test pits were excavated on May 19, 2022. The exploration locations are shown on Plate 2. During our exploration, an archeologist and a member of the Karuk Tribe were on hand to observe materials exposed in the test pits. Descriptions of soils and rocks encountered are presented on the test pit logs included in Appendix A.

Geologic mapping was performed during our field studies. Results of the mapping are presented on Plate 2.

2.2 SITE CONDITIONS

2.2.1 Surface Conditions

The proposed WTP is located on a relative flat to slightly undulatory area that has previously been graded during historical placer mining. An incised drainage is located east of the proposed WTP site. The proposed WTP site is located southwest of the existing WTP. The site is covered with seasonal grasses, shrubs, and local trees. Elevations at the proposed WTP and tank range from about 560 to 640 feet. Drainage occurs as sheetflow into the adjacent drainage, which discharges into the Klamath River.

The proposed tank site is located mid-slope on a ridge that descends to the west and south of the proposed site. The existing redwood tank is present west of where the proposed tank is to be situated. An unpaved access road ascends from the area where the proposed WTP is to be located. The area is covered by shrubs and surrounded by mature trees. The slope located south of the proposed tank is about 40 feet tall and inclined at about a 1:1 (horizontal to vertical) angle. The slope located west of the proposed tank is about 55 feet tall and inclined at about a 1.1:1 angle. Drainage at the site occurs as sheetflow west into Crawford Creek, which discharges into the Klamath River.

2.2.2 Subsurface Conditions

Subsurface conditions were explored at selected locations at the site during this study, as shown on Plate 2. As noted in Section 2.1, five exploratory test pits were advanced for this study.

Metamorphic rock consisting of phyllite was encountered beneath the proposed WTP. The phyllite is anticipated to be present in the lower terrace area surrounding the proposed WTP, as shown on Plate 2. It consisted of dry, moderately to slightly weathered, weak, poorly indurated, slightly to moderately fractured rock with a platy, fissile texture.

Artificial fill and older alluvium were encountered beneath the proposed tank site. These materials predominantly consist of sandy gravel with cobbles and boulders. The materials were moist to wet, dense to very dense, slightly cemented, fine to coarse grained, with abundant fine to coarse subrounded to rounded gravels and cobbles, and boulders up to at least 18 inches in largest dimension. In addition, an approximately 15- to 16-inch-thick concrete slab was encountered within the artificial fill materials underlying the proposed tank site, as shown on TP-3 and on Plate 4.3 – Section C–C'.

2.3 GEOLOGIC CONDITIONS

2.3.1 Regional Geology

The project site is located in the Klamath Mountains geomorphic/geologic province of California (Irwin, 1966). The Klamath Mountains province extends from the northern end of the California Coast Ranges north into Oregon. It is bounded to the east by the Cascade Range province, to the south by the Coast Ranges and Great Valley provinces, to the west by the Pacific Ocean, and to the north by the Coast Ranges of Oregon.

The Klamath Mountains province is predominately composed of pre-Paleozoic and Paleozoic sedimentary, volcanic, intrusive, and metamorphic rocks that have been locally intruded by Mesozoic-age rocks (Hinds, 1952). Rock materials within this province have been accreted during tectonic processes into differing terrains or differing ages. Five terrains of subjacent rock materials have been identified within the Klamath Mountains province: Western Jurassic belt, Western Paleozoic and Triassic belt, Central Metamorphic belt, Eastern Klamath belt, and Granitic rocks (Irwin, 1966). The project site is located within the Western Jurassic belt.

2.3.2 Local Geologic Setting

The proposed tank site is situated on artificial fill and older alluvium consisting of terrace deposits, as shown on Plate 2 – Geotechnical Map. Those terrace deposits are not shown underlying the proposed tank site on Plate 3 – Regional Geologic Map; however, they were encountered in our explorations and observed on site. The terrace deposits were observed to dip at about 6 to 10 degrees to the southeast. Cross sections through the proposed tank site and underlying slope are shown on Plate 4.1 – Section A-A' and Plate 4.3 – Section C-C'.

The proposed WTP site is underlain by phyllite of the Galice Formation, as shown on Plate 2 and Plate 3. Those rock materials were likely exposed during placer mining of overlying older alluvium consisting of terrace deposits. The observed rock materials have a foliation orientation of about 30 to 66 degrees east of north with dips ranging from about 6 to 54 degrees to the south, as shown on Plate 2. A cross section through the proposed WTP is shown on Plate 4.2 – Section B-B'.

2.3.3 Groundwater

Groundwater was not encountered within test pits advanced for this study. A search of regional groundwater data (DWR, 2022) did not identify any wells within 2,000 feet of the project site. In addition, a search of the Geotracker database (Geotracker, 2022) did not indicate the presence of subsurface exploration or data close to the project site. Springs have not been mapped on U.S. Geologic topographic maps in the project region. It is our opinion that groundwater will be at depths below anticipated construction depths for this project.

Groundwater elevations at project improvement locations will fluctuate over time. The depth to groundwater can vary throughout the year and from year to year. Intense and long duration precipitation or drought, modification of topography, and cultural land use changes can contribute to fluctuations in groundwater levels. Localized saturated conditions or perched groundwater conditions near the ground surface could be present during and following periods of heavy precipitation or if on-site sources contribute water. If groundwater is encountered during construction, it is the Contractor's responsibility to install mitigation measures for adverse impacts caused by groundwater encountered in excavations.

3 GEOLOGICAL HAZARDS

3.1 *FAULTING & SEISMICITY*

3.1.1 Regulatory Seismic Setting

The State of California designates faults as Holocene-age or Pre-Holocene-age depending on the recency of movement that can be substantiated for a fault. Fault activity is rated as follows:

FAULT ACTIVITY RATINGS		
Fault Activity Rating	**Geologic Period of Last Rupture**	**Time Interval (Years)**
Holocene-Active	Holocene	Within last 11,000 Years[1]
Pre-Holocene	Quaternary & Older	>11,000 Years[1]
Age Undetermined	Unknown	Unknown

[1] – Holocene is defined as 11,700 years before present by the International Commission on Stratigraphy. The California State Mining and Geology Board, which administers the review and application of the Alquist-Priolo Earthquake Fault Zoning Act, currently recognizes the Holocene as 11,000 years before present.

The California Geologic Survey (CGS) evaluates the activity rating of a fault in fault evaluation reports (FER). FERs compile available geologic and seismologic data and evaluate if a fault should be zoned as Holocene-active, pre-Holocene, or age undetermined. If an FER evaluates a fault as Holocene-active, then it is typically incorporated into a Special Studies Zone in accordance with the Alquist-Priolo Earthquake Fault Zoning Act (AP). AP Special Studies Zones require site-specific evaluation of fault location for structures for human occupancy and require a habitable structure setback if the fault is found traversing a project site.

No known faults have been mapped projecting through the project site, as shown on Plate 5 – Regional Fault Map. The closest Holocene-active fault to the site is the Trinidad fault, located about 32 miles southwest of the project.

3.1.2 CBC Seismic Design Recommendations

We understand that the proposed tank will be designed and constructed under the 2019 California Building Code (CBC) criteria. At a minimum, structures should be designed in accordance with the following seismic design criteria:

CBC SEISMIC DESIGN PARAMETERS

California Building Code	Parameter	CBC Designation
Site Coordinates	Latitude	41.298717°
	Longitude	-123.562247°
Section 1613.5.3 Table 1613.5.3(1)	Site Coefficient, F_a	1.2
Section 1613.5.3 Table 1613.5.3(2)	Site Coefficient, F_v	1.4
Section 1613.5.1 Figure 1613.5	Site Class Designation	C
	Seismic Factor, Site Class C at 0.2 Seconds, S_s	1.345g
	Seismic Factor, Site Class C at 1.0 Seconds, S_1	0.652g
Section 1613.5.3	Site Specific Response Parameter for Site Class C at 0.2 Seconds, S_{MS}	1.614g
	Site Specific Response Parameter for Site Class C at 1.0 Seconds, S_{M1}	0.913g
Section 1613.5.4	$S_{DS}=2/3S_{MS}$	1.076g
	$S_{D1}=2/3S_{M1}$	0.609g

Per the 2019 CBC

3.1.3 Probabilistic Estimates of Strong Ground Motion

Probabilistic evaluations of horizontal strong ground motion that could affect the site were performed using attenuation evaluation methods provided by the U.S. Geological Survey (USGS, 2021c). The evaluations were performed using an estimated shear wave velocity in the upper 100 feet of the profile of 537 meters per second. Evaluations were performed for upper-bound (UBE) and design-basis (DBE) probabilistic exposures, and maximum considered earthquake (MCEg). The UBE corresponds to horizontal ground accelerations having a 10 percent probability of exceedance in a 100-year exposure period, with a statistical return period of 949 years. The DBE corresponds to horizontal ground accelerations having a 10 percent probability of exceedance in a 50-year exposure period, with a statistical return period of 475 years. The MCEg corresponds to horizontal ground accelerations having a 2 percent probability of exceedance in a 50-year exposure period, with a statistical return period of 2,475 years. The results of these evaluations are presented in the following table:

PROBABILISTIC GROUND MOTION DATA				
Earthquake Level	**Probabilistic Estimate Exposure Period (years)**	**Probability of Exceedance (%)**	**Return Period (years)**	**Estimated Peak Horizontal Ground Acceleration (g)**
Maximum Considered Earthquake, geometric mean (MCEg)	50	2	2,475	0.51
Upper-Bound Ground-Motion	100	10	949	0.31
Design-Basis Ground-Motion	50	10	475	0.21

It should be noted that although the seismic hazard models used for this study predict the probability of exceedance for various levels of acceleration during a given exposure period, the models are not able to account for the effect that the passage of time since past earthquakes has on future earthquake probability. Thus, while time may affect the incipient risk of earthquakes occurring, the UBE, DBE, MCEg values are based on any 100-year and 50-year exposure period, respectively, regardless of how recently earthquakes have occurred.

3.2 LANDSLIDES

The proposed WTP project site is relatively flat but located adjacent to an incised drainage. No landslides, older, active, or incipient were observed in the vicinity of the proposed site. It is our opinion that natural landslides pose a low risk to the proposed WTP site.

The proposed tank is located in mountainous terrain with descending slopes to the west and south and ascending slopes to the north and east. No landslides, older, active, or incipient were observed in the vicinity of the proposed site. To evaluate the risks of slope instabilities, we performed slope stability analyses, which are discussed in Section 5 of this report.

3.3 LIQUEFACTION AND LATERAL SPREADING

Liquefaction is described as the sudden loss of soil shear strength due to a rapid increase of soil pore water pressures caused by cyclic loading from a seismic event. In simple terms, it means that a liquefied soil acts more like a fluid than a solid when shaken during an earthquake. For liquefaction to occur, the following are needed:

- Granular soils (sand, silty sand, sandy silt, and some gravels);
- A high groundwater table; and
- A low density in the granular soils underlying the site.

If those criteria are present, then there is a potential that the soils could liquefy during a seismic event.

The adverse effects of liquefaction include local and regional ground settlement, ground cracking and expulsion of water and sand, the partial or complete loss of bearing and confining forces used to support loads, amplification of seismic shaking, and lateral spreading. In general, the effects of liquefaction on the proposed project could include:

- Lateral spreading;
- Vertical settlement; and/or
- The soils surrounding lifelines can lose their strength and those lifelines can become damaged or severed.

Lateral spreading is defined as lateral earth movement of liquefied soils, or soil riding on a liquefied soil layer, down slope toward an unsupported slope face, such as a creek bank, or an inclined slope face. In general, lateral spreading has been observed on low to moderate gradient slopes, but has been noted on slopes inclined as flat as one degree.

Dense to very dense sediments and cemented rock underlie the site. In addition, groundwater is not anticipated to be present within the upper 50 feet of the soil/rock column. Based on those two conditions, it is our opinion that the potential for liquefaction to adversely impact the site is very low.

3.4 EXPANSION POTENTIAL

There is a direct relationship between plasticity of a soil and the potential for expansive behavior, with expansive soil generally having a high plasticity. Thus, granular soils typically have a low potential to be expansive, whereas, clay-rich soils can have a low to high potential to be expansive.

Atterberg limit testing was performed on two selected samples during this study to estimate the plasticity of foundation soils. The results of that testing found that on-site soils have PIs ranging from nonplastic to 4. PIs of less than 10 are correlated to soils having a very low potential for expansion (Day, 1999), as noted in the following table:

EXPANSION POTENTIAL – PLASTICITY INDEX CORRELATION	
Plasticity Index	Correlated Expansion Potential
0 – 10	Very Low
10 – 15	Low
15 – 25	Medium
25 – 35	High
35+	Very High
Taken from Day (1999)	

Based on the Plasticity Index data obtained during this study, it is our opinion that the existing site soils have a very low expansion potential.

3.5 SOIL CHEMISTRY

Three samples of near-surface soils were subjected to chemical analysis for assessment of corrosion and reactivity with concrete. The samples were tested for soluble sulfates and chlorides. Testing was conducted by Sunland Analytical of Rancho Cordova and results are presented below.

SOIL CHEMISTRY RESULTS					
Sample Location	Sample Depth	Sulfates (ppm)	Chlorides (ppm)	pH	Resistivity (ohms-cm)
TP-1	1' – 5'	478	4.3	5.81	1,050
TP-3	1' – 5'	1.9	5.2	4.68	7,500
TP-5	1' – 3'	5.0	1.8	5.43	16,080

According to the ACI-318, a sulfate concentration below 0.10 percent by weight (1,000 ppm) is considered negligible. A chloride content of less than 500 ppm is generally considered non-corrosive to reinforced concrete.

Minimum resistivity testing was performed on soil samples from TP-1, -3, and -5, as noted above. A commonly accepted correlation between soil resistivity and corrosivity towards ferrous metals (NACE Corrosion Basics, 1984) is provided below:

RESISTIVITY & CORROSION CORRELATION	
Minimum Resistivity (ohm-cm)	Corrosion Potential
0 to 1000	Severely Corrosive
1,000 to 2,000	Corrosive
2,000 to 10,000	Moderately Corrosive
Over 10,000	Mildly Corrosive

Thus, according to the table above, the soils at TP-1, where the proposed WTP will be sited, are estimated to be corrosive to severely corrosive to ferrous metals. Resistivities at TP-3 and TP-5, where the proposed tank and pipelines are located, are estimated to be mildly to moderately corrosive. We recommend that a corrosion expert be consulted for design of corrosion protection measures for the proposed improvements at this site.

4 ENGINEERING PROPERTIES OF SELECTED ON-SITE SOILS

4.1 GENERAL

The purpose of the laboratory testing program was to help classify soil and rock materials and provide relevant physical indices and engineering properties of the subsurface materials. The primary objectives of the program were to:

- Classify and characterize selected sampled subsurface materials;
- Evaluate existing selected in-situ conditions; and
- Develop relevant consolidation and strength estimates of selected subsurface materials.

To meet these objectives, various tests were performed on selected samples. Test types are generally grouped into the following categories: classification/index tests, moisture content/density evaluations, consolidation tests, permeability tests, relevant strength tests, and subgrade characterization tests.

The numbers of the various tests performed for the project are noted below:

SUMMARY OF LABORATORY TESTS PERFORMED		
Laboratory Test	**Number of Tests**	**Standard Designation[1]**
Moisture Content	2	ASTM D2216
Sieve Analysis with #200 Wash	2	ASTM D422
Atterberg Limits	2	ASTM D4318
Direct Shear	2	ASTM D3080
Unconfined Compression	1	ASTM D7012
Modified Proctor	2	ASTM D1557
Soil Chemistry	3	ASTM G51 & G57 Caltrans 417 & 422
[1] – ASTM International (2007)		

Results of those tests are presented in Appendix B.

4.2 LABORATORY TEST RESULTS

4.2.1 In-Situ Moisture Content

Two in-situ moisture values were obtained from this study and are presented in Appendix B – Laboratory Testing. Moisture content values obtained during this study were 8.9 and 9.6 percent.

4.2.2 Grain-Size Distribution

Grain-size distributions were performed on two samples during this study. The samples tested had 9.8 and 16 percent of the soil fraction passing the No. 200 sieve. Test results are presented in Appendix B – Laboratory Testing.

4.2.3 Plasticity

Two samples were tested to evaluate Plasticity Index (PI) during this study. One sample was found to be nonplastic; thus, a PI and liquid limit were not applicable. The other sample had a liquid limit of 30 and a PI of 4. Test results are presented in Appendix B – Laboratory Testing.

4.2.4 Maximum Dry Density/Optimum Moisture Content

Two maximum dry density/optimum moisture content tests were performed on samples obtained during this study in general accordance with ASTM D1557. The maximum dry densities obtained from these tests were 133.4 and 143.3. Optimum moisture contents of 8.4 and 6.3 percent were obtained from these tests, respectively. Test results are presented in Appendix B – Laboratory Testing.

4.2.5 Direct Shear Tests

The shear strength characteristics of selected soils were estimated by performing a 3-point direct shear test on two near-surface remolded samples, in general accordance with ASTM test method D3080. The results of that test yielded cohesions (C) of 475 and 593 pounds per square foot (psf) and angles of internal friction (Ø) of 39.9 and 40.3 degrees, respectively. Test results are presented in Appendix B – Laboratory Testing.

4.2.6 Unconfined Compression Test

One unconfined compression test was performed on a selected rock sample, in general accordance with ASTM test method D7012 . The tested sample was obtained by coring a specimen from a boulder of phyllite obtained from Test Pit TP-1. The test found that the sample had an unconfined compression strength of 2,710 pounds per square inch. The results of that test are included in Appendix B – Laboratory Testing.

4.2.7 Soil Chemistry

The results of soil chemistry testing for the purpose of evaluating corrosion potential to buried concrete and ferrous metal were presented and discussed in Section 3.5 above.

5 SLOPE STABILITY

5.1 GENERAL

The following section discusses slope stability evaluations performed for this project. Results of the stability analyses are included in Appendix C – Slope Stability Analyses. Engineering data for materials properties used within the stability analyses are discussed in Section 4 – Laboratory Test Results and Section 5.5 – Engineering Properties Used in Stability Analyses. The pseudostatic acceleration used in the analyses was estimated in accordance with Blake et al. (2002) and CGS (2008), as discussed below.

5.2 DISCUSSION REGARDING FACTORS OF SAFETY

Evaluation of slope stability generally takes into consideration several soil and rock strength parameters, geologic conditions within the slope, hydrogeologic conditions, and surcharge and seismic loads that could affect the slope. Those parameters are typically modeled using limit-equilibrium methods (and less commonly using finite-element or finite-difference modeling) to estimate a slope inclination that meets or exceeds a target minimum factor of safety (FOS) against failure. The FOS is estimated by calculating the forces resisting slope failure divided by the forces causing slope failure. Thus, an FOS of greater than 1 implies a stable slope, an FOS of less than 1 a slope that is failing, and an FOS of 1, a slope that is creeping and/or on the verge of failure.

Conventional engineered cut or fill slopes typically utilize minimum FOS thresholds of 1.5 and 1.1 for static and pseudostatic (pseudo-earthquake forces) evaluations, respectively, of slope stability for acceptable maximum slope inclinations (Blake et al., 2002, CGS, 2008). In addition, temporary slopes, which in this study are defined as slopes exposed (i.e., unprotected) for less than a year and not during winter, typically utilize a minimum static FOS of 1.2. These FOS thresholds have been incorporated into this study.

5.3 SURFACE SLOPE GEOMETRY

Surface topography used in our slope stability analyses is based upon topographic information prepared by Trinity Valley Consulting Engineers (2022) and by LiDAR data that WWE used to estimate topography data. That topography is shown on Plate 2.

5.4 SUBSURFACE PROFILE

Subsurface geological conditions for our slope model were estimated through subsurface exploration and field mapping at the site. Cross sections were prepared for the tank and WTP sites and presented as Plates 4.1 and 4.2, respectively. Locations of those cross sections are presented on Plate 2.

5.5 ENGINEERING PROPERTIES USED IN STABILITY ANALYSES

Laboratory-derived soil shear strengths for the older alluvium/terrace deposits resulted in a cohesion intercept (C) range of 475 to 593 psf and an angle of internal friction (Ø) range of 39.9 to 40.3 degrees. For our stability analyses, we assigned a strength value having a C of 500 psf and a Ø of 40 degrees for the older alluvium/terrace deposit soils.

Shear strength of the Galice Formation rock was estimated from laboratory unconfined compression tests (UCS) obtained from a rock sample taken from the test pits. The UCS test result was 2,710 psi. The rock mass strength parameter was derived using the Hoek-Brown failure criterion (Marinos et al., 2005; Marinos et al., 2000). The overall strength of a rock mass is difficult to estimate because of scale issues. Methods of estimating rock mass strength based on the strength of intact rock materials and the lithology, rock mass quality and other factors are used to downgrade the measured intact rock strength to rock mass scale values

The Geological Strength Index (GSI) is based on the Rock Mass Rating (RMR) system and was introduced by Hoek et al. (1995) to overcome issues with the RMR values for very poor-quality rock masses. For better quality rock masses (GSI>25), the value of GSI can be estimated from Bieniawski's RMR (1989) as GSI=RMR-5. This assumes a groundwater rating set to 15 (dry) and the adjustment for joint orientation set to 0 (very favorable). For this study, the GSI for the Galice Formation phyllite was estimated to be 60.

The following table presents a summary of the rock mass strength parameters for the phyllite at the site.

SUMMARY OF ROCK MASS STRENGTH PARAMETERS			
Basic Parameter	**Symbol**	**Unit**	**Values**
		Rock Type:	Phyllite
Unit Weight	Γ	pcf	155
Intact Unconfined Compressive Strength (UCS)	σ_{ci}	psi	2,170
Basic Rock Mass Rating (1989)	RMR	-	55
Geologic Strength Index	GSI	-	60
Petrographic Constant for Intact Rock	m_i	-	7
Disturbed Rock Mass (Disturbance Factor D=0.7)			
Hoek-Brown Constant for Rock Mass	m_b	-	1.678
Hoek-Brown Constant	S	-	0.0117
Friction angle of Rock Mass	Ø'	degrees	30.4
Cohesion of Rock Mass	C'	psf	20,880

SUMMARY OF ROCK MASS STRENGTH PARAMETERS			
Basic Parameter	Symbol	Unit	Values
Compressive Strength of Rock Mass	S_{cm}	ksf	41.62
Deformation Modulus	E_m	ksi	1,112.8

For the phyllite, we elected to use a cohesion (C) of 3,000 psf and Ø of 23° for the strength of those rock materials.

The soil unit weight used in the analyses was 130 pcf. Rock unit weight used in the analyses was 155 pcf.

5.6 HYDROGEOLOGIC CONDITIONS

As noted in Section 2.3.3, groundwater was not encountered in explorations advanced during this study. Groundwater is not anticipated at the depths that might adversely impact slope stability at the site. However, to model the sensitivity of the slopes to groundwater elevation fluctuations, we performed slope stability analyses in dry, semi-elevated groundwater, and fully-elevated groundwater conditions.

5.7 SLOPE STABILITY EVALUATIONS

BAJADA performed several slope stability evaluations to estimate the following:

- Slope stability using laboratory-derived strength data; and
- Gross stability of proposed slopes with loading from the WTP and tanks, under static and pseudostatic conditions and with varying groundwater elevations.

Limit-equilibrium analyses were performed using the computer program SLIDE 2018 (Rocscience, 2019). Static and pseudostatic analyses output results are presented in Appendix C of this report.

Slope stability analyses were performed under static conditions using the strength values noted above along with slopes underlying and descending from the WTP and tank sites (Plates 4.1 - 4.3). Surcharge loads of 1,800 psf and 1,000 psf for the proposed tank and WTP building, respectively, were assumed for our analyses.

Results of those analyses indicate that the existing slopes beneath the proposed WTP and tank sites have a FOS in excess of 1.5 under static loading conditions for all conditions evaluated.

Pseudostatic evaluations of the slope were also modeled. To estimate the appropriate horizontal ground acceleration to use within our model, we used methods of Blake et al (2002) and CGS (2007). Using a probabilistic horizontal ground acceleration of 0.21g, which corresponds to a 475-year return period (10% chance of exceedance in 50 years; see Section 3.1.5), we reduced that value by 45 percent, which resulted in a pseudostatic acceleration of less than 0.15g. However, to be conservative, we used 0.15g within our model. Pseudostatic evaluations were performed using the same soil strength and tank loading conditions as noted above for the static analyses. The pseudostatic analyses for the proposed WTP and tank resulted in a FOS in excess of 1.1 for all conditions evaluated.

Thus, mitigation measures for increasing slope stability for the proposed WTP and tank are not considered necessary for this project.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 GENERAL

Based on the results of our investigation, it is our opinion that the site is suitable for the proposed improvements provided recommendations presented, herein, are utilized during design and construction of the project. Specific comments and recommendations regarding the geotechnical aspects of project design and construction are presented in the following sections of this report and are intended to be refined, where needed, as the project moves from predesign to design stages.

Recommendations presented, herein, are based upon the preliminary site plans and studies provided by WWE along with stated assumptions. Changes in the configuration from those studied during this investigation may require supplemental recommendations.

6.2 GEOLOGIC HAZARDS

6.2.1 Faulting

As previously noted, no faults or special studies zones extend across the project property. Thus, faulting should not have a direct adverse impact on the proposed tank.

6.2.2 Landslides

Landslides were not observed underlying the project parcel or present below the proposed tank or WTP sites. Thus, in our opinion, naturally occurring landslides pose a low risk to the proposed tank and WTP.

6.2.3 Liquefaction

Based on our observations of the materials exposed during the investigation, it our opinion that liquefaction and lateral spreading pose a very low risk of adversely affecting the project site or proposed improvements.

6.2.4 Expansive Soils

Soils with a very low expansion potential are present beneath the tank site. It is our opinion that expansive soils have a low potential to adversely affect the proposed project.

6.2.5 Soil Chemistry

Based on the results of the soil chemistry tests performed for this study as discussed in Section 3.5, the site soils have a low potential for corrosion of concrete due to sulfates and chlorides.

Based on a commonly accepted correlation between soil resistivity and corrosivity as presented in Section 3.5, the soils at the proposed WTP site are estimated to be corrosive to severely corrosive to ferrous metals, whereas the soils at the proposed tank site are estimated to be mildly to moderately corrosive to ferrous metals. We recommend a corrosion specialist be consulted for those areas having corrosive to severely corrosive soils.

6.3 SLOPE STABILITY

It is our opinion that the slopes underlying the proposed WTP and tank will be grossly stable under static and earthquake loading conditions. Thus, no mitigations for increasing slope stability have been made for this project.

6.4 SITE PREPARATION AND GRADING

6.4.1 Stripping

The existing site is currently covered by vegetated fallow areas, an existing tank, and an existing WTP building. For proposed improvement areas, prior to general site grading and/or construction of planned improvements, existing vegetation, trees, organic topsoil, debris, and deleterious materials should be stripped and disposed of off-site or outside the construction limits. It is anticipated that stripping depths of 4 to 5 inches should be anticipated in areas that are fallow. Where large shrubs and trees have been removed, deeper stripping to remove root balls will be needed. Such deeper stripping could exceed three or more feet in depth. In addition, existing fill material and a remnant concrete foundation slab are present upslope of the proposed tank and will require removal as discussed in following sections of this report.

6.4.2 Existing Utilities, Wells, and/or Foundations

It is anticipated that the existing concrete tank slab and foundations and associated buried pipelines and improvements will be removed and/or rerouted beyond construction limits. It is also anticipated that the existing buried tank slab encountered in TP-3 will be removed as part of this project. Buried cisterns, tanks, or wells, if present, should be removed or destroyed in compliance with applicable regulatory agency requirements. Existing, below-grade utility pipelines that extend beyond the limits of the proposed construction and that will be abandoned in-place should be plugged with lean concrete or grout to prevent migration of soil and/or water. All excavations resulting from removal and demolition activities should be cleaned of loose or disturbed material prior to placing any fill or backfill.

6.4.3 Keying and Benching

Keying and benching are not anticipated to be needed for construction of the proposed WTP or tank foundations. If keying or benching become necessary, we can provide details and recommendations for those tasks, as needed.

6.4.4 Scarification and Compaction

Following site stripping, areas to receive engineered fill should be scarified to a minimum depth of 8 inches, uniformly moisture-conditioned to near optimum moisture content, and compacted to at least 90 percent of the maximum dry density as determined using standard test method ASTM D1557.

6.4.5 Wet/Unstable Soil Conditions

Following periods of precipitation, near-surface on-site soils may be significantly over optimum moisture content. These conditions could hinder equipment access as well as efforts to compact site soils to a specified level of compaction. If over-optimum soil moisture content conditions are encountered during construction, disking to aerate, replacement with imported material, chemical treatment, stabilization with a geotextile fabric or grid, and/or other methods will likely be required to facilitate earthwork operations. The applicable method of stabilization is the Contractor's responsibility and will depend on the Contractor's capabilities and experience, as well as other project-related factors beyond the scope of this investigation. Therefore, if over-optimum moisture within the soil is encountered during construction, BAJADA should review these conditions (as well as the Contractor's capabilities) and, if requested, provide recommendations for their treatment.

6.4.6 Site Drainage

Grading should be performed in such a manner that provides positive surface gradient away from all structures. The ponding of water should not be allowed adjacent to structures, retaining walls, or the top of cut or fill sections. Unlined retention/detention basins should not be situated on the site due to the underlying relatively steep slopes. Surface runoff should be directed toward engineered collection systems or suitable discharge areas and not allowed to flow over slopes. Discharge from structures should also be collected, conveyed, and discharged away into engineered systems, such as the existing gunite V-ditch at the southern portion of the property. Water should not be discharged over the slopes located west of the site. Landscape plantings around the proposed tank should be avoided.

6.4.7 Excavation Characteristics & Bulking

Exploration at the site was performed using a Case 580 Super M+ backhoe equipped with a 2-foot-wide bucket. Penetration of the underlying phyllite posed difficult excavation conditions for this backhoe, while penetration of the older alluvial soils posed low to moderate difficult excavation conditions. It is our opinion that the underlying phyllite and older alluvium should be excavatable with moderate difficulty using conventional heavy grading equipment in good working order, operated by experienced personnel. Blasting and other relatively unconventional excavation methods are not anticipated as necessary for this site.

It should be noted that the ability to excavate underlying soil and rock materials does not imply that the excavated materials will be of small enough dimension to be used within engineered fill, as discussed in Section 6.4.12, without further mechanical breaking or crushing of those materials.

Based on the results of the laboratory tests performed for this study, we estimate that phyllitic rock will neither bulk or shrink and that older alluvial soils excavated at the site could shrink on the order of 2 to 5 percent when placed as engineered fill, depending on the soil type and degree of compaction.

6.4.8 Temporary Slopes

This section explicitly excludes trench slopes for buried utilities. Temporary trench excavations are discussed in Section 6.6.4 – Excavations, Trenches, Dewatering & Shoring, of this report.

Construction of the proposed project could require temporary slopes to facilitate construction of below-ground improvements. Based on the results of our observations and testing, we anticipate that temporary construction slopes up to 20 feet tall can be constructed at inclinations of 1:1 (horizontal:vertical) or flatter. However, the actual temporary slope inclinations must be made at the time of construction by the Contractor and their Competent Person, as discussed in Section 6.6.4.1 – Excavation and Trench Slopes.

All temporary excavations must comply with applicable local, state, and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards. Construction site safety is the responsibility of the Contractor, who should be solely responsible for the means, methods, and sequencing of construction operations so that a safe working environment is maintained.

We recommend that efforts be made during construction to limit exposure of temporary slopes to only seasonal dry times of year. Temporary cut slopes exposed between November and March have an increased risk of failure due to the chance for heavy precipitation.

Heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed within a 1:1 (horizontal to vertical) projection from the toe of the excavation to the ground surface, unless shoring is being used and has specifically been designed for those surcharge loads. Where the stability of adjoining improvements, walls, utility poles, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning may be required to provide structural stability and to protect personnel working within the excavation.

During wet weather, earthen berms or other methods should be used to prevent runoff water from entering excavations. All runoff water entering the excavation(s) should be collected and disposed of outside the construction limits.

6.4.9 Permanent Slopes

Permanent slopes should be constructed at inclinations of 2:1 or flatter. If proposed unsupported cut slopes cannot be excavated at 2:1 or flatter, then additional slope stability analyses will need to be performed to confirm the maximum slope inclination pertinent to the slope height and location. If a minimum FOS of 1.1 and 1.5 for pseudostatic and static conditions, respectively, cannot be obtained for slopes steeper than 2:1, then additional slope reinforcements or retaining structures will be necessary to support some or all of the entire proposed slope. Slope reinforcement can include construction of retaining walls, installation of soil nails, construction of soldier pile or tieback walls, etc. Retaining walls/retention systems should be of sufficient height to allow construction of permanent cut slopes above the walls that meet the inclination recommendations made herein.

6.4.10 Overexcavation

Overexcavation of soils beneath proposed structure foundation areas for the purpose of improving subgrade soil conditions is not anticipated to be necessary for this project. However, some overexcavation will be required to remove existing fill material and/or remnant concrete foundations upslope of the proposed tank pad, as depicted on Plate 4.3 – Section C – C'.

6.4.11 On-Site Soil Materials

It is our opinion that most of the near-surface soils encountered at the site can be used for general engineered fill provided they are free of organics, debris, oversized particles (>3") and deleterious materials. Highly plastic clayey materials (materials having a plasticity index exceeding 30 and a liquid limit more than 50), if encountered, should be segregated and excluded from engineered fill, where possible. If potentially unsuitable soil is considered for use as engineered fill, BAJADA should observe, test, and provide recommendations as to the suitability of the material prior to placement as engineered fill.

6.4.12 Engineered Fill Materials and Placement

6.4.12.1 General Engineered Fill

If imported fill materials are used for this project, they should consist of soil and/or soil-aggregate mixtures generally less than 3 inches in maximum dimension, nearly free of organic or other deleterious debris, and essentially non-plastic. Typically, well-graded mixtures of gravel, sand, non-plastic silt, and minor quantities of clay are acceptable for use as imported general engineered fill. Gradation and plasticity recommendations for general engineered fill are presented in the table below.

6.4.12.2 Structural Fill

Structural fill materials are defined as those materials specifically intended for support of structures and pavements. General recommendations for structural fill are presented in the table below and should be considered minimum requirements.

All imported fill materials, whether General or Structural, should be sampled and tested prior to importation to the project site to verify that those materials meet the recommended material criteria, in accordance with applicable test procedures, as shown in the following table.

IMPORTED FILL RECOMMENDATIONS				
GRADATION				
Sieve Size			**Test Procedures**	
	Percent Passing			**AASHTO**
3-inch	100	100	D422	T88
¾-inch	70 – 100	70 – 100	D422	T88
No. 200	0 - 30	<5	D422	T88
PLASTICITY				
Liquid Limit	<30	NA	D4318	T89
Plasticity Index	<12	Nonplastic	D4318	T90
ORGANIC CONTENT	<1%	<1%	D2974	NA
SOIL CHEMISTRY	Chloride <500 ppm	Sulfate <1,000 ppm	Resistivity >2,000 ohm-cm	pH 6-7

6.4.13 Controlled Low Strength Material

Controlled low strength material (CLSM) can be used to backfill excavated areas or as engineered fill material. CLSM consists of a fluid, workable mixture of aggregate, cement, and water that is of limited strength as to allow future excavation and maintenance of buried improvements yet capable of supporting the proposed improvements. If CLSM is used as engineered fill material, we recommend that it conform and be placed per specifications presented in Section 19-3.062 of the Caltrans Standard Specifications (most current edition).

6.4.14 Placement & Compaction

In general, soil and/or soil-aggregate mixtures used for engineered fill should be uniformly moisture-conditioned to within 3-percent of optimum moisture content, placed in horizontal lifts less than 8 inches in loose thickness, and compacted to at least 90 percent relative compaction in accordance with standard test method ASTM D1557[1]. All structural fill should be compacted to at least 95% relative compaction per ASTM D1557.

It is recommended that fill materials be placed and compacted uniformly in elevation around buried structures and that the vertical elevation differential of contiguous lifts diverge no more than three feet around the structure during compaction. Testing should be performed to verify that the relative compactions are being obtained as recommended herein. Compaction testing, at a minimum, should consist of one test per every 500 cubic yards of soil being placed or at every 1.5-foot vertical fill interval, whichever comes first.
In general, a "sheep's foot" or "wedge foot" compactor should be used to compact fine-grained fill materials. A vibrating smooth-drum roller could be used to compact granular fill materials and final fill surfaces.

6.5 FOUNDATIONS & SLABS

6.5.1 General

The following sections provide foundation design recommendations for the proposed tank and WTP building.

6.5.2 Transition Lots

Transitions lots are those sites where a structure foundation will be supported partially by two different geologic materials, such as artificial fill beneath one portion of the structure and undisturbed native soil beneath the remainder of the structure. Those two materials under structural load could cause settlement to occur at differing rates and magnitudes across the structure foundation and slab. The resulting differential settlement could cause damage to the structure, structure performance, or performance of equipment within the structure.

It is anticipated that the WTP will rest entirely on undisturbed phyllite and that the tank will be supported entirely on undisturbed older alluvium, as depicted on Plates 4.1 – 4.3. Thus, we do not anticipate that a transition lot will be present for either structure. We recommend that no design or construction procedure be implemented that would create such a condition. If, during design or construction, it becomes apparent that a transition lot is present or will occur, BAJADA should be consulted to provide recommendations for reducing potential differential settlement associated with those conditions.

[1] This test method (ASTM D1557) applies wherever relative compaction, maximum dry density, or optimum moisture content is referenced within this report.

6.5.3 Shallow Foundations

Foundations must be sized, embedded, and reinforced as determined by the project Structural Engineer. All foundation excavations should be made level, except for vertical steps. The allowable bearing pressures provided below are based on a recommended minimum embedment depth of 18 inches into undisturbed soil or rock and a minimum width of 12 inches. Deeper embedment and larger foundations may be required for the tank foundations.

6.5.4 Allowable Bearing Pressures

It is assumed that all foundations for the proposed structures will be placed at least 18 inches below finished grade and rest entirely on undisturbed phyllite or undisturbed older alluvium. Structure foundations founded on the phyllite (WTP) may be designed using a maximum allowable bearing pressure of 3,000 pounds per square foot (psf). Structure foundations founded on the older alluvium (tank) may be designed using a maximum allowable bearing pressure of 2,000 pounds per square foot (psf). Additional bearing pressure recommendations can be provided, if desired, once further details of the structures are known.

An increase of allowable bearing pressure by one-third for short-term loading due to wind or seismic forces should not be incorporated unless an alternative load combination, as described in Section 1605A.3.2 of the 2019 CBC, is applied. The allowable bearing value is for vertical loads only; eccentric loads may require adjustment to the values recommended above. We recommend that BAJADA be allowed to observe foundation excavations to confirm projected site conditions.

6.5.5 Estimated Settlements

The anticipated total settlement for the WTP and tank structures, if construction occurs as recommended within this report, is estimated to be less than one inch. Differential settlement for all structures is estimated to be ½-inch or less over a horizontal distance of about 50 feet.

6.5.6 Frost Penetration

Frost penetration in the project area is anticipated to be less than 6 inches, which is shallower than proposed foundations. Therefore, no recommendations for frost protection have been provided herein.

6.5.7 Slab-on-Grade Design

All ground-supported slabs should be designed to support the anticipated loading conditions. Reinforcement for slabs should be designed to maintain structural integrity and should not be less than that required to meet pertinent code, shrinkage, and temperature requirements. Unless specified otherwise by the design engineer, reinforcement should be placed at mid-thickness in the slab with provisions to ensure it stays in that position during construction and concrete placement.

A modulus of subgrade reaction (k_{s1}) of 200 pounds per cubic inch (pci) is recommended for design of mat-type foundations. The modulus of subgrade reaction value represents a presumptive value based on soil classification. No plate-load tests were performed as part of this study. The modulus value is for a 1-foot-square plate and must be corrected for mat size and shape, assuming a cohesionless subgrade.

Subgrade soils supporting interior concrete floor slabs should be uniformly moisture-conditioned to near the optimum moisture content and compacted to at least 95-percent relative compaction for a depth of at least 12 inches.

6.5.8 Lateral Earth Pressures

It is our understanding that buried structures and retaining walls (hereafter referred to as retaining walls) might be utilized in this project. Retaining walls should be designed to resist earth pressures exerted by the retained, compacted backfill plus any additional lateral force that will be applied to the wall due to surface loads placed at or near the wall. The recommended equivalent fluid weights presented below are for static (non-earthquake) conditions.

LATERAL EARTH PRESSURES UNDER STATIC CONDITIONS		
Lateral Earth Pressure Condition	Slope Inclination Above Structure	Equivalent Fluid Weight (pcf) Drained
At-Rest	Flat	60
Active	Flat	40
At-Rest	2:1	80
Active	2:1	60

The resultant force of the static lateral force prism should be applied at a distance of 33 percent of the wall height above the soil elevation on the toe side of the wall.

The tabulated values are based Rankine lateral earth pressure assumptions for granular soil with a phi-angle of 31 degrees and a compacted, moist unit weight of 125 pounds per cubic foot (pcf), and do not provide for surcharge conditions resulting from construction materials, equipment, or vehicle traffic. Loads not considered as surcharges should bear behind a 1:1 (horizontal to vertical) line projected upward from the base of the shoring. If surcharges are expected, BAJADA should be advised so that we can provide additional recommendations as needed. Surcharge loads induce additional pressures on earth retaining structures. An additional lateral load on non-yielding walls equal to 0.5 times the applied surcharge pressure should be included in the design for uniform area surcharge pressures. Lateral pressures for other surcharge loading conditions can be provided, if required.

6.5.9 Sliding Resistance

Sliding resistance generated through a compacted soil/concrete interface can be computed by multiplying the total dead weight structural loads by the friction coefficient of 0.40 for on-site granular soils and imported granular engineered fill. If a membrane, such as polysheeting or PVC, is utilized, then the coefficient of friction between the foundations and/or slab and that sheeting should be established through consultation with the membrane manufacturer.

6.5.10 Passive Resistance

Ultimate passive lateral resistance developed shallow foundation elements bearing against compacted soil surfaces for that portion of the foundation element extending below a depth of 1 foot below the lowest adjacent grade can be estimated using an equivalent fluid weight of 375 pcf.

6.5.11 Safety Factors

Sliding resistance and passive lateral pressure may be used together in conjunction with the following recommended safety factors. A minimum factor of safety of 1.5 is recommended for sliding resistance where passive pressure is neglected; a minimum factor of safety of 2.0 is recommended for sliding resistance where passive pressure is included.

6.6 PIPELINES & TRENCH BACKFILL

6.6.1 External Loads on Buried Pipelines

External loads on buried pipes will consist of loads due to the overlying earth materials, loads due to construction activities, loads due to traffic, and other post construction land uses. It is recommended that buried pipes be designed to resist the imposed loads with a factor of safety and an amount of deflection as recommended by the pipeline manufacturer. Loads on the pipe due to the overlying soil will be dependent upon the depth of placement, type and method of backfill, the configuration of the trench, the depth of ground water, and whether any additional fill will be placed above the pipeline, on the ground surface. The earth loads on the pipe can be estimated using formulas developed by Marston (1930) and Spangler (1982).

The following Marston formula can be used to estimate vertical soil loads on rigid pipeline placed in backfilled trenches or tunneled in place (American Concrete Pipe Association [ACPA], 2011):

$$W_d = C_d \gamma B_d^2$$
$$W_t = C_t \gamma B_t^2 - 2cC_tB_t$$

Where:

W_d, W_t	=	Vertical soil load on rigid pipe due to trench backfill or overlying soils, respectively (pounds per foot [lb./ft])
γ	=	145 pounds per cubic foot (pcf) for imported granular trench backfill; and 125 pcf for native soil trench backfill
B_d, B_t	=	Trench width, width of tunnel bore, respectively (feet)
C_d, C_t	=	See below
c	=	Soil cohesion (psf)

Plate 6 – Marston's Load Coefficients, can be used to estimate C_d and C_t. The parameters C_d and C_t will depend on: 1) the backfill type; 2) the trench or tunnel width; and 3) the installation depth. For a trench installation with a ratio of backfill depth to trench width at the top of pipe (H/B_d) of at least 1 and for a trench width at top of pipe no greater than 3 times the pipe diameter, the value of C_d and C_t may be calculated using the following equation (ACPA, 2011):

$$C_{d/t} = \frac{1 - e^{-2K\mu' \frac{H}{B_d \text{ or } B_t}}}{2K\mu'}$$

Where:

K	=	Rankine's lateral earth pressure coefficient
μ'	=	Friction coefficient between fill material and sides of trench
H	=	Backfill height above pipe crown

The value Kμ' is dependent on the backfill type, degree of compaction, and moisture content. Where backfill materials are compacted as recommended in Section 6.6.6 of this report, the following estimated Kμ' values are applicable for various types of soil and rock encountered during this study and anticipated to be used within the trench zone:

ESTIMATED Kμ' VALUES FOR PIPE DESIGN	
Soil Type	**Kμ'**
Clay (CL, CH)	0.120
Silt (ML)	0.130
Clayey Sand (SC)	0.150
Sand & Gravel (SM, GM)	0.165
Estimated from ASCE (1982)	

For flexible pipelines, the prism method (Moser & Folkman, 2008) can be used to estimate the vertical soil loads imposed on pipelines in new trenches. That formula is as follows:

$$W = B\gamma H$$

Where:

W	=	Vertical soil load (lb./ft)
B	=	Outside diameter of the pipeline (ft)
γ	=	145 pounds per cubic foot (pcf) for imported granular trench backfill; and 125 pcf for native soil trench backfill
H	=	Depth of backfill (ft)

In addition to the dead loads noted above, proposed pipelines may be subjected to vertical live loads within roadways and driveways. Vertical soil pressures due to live vehicular loads can be estimated using the graph presented on Plate 7 – Vertical Soil Pressures Induced by Live Loads.

6.6.2 Modulus of Soil Reaction (E')

Flexible and semi-rigid pipes are typically designed to withstand a certain amount of deflection from applied earth loads. Those deflections can be estimated with the equations developed by Spangler (1982). The modulus of soil reaction (E') values for the project were estimated using relations of Howard (1996). The table below presents E'_b values, which are recommended E' values for pipe zone backfill materials (pipe zone backfill). The recommended E'_b values presented in the table below apply to the initial backfill materials along the sides of the pipe at the recommended level of compaction.

MODULUS OF SOIL REACTION FOR PIPE ZONE BACKFILL MATERIALS (E'_B)		
Soil Type	**Depth of Burial**	**Recommended E'_b (psi)**
Pipe Bedding and Pipe Embedment (clean crushed rock or sand)	5’	1,000
	10’	1,500
	15’	1,600
	15’+	1,700
Soil-Cement Slurry (backfilled within 2 days of placement)	Not Applicable	3,000

Where the zone of backfill beside the pipe is less than five times the pipeline diameter, the E'_b values above may not be applicable and the constrained soil modulus E'_n will affect flexible pipe design. E'_n corresponds to the E’ value for the natural trench wall soils. The actual lateral soil modulus at the pipe depth will lie somewhere in between E'_b and E'_n depending on the trench width. The following E'_n values are recommended for varying earth materials based on data obtained in our field and laboratory investigations.

E'_N VALUES FOR ON-SITE MATERIALS	
Earth Material	**E'_n Value (psi)**
Phyllite	3,000
Older Alluvium	1,000

For trench widths of less than five times the diameter of the pipe, the composite design E_c’ (E'_b and E'_n) may be calculated using the Soil Support Combining Factors (S_c) presented in the table below, where B_d is the trench width at pipe springline and D is the diameter of the pipe.

SOIL SUPPORT COMBINING FACTORS (S_C)						
E'_n/E'_b	**B_d/D=1.5**	**B_d/D=2.0**	**B_d/D=2.5**	**B_d/D=3.0**	**B_d/D=4.0**	**B_d/D=5.0**
0.1	0.15	0.30	0.60	0.80	0.90	1.00
0.2	0.30	0.45	0.70	0.85	0.92	1.00
0.4	0.50	0.60	0.80	0.90	0.95	1.00
0.6	0.70	0.80	0.90	0.95	1.00	1.00
0.8	0.85	0.90	0.95	0.98	1.00	1.00
1.0	1.00	1.00	1.00	1.00	1.00	1.00
1.5	1.30	1.15	1.10	1.05	1.00	1.00
2.0	1.50	1.30	1.15	1.10	1.05	1.00
3.0	1.75	1.45	1.30	1.20	1.08	1.00
>5.0	2.00	1.60	1.40	1.25	1.10	1.00
Source: “Pipeline Installation,” A. Howard, 1996						

The corresponding composite design E_c' can be calculated by selecting the appropriate S_c value from the table above and multiplying the appropriate E'_b value by S_c, as noted below:

$$E_c' = E'_b(S_c)$$

6.6.3 *Thrust Resistance*

Where the proposed pipelines change direction abruptly, resistance to thrust, if needed, can be provided by mobilizing frictional resistance between pipe and the surrounding soil, by use of a thrust block, by use of restrained pipe joints, or by a combination of the above.

To design thrust resistance by mobilizing frictional resistance, we recommend that a coefficient of friction of 0.20 for PVC or HDPE pipelines be used. The coefficient of friction value includes a factor of safety of 1.5 and assumes that a sand with a sand equivalent (SE) of 30 or greater will be placed within the pipe zone in accordance with recommendations presented in Section 6.6.5.1. For design of thrust block resistance, an ultimate passive lateral earth pressure of 375 psf/ft of depth may be used.

6.6.4 *Excavations, Trenches, Dewatering, & Shoring*

6.6.4.1 Excavation and Trench Slopes

Construction of the proposed project will require temporary excavations and trenching to facilitate construction of earthwork, pipelines, manholes, vaults, and other below ground improvements. All temporary excavations and slope inclinations must comply with applicable local, state, and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards. Construction site safety is the responsibility of the Contractor, who should be solely responsible for the means, methods, and sequencing of construction operations so that a safe working environment is maintained.
Subsurface soil conditions encountered in project excavations are to be monitored and evaluated by the Contractor in accordance with OHSA guidelines. OSHA soil classification typing includes the following:

OSHA SOIL TYPE DETERMINATIONS	
Stable Rock	Natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed. It is usually identified by a rock name such as granite or sandstone. Determining whether a deposit is of this type may be difficult unless it is known whether cracks exist and whether or not the cracks run into or away from the excavation.
Type A Soils	Cohesive soils with an unconfined compressive strength of 1.5 tons per square foot (tsf) (144 kPa) or greater. Examples of Type A cohesive soils are often: clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam. (No soil is Type A if it is fissured, is subject to vibration of any type, has previously been disturbed, is part of a sloped, layered system where the layers dip into the excavation on a slope of 4 horizontal to 1 vertical (4H:1V) or greater, or has seeping water.

OSHA SOIL TYPE DETERMINATIONS	
Type B Soils	Cohesive soils with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa). Examples of other Type B soils are: angular gravel; silt; silt loam; previously disturbed soils unless otherwise classified as Type C; soils that meet the unconfined compressive strength or cementation requirements of Type A soils but are fissured or subject to vibration; dry unstable rock; and layered systems sloping into the trench at a slope less than 4H:1V (only if the material would be classified as a Type B soil).
Type C Soils	Cohesive soils with an unconfined compressive strength of 0.5 tsf (48 kPa) or less. Other Type C soils include granular soils such as gravel, sand and loamy sand, submerged soil, soil from which water is freely seeping, and submerged rock that is not stable. Also included in this classification is material in a sloped, layered system where the layers dip into the excavation or have a slope of four horizontal to one vertical (4H:1V) or greater.
Layered Geological Strata	Where soils are configured in layers, i.e., where a layered geologic structure exists, the soil must be classified on the basis of the soil classification of the weakest soil layer. Each layer may be classified individually if a more stable layer lies below a less stable layer, i.e., where a Type C soil rests on top of stable rock.

Preliminary OSHA Soil Types of Type A and B for phyllite and older alluvium, respectively, may be considered for use at the site. Actual OSHA Soil Types at the site should be determined during construction by the Contractor's Competent Person or by a registered design professional retained by the Contractor as soils are exposed within the excavations. OSHA allows designation of slope inclinations based on soil types without the support of a registered design professional if those slopes are less than 20 feet high. To do so, the Contractor is required to designate a "Competent Person" that takes the ultimate responsibility for soil type classification.

The following maximum slope inclinations are allowed based upon OSHA soil types:

OSHA MAXIMUM ALLOWABLE SLOPES	
Soil Type	**Slope Ratio[1]**
Stable Rock	Vertical
Type A	¾:1
Type B	1:1
Type C	1½:1
[1] – horizontal : vertical	

Based on the soils observed at the project site during this investigation, it is not anticipated that loose, running, raveling, and/or flowing conditions will be encountered in excavations or trenches. However, if such conditions are encountered during construction, inclinations of unshored slope excavations may not stand exposed at the slope ratios noted above for OSHA Soil Types. In such situations, proposed excavations in those areas could fail and expand in an area much larger than the proposed width unless the excavation and/or trench is shored and adequately supported.

Heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed within a 1:1 (horizontal to vertical) projection from the toe of an unsupported trench or other excavation to the ground surface. Where the stability of project improvements is endangered by excavation operations, support systems such as shoring, bracing, or underpinning may be required to provide structural stability and to protect personnel working within the excavation.

6.6.4.2 Dewatering

Groundwater was not encountered within explorations advanced for this study. If construction is performed during winter or early spring or following a wet weather season, then shallower groundwater could be encountered in areas and/or at depths not observed in our explorations. In addition, as previously noted, there is a potential for local perched water conditions to be present and/or for existing trenches and underground utilities to store and transport groundwater that could impact construction.

It is the Contractor's responsibility for developing and implementing the means and measures for capturing and removing or diverting groundwater during construction of the proposed pipeline. If groundwater is encountered during construction, it is recommended that the Contractor install measures to capture and/or divert groundwater from entering the excavations. If this is not possible, then the Contractor should channel groundwater to flow towards collection points to be removed from the excavations and disposed of at an approved area.

6.6.4.3 Shoring

Preliminary design of braced shoring for trenches may be based on the preliminary shoring pressure diagrams provided on Plate 8 - Preliminary Shoring Pressure Diagrams. The preliminary shoring pressure diagrams provided on Plate 8 represent typical soil conditions encountered during this study or that we anticipate could be encountered during construction. Final earth pressures and pressure diagrams for the design and implementation of individual shoring systems will be dependent upon the following:

- The actual subsurface conditions encountered during construction;
- The shoring type, design, and installation method; and
- Surcharge pressures from traffic, equipment, stockpiles, etc.

If thick layers of cohesionless materials (i.e., sands and gravels) are encountered, then those materials could flow or ravel, if in a wet or saturated condition, or ravel or run when dry (Federal Highways Administration, 2014). Flowing soils act like a viscous fluid and can enter a trench from the sidewalls and can flow for relatively long distances. Raveling soils have chunks or flakes of material falling or toppling from trench sidewalls into the trench.

Running soils are unstable at angles greater than their angle of repose and will run like pea gravel, granulated sugar, or dune sand from a trench side wall into the trench until the slope flattens to that angle of repose.

Hydraulic speed shores and trench box shoring in flowing, running, or raveling ground conditions should not be allowed. Furthermore, soils subject to running, flowing, or raveling will have insufficient strength and stand-up time to safely hold full-depth vertical excavations long enough for complete trench box or speed-shore installations. Vertical excavations in such soils will most likely experience excavation wall loss and related undermining of adjacent pavements, utilities, structures, and improvements. Therefore, as a precautionary measure, shoring with trench boxes in flowing, running, or raveling soils will require very careful interior excavation through the trench box so that there are no unsupported vertical excavation faces as the trench box is incrementally lowered into place. Additionally, pre-advancing/driving steel backer plates in soil around the exterior perimeter of the trench box and ahead of excavations within the trench box may be necessary to maintain stable sidewalls and protect adjacent pavement, utilities, and structures. Shoring with speed shores in running or fast raveling ground will require solid sheet backing to provide full face support.

In localized cases near critical structures or utilities, special shoring or ground improvement (such as grout stabilization) prior to excavation may be needed to reduce consequential damage. The Contractor should be required to provide any special shoring designs for engineering review. Areas requiring special shoring design should receive preconstruction condition surveys and video/photo documentation of conditions.

Shoring systems that do not provide positive support of excavation walls may allow surface settlement and related damage to existing roadways, utilities, structures, and improvements. A summary of the potential surface settlement of passively-shored excavations is provided in the following table:

POTENTIAL SURFACE SETTLEMENT OF PASSIVELY-SHORED EXCAVATIONS		
Soil Type	**Surface Settlement (% of Excavation Depth)**	**Lateral Zone of Disturbance (Multiples of Excavation Depth)**
Sand	0.5%H	H
Soft to medium stiff clay	1%-2%H	3-4H
Stiff clay	<1%H	2H
Suprenant and Basham (1993)		

6.6.5 *Pipe Zone & Trench Zone Materials*

The use of appropriate pipe zone and trench zone backfill materials is critical for the long-term performance of a buried, flexible pipeline. Pipe zone and trench zone backfill materials are discussed below. Plate 9 - Trench Nomenclature, graphically illustrates the locations of pipe zone and trench zone backfill areas.

6.6.5.1 Pipe Zone Backfill

The pipe zone, as discussed herein, is that cross-sectional area that extends from the bottom of the trench to 6 inches over the crown of the pipeline, and from trench wall to trench wall, as shown on Plate 9 – Trench Nomenclature. Pipe zone backfill materials should consist of imported soil having an SE of no less than 30 and having a particle size no greater than ½-inch in maximum dimension, per Section 306-1.2.1 of the Greenbook. Some on-site soils might meet these specifications; however, most of those soils will likely not meet these recommendations unless screened to remove oversized materials.

6.6.5.2 Trench Zone Backfill

Trench zone backfill (i.e., material placed between the top of pipe zone backfill and finished subgrade) may consist of on-site soils or imported materials. If on-site soils are used, then those materials should be screened of deleterious materials, organic debris, highly plastic clay, and oversized materials having dimensions of greater than 3 inches in any direction prior to placement within the trench.

Alternatively, imported soils can be used as trench zone backfill. We recommend that imported trench zone materials conform to recommendations presented for imported general engineered fill materials presented in Section 6.4.12 of this report. Those imported materials should be free of deleterious materials, organic debris, or clasts exceeding 3 inches in diameter in any direction.

6.6.5.3 Controlled Low Strength Backfill

An alternative to the use of pipe zone and trench zone backfill materials noted above is the use of controlled low strength material (CLSM) as pipe and/or trench zone backfill. CLSM consists of a fluid, workable mixture of aggregate, cement, and water that is of limited strength as to allow future excavation and maintenance of buried improvements yet capable of supporting the proposed pipeline and backfill. If CLSM is used in the pipe zone or trench zone, we recommend that those materials conform and be placed according to specifications presented in Section 19-3.062 of the Caltrans Standard Specifications (most current edition). Care should be taken during placement of CLSM materials to prevent the pipeline from floating.

6.6.6 Placement & Compaction

Trench backfill should be placed and compacted in accordance with recommendations previously provided for engineered fill. Mechanical compaction should be the means in which compaction is achieved. Jetting should not be allowed as a means of compaction.

Special care should be given to ensuring that adequate compaction is made beneath the haunches of the pipeline (that area from the pipe springline to the pipe invert, as shown on Plate 9 of this report) and that no voids remain in this space. Compaction tests of pipe zone backfill should be performed at horizontal intervals of no more than 200 feet and vertical intervals of no more than 18 inches. Within the pipe zone, compaction tests should be performed near springline and near the top of the pipe zone backfill. Assessment of the potential presence of voids within the haunch area should be performed following completion of those compaction tests. If voids are observed, then the Contractor should be required to rework the pipe zone materials to eliminate the presence of voids in the pipeline haunches. Retesting of the pipe zone materials should then be performed. All areas of failing compaction tests should be reworked and retested until the specified relative compaction is achieved. Compaction of trench zone backfill should be performed at horizontal intervals of no more than 300 feet and vertical intervals of no more than 18 inches.

Placement of CLSM materials should be performed in accordance with specifications presented in Caltrans Standard Specification 19-3.062. If CLSM is used, then compaction tests are not required; however, a minimum of four hours should be allowed between placement of CLSM and placement of engineered fill materials above the CLSM, as noted in Caltrans Standard Specification 19-3.062.

6.6.7 *Trench Subgrade Stabilization*

Soft and yielding trench subgrade is unlikely to be encountered along the bottom of trench excavations made within the existing site soils. However, if yielding subgrade is observed, it is recommended that the bottom of trenches be stabilized prior to placement of the pipeline bedding so that, in the judgment of the geotechnical engineer, the trench subgrade is firm and unyielding. The Contractor should have the sole responsibility for design and implementation of trench subgrade stabilization techniques. Some methods that we have observed used to stabilize trench subgrades include the following:

- Use of ¾–inch to 1½-inch floatrock worked into the trench bottom and covered with a geotextile fabric such as Mirafi 500X;
- Placement of a geotextile fabric, such as Mirafi 500X, on the trench bottom and covered with at least one foot of compacted processed miscellaneous base (PMB) conforming to the requirements of Section 200-2.5 of the Greenbook, latest edition;
- Overexcavation of trench subgrade and placement of two-sack sand-cement slurry; and
- In extreme conditions, injection grouting along the trench alignment.

If floatrock is used, typically sand with an SE of 50 or more should be used to fill the voids in the rock prior to placement of pipe bedding materials.

7 REVIEW OF PLANS AND SPECIFICATIONS

We recommend BAJADA conduct a general review of preliminary and final plans and specifications to evaluate whether recommendations contained herein have been properly interpreted and implemented during design. If BAJADA is not retained to perform this recommended review, we will assume no responsibility for misinterpretation of our recommendations.

8 ADDITIONAL SERVICES

This report and its associated recommendations were intended to assist WWE during predesign stages of the project. We recommend that as the project continues, BAJADA be given the opportunity to collaborate on the project refinements so that: 1) we can confirm that project design conforms with recommendations made, herein; and 2) preliminary recommendations made within this report can be refined, where necessary, based on the design elements of the project. BAJADA should be provided the opportunity to review and comment on project plans and specifications prior to bid advertisement for the project.

9 LIMITATIONS

This report has been prepared in substantial accordance with the generally accepted engineering geologic and geotechnical engineering practices, as they exist in the site area at the time our services were rendered. No other warranty, either express or implied, is made.

Conclusions contained in this report were based on the conditions encountered during our field investigation and are applicable only to those project features described herein (see Section 1.1 – Project Understanding). Soil and rock deposits can vary in type, strength, and other geotechnical properties between points of observation and exploration. Additionally, groundwater and soil moisture conditions can also vary seasonally and for other reasons. Therefore, we do not and cannot have a complete knowledge of the subsurface conditions underlying the project site.

The conclusions and recommendations presented in this report are based upon the findings at the points of exploration, and interpolation and extrapolation of information between and beyond the points of observation, and are subject to confirmation based on the conditions revealed by construction. If conditions encountered during construction differ from those described in this report, or if the scope or nature of the proposed construction changes, we should be notified immediately to review and, if deemed necessary, conduct additional studies.

The scope of services provided by BAJADA for this project did not include the investigation and/or evaluation of toxic substances, or soil or groundwater contamination of any type. If such conditions are encountered during site development, additional studies may be required. Further, services provided by BAJADA for this project did not include the evaluation of the presence of critical environmental habitats or culturally sensitive areas.

This report may be used only by our client and their agents and only for the purposes stated herein, within a reasonable time from its issuance. Land use, site conditions, and other factors may change over time that may require additional studies. In the event significant time elapses between the issuance date of this report and construction, BAJADA shall be notified of such occurrence to review current conditions. Depending on that review, BAJADA may require that additional studies be conducted and that an updated or revised report is issued.

Any party other than our client who wishes to use all or any portion of this report shall notify BAJADA of such intended use. Based on the intended use as well as other site-related factors, BAJADA may require that additional studies be conducted and that an updated or revised report be issued. Failure to comply with any of the requirements outlined above by the client or any other party shall release BAJADA from any liability arising from the unauthorized use of this report.

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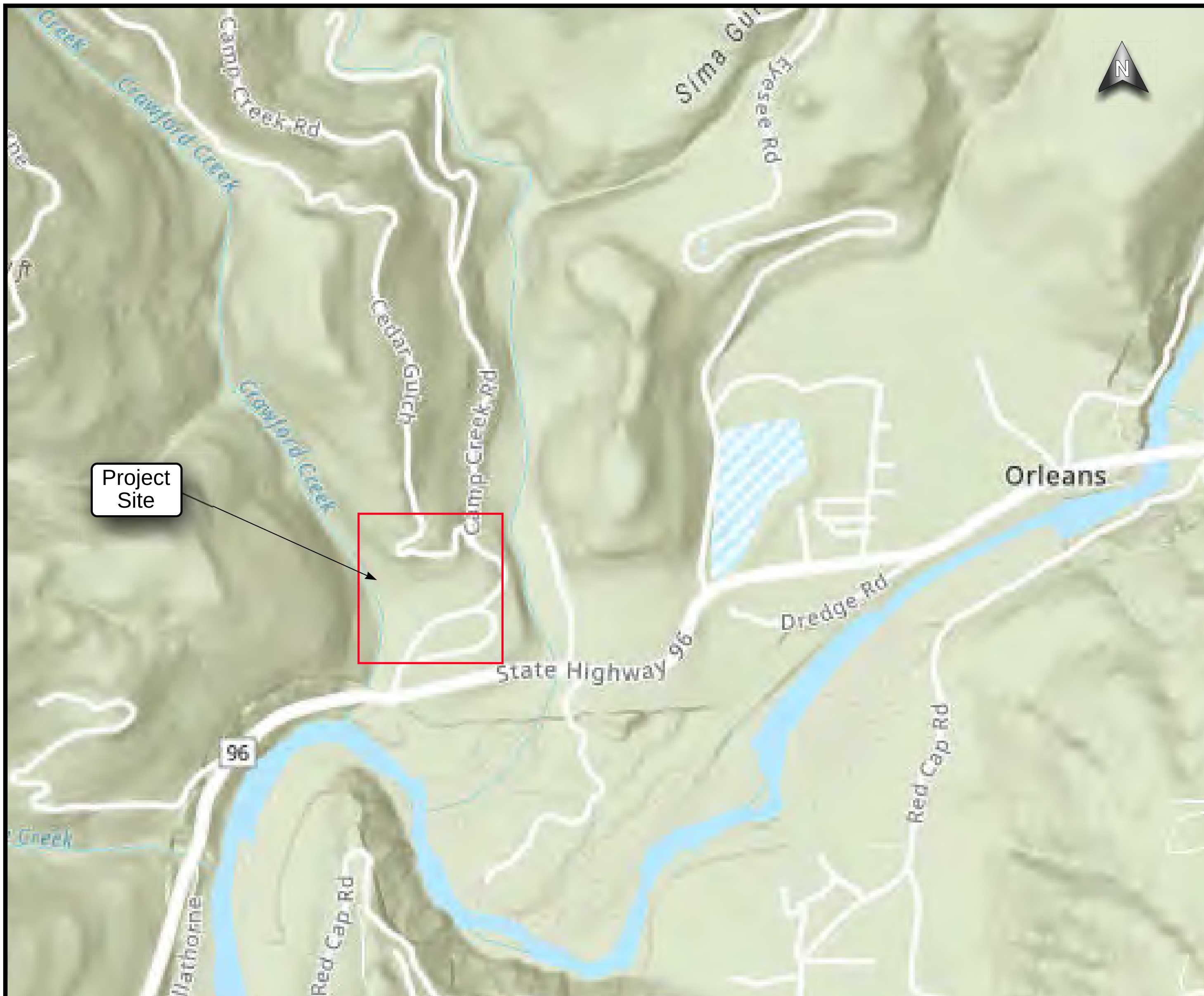
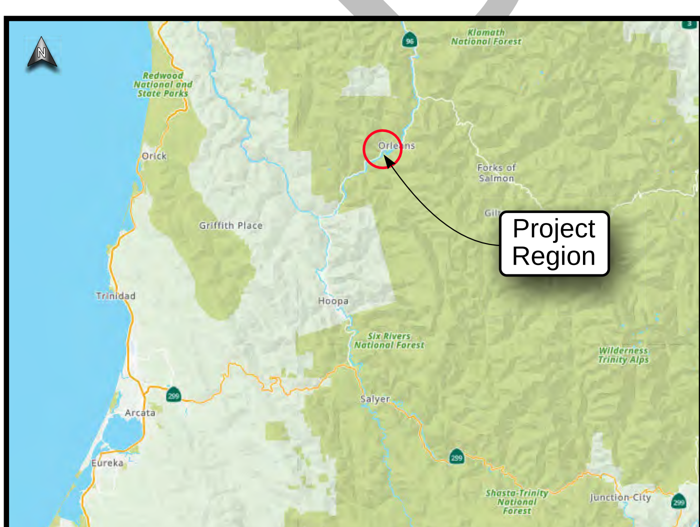
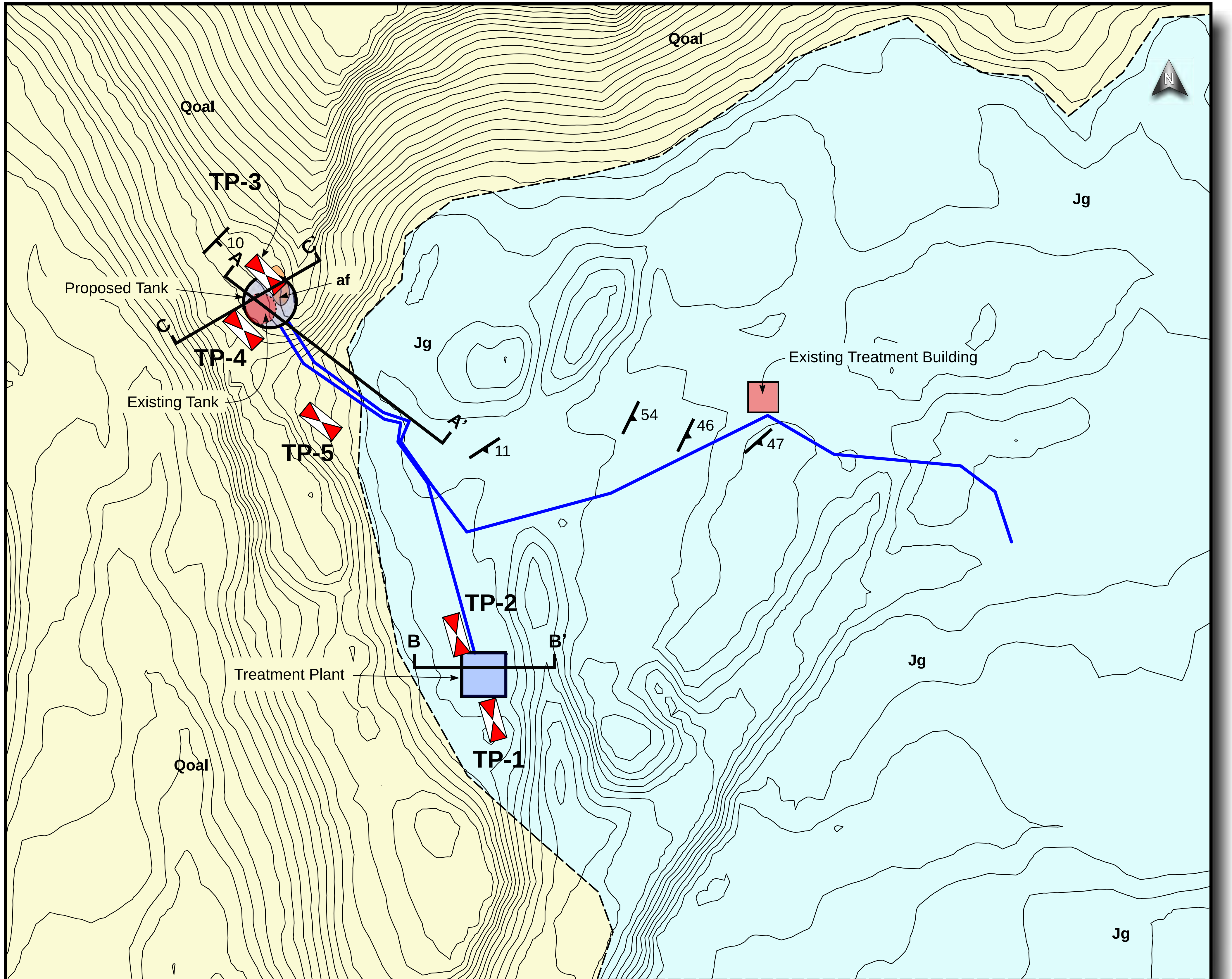




SITE LOCATION MAP

Water Treatment Plant Orleans Mutual Water Company Waterworks Engineers Humboldt County, CA	Plate No. 1
BAJADA Geosciences, Inc.	Project no. 2201.0119

Base maps from Mapquest. Scale undetermined.



af — Artificial Fill
Qoal — Older Alluvium (Sandy Gravel)
Jg — Galice Formation (Phyllite)

TP-5 — Approximate Test Pit Locations

64 — Strike and dip of bedding

64 — Strike and dip of inclined foliation

C C' — Cross Sections see Plates 4.1, 4.2, & 4.3

0 40 80
Scale: 1"=80'
1:960

Contour Intervals: 5'

GEOTECHNICAL MAP

Water Treatment Plant
Orleans Mutual Water Company
Waterworks Engineers
Humboldt County, CA

Plate No.
2

BAJADA Geosciences, Inc.

Project no.
2201.0119

Base maps from derived from open-source LiDAR data.

Q	Alluvium
Qt	Terrace Deposits
Jg	Galice Formation

REGIONAL GEOLOGIC MAP

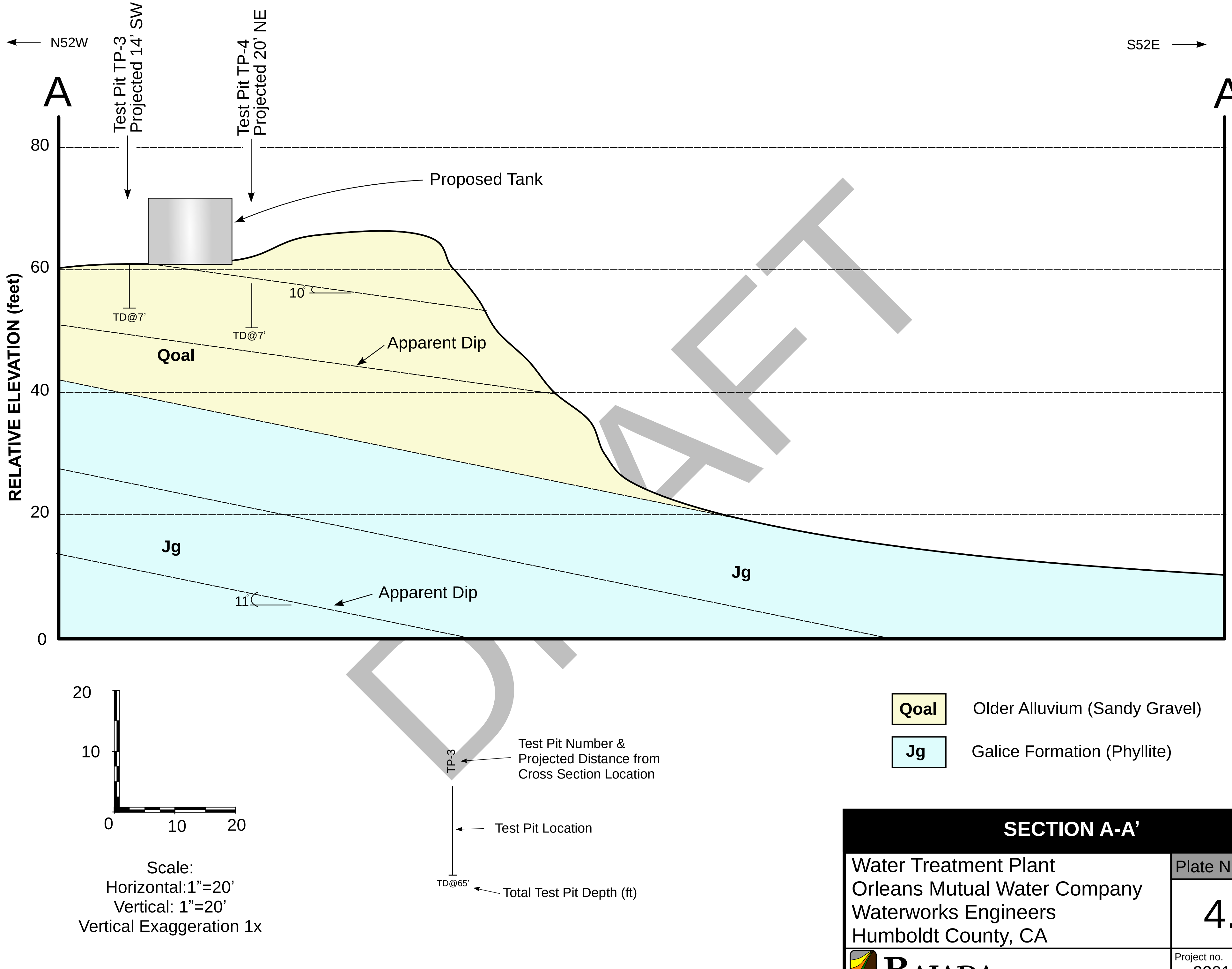
Water Treatment Plant
Orleans Mutual Water Company
Waterworks Engineers
Humboldt County, CA

Plate No. 3

BAJADA Geosciences, Inc.

Project no. 2201.0119

Base map from Wagner & Saucedo (1987). Scale undetermined.



Scale:
Horizontal:1”=20’
Vertical: 1”=20’
Vertical Exaggeration 1x

Qoal	Older Alluvium (Sandy Gravel)
Jg	Galice Formation (Phyllite)

See Plate 2 for cross section location..

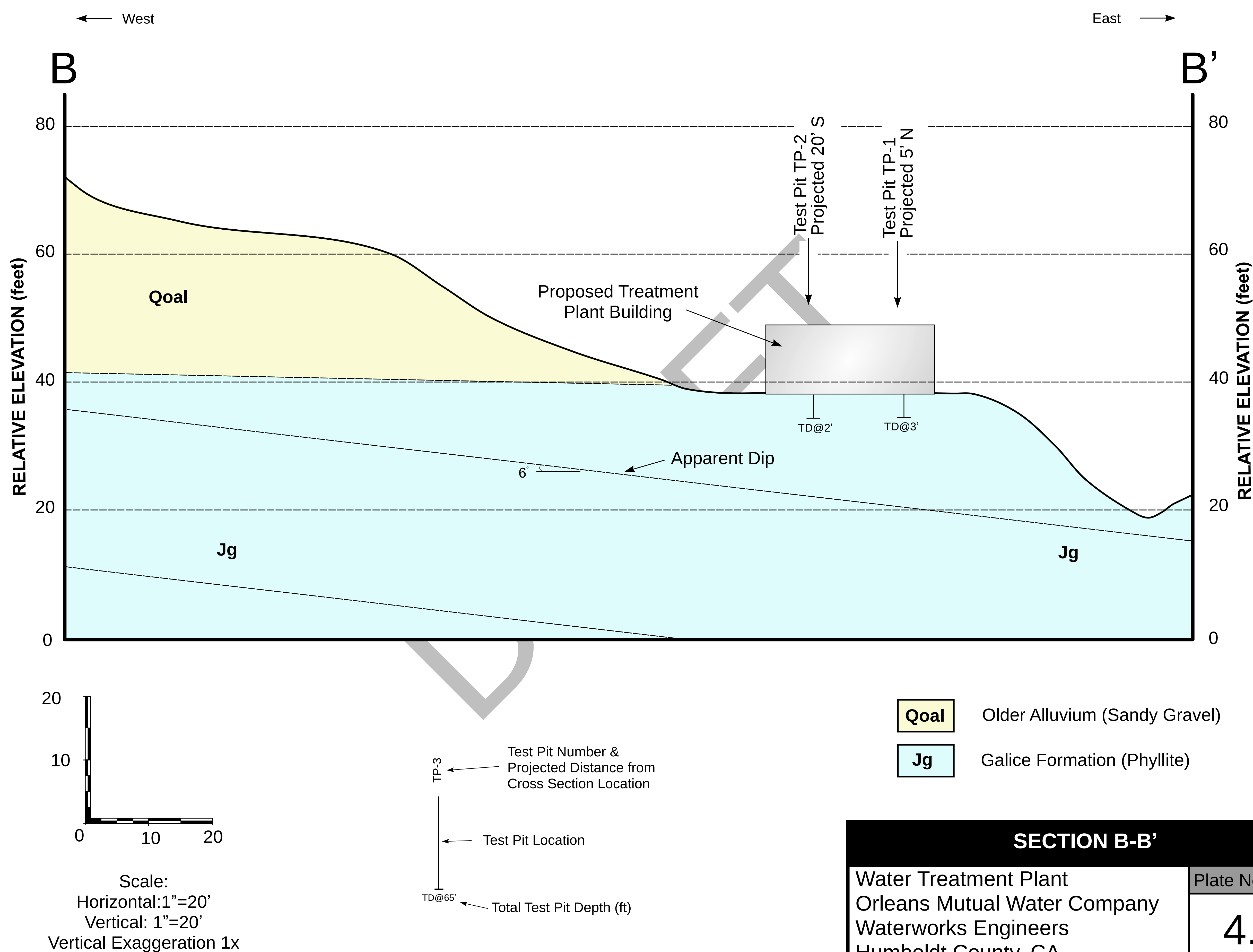
SECTION A-A’

Water Treatment Plant
Orleans Mutual Water Company
Waterworks Engineers
Humboldt County, CA

Plate No. 4.1

Project no. 2201.0119

BAJADA Geosciences, Inc.



See Plate 2 for cross section location..

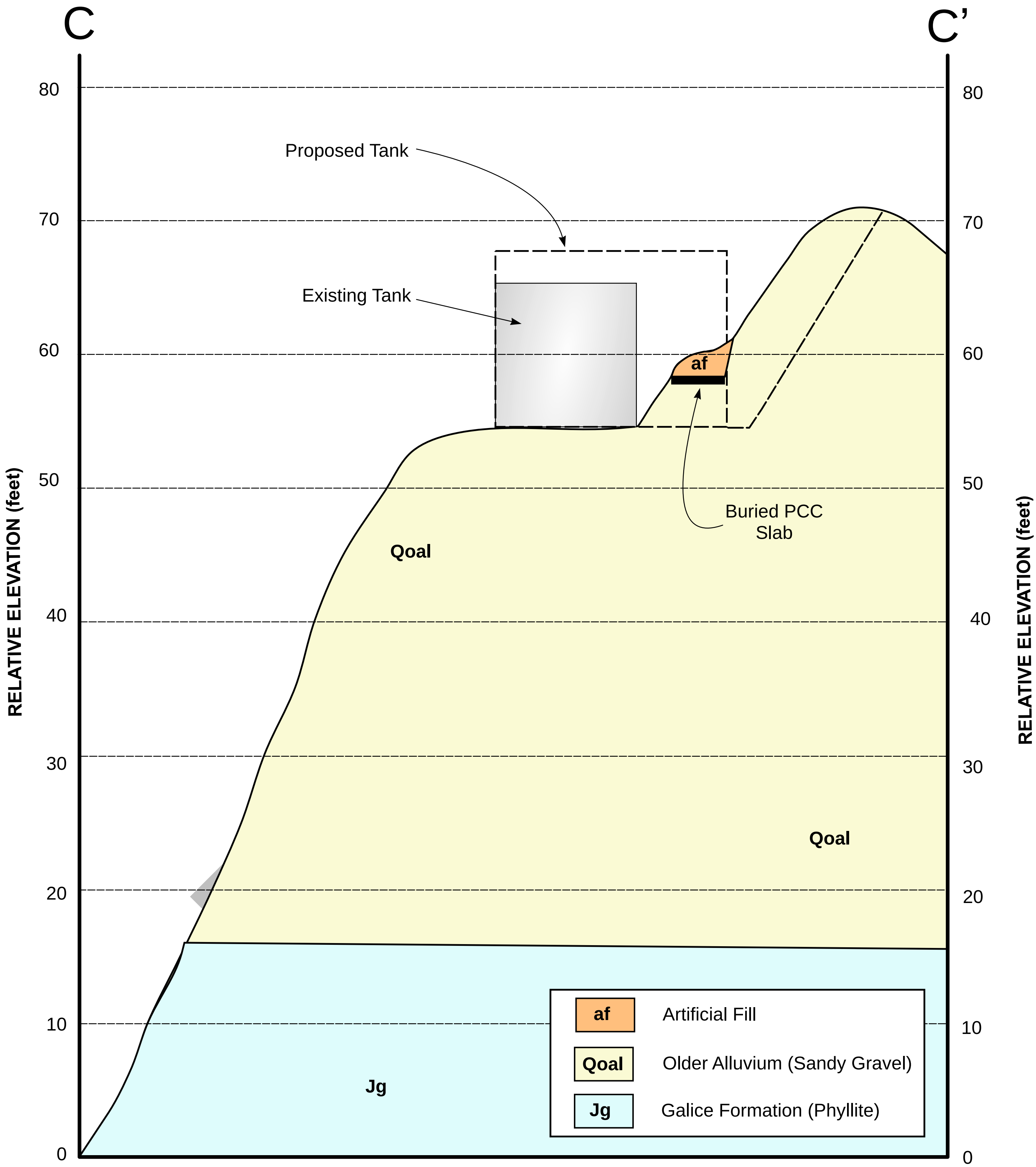
SECTION B-B'

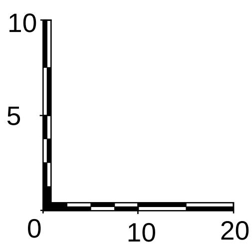
Water Treatment Plant
Orleans Mutual Water Company
Waterworks Engineers
Humboldt County, CA

BAJADA Geosciences, Inc.

Plate No. 4.2

Project no. 2201.0119





Scale:
Horizontal:1"=20'
Vertical: 1"=10'
Vertical Exaggeration 2x

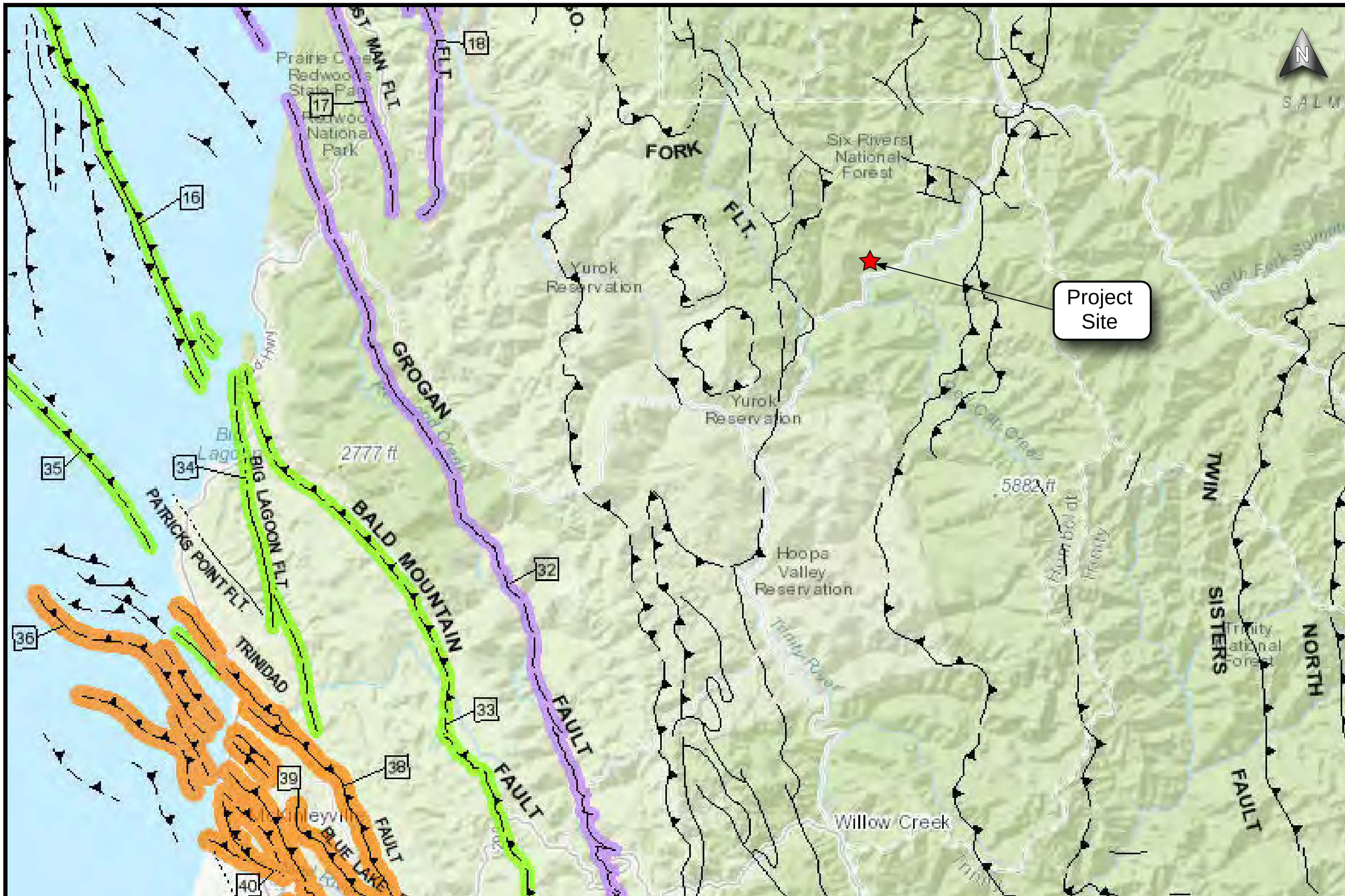
SECTION C-C'

Water Treatment Plant
Orleans Mutual Water Company
Waterworks Engineers
Humboldt County, CA

Plate No.
4.3

Project no.
2201.0119

BAJADA Geosciences, Inc.



Active	
Historic Displacement (last 200 years)	Holocene Displacement (last 11,700 years)

Potentially Active	Inactive
Late Quaternary Displacement (last 700,000 years)	Quaternary Fault (last 1.6 million years)

Base map from CGS (2022). Scale undetermined.

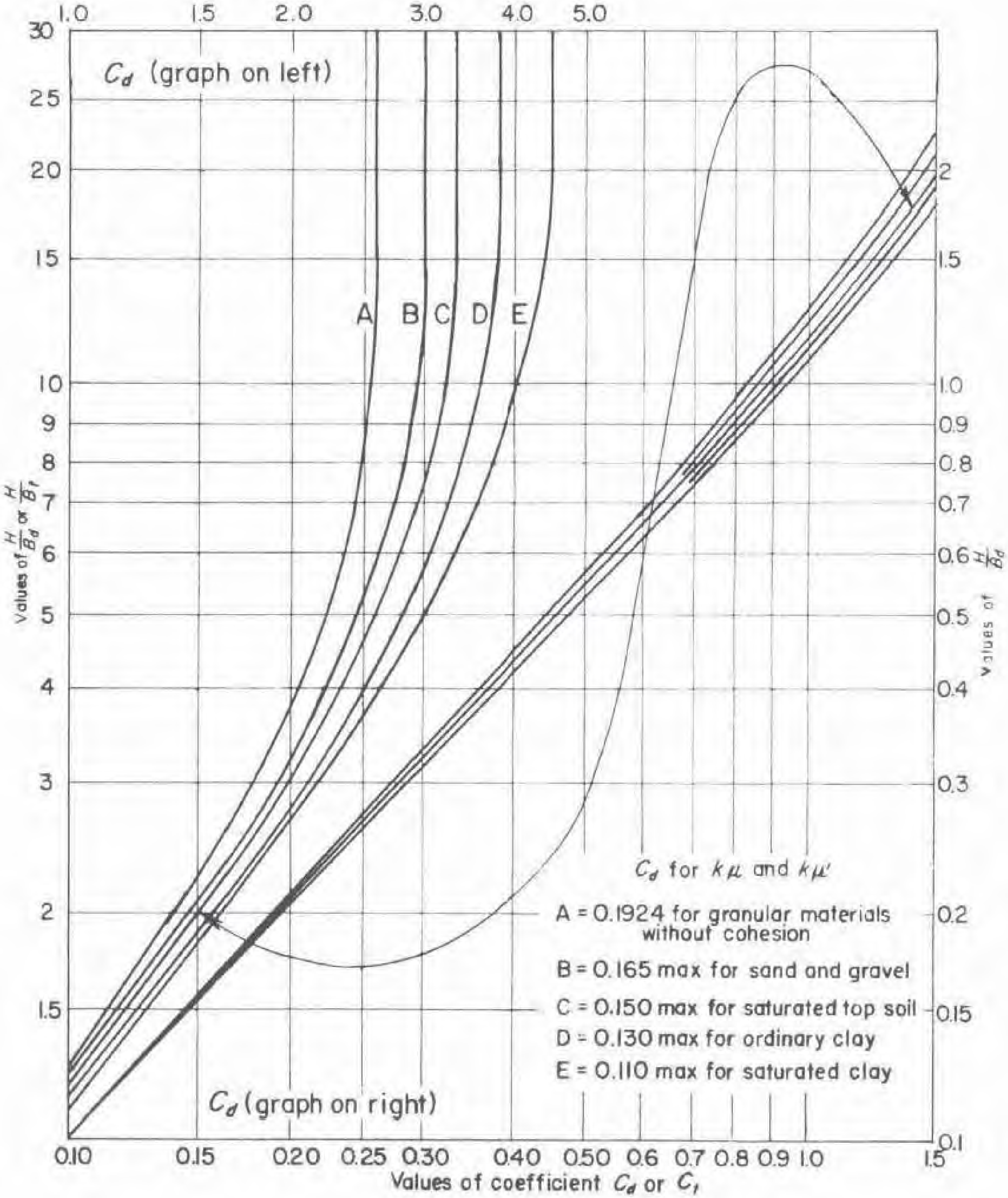
REGIONAL FAULTS

Water Treatment Plant
Orleans Mutual Water Company
Waterworks Engineers
Humboldt County, CA

Plate No.
5

BAJADA Geosciences, Inc.

Project no.
2201.0119



Curve from ASCE (1982)

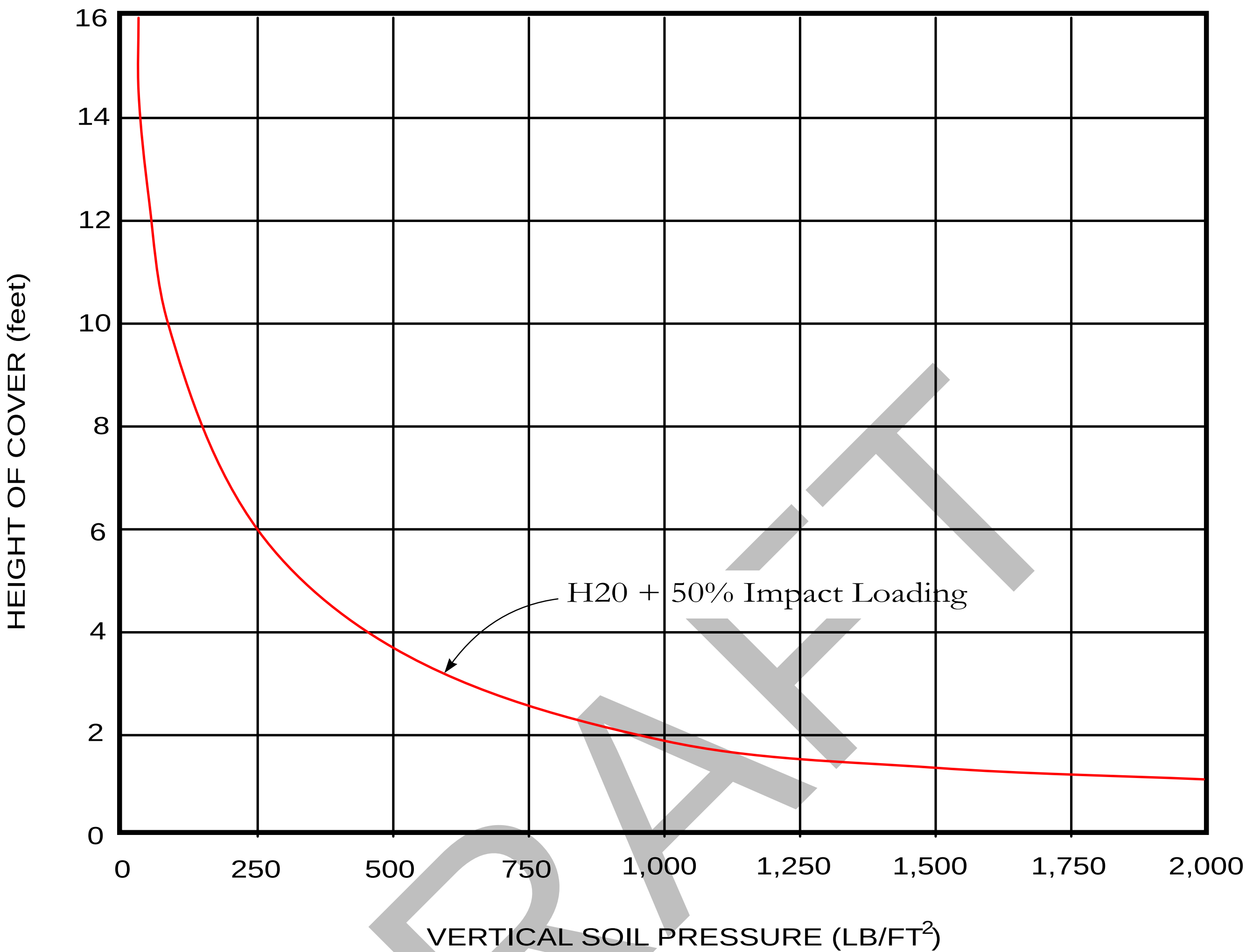
MARTSONS LOAD COEFFICIENTS

Water Treatment Plant
Orleans Mutual Water Company
Waterworks Engineers
Humboldt County, CA

Plate No. 6

BAJADA Geosciences, Inc.

Project no. 2201.0119



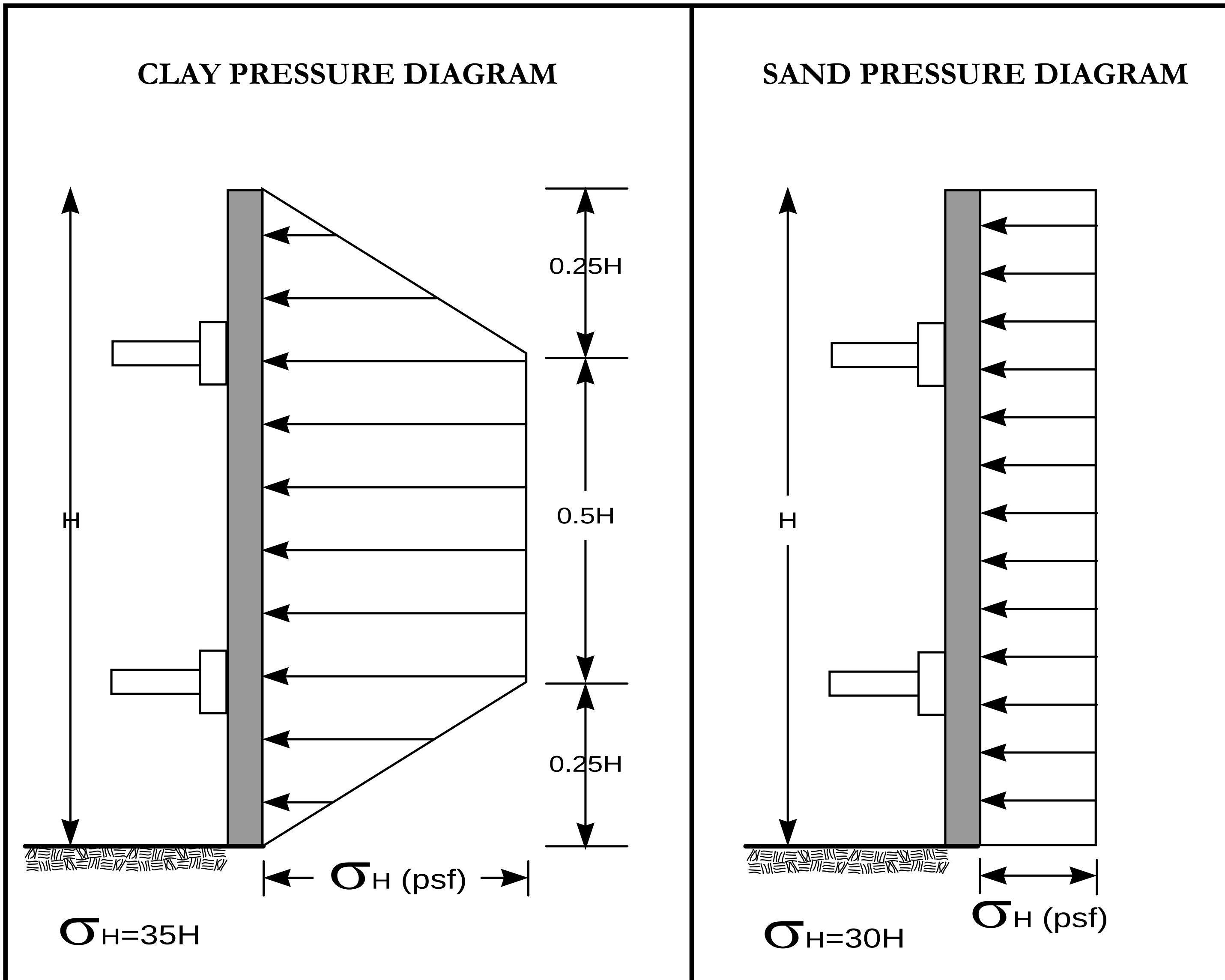
Apply vertical soil pressure to diameter of pipeline (horizontal projection to calculate vertical load

H20 +50% Impact Loading: Simulates a highway load of a 20-ton truck with a 50% impact factor to account for the dynamic effects of traffic

Derived from Moser & Feldman (2008)

VERTICAL SOIL PRESSURES INDUCED BY LIVE LOADS

Water Treatment Plant Orleans Mutual Water Company Waterworks Engineers Humboldt County, CA	Plate No. 7
BAJADA Geosciences, Inc.	Project no. 2201.0119



Preliminary shoring pressure diagrams are for excavations in unsaturated soils only.

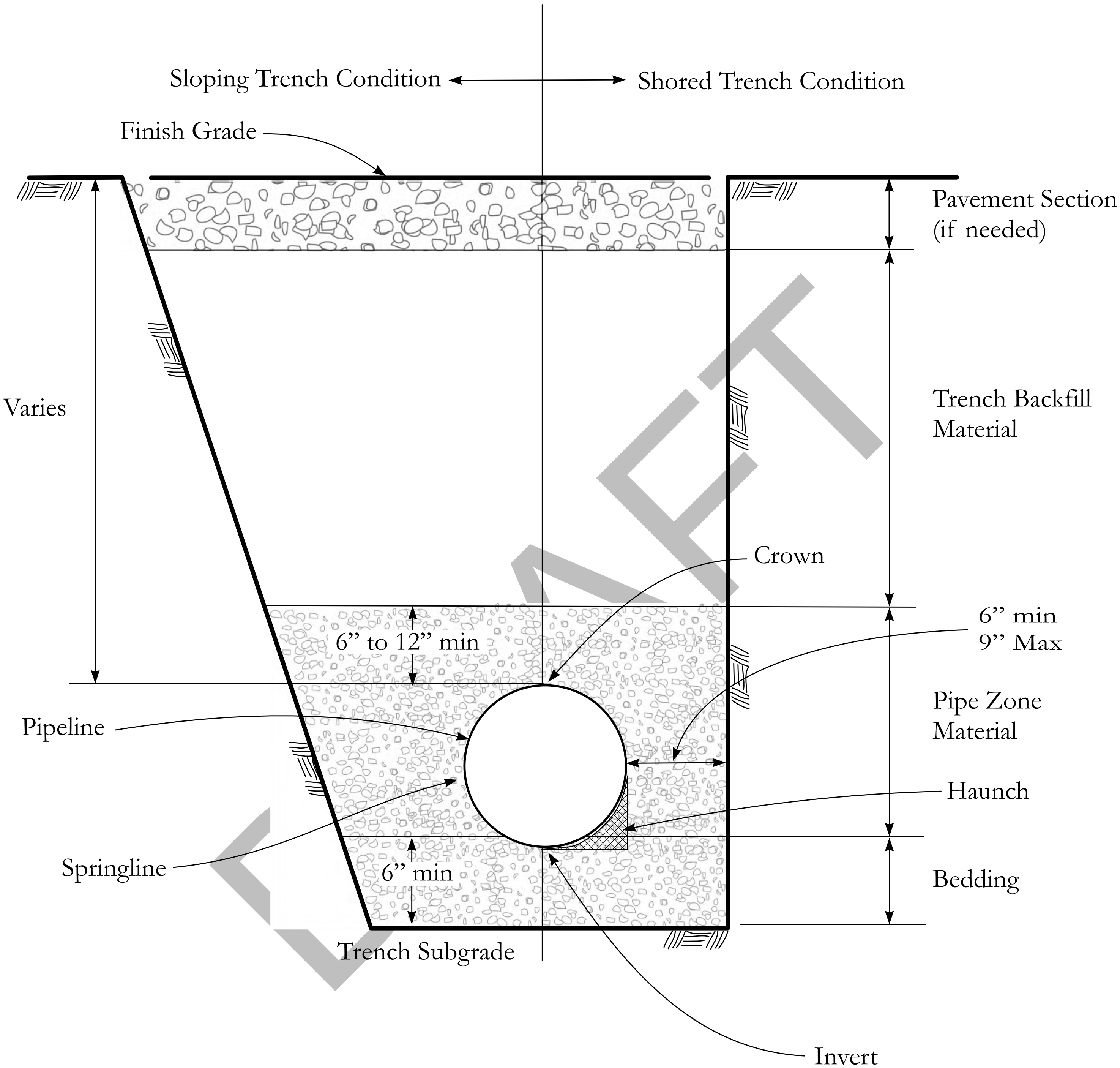
These preliminary shoring pressure diagrams do not take into account hydrostatic pressures nor surcharge pressures. The effects of these conditions must be added to these pressure diagrams where applicable.

Excavation base stability should be analyzed after base width has been selected.

Final design shoring pressure diagrams will need to be developed by the Contractor based on selection of a shoring system and the actual soil, groundwater, and surcharge conditions encountered during construction.

PRELIMINARY SHORING PRESSURE DIAGRAMS

Water Treatment Plant Orleans Mutual Water Company Waterworks Engineers Humboldt County, CA	Plate No. 8
BAJADA Geosciences, Inc.	Project no. 2201.0119



Not to Scale

TRENCH NOMENCLATURE

Water Treatment Plant
Orleans Mutual Water Company
Waterworks Engineers
Humboldt County, CA

Plate No. 9

BAJADA Geosciences, Inc.

Project no. 2201.0119

APPENDIX A

Subsurface Exploration

APPENDIX A
SUBSURFACE EXPLORATION

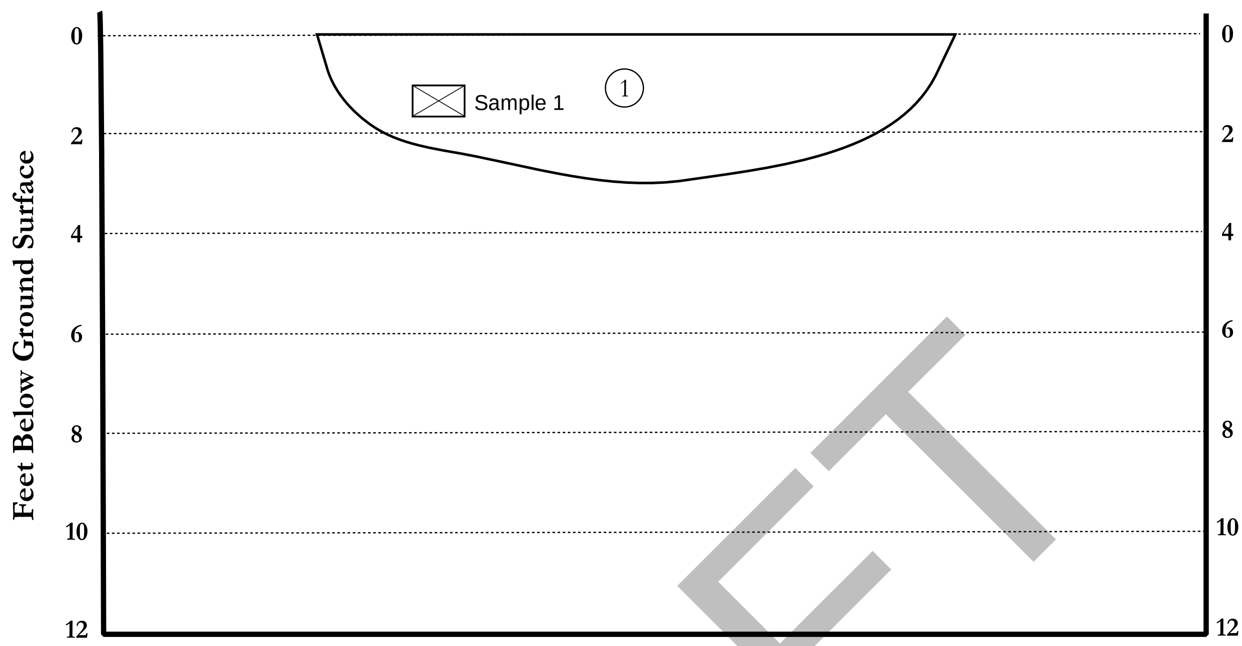
The subsurface exploration program for this study consisted of the advancement of five exploratory test pits at selected locations shown on Plate 2. Test pits were excavated on May advanced on May 19, 2022, using a Case 580 Super M+ backhoe equipped with a 2-foot-wide bucket.

Bulk samples of soil and rock were collected from selected depth increments from the test pits. Sample types and depths are presented on Plates A-1.1 and A-1.3. All samples were returned to Bajada's office for later assignment of laboratory testing.

The exploration logs describe the earth materials encountered in each test pit. The logs also show the location, exploration number, date of exploration, and the names of the logger and equipment used. A BAJADA geologist, using ASTM 2488 for visual soil classification, logged the explorations and samples. The boundaries between soil types shown on the logs are approximate because the transition between different soil layers may be gradual and may change with time. The test pits were backfilled with the excavated earth materials and wheel rolled.

The test pit logs are presented as Plates A-1.1 through A-1.5. A legend to the test pit logs is presented as Plate A-2.1.

LOG OF TEST PIT



Soil Descriptions	
1	GALICE FORMATION (Jg) PHYLLITE (rx), medium to dark gray, weak, poorly indurated, locally fissile, highly fractured with platy rock structure.

DRAFT

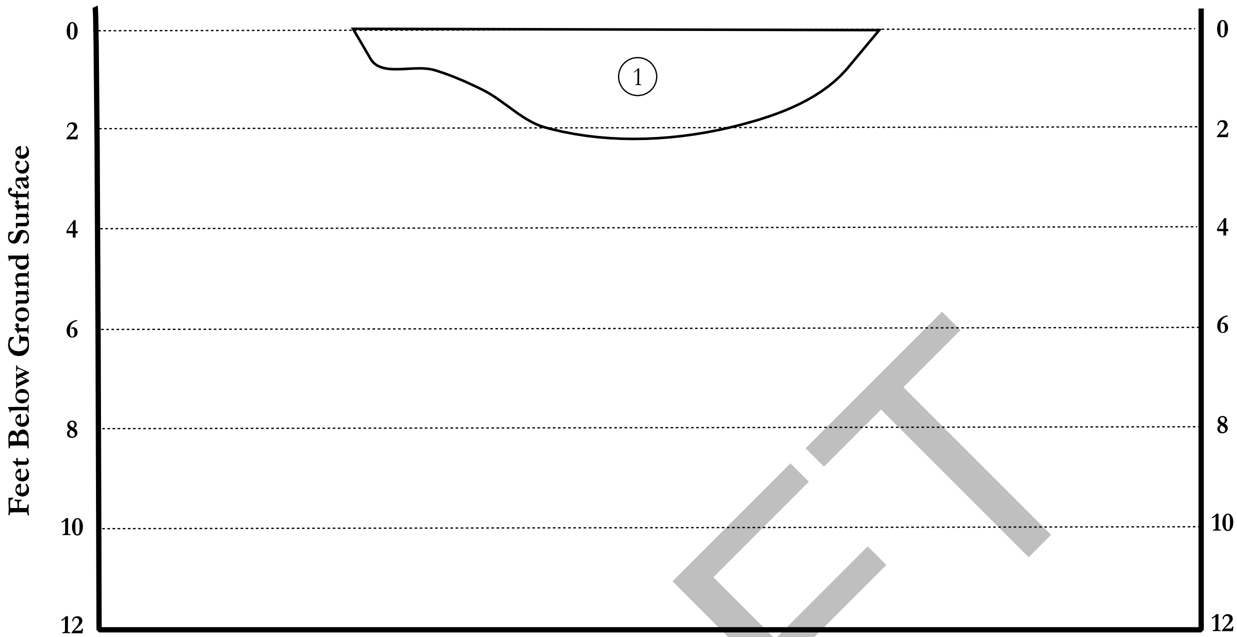
Estimated Latitude:	41.2981380°
Estimated Longitude:	-123.5630625°

Measured using Bad Elf GNSS Surveyor
Not considered survey quality

TEST PIT TP-1

Date Logged:	May 19, 2022	Water Treatment Plant Orleans Mutual Water Company Waterworks Engineers Humboldt County, CA	Plate No. A-1.1
Logged by:	Jim Bianchin		
Excavator:	TT Construction		
Excavated With:	Cas 580 Super M+	BAJADA Geosciences, Inc.	Project no. 2201.0119
Backfilled With:	Excavated Cuttings		
Depth to Water (ft):	Not Encountered		

LOG OF TEST PIT



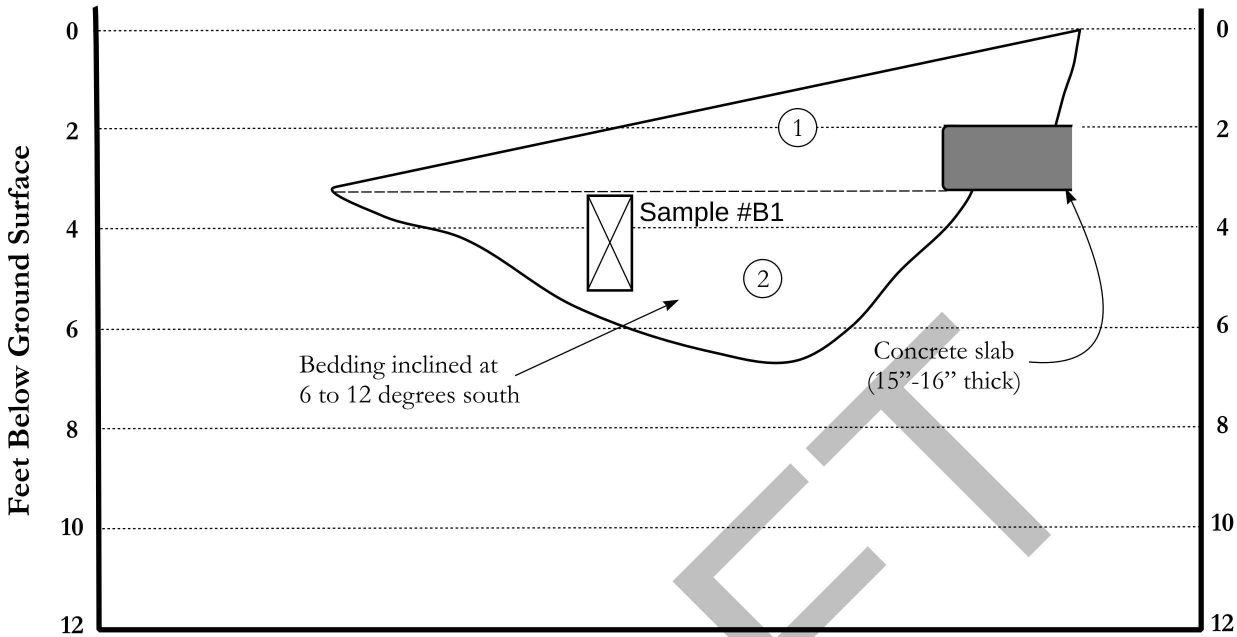
Soil Descriptions	
1	GALICE FORMATION (Jg) PHYLLITE (rx), medium to dark gray, weak, poorly indurated, locally fissile, highly fractured with platy rock structure.

Estimated Latitude: 41.2982511°
Estimated Longitude: -123.5631136°
Measured using Bad Elf GNSS Surveyor
Not considered survey quality

TEST PIT TP-2

Date Logged:	May 19, 2022	Water Treatment Plant Orleans Mutual Water Company Waterworks Engineers Humboldt County, CA	Plate No. A-1.2
Logged by:	Jim Bianchin		
Excavator:	TT Construction		
Excavated With:	Cas 580 Super M+		
Backfilled With:	Excavated Cuttings	BAJADA Geosciences, Inc.	Project no. 2201.0119
Depth to Water (ft):	Not Encountered		

LOG OF TEST PIT



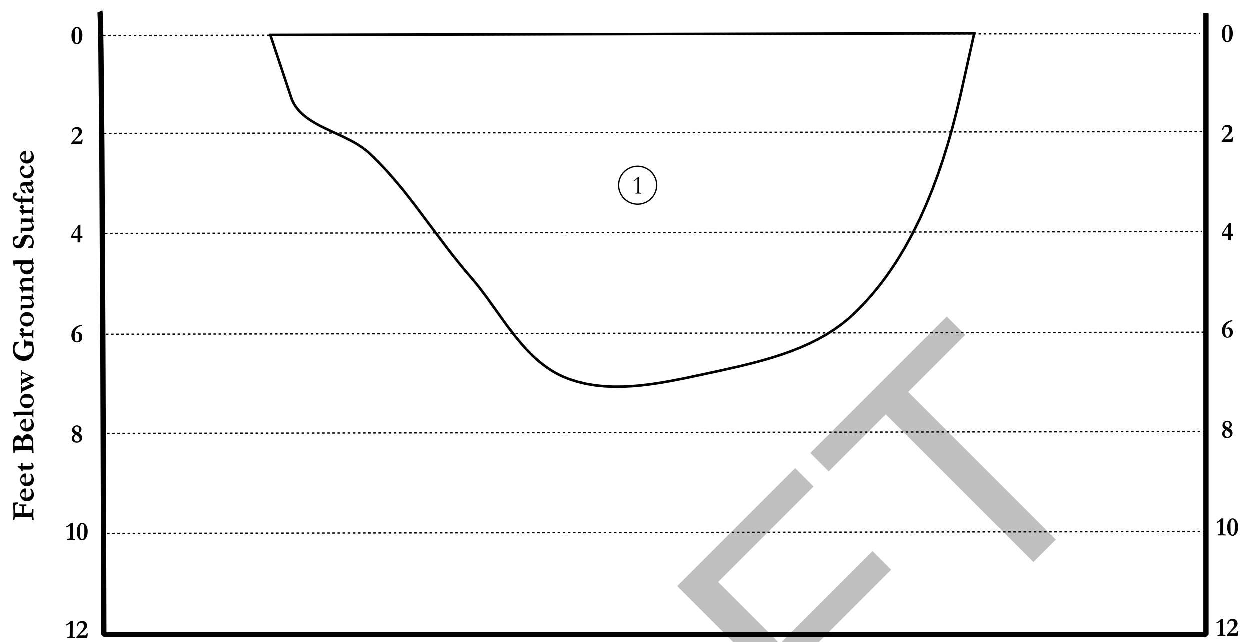
Soil Descriptions	
1	ARTIFICIAL FILL (af) Sandy GRAVEL (GP), moderate brown, moist, medium dense, slightly cemented, fine to coarse grained with abundant fine to coarse subrounded gravels, fine to coarse subrounded cobbles, and boulder up to at least 18 inches in diameter.
2	OLDER ALLUVIUM (Qoal) Sandy GRAVEL (GP), moderate brown, moist, dense to very dense, slightly cemented, fine to coarse grained with abundant fine to coarse subrounded gravels, fine to coarse subrounded cobbles, and boulder up to at least 18 inches in diameter.

Estimated Latitude: 41.2989684°
Estimated Longitude: -123.5637607°
Measured using Bad Elf GNSS Surveyor
Not considered survey quality

TEST PIT TP-3

Date Logged:	May 19, 2022	Water Treatment Plant	Plate No.
Logged by:	Jim Bianchin	Orleans Mutual Water Company	A-1.3
Excavator:	TT Construction	Waterworks Engineers	
Excavated With:	Cas 580 Super M+	Humboldt County, CA	
Backfilled With:	Excavated Cuttings	BAJADA Geosciences, Inc.	Project no.
Depth to Water (ft):	Not Encountered		2201.0119

LOG OF TEST PIT



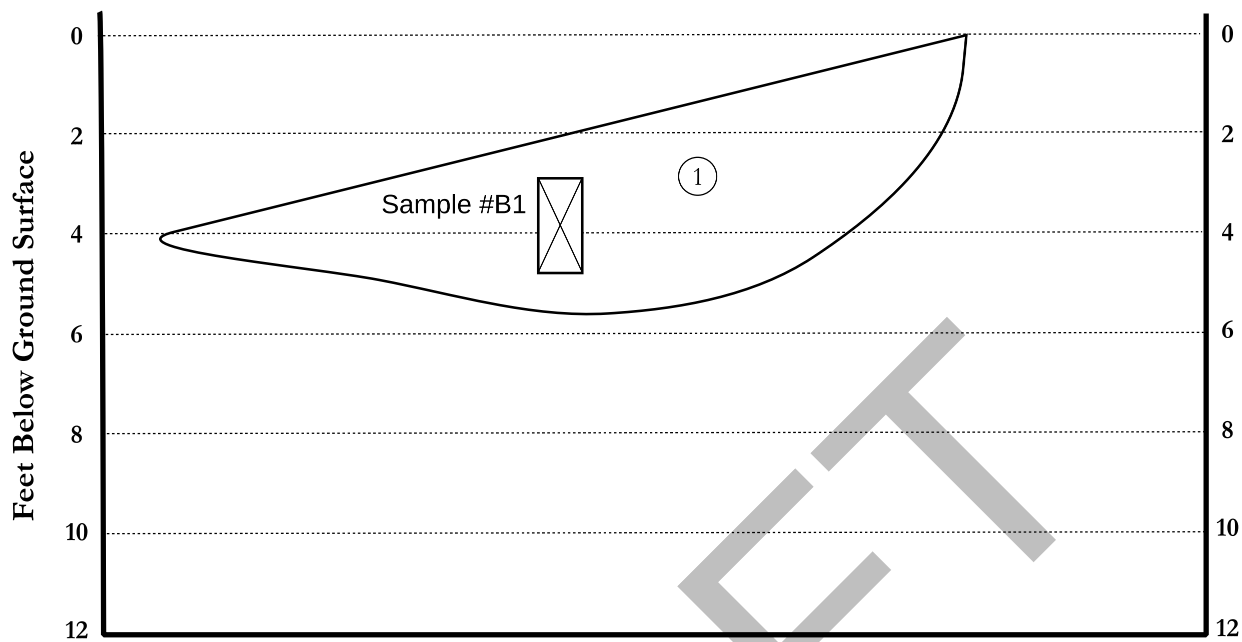
Soil Descriptions	
1	OLDER ALLUVIUM (Qoal) Sandy GRAVEL (GP), moderate brown, moist, dense to very dense, slightly cemented, fine to coarse grained with abundant fine to coarse subrounded gravels, fine to coarse subrounded cobbles, and boulder up to at least 18 inches in diameter.

Estimated Latitude: 41.2989606°
Estimated Longitude: -123.5637900°
Measured using Bad Elf GNSS Surveyor
Not considered survey quality

TEST PIT TP-4

Date Logged:	May 19, 2022	Water Treatment Plant	Plate No.
Logged by:	Jim Bianchin	Orleans Mutual Water Company	A-1.4
Excavator:	TT Construction	Waterworks Engineers	
Excavated With:	Cas 580 Super M+	Humboldt County, CA	
Backfilled With:	Excavated Cuttings	BAJADA Geosciences, Inc.	Project no.
Depth to Water (ft):	Not Encountered		2201.0119

LOG OF TEST PIT



Soil Descriptions	
1	OLDER ALLUVIUM (Qoal) Sandy GRAVEL (GP), moderate brown, moist, dense to very dense, slightly cemented, fine to coarse grained with abundant fine to coarse subrounded gravels, fine to coarse subrounded cobbles, and boulder up to at least 18 inches in diameter.

Estimated Latitude: 41.2989606°
Estimated Longitude: -123.5637900°
Measured using Bad Elf GNSS Surveyor
Not considered survey quality

TEST PIT TP-5

Date Logged:	May 19, 2022	Water Treatment Plant Orleans Mutual Water Company Waterworks Engineers Humboldt County, CA	Plate No. A-1.5
Logged by:	Jim Bianchin		
Excavator:	TT Construction		
Excavated With:	Cas 580 Super M+		
Backfilled With:	Excavated Cuttings	BAJADA Geosciences, Inc.	Project no. 2201.0119
Depth to Water (ft):	Not Encountered		

Major Divisions			USCS Symbol	Description
COARSE-GRAINED SOILS More than 50% of sample or material is larger than the No. 200 Sieve (0.0029 inches)	GRAVELS More than 50% of the coarse fraction is retained on No. 4 sieve (0.187 inches)	GRAVELS Clean Gravels, few fines	GW	Well graded gravels and sand mixtures with little to no fines
			GP	Poorly graded gravels & gravel/sand mixtures with little to no fines
		GRAVELS With appreciable fines	GM	Silty gravels and poorly graded gravel/sand/silt mixtures
			GC	Clayey gravels and poorly graded gravel/sand/clay mixtures
	SANDS More than 50% of the coarse fraction passes the No. 4 sieve (0.187 inches)	SANDS Clean Sands, few fines	SW	Well graded sands and gravelly sands with little to no fines
			SP	Poorly graded sands and gravelly sands with little to no fines
		SANDS With appreciable fines	SM	Silty sands and poorly graded sand/gravel/silt mixtures
			SC	Clayey sands and poorly graded sand/gravel/clay mixtures
FINE-GRAINED SOILS More than 50% of sample or material is smaller than the No. 200 Sieve (0.0029 inches)	SILTS & CLAYS Liquid limit less than 50		ML	Inorganic silts with very fine sands, silty and/or clayey fine sands, clayey silts with slight plasticity
			CL	Inorganic clays with low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and clays with low plasticity
	SILTS & CLAYS Liquid limit greater than 50		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts
			CH	Inorganic clays with high plasticity, fat clays
			OH	Orgainic silts and clays with high plasticity
HIGHLY ORGANIC SOIL			PT	Peat, humus, swamp soil with high organic content

Samples

Bulk or disturbed sample

Relatively undisturbed sample

Symbols

Groundwater

Caving

Contact Between Soil/Rock Layers

GENERAL NOTES

Dual symbols (such as ML/CL or SM/SC) are used to indicate borderline classifications.
In general, USCS designations shown on the logs were evaluated using visual methods. Actual designations (based on laboratory tests) may vary.
Logs represent general soil conditions observed on the date and locations indicated. No warranty is provided regarding soil continuity between locations.
Lines separating soil strata on logs are approximate. Actual transitions may be gradual and vary with depth.

TEST PIT LEGEND TO TERMS & SYMBOLS

Water Treatment Plant
Orleans Mutual Water Company
Waterworks Engineers
Humboldt County, CA

Plate No. A-2.0

BAJADA Geosciences, Inc.

Project no. 2201.0119

APPENDIX B
Laboratory Testing

APPENDIX B
LABORATORY TESTING

Laboratory Analyses

Laboratory tests were performed on selected bulk soil samples to estimate engineering characteristics of the various earth materials encountered. Testing was performed under procedures described in one of the following references:

- ASTM Standards for Soil Testing, latest revision;
- Lambe, T. William, Soil Testing for Engineers, Wiley, New York, 1951;
- Laboratory Soils Testing, U.S. Army, Office of the Chief of Engineers, Engineering Manual No. 1110-2-1906, November 30, 1970.

In-Situ Moisture Density Relations

Estimates of soil moisture content evaluations were performed on selected soil samples collected during this study. Tests were performed using standard test methods ASTM D2216. The results are presented on the respective Log of Test Pit.

Grain Size Distribution

Grain size distribution was determined for two selected soil samples in accordance with standard test method ASTM D422. The grain size distribution data are shown on the attached plates labeled *Particle Size Distribution*.

Plasticity Index Tests

Atterberg Limits (plastic limit, liquid limit, and plasticity index) tests were performed on two selected samples in accordance with standard test method ASTM D4318. The results of the test are presented on the drill hole logs and on attached plates.

Direct Shear Tests

Direct shear tests were performed on two selected soil samples in accordance with standard test method ASTM D3080. Results of those tests are presented on attached plates labeled *Consolidated Drained Direct Shear*.

Maximum Density & Optimum Moisture

Two selected soil samples were tested to evaluate the maximum density and optimum moisture content of those soils. Tests were performed in accordance with standard test method ASTM D1557. Results of those tests are presented on the attached plates labeled *Laboratory Proctor Test Reports*.

Unconfined Compression Test

One rock sample was tested to estimate its unconfined compressive strength. The test was performed in accordance with standard test method ASTM D7012 Method D. The result of that test is presented on the attached plate labeled *Rock Core Compressive Strength Data*.

Soil Chemistry Tests for Corrosion

Three selected soil samples were tested to evaluate sulfate and chloride contents, pH, and resistivity. Tests were performed in accordance with standard test methods ASTM G51 and G75, and California Test Method 417 and 422. Test results are presented on the attached plate labeled *Corrosivity Test Summary*.

M T I
Materials Testing, Inc.

8798 Airport Road
Redding, California 96002
(530) 222-1116, fax 222-1611

865 Cotting Lane, Suite A
Vacaville, California 95688
(707) 447-4025, fax 447-4143

Client: BAJADA Geosciences, Inc.
28301 Inwood Road
Shingletown, CA 96088

Project: Orleans WTP #2201.0119
Humboldt County, California

Client No.: 3237-076
Figure No.: 0300-001
Date: 07/06/2022

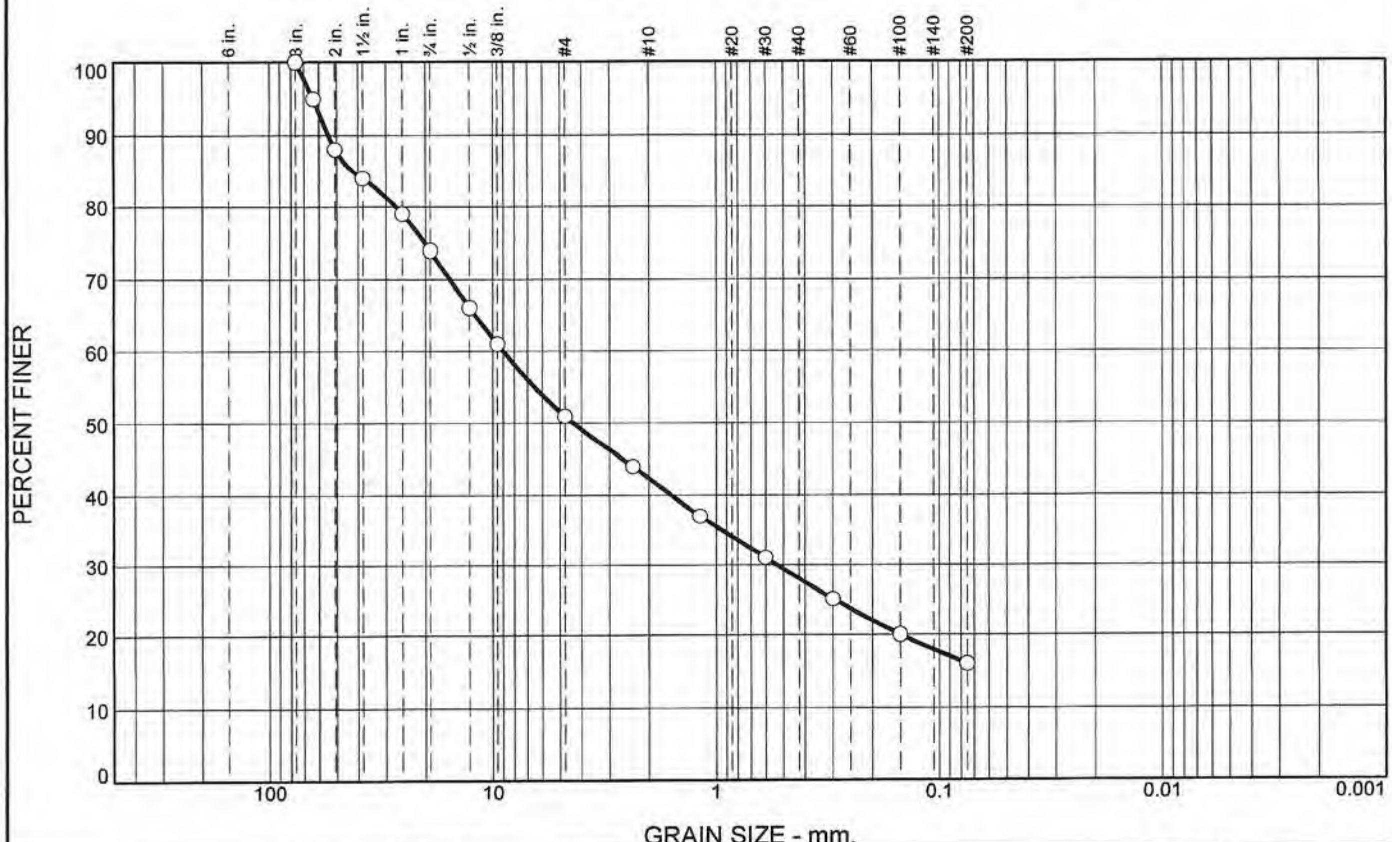
Submitted by: KC Engineering
Date Sampled: 06/07/2022

As Received Moisture Content of Soil (ASTM D2216) and Liquid Limit, Plastic Limit & Plasticity Index of Soils (ASTM D4318)

Sample #	Description	Dry Density p.c.f.	Moisture Content %	Liquid Limit	Plastic Limit	Plastic Index
TP-3, B1 @ 1.0'-3.0'	Gray Silty Gravel with Sand	---	9.6	30	26	4
TP-5, B1 @ 1.0'-3.0'	Gray Gravel with Silt and Sand	---	8.9	---	---	NP

Tested by John Hubbard.

PARTICLE SIZE DISTRIBUTION REPORT



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	26	23	9	14	12	16	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100		
2-1/2"	95		
2"	88		
1 1/2"	84		
1"	79		
3/4"	74		
1/2"	66		
3/8"	61		
#4	51		
#8	44		
#16	37		
#30	31		
#50	25		
#100	20		
#200	16		

* (no specification provided)

Material Description

Gray Silty Gravel with Sand

Atterberg Limits

PL= 26 LL= 30 PI= 4

Coefficients

D_{90}= 54.5175 D_{85}= 42.2901 D_{60}= 8.9569
D_{50}= 4.3502 D_{30}= 0.5353 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= GM AASHTO= A-1-b

Remarks

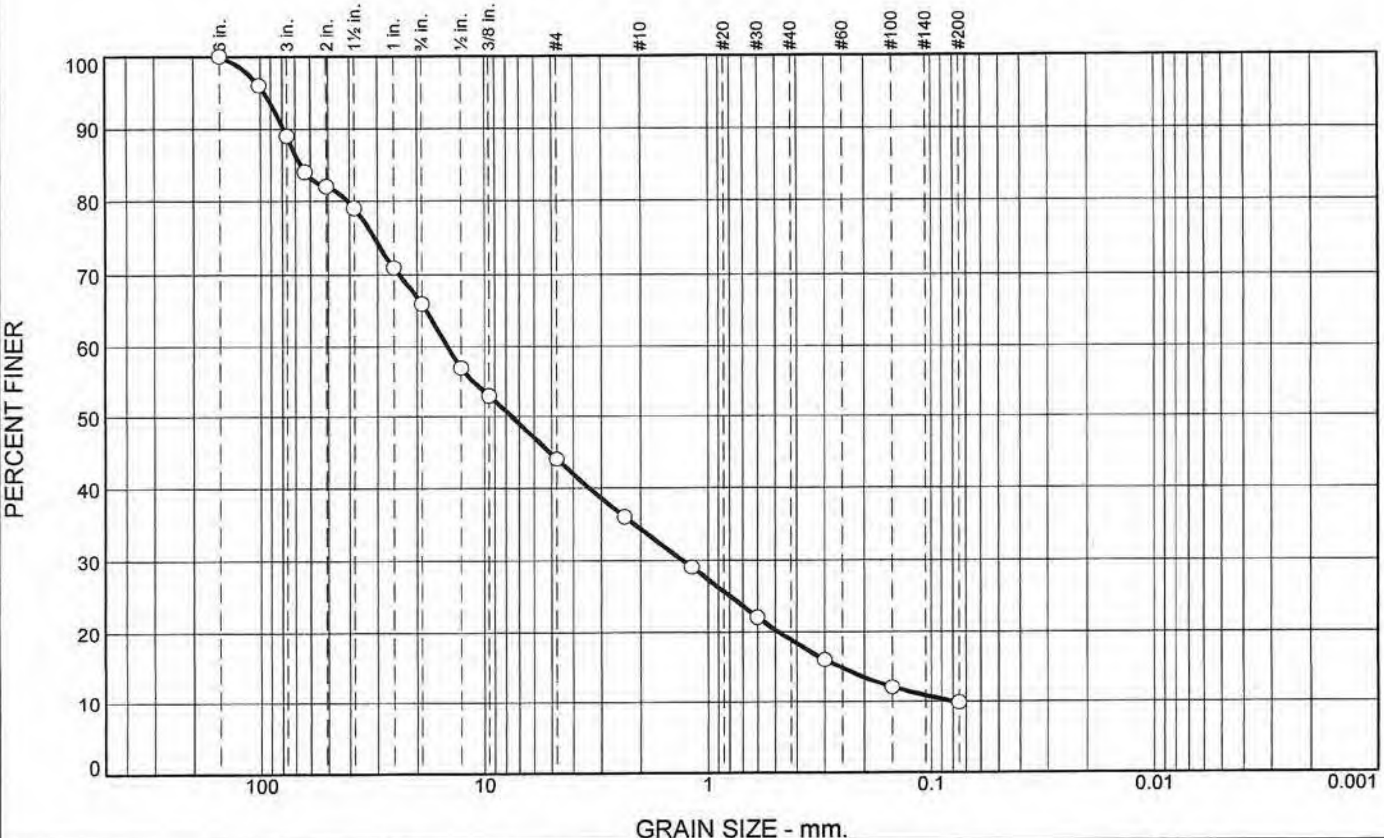
Material Tested in Accordance with ASTM D6913.

Location: TP-3, B1
Sample Number: 2 **Depth:** 1.0'-3.0' **Date:** 07/06/2022

Client: BAJADA Geosciences, Inc.
Project: Orleans WTP #2201.0119
Humboldt County, California
Project No: 3237-076 **Figure** 0300-002

Tested By: Travis Fiscus

PARTICLE SIZE DISTRIBUTION REPORT



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
11	23	22	10	15	9	10	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
6"	100		
4"	96		
3"	89		
2 1/2"	84		
2"	82		
1 1/2"	79		
1"	71		
3/4"	66		
1/2"	57		
3/8"	53		
#4	44		
#8	36		
#16	29		
#30	22		
#50	16		
#100	12		
#200	9.8		

* (no specification provided)

Material Description

Gray Gravel with Silt and Sand

Atterberg Limits

PL= NP   LL=   PI=

Coefficients

D_{90}= 78.8244 D_{85}= 66.4203 D_{60}= 14.6398
D_{50}= 7.5112 D_{30}= 1.3017 D_{15}= 0.2600
D_{10}= 0.0809 C_u= 181.04 C_c= 1.43

Classification

USCS= GW-GM   AASHTO=

Remarks

Material Tested in Accordance with ASTM D6913.

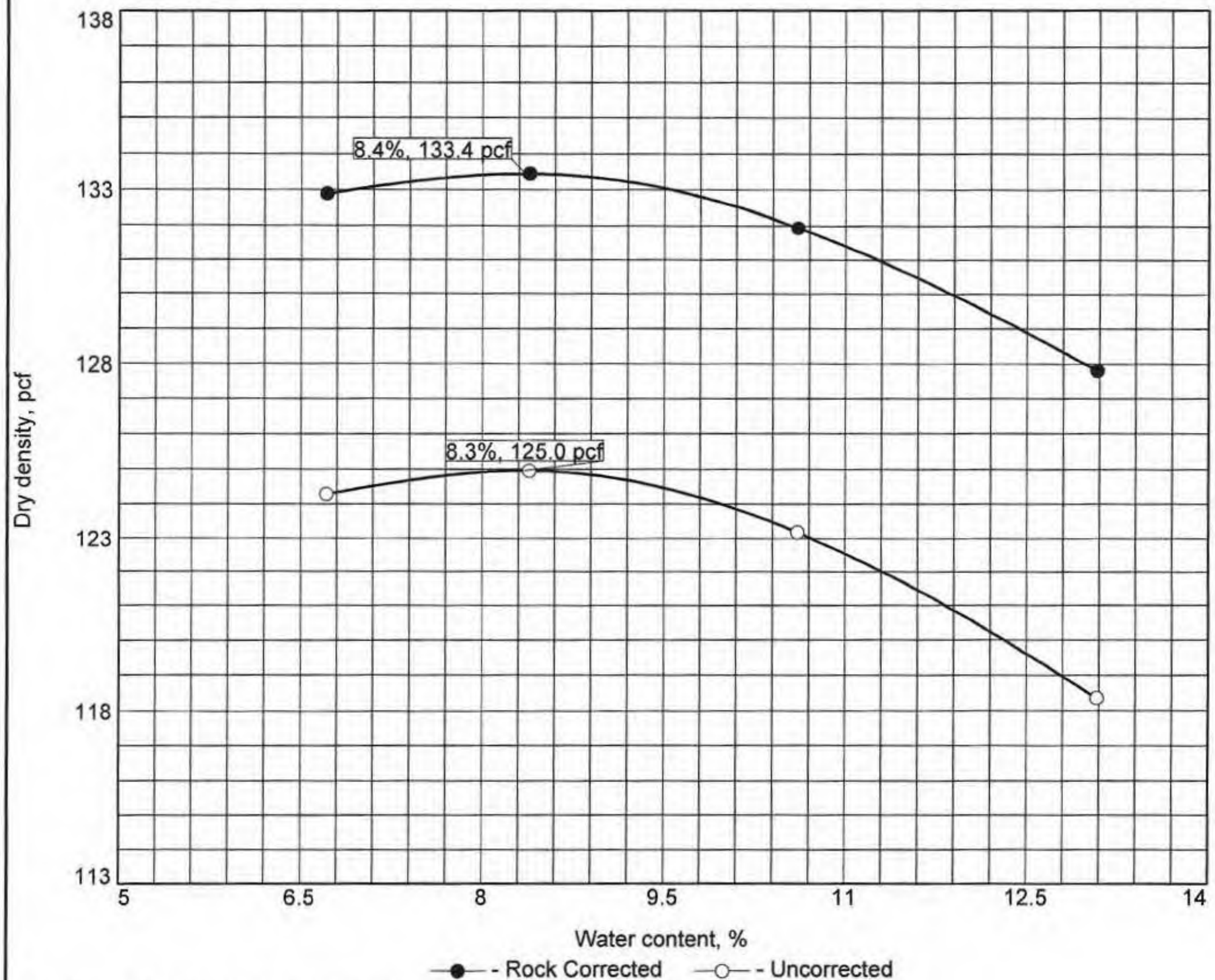
Location: TP-5, B1
Sample Number: 3   **Depth:** 1.0'-3.0'   **Date:** 07/06/2022

MATERIALS TESTING INCORPORATED M T I

Client: BAJADA Geosciences, Inc.
Project: Orleans WTP #2201.0119
Humboldt County, California
Project No: 3237-076   **Figure** 0300-003

Tested By: John Hubbard

LABORATORY PROCTOR TEST REPORT



Test specification: ASTM D1557-12 Method C (with uncorrected) Modified
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
1.0'-3.0'	GM	A-1-b		2.65	30	4	26	16

ROCK CORRECTED TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 133.4 pcf Optimum moisture = 8.4 %	Gray Silty Gravel with Sand

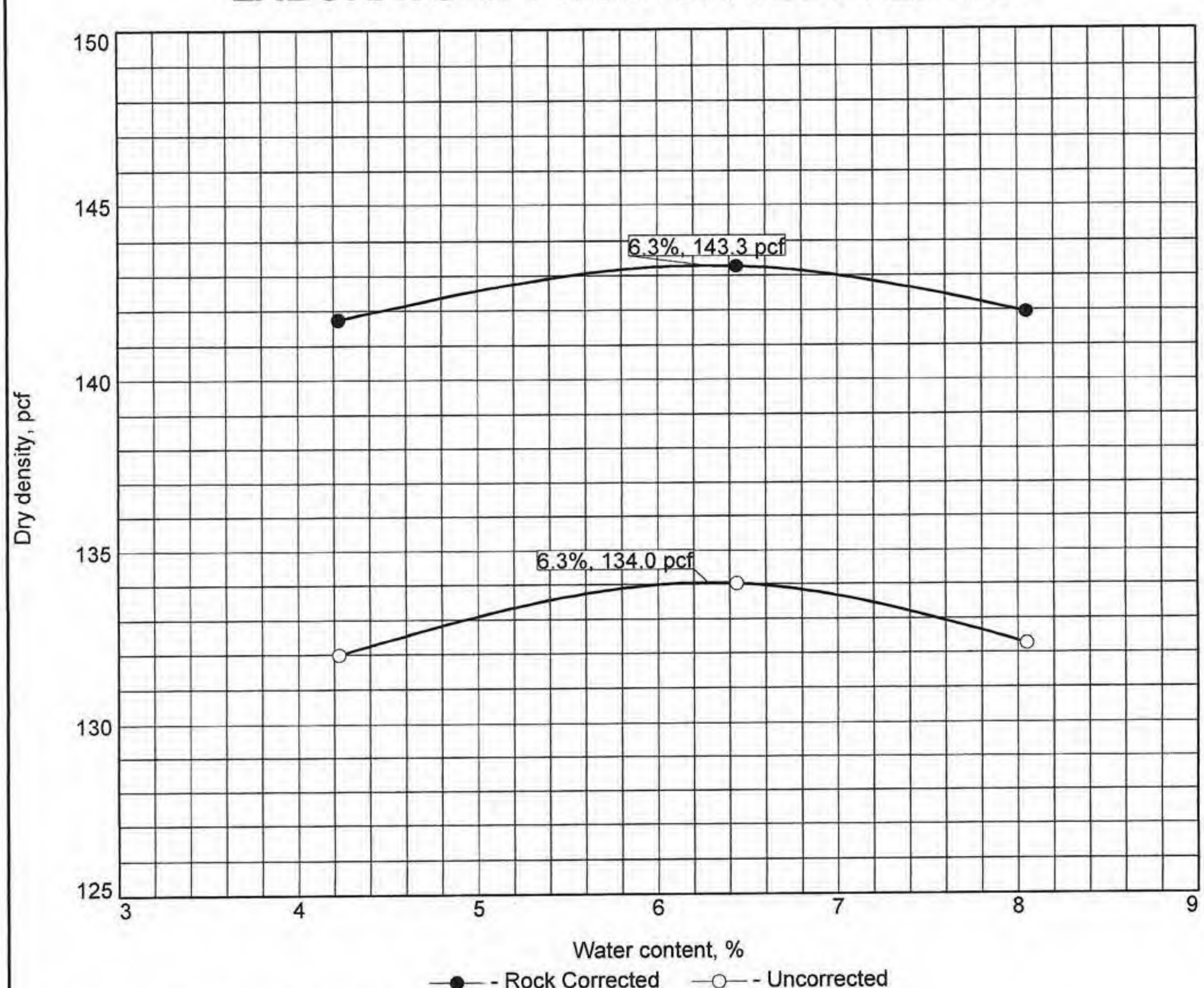
Project No. 3237-076 **Client:** BAJADA Geosciences, Inc.
Project: Orleans WTP #2201.0119
Humboldt County, California
○ **Location:** TP-3, B1 **Sample Number:** 2

Remarks:
Curve #1
07/06/2022

Figure 0300-004

Tested By: Travis Fiscus

LABORATORY PROCTOR TEST REPORT



Test specification: ASTM D1557-12 Method C (with uncorrected) Modified
ASTM D4718-15 Oversize Corr. Applied to Each Test Point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
1.0'-3.0'	GW-GM			2.65			34	9.8

ROCK CORRECTED TEST RESULTS

Maximum dry density = 143.3 pcf

Optimum moisture = 6.3 %

MATERIAL DESCRIPTION

Gray Gravel with Silt and Sand

Project No. 3237-076 **Client:** BAJADA Geosciences, Inc.
Project: Orleans WTP #2201.0119
Humboldt County, California
○ **Location:** TP-5, B1 **Sample Number:** 3

Remarks:
Curve #2
07/06/2022

Figure 0300-005

Tested By: Travis Fiscus

MTI
Materials Testing, Inc.

8798 Airport Road
Redding, California 96002
(530) 222-1116, fax 222-1611

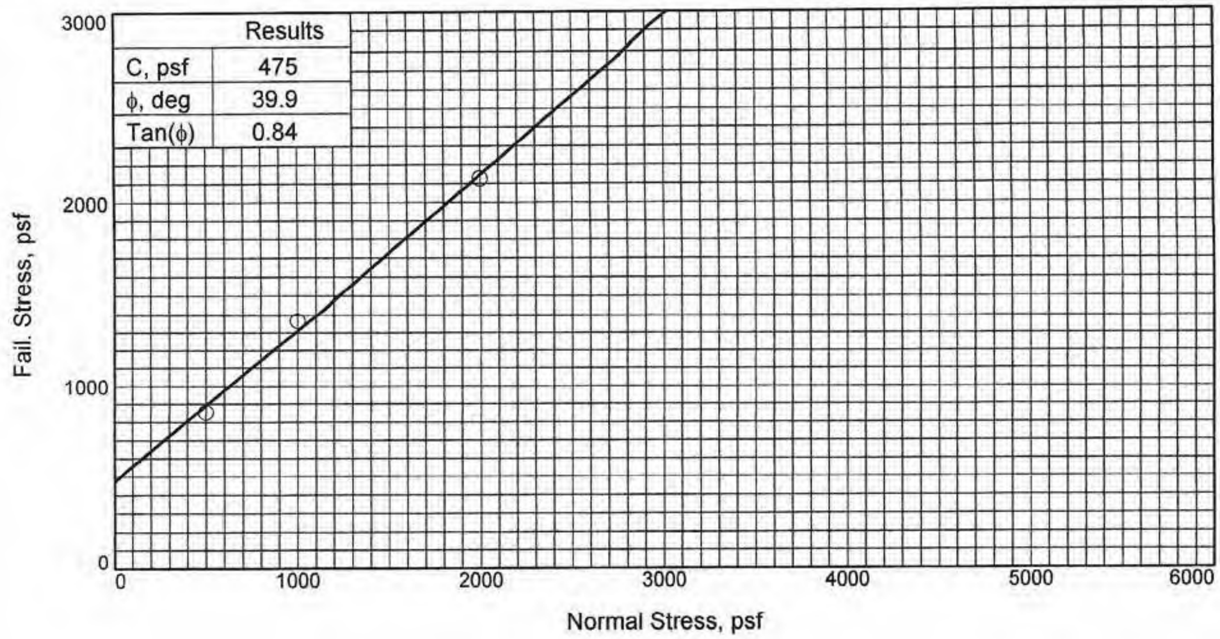
865 Cotting Lane, Suite A
Vacaville, California 95688
(707) 447-4025, fax 447-4143

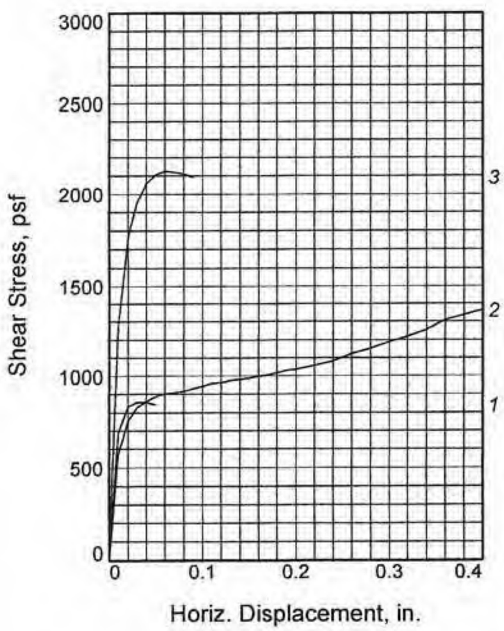
Client:	BAJADA Geosciences, Inc. 28301 Inwood Road Shingletown, CA 96088	Date:	07/06/2022
		Client No:	3237-076
		Report No:	0100-006
Project:	Orleans WTP #2201.0119 Humboldt County, California	Page No:	1 of 1
Location:	Bulk	Performed By:	Allanté Blocker

ROCK CORE COMPRESSIVE STRENGTH DATA
(ASTM D7012 Method C)

Identification	Rock 1			
Date Cored	07/06/22			
End Preparation Date	07/06/22			
Date Tested	07/06/22			
Bagged Age in Days	1			
Width, in	2.00			
Length, in	2.00			
Cross Sect. Area, in^2	4.00			
As Received Length, in	---			
Height, in	2.00			
L/D Factor	Cube / 1.00			
Maximum Load, lbs.	10,840			
Compr. Strength, psi	**2,710**			
Fracture Pattern, Type	Columnar vertical cracking			
Testing Technician	Allanté Blocker			

Notes:
Specimens prepared and tested in accordance with ASTM D4543.
Specimens trimmed are too short and do not conform to core Length to Diameter criteria.





	Sample No.	1	2	3
Initial	Water Content, %	8.3	8.3	8.3
	Dry Density, pcf	118.6	118.6	118.6
	Saturation, %	55.7	55.7	55.7
	Void Ratio	0.3953	0.3953	0.3953
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	19.1	20.9	19.1
	Dry Density, pcf	117.4	116.6	115.8
	Saturation, %	123.4	132.4	117.8
	Void Ratio	0.4091	0.4186	0.4289
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.01	1.02	1.02
Normal Stress, psf		500	1000	2000
Fail. Stress, psf		855	1367	2128
Displacement, in.		0.03	0.40	0.06
Ult. Stress, psf				
Displacement, in.				
Strain rate, in./min.		0.002	0.002	0.002

Sample Type: Tube
Description: Gray Silty Gravel with Sand

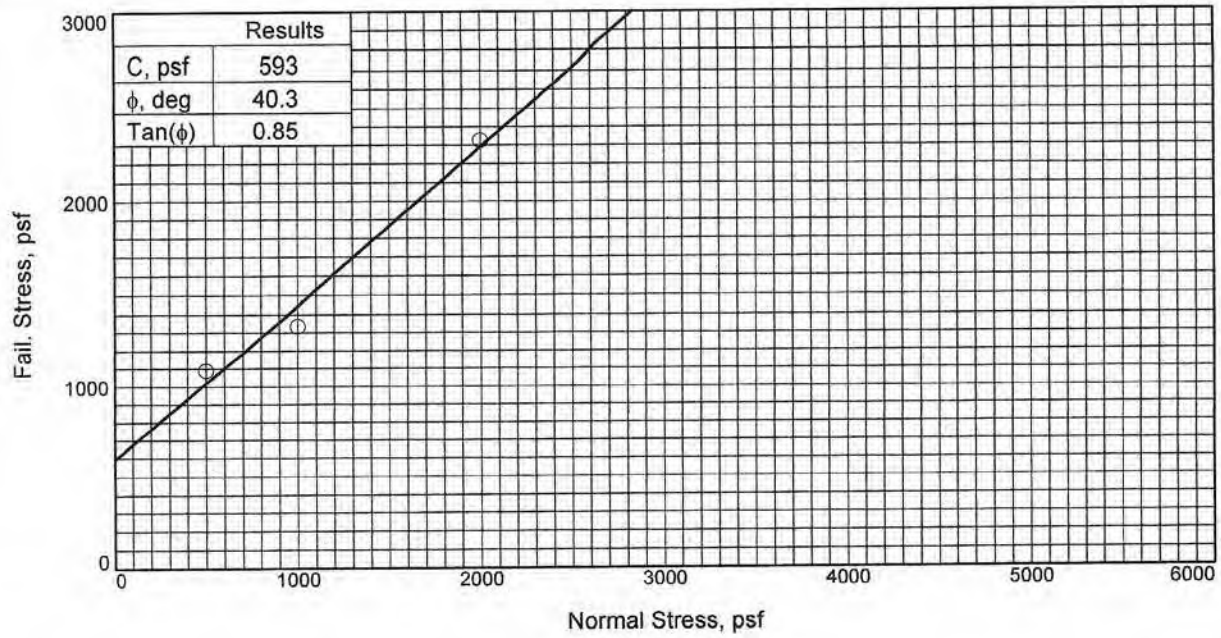
LL= 30 **PL=** 26 **PI=** 4
Specific Gravity= 2.65
Remarks: Material Tested in Accordance with ASTM D3080.
Remolded to 95% of maximum uncorrected density near optimum moisture.
Figure 0300-007

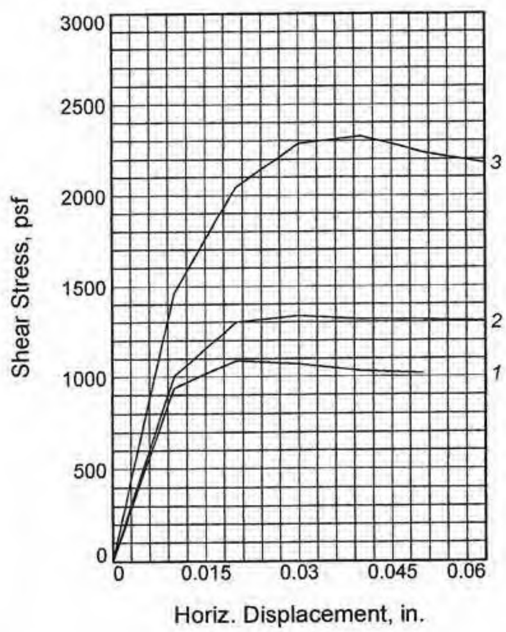
Client: BAJADA Geosciences, Inc.

Project: Orleans WTP #2201.0119
Humboldt County, California
Location: TP-3, B1
Sample Number: 2 **Depth:** 1.0'-3.0'
Proj. No.: 3237-076 **Date Sampled:** 07/06/2022

MATERIALS TESTING INCORPORATED M T I

Tested By: Jack Bianchin





	Sample No.	1	2	3
Initial	Water Content, %	6.3	6.3	6.3
	Dry Density, pcf	127.2	127.2	127.2
	Saturation, %	55.7	55.7	55.7
	Void Ratio	0.3006	0.3006	0.3006
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	13.0	32.9	12.9
	Dry Density, pcf	126.8	126.2	126.2
	Saturation, %	112.8	280.2	109.8
	Void Ratio	0.3049	0.3113	0.3106
	Diameter, in.	2.41	2.41	2.41
	Height, in.	1.00	1.01	1.01
Normal Stress, psf		500	1000	2000
Fail. Stress, psf		1089	1335	2327
Displacement, in.		0.02	0.03	0.04
Ult. Stress, psf				
Displacement, in.				
Strain rate, in./min.		0.002	0.002	0.002

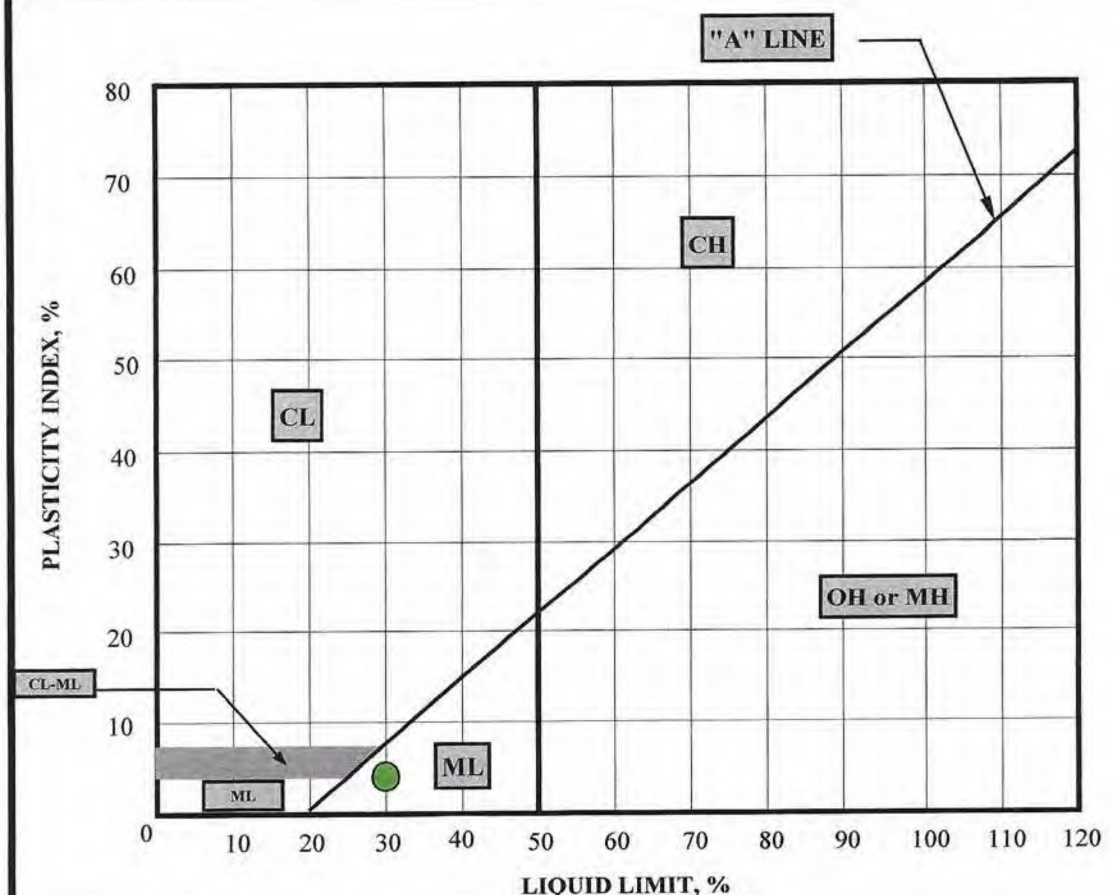
Sample Type: Tube
Description: Gray Gravel with Silt and Sand

Specific Gravity= 2.65
Remarks: Material Tested in Accordance with ASTM D3080.
Remolded to 95% of maximum uncorrected density near optimum moisture.
Figure 0300-008

Client: BAJADA Geosciences, Inc.

Project: Orleans WTP #2201.0119
Humboldt County, California
Location: TP-5, B1
Sample Number: 3 **Depth:** 1.0'-3.0'
Proj. No.: 3237-076 **Date Sampled:** 07/06/2022

Tested By: Andy King



KEY SYMBOL	SAMPLE NUMBER	DEPTH	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, LL	PLASTIC LIMIT, PL	PLASTICITY INDEX, PI	LIQUIDITY INDEX	UNIFIED SOIL CLASSIFICATION SYMBOL
●	TP-3, B1	1.0'-3.0'	N/A	30	26	4	N/A	GM
▲	TP-5, B1	1.0'-3.0'	N/A	---	---	NP	N/A	GW-GM

Note: Atterberg Limits tested in accordance with ASTM D4318.

Materials Testing, Inc.

PLASTICITY CHART AND DATA

Orleans WTP #2201.0119
Humboldt County, California

Project No:	Date:	Figure No:
3237-076	7/6/2022	0300-009

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

Date Reported 07/06/2022
Date Submitted 06/30/2022

To: Andy King
K.C. Engineerig
8798 Airport Rd.
Redding, CA 96002

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

The reported analysis was requested for the following location:
Location : #3237 BAJADA GEO SCI Site ID : TP-1.1.
Thank you for your business.

* For future reference to this analysis please use SUN # 87699-182377.

EVALUATION FOR SOIL CORROSION

Soil pH	5.81		
Minimum Resistivity	1.05 ohm-cm (x1000)		
Chloride	4.3 ppm	0.00043	%
Sulfate-SO4	478.5ppm	0.04785	%

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate-SO4 ASTM C1580, Chloride CA DOT Test #422m

Sunland Analytical

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

Date Reported 07/01/2022
Date Submitted 06/28/2022

To: Andy King
K.C. Engineerig
8798 Airport Rd.
Redding, CA 96002

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

The reported analysis was requested for the following location:
Location : 3237-076 ORLEANS Site ID : #2 TP-3,B1 @1-3.
Thank you for your business.

* For future reference to this analysis please use SUN # 87683-182335.

EVALUATION FOR SOIL CORROSION

Soil pH	4.68		
Minimum Resistivity	7.50 ohm-cm (x1000)		
Chloride	5.2 ppm	0.00052	%
Sulfate-SO4	1.9ppm	0.00019	%

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate-SO4 ASTM C1580, Chloride CA DOT Test #422m

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

Date Reported 06/29/2022
Date Submitted 06/22/2022

To: Andy King
K.C. Engineerig
8798 Airport Rd.
Redding, CA 96002

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

The reported analysis was requested for the following location:
Location : 3237 BAJADA ORLEANS Site ID : TP-5 B1@1-3.
Thank you for your business.

* For future reference to this analysis please use SUN # 87641-182259.

EVALUATION FOR SOIL CORROSION

Soil pH	5.43	
Minimum Resistivity	16.08 ohm-cm (x1000)	
Chloride	1.8 ppm	0.00018 %
Sulfate-SO4	5.0ppm	0.00050 %

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate-SO4 ASTM C1580, Chloride CA DOT Test #422m

APPENDIX C

Slope Stability Analyses

APPENDIX B
SLOPE STABILITY EVALUATIONS

METHODS OF ANALYSIS

Computer-aided slope stability analyses were performed using the computer program SLIDE 2018. SLIDE 2018 was developed by Rocscience, Inc. (2020) and offers a wide variety of limit-equilibrium procedures. Those include the Modified Bishop, the Simplified and Corrected Janbu, Corps of Engineers #1 and #2, GLE/Morgenstern-Price, Lowe-Karafiath, and the Spencer methods. Those limit-equilibrium procedures are all "method of slices", but they differ from the Ordinary Method of Slices (Fellenius method – also included within SLIDE 2018) in:

1. The simplifying assumptions that have been made achieve static determinacy; and
2. The particular conditions of equilibrium that are satisfied.

SLIDE 2018 allows the use of any or all of the methods listed above because they better satisfy limit equilibrium conditions. A summary of the equilibrium conditions satisfied by each of these procedures and the type of failure surface for which each is useful is presented in the following table.

EQUILIBRIUM CONDITIONS SATISFIED BY PROCEDURES

Procedure of Analysis	Overall			Individual Slices			
	Moment	Vertical Force	Horizontal Force	Moment	Vertical Force	Horizont al Force	Slip Surface
Ordinary Method of Slices (Fellenius)	Yes	No	No	No	No	No	Circular Arc
Modified Bishop	Yes	(Yes)[1]	No	No	Yes	No	General Shape[2]
Simplified Janbu	No	(Yes)[1]	(Yes)[1]	No	Yes	Yes	General Shape
Spencer	Yes	(Yes)[1]	(Yes)[1]	Yes	Yes	Yes	General Shape

Per Wright (1969); (Yes)[1] - Parentheses indicate that this condition of equilibrium is implicitly satisfied as a result of the direct consideration of other equilibrium conditions; [2] – The original presentation of this procedure was for circular surfaces only.

Ordinary Method of Slices. From the above table, it is apparent that for circular failures, the Ordinary Method of Slices (Fellenius method) satisfies overall moment equilibrium, but does not satisfy individual slice moment equilibrium, or horizontal or vertical force equilibrium. Sherard et al. (1963), have suggested that the Fellenius method of slices might also be applied to non-circular surfaces; however, for noncircular surfaces that method would not, in general, satisfy any of the equilibrium conditions (Wright, 1969).

The Ordinary Method of Slices has been widely used by practicing engineers for many years because of its simplicity, but it has long been known to grossly underestimate (and in some cases overestimate) the factor of safety. Lambe and Whitman (1969) report that in some cases the Ordinary Method of Slices may underestimate the factor of safety by about 10 to 15 percent, but in other problems (particularly for noncircular slip surfaces) the error may be as much as 60 percent. With the development of high-speed computers, this approximate method has largely been replaced by more accurate methods that better satisfy equilibrium conditions. The Ordinary Method of Slices remains an acceptable method for performing hand-calculated estimates of slope stability for conditions where accurate solutions are not required.

Modified Bishop Method. The Modified Bishop Method assumes that the normal and weight forces act through a point on the center of the base of each slice and that there are no interslice shear forces. The resulting equation can be demonstrated to satisfy vertical force equilibrium as well as overall moment equilibrium for circular shear surfaces. The Modified Bishop Method is relatively simple to perform on a calculator, although the necessary iterations make it more suitable for use on a computer system. In spite of the necessary iterations, the Modified Bishop Method typically converges rapidly, therefore, it requires little computer time to perform.

Fredlund and Krahn (1977) have shown that the Modified Bishop Method typically estimates factors of safety that are typically within a few percent of those obtained from more rigorous methods that satisfy complete moment and force equilibrium.

Simplified Janbu Method. Although the simplifying assumption made in the Simplified Janbu Method is the same as that made for the Modified Bishop Method, the conditions of equilibrium that are satisfied are not the same. The Simplified Janbu Method satisfies vertical and horizontal force equilibrium for individual slices and for the overall shear surface while assuming that there are no interslice shear forces. An advantage of the Simplified Janbu Method is its suitability for the analysis of noncircular failure surfaces. While retaining a rapid computational speed, the Simplified Janbu Method yields factors of safety that are closer to those obtained by more rigorous methods (such as the Spencer Method) than those obtained from the Ordinary Method of Slices.

Spencer Method. The Spencer Method assumes that the normal forces are located at the center of the base of each slice and that all side forces are parallel. The result is an equation that satisfies complete moment and force equilibrium. Although the Spencer Method was directly applicable to a circular shear surface, the procedure may be readily extended to slip surfaces of a general shape (Wright, 1969).

Because of the complexity of the procedure, the Spencer Method is suitable only for computer-aided slope stability analyses. Although the Spencer Method typically yields a relatively accurate estimate of the factor of safety for a slope, its solution requires several iterations. Consequently, considerable time is needed to perform the analyses on a personal computer. Therefore, the Spencer Method is commonly used to refine the factor of safety for a critical failure plane that has been located by a search, which has used a more time-efficient method of analysis such as the Modified Bishop Method or Simplified Janbu procedure.

ANALYSES PERFORMED

Introduction. Analyses were performed to calculate the stability of the earth materials exposed in the slope. It is necessary to know the: 1) surface and subsurface geometry, 2) soil properties (unit weight and shear strength of the soil materials present), and 3) phreatic water level (groundwater) conditions.

Engineering Properties. A summary and discussion of soil and rock mass strength values is presented in the text of the report.

Results of Analyses. The following table presents the conditions evaluated and results of the stability evaluations:

RESULTS OF STABILITY ANALYSES		
Slope Condition Evaluated	**Factor of Safety**	**File Name**
Section A-A’, static, dry	1.779	A-A’_Static_Dry
Section A-A’, pseudostatic, dry	1.452	A-A’_PS_Dry
Section A-A’, static, elevated groundwater conditions	1.779	A-A’_Static_ElevatedGW
Section A-A’, pseudostatic, elevated groundwater conditions	1.452	A-A’_PS_ElevatedGW
Section A-A’, static, groundwater at ground surface	>1.5	A-A’_Static_FullGW
Section A-A’, pseudostatic, groundwater at ground surface	>1.1	A-A’_PS_ElevatedGW
Section B-B’, static, dry	4.000	B-B’_Static_Dry
Section B-B’, pseudostatic, dry	2.867	B-B’_PS_Dry
Section B-B’, static, groundwater at ground surface	2.705	B-B’_Static_FullGW
Section B-B’, pseudostatic, groundwater at ground surface	1.913	B-B’_PS_FullGW

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Fellenius, W. (1936), Calculation of the Stability of Earth Dams, Transactions of the Second Congress on Large Dams, vol. 4, pp. 445-463.

Frelund, D.G., and Krahn, J. (1977), Comparison of Slope Stability Methods of Analysis, Canadian Geotechnical Journal, vol. 14, pp. 429-439.

Janbu, N., Bjerrum, L., and Kjaernsli, B. (1956), Veiledning ved losning av fundamenterings-oppgaver-2. Stabilitetsberegning for fyllinger, skjaeringer og naturlige skraninger. (Soil Mechanics Applies to Some Engineering Problems – Chapter 2. Stability Calculations for Embankments, Cuts, and Natural Slopes), Publication 16, Norwegian Geotechnical Institute, Oslo, pp. 17-26.

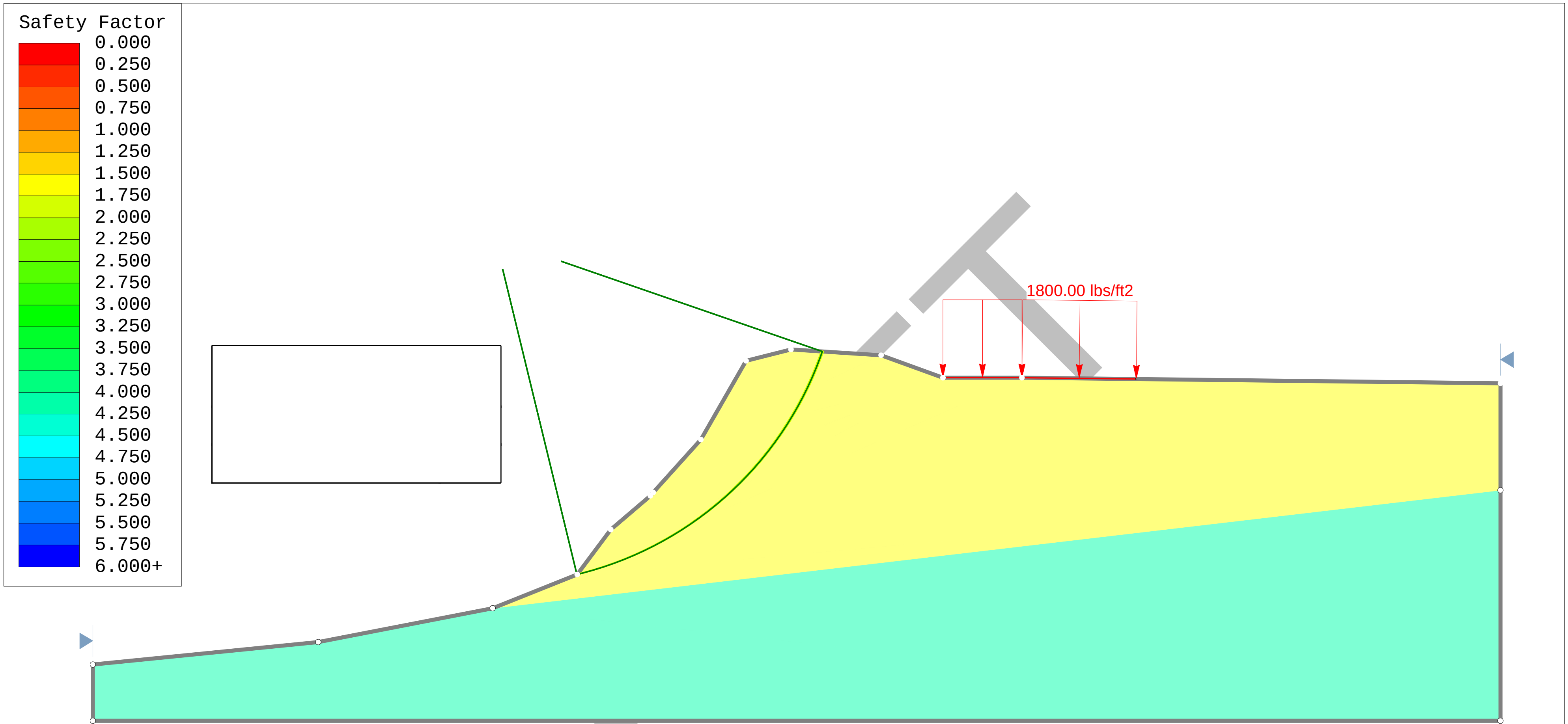
Lambe, T.W., and Whitman, R.V., (1969), Soil Mechanics, John Wiley & Sons, New York, 553 pp.

Rocscience (2020), SLIDE 2018, 2D Limit Equilibrium Slope Stability Analysis, Build 8.031, January 29.

Sherard, J.L., Woodward, R.J., Gizienski, S.F., and Clevenger, W.A. (1963), Stability Analyses, Earth and Earth-Rock Dams, 1st Edition, John Wiley & Sons, New York, 345 pp.

Spencer, E. (1967), A Method of Analyses of the Stability of Embankments Assuming Parallel Inter-Slice Forces, Geotechnique, vol. 17, no. 1, pp. 11-26.

Wright, S. (1969), A Study of Slope Stability and the Undrained Shear Strength of Clay Shales, Ph.D. Thesis, University of California, Berkley.



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Older Alluvium		130	Mohr-Coulomb	500	40	None	0
Galice Formation		155	Mohr-Coulomb	3000	23	None	0

BAJADA Geosciences, Inc.

SLIDEINTERPRET 8.032

Project	Orlens MWC Treatment Plant Improvements		
Analysis Description	Static, dry, with 1,800 psf tank surcharge		
Drawn By J.Bianchin	*Scale* 1:323	*Company*	Bajada Geosciences, Inc.
Date	7/13/2022, 1:30:35 PM	*File Name*	A-A'_Static_Dry.slim

Slide Analysis Information

Orlens MWC Treatment Plant Improvements

Project Summary

Slide Modeler Version:	8.032
Compute Time:	00h:00m:06.7s

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
GLE/Morgenstern-Price with interslice force function (Half Sine)
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search

Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

1 Distributed Load present

Distributed Load 1	
Distribution:	Constant
Magnitude [psf]:	1800
Orientation:	Normal to boundary

Materials

Property	Older Alluvium	Galice Formation
Color		
Strength Type	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	130	155
Cohesion [psf]	500	3000
Friction Angle [°]	40	23
Water Surface	None	None
Ru Value	0	0

Global Minimums

Method: spencer

FS	1.779060
Center:	71.429, 85.756
Radius:	61.508
Left Slip Surface Endpoint:	85.989, 25.996
Right Slip Surface Endpoint:	129.559, 65.653
Resisting Moment:	4.44683e+06 lb-ft
Driving Moment:	2.49953e+06 lb-ft
Resisting Horizontal Force:	53771.8 lb
Driving Horizontal Force:	30224.8 lb
Total Slice Area:	488.39 ft2
Surface Horizontal Width:	43.5704 ft
Surface Average Height:	11.2092 ft

Method: gle/morgenstern-price

FS	1.778040
Center:	71.355, 85.744

Radius:	61.514
Left Slip Surface Endpoint:	85.989, 25.996
Right Slip Surface Endpoint:	129.497, 65.656
Resisting Moment:	4.43046e+06 lb-ft
Driving Moment:	2.49176e+06 lb-ft
Resisting Horizontal Force:	53509.3 lb
Driving Horizontal Force:	30094.5 lb
Total Slice Area:	486.322 ft2
Surface Horizontal Width:	43.5076 ft
Surface Average Height:	11.1779 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 8339
Number of Invalid Surfaces: 2262

Error Codes:

Error Code -108 reported for 19 surfaces
Error Code -111 reported for 2240 surfaces
Error Code -112 reported for 3 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 10576
Number of Invalid Surfaces: 25

Error Codes:

Error Code -111 reported for 25 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.77906

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.871408	52.2533	14.111	Older Alluvium	500	40	357.968	636.846	163.087	0	163.087	253.076	253.076
2	0.871408	158.28	14.9496	Older Alluvium	500	40	411.964	732.908	277.57	0	277.57	387.567	387.567
3	0.871408	262.763	15.7915	Older Alluvium	500	40	463.294	824.227	386.398	0	386.398	517.423	517.423
4	0.871408	365.676	16.6369	Older Alluvium	500	40	512.04	910.95	489.751	0	489.751	642.756	642.756
5	0.871408	466.999	17.486	Older Alluvium	500	40	558.284	993.22	587.797	0	587.797	763.674	763.674

6	0.871408	566.71	18.3392	Older Alluvium	500	40	602.1	1071.17	680.696	0	680.696	880.278	880.278
7	0.871408	664.54	19.1965	Older Alluvium	500	40	643.435	1144.71	768.336	0	768.336	992.359	992.359
8	0.871408	732.899	20.0583	Older Alluvium	500	40	668.875	1189.97	822.272	0	822.272	1066.49	1066.49
9	0.871408	780.618	20.925	Older Alluvium	500	40	683.413	1215.83	853.095	0	853.095	1114.41	1114.41
10	0.871408	826.621	21.7966	Older Alluvium	500	40	696.513	1239.14	880.87	0	880.87	1159.41	1159.41
11	0.871408	870.876	22.6736	Older Alluvium	500	40	708.209	1259.95	905.669	0	905.669	1201.54	1201.54
12	0.871408	913.35	23.5562	Older Alluvium	500	40	718.533	1278.31	927.558	0	927.558	1240.82	1240.82
13	0.871408	954.008	24.4448	Older Alluvium	500	40	727.514	1294.29	946.6	0	946.6	1277.3	1277.3
14	0.871408	992.812	25.3397	Older Alluvium	500	40	735.178	1307.93	962.849	0	962.849	1310.99	1310.99
15	0.871408	1029.78	26.2413	Older Alluvium	500	40	741.576	1319.31	976.414	0	976.414	1341.98	1341.98
16	0.871408	1078.96	27.1499	Older Alluvium	500	40	752.756	1339.2	1000.12	0	1000.12	1386.15	1386.15
17	0.871408	1137.01	28.066	Older Alluvium	500	40	767.048	1364.62	1030.42	0	1030.42	1439.4	1439.4
18	0.871408	1193.03	28.99	Older Alluvium	500	40	779.749	1387.22	1057.34	0	1057.34	1489.39	1489.39
19	0.871408	1246.96	29.9223	Older Alluvium	500	40	790.881	1407.03	1080.95	0	1080.95	1536.14	1536.14
20	0.871408	1298.74	30.8634	Older Alluvium	500	40	800.464	1424.07	1101.26	0	1101.26	1579.64	1579.64
21	0.871408	1348.31	31.8139	Older Alluvium	500	40	808.513	1438.39	1118.34	0	1118.34	1619.91	1619.91
22	0.871408	1395.59	32.7742	Older Alluvium	500	40	815.044	1450.01	1132.18	0	1132.18	1656.92	1656.92
23	0.871408	1440.53	33.745	Older Alluvium	500	40	820.07	1458.95	1142.84	0	1142.84	1690.69	1690.69
24	0.871408	1483.03	34.727	Older Alluvium	500	40	823.6	1465.23	1150.32	0	1150.32	1721.18	1721.18
25	0.871408	1523	35.7207	Older Alluvium	500	40	825.642	1468.87	1154.65	0	1154.65	1748.39	1748.39
26	0.871408	1577.68	36.727	Older Alluvium	500	40	832.382	1480.86	1168.94	0	1168.94	1789.99	1789.99
27	0.871408	1673.28	37.7467	Older Alluvium	500	40	852.675	1516.96	1211.97	0	1211.97	1872.11	1872.11
28	0.871408	1768.16	38.7807	Older Alluvium	500	40	871.37	1550.22	1251.61	0	1251.61	1951.72	1951.72
29	0.871408	1860.09	39.8298	Older Alluvium	500	40	887.705	1579.28	1286.24	0	1286.24	2026.63	2026.63
30	0.871408	1948.93	40.8953	Older Alluvium	500	40	901.667	1604.12	1315.84	0	1315.84	2096.76	2096.76
31	0.871408	2034.52	41.9782	Older Alluvium	500	40	913.252	1624.73	1340.4	0	1340.4	2162.07	2162.07
32	0.871408	2116.71	43.0798	Older Alluvium	500	40	922.431	1641.06	1359.87	0	1359.87	2222.45	2222.45
33	0.871408	2195.31	44.2017	Older Alluvium	500	40	929.193	1653.09	1374.2	0	1374.2	2277.85	2277.85
34	0.871408	2270.1	45.3453	Older Alluvium	500	40	933.493	1660.74	1383.32	0	1383.32	2328.13	2328.13
35	0.871408	2317.61	46.5125	Older Alluvium	500	40	928.49	1651.84	1372.71	0	1372.71	2351.57	2351.57
36	0.871408	2250.31	47.7054	Older Alluvium	500	40	889.728	1582.88	1290.53	0	1290.53	2268.51	2268.51
37	0.871408	2164.1	48.9263	Older Alluvium	500	40	846.413	1505.82	1198.69	0	1198.69	2169.85	2169.85
38	0.871408	2072.95	50.1778	Older Alluvium	500	40	802.737	1428.12	1106.08	0	1106.08	2068.8	2068.8

39	0.871408	1976.47	51.4631	Older Alluvium	500	40	758.695	1349.76	1012.71	0	1012.71	1965.26	1965.26
40	0.871408	1874.19	52.7856	Older Alluvium	500	40	714.284	1270.75	918.552	0	918.552	1859.1	1859.1
41	0.871408	1765.56	54.1497	Older Alluvium	500	40	669.5	1191.08	823.599	0	823.599	1750.17	1750.17
42	0.871408	1649.95	55.5604	Older Alluvium	500	40	624.337	1110.73	727.845	0	727.845	1638.32	1638.32
43	0.871408	1526.58	57.0238	Older Alluvium	500	40	578.789	1029.7	631.275	0	631.275	1523.34	1523.34
44	0.871408	1392.26	58.5473	Older Alluvium	500	40	532.355	947.092	532.823	0	532.823	1403.16	1403.16
45	0.871408	1225.36	60.1404	Older Alluvium	500	40	480.74	855.266	423.389	0	423.389	1260.79	1260.79
46	0.871408	1041.1	61.815	Older Alluvium	500	40	427.95	761.348	311.462	0	311.462	1110.09	1110.09
47	0.871408	843.448	63.5867	Older Alluvium	500	40	375.264	667.618	199.76	0	199.76	955.286	955.286
48	0.871408	629.715	65.477	Older Alluvium	500	40	322.602	573.929	88.1049	0	88.1049	795.24	795.24
49	0.871408	396.098	67.5163	Older Alluvium	500	40	269.761	479.921	-23.9293	0	-23.9293	627.856	627.856
50	0.871408	136.878	69.7504	Older Alluvium	500	40	206.569	367.498	-157.91	0	-157.91	402.031	402.031

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.77804

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.870152	52.0375	14.1808	Older Alluvium	500	40	281.702	500.877	1.04496	0	1.04496	72.2262	72.2262
2	0.870152	157.632	15.0184	Older Alluvium	500	40	342.069	608.212	128.962	0	128.962	220.737	220.737
3	0.870152	261.688	15.8593	Older Alluvium	500	40	401.948	714.68	255.846	0	255.846	370.035	370.035
4	0.870152	364.179	16.7036	Older Alluvium	500	40	460.887	819.475	380.736	0	380.736	519.041	519.041
5	0.870152	465.086	17.5518	Older Alluvium	500	40	518.43	921.79	502.67	0	502.67	666.646	666.646
6	0.870152	564.386	18.4039	Older Alluvium	500	40	574.134	1020.83	620.705	0	620.705	811.737	811.737
7	0.870152	661.857	19.2602	Older Alluvium	500	40	627.481	1115.69	733.746	0	733.746	952.998	952.998
8	0.870152	730.317	20.1211	Older Alluvium	500	40	665.135	1182.64	813.536	0	813.536	1057.22	1057.22
9	0.870152	777.777	20.9867	Older Alluvium	500	40	690.87	1228.39	868.066	0	868.066	1133.08	1133.08
10	0.870152	823.526	21.8574	Older Alluvium	500	40	713.764	1269.1	916.579	0	916.579	1202.89	1202.89
11	0.870152	867.533	22.7334	Older Alluvium	500	40	733.701	1304.55	958.824	0	958.824	1266.24	1266.24
12	0.870152	909.764	23.615	Older Alluvium	500	40	750.612	1334.62	994.66	0	994.66	1322.83	1322.83
13	0.870152	950.185	24.5027	Older Alluvium	500	40	764.482	1359.28	1024.05	0	1024.05	1372.49	1372.49
14	0.870152	988.757	25.3966	Older Alluvium	500	40	775.339	1378.58	1047.05	0	1047.05	1415.15	1415.15
15	0.870152	1025.47	26.2972	Older Alluvium	500	40	783.269	1392.68	1063.85	0	1063.85	1450.92	1450.92
16	0.870152	1073.88	27.2049	Older Alluvium	500	40	794.202	1412.12	1087.03	0	1087.03	1495.28	1495.28
17	0.870152	1131.65	28.1201	Older Alluvium	500	40	807.004	1434.88	1114.15	0	1114.15	1545.41	1545.41
18	0.870152	1187.38	29.0431	Older Alluvium	500	40	816.902	1452.49	1135.13	0	1135.13	1588.75	1588.75

19	0.870152	1241.04	29.9744	Older Alluvium	500	40	824.091	1465.27	1150.37	0	1150.37	1625.66	1625.66
20	0.870152	1292.55	30.9146	Older Alluvium	500	40	828.788	1473.62	1160.32	0	1160.32	1656.62	1656.62
21	0.870152	1341.85	31.8641	Older Alluvium	500	40	831.225	1477.95	1165.48	0	1165.48	1682.15	1682.15
22	0.870152	1388.89	32.8235	Older Alluvium	500	40	831.642	1478.69	1166.36	0	1166.36	1702.8	1702.8
23	0.870152	1433.57	33.7933	Older Alluvium	500	40	830.275	1476.26	1163.47	0	1163.47	1719.15	1719.15
24	0.870152	1475.83	34.7743	Older Alluvium	500	40	827.357	1471.07	1157.28	0	1157.28	1731.76	1731.76
25	0.870152	1515.57	35.7671	Older Alluvium	500	40	823.099	1463.5	1148.26	0	1148.26	1741.18	1741.18
26	0.870152	1568.31	36.7725	Older Alluvium	500	40	823.17	1463.63	1148.41	0	1148.41	1763.6	1763.6
27	0.870152	1662.87	37.7912	Older Alluvium	500	40	837.368	1488.87	1178.49	0	1178.49	1827.81	1827.81
28	0.870152	1757.36	38.8242	Older Alluvium	500	40	850.898	1512.93	1207.16	0	1207.16	1891.89	1891.89
29	0.870152	1848.9	39.8723	Older Alluvium	500	40	863.001	1534.45	1232.81	0	1232.81	1953.68	1953.68
30	0.870152	1937.36	40.9368	Older Alluvium	500	40	873.827	1553.7	1255.75	0	1255.75	2013.67	2013.67
31	0.870152	2022.58	42.0187	Older Alluvium	500	40	883.529	1570.95	1276.31	0	1276.31	2072.37	2072.37
32	0.870152	2104.41	43.1194	Older Alluvium	500	40	892.207	1586.38	1294.7	0	1294.7	2130.18	2130.18
33	0.870152	2182.65	44.2402	Older Alluvium	500	40	899.952	1600.15	1311.1	0	1311.1	2187.5	2187.5
34	0.870152	2257.1	45.3828	Older Alluvium	500	40	906.807	1612.34	1325.64	0	1325.64	2244.65	2244.65
35	0.870152	2308.27	46.5491	Older Alluvium	500	40	907.089	1612.84	1326.24	0	1326.24	2283.75	2283.75
36	0.870152	2244.43	47.7409	Older Alluvium	500	40	874.193	1554.35	1256.53	0	1256.53	2218.63	2218.63
37	0.870152	2158.34	48.9608	Older Alluvium	500	40	836.234	1486.86	1176.09	0	1176.09	2136.74	2136.74
38	0.870152	2067.31	50.2112	Older Alluvium	500	40	798.271	1419.36	1095.65	0	1095.65	2054.14	2054.14
39	0.870152	1970.97	51.4954	Older Alluvium	500	40	760.121	1351.53	1014.81	0	1014.81	1970.26	1970.26
40	0.870152	1868.83	52.8168	Older Alluvium	500	40	721.579	1283	933.136	0	933.136	1884.36	1884.36
41	0.870152	1760.37	54.1798	Older Alluvium	500	40	682.404	1213.34	850.129	0	850.129	1795.6	1795.6
42	0.870152	1644.94	55.5894	Older Alluvium	500	40	642.306	1142.05	765.162	0	765.162	1702.85	1702.85
43	0.870152	1521.77	57.0516	Older Alluvium	500	40	600.919	1068.46	677.46	0	677.46	1604.62	1604.62
44	0.870152	1388.35	58.5739	Older Alluvium	500	40	557.369	991.025	585.18	0	585.18	1497.36	1497.36
45	0.870152	1223.01	60.1658	Older Alluvium	500	40	505.747	899.238	475.794	0	475.794	1357.66	1357.66
46	0.870152	1039.1	61.839	Older Alluvium	500	40	449.125	798.562	355.812	0	355.812	1194.8	1194.8
47	0.870152	841.829	63.6095	Older Alluvium	500	40	388.236	690.299	226.79	0	226.79	1009.21	1009.21
48	0.870152	628.506	65.4984	Older Alluvium	500	40	321.646	571.899	85.6854	0	85.6854	791.42	791.42
49	0.870152	395.338	67.5362	Older Alluvium	500	40	247.506	440.076	-71.4142	0	-71.4142	527.189	527.189
50	0.870152	136.616	69.7688	Older Alluvium	500	40	163.467	290.65	-249.494	0	-249.494	194.049	194.049

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.77906

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	85.9891	25.9956	0	0	0
2	86.8605	26.2147	275.835	167.373	31.2488
3	87.7319	26.4474	569.81	345.753	31.2488
4	88.6033	26.6938	877.818	532.648	31.2488
5	89.4747	26.9542	1195.95	725.688	31.2489
6	90.3461	27.2287	1520.5	922.618	31.2488
7	91.2175	27.5176	1847.92	1121.3	31.249
8	92.0889	27.821	2174.83	1319.66	31.2489
9	92.9603	28.1391	2495.37	1514.16	31.2489
10	93.8317	28.4723	2805.94	1702.61	31.2489
11	94.7031	28.8208	3105.2	1884.19	31.2488
12	95.5745	29.1848	3391.89	2058.15	31.2488
13	96.446	29.5648	3664.88	2223.8	31.2488
14	97.3174	29.9609	3923.12	2380.5	31.2489
15	98.1888	30.3735	4165.67	2527.67	31.2488
16	99.0602	30.8031	4391.68	2664.81	31.2488
17	99.9316	31.25	4599.91	2791.17	31.2489
18	100.803	31.7146	4788.76	2905.76	31.2489
19	101.674	32.1974	4956.91	3007.79	31.2488
20	102.546	32.699	5103.13	3096.51	31.2488
21	103.417	33.2197	5226.31	3171.26	31.2489
22	104.289	33.7603	5325.45	3231.42	31.2489
23	105.16	34.3214	5399.65	3276.44	31.2489
24	106.031	34.9035	5448.11	3305.84	31.2488
25	106.903	35.5075	5470.15	3319.21	31.2488
26	107.774	36.1341	5465.2	3316.21	31.2488
27	108.646	36.7843	5429.66	3294.65	31.2489
28	109.517	37.4589	5354.16	3248.83	31.2488
29	110.388	38.1591	5236.26	3177.3	31.2489
30	111.26	38.8859	5074.05	3078.87	31.2489
31	112.131	39.6406	4865.75	2952.47	31.2488
32	113.003	40.4246	4609.71	2797.11	31.2488
33	113.874	41.2395	4304.44	2611.88	31.2488
34	114.746	42.0869	3948.61	2395.96	31.2488
35	115.617	42.9689	3541.03	2148.65	31.2488
36	116.488	43.8876	3088.08	1873.81	31.2489
37	117.36	44.8454	2626.34	1593.63	31.2488
38	118.231	45.8453	2164.53	1313.41	31.2489
39	119.103	46.8904	1707.26	1035.94	31.2488
40	119.974	47.9844	1259.63	764.326	31.2488
41	120.845	49.1319	827.336	502.016	31.2488
42	121.717	50.3379	416.781	252.897	31.2488
43	122.588	51.6086	35.2555	21.3926	31.2489
44	123.46	52.9517	-308.833	-187.396	31.2489
45	124.331	54.3764	-604.578	-366.85	31.2488
46	125.202	55.8943	-828.823	-502.919	31.2488
47	126.074	57.5204	-962.848	-584.244	31.2488
48	126.945	59.2749	-986.695	-598.713	31.2488
49	127.817	61.185	-874.203	-530.455	31.2488
50	128.688	63.2904	-589.031	-357.416	31.2488
51	129.559	65.6525	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.77804

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]

1	85.9891	25.9956	0	0	0
2	86.8592	26.2155	245.105	10.892	2.54444
3	87.7294	26.449	512.907	45.4954	5.06893
4	88.5995	26.6962	799.719	106.054	7.55415
5	89.4697	26.9573	1101.69	193.901	9.98201
6	90.3398	27.2325	1414.85	309.424	12.3362
7	91.21	27.522	1735.15	452.059	14.6027
8	92.0801	27.8261	2058.53	620.305	16.7693
9	92.9503	28.1449	2378.45	810.928	18.8267
10	93.8204	28.4786	2690.38	1020.24	20.7676
11	94.6906	28.8277	2992.07	1244.67	22.5868
12	95.5607	29.1923	3281.48	1480.34	24.2811
13	96.4309	29.5727	3556.79	1723.15	25.8487
14	97.301	29.9693	3816.44	1968.93	27.2895
15	98.1712	30.3824	4059.13	2213.48	28.604
16	99.0413	30.8124	4283.82	2452.74	29.7937
17	99.9115	31.2597	4489.27	2682.56	30.8604
18	100.782	31.7247	4674	2898.73	31.8064
19	101.652	32.2079	4836.96	3097.43	32.6342
20	102.522	32.7098	4977.34	3275.21	33.3459
21	103.392	33.2309	5094.52	3429.04	33.9439
22	104.262	33.7717	5188.07	3556.36	34.4302
23	105.132	34.333	5257.7	3655.08	34.8065
24	106.003	34.9154	5303.22	3723.61	35.0743
25	106.873	35.5196	5324.55	3760.87	35.2346
26	107.743	36.1464	5321.64	3766.25	35.2879
27	108.613	36.7967	5291.73	3737.68	35.2345
28	109.483	37.4714	5225.81	3669.26	35.0743
29	110.353	38.1717	5121.57	3560.45	34.8065
30	111.223	38.8985	4977.1	3411.74	34.4302
31	112.094	39.6532	4790.37	3224.32	33.9439
32	112.964	40.4372	4559.2	3000.06	33.3458
33	113.834	41.2521	4281.28	2741.58	32.6341
34	114.704	42.0994	3954.05	2452.23	31.8064
35	115.574	42.9813	3574.76	2136.1	30.8605
36	116.444	43.8998	3146.57	1801.6	29.7937
37	117.315	44.8575	2704.58	1474.84	28.6042
38	118.185	45.8571	2257.23	1164.52	27.2895
39	119.055	46.9019	1807.7	875.778	25.8488
40	119.925	47.9957	1359.75	613.409	24.281
41	120.795	49.1427	917.787	381.789	22.5868
42	121.665	50.3483	487.181	184.747	20.7675
43	122.535	51.6187	74.57	25.4245	18.8267
44	123.406	52.9612	-311.623	-93.9024	16.7693
45	124.276	54.3853	-659.553	-171.833	14.6026
46	125.146	55.9026	-941.003	-205.796	12.3363
47	126.016	57.5281	-1128.23	-198.572	9.982
48	126.886	59.2817	-1187.82	-157.521	7.55412
49	127.756	61.1909	-1071.29	-95.0246	5.06893
50	128.627	63.2954	-705.444	-31.3487	2.54445
51	129.497	65.6565	0	0	0

Entity Information

Distributed Load

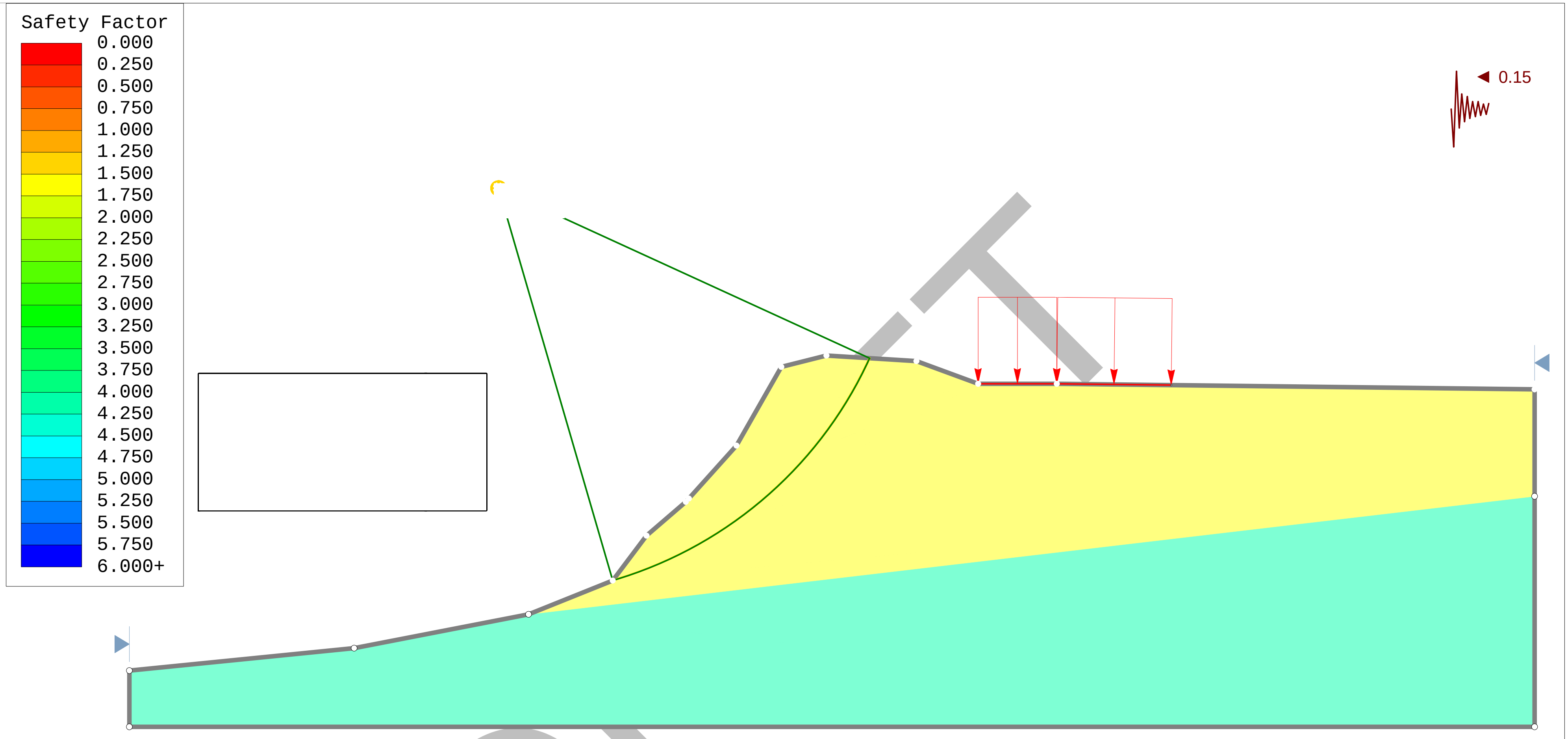
X	Y
185.342	60.7607
165	61
151	61

External Boundary

X	Y
0	0
250	0
250	41
250	60
165	61
151	61
140	65
124	66
116	64
108	50
99.5299	40.5887
99	40
92	34
86	26
71	20
40	14
0	10

Material Boundary

X	Y
71	20
250	41



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Older Alluvium		130	Mohr-Coulomb	500	40	None	0
Galice Formation		155	Mohr-Coulomb	3000	23	None	0

BAJADA Geosciences, Inc.

SLIDEINTERPRET 8.032

Project	Orleans MWC Treatment Plant Improvements		
Analysis Description	Pseudostatic, dry, with 1,800 psf tank surcharge		
Drawn By J.Bianchin	*Scale* 1:323	*Company*	Bajada Geosciences, Inc.
Date	7/13/2022, 1:30:35 PM	*File Name*	A-A'_PS_Dry.slim

Slide Analysis Information

Orleans MWC Treatment Plant Improvements

Project Summary

Slide Modeler Version:	8.032
Compute Time:	00h:00m:07.848s

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
GLE/Morgenstern-Price with interslice force function (Half Sine)
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search

Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Seismic Load Coefficient (Horizontal): 0.15

Loading

1 Distributed Load present

Distributed Load 1	
Distribution:	Constant
Magnitude [psf]:	1800
Orientation:	Normal to boundary

Materials

Property	Older Alluvium	Galice Formation
Color		
Strength Type	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	130	155
Cohesion [psf]	500	3000
Friction Angle [°]	40	23
Water Surface	None	None
Ru Value	0	0

Global Minimums

Method: spencer

FS	1.452170
Center:	65.693, 95.744
Radius:	72.641
Left Slip Surface Endpoint:	85.993, 25.997
Right Slip Surface Endpoint:	131.746, 65.516
Resisting Moment:	5.0607e+06 lb-ft
Driving Moment:	3.48492e+06 lb-ft
Resisting Horizontal Force:	53389.1 lb
Driving Horizontal Force:	36765 lb
Total Slice Area:	503.963 ft2
Surface Horizontal Width:	45.7529 ft
Surface Average Height:	11.0149 ft

Method: gle/morgenstern-price

FS	1.451300
Center:	66.496, 96.062
Radius:	72.749
Left Slip Surface Endpoint:	85.808, 25.923
Right Slip Surface Endpoint:	132.499, 65.469
Resisting Moment:	5.25394e+06 lb-ft
Driving Moment:	3.62015e+06 lb-ft
Resisting Horizontal Force:	55765.1 lb
Driving Horizontal Force:	38424.1 lb
Total Slice Area:	527.766 ft2
Surface Horizontal Width:	46.691 ft
Surface Average Height:	11.3034 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 8572
Number of Invalid Surfaces: 3359

Error Codes:

Error Code -108 reported for 11 surfaces
Error Code -111 reported for 3348 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 11877
Number of Invalid Surfaces: 54

Error Codes:

Error Code -111 reported for 54 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.45217

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.915059	55.5835	16.6043	Older Alluvium	500	40	556.781	808.54	367.704	0	367.704	533.733	533.733
2	0.915059	167.475	17.3589	Older Alluvium	500	40	614.255	892.003	467.171	0	467.171	659.183	659.183
3	0.915059	277.792	18.1167	Older Alluvium	500	40	667.698	969.611	559.66	0	559.66	778.114	778.114
4	0.915059	386.512	18.8778	Older Alluvium	500	40	717.346	1041.71	645.583	0	645.583	890.876	890.876
5	0.915059	493.613	19.6424	Older Alluvium	500	40	763.415	1108.61	725.311	0	725.311	997.788	997.788
6	0.915059	599.072	20.4106	Older Alluvium	500	40	806.101	1170.6	799.184	0	799.184	1099.14	1099.14

7	0.915059	697.948	21.1827	Older Alluvium	500	40	843.023	1224.21	863.083	0	863.083	1189.78	1189.78
8	0.915059	756.471	21.9589	Older Alluvium	500	40	857.402	1245.09	887.968	0	887.968	1233.67	1233.67
9	0.915059	805.019	22.7393	Older Alluvium	500	40	865.888	1257.42	902.654	0	902.654	1265.56	1265.56
10	0.915059	851.818	23.5241	Older Alluvium	500	40	872.853	1267.53	914.708	0	914.708	1294.67	1294.67
11	0.915059	896.838	24.3137	Older Alluvium	500	40	878.367	1275.54	924.25	0	924.25	1321.1	1321.1
12	0.915059	940.045	25.1083	Older Alluvium	500	40	882.492	1281.53	931.39	0	931.39	1344.93	1344.93
13	0.915059	981.406	25.908	Older Alluvium	500	40	885.288	1285.59	936.229	0	936.229	1366.26	1366.26
14	0.915059	1020.88	26.7132	Older Alluvium	500	40	886.809	1287.8	938.86	0	938.86	1385.13	1385.13
15	0.915059	1066.97	27.5242	Older Alluvium	500	40	890.755	1293.53	945.69	0	945.69	1409.87	1409.87
16	0.915059	1129.56	28.3411	Older Alluvium	500	40	901.067	1308.5	963.539	0	963.539	1449.55	1449.55
17	0.915059	1190.78	29.1644	Older Alluvium	500	40	909.966	1321.42	978.932	0	978.932	1486.75	1486.75
18	0.915059	1249.94	29.9944	Older Alluvium	500	40	917.241	1331.99	991.53	0	991.53	1520.98	1520.98
19	0.915059	1306.99	30.8313	Older Alluvium	500	40	922.946	1340.27	1001.4	0	1001.4	1552.27	1552.27
20	0.915059	1361.87	31.6757	Older Alluvium	500	40	927.131	1346.35	1008.64	0	1008.64	1580.7	1580.7
21	0.915059	1414.52	32.5277	Older Alluvium	500	40	929.843	1350.29	1013.33	0	1013.33	1606.34	1606.34
22	0.915059	1464.89	33.388	Older Alluvium	500	40	931.125	1352.15	1015.55	0	1015.55	1629.23	1629.23
23	0.915059	1512.9	34.2568	Older Alluvium	500	40	931.016	1351.99	1015.37	0	1015.37	1649.43	1649.43
24	0.915059	1558.48	35.1347	Older Alluvium	500	40	929.554	1349.87	1012.84	0	1012.84	1666.98	1666.98
25	0.915059	1632.96	36.0222	Older Alluvium	500	40	937.315	1361.14	1026.27	0	1026.27	1707.82	1707.82
26	0.915059	1742.89	36.9198	Older Alluvium	500	40	955.726	1387.88	1058.13	0	1058.13	1776.22	1776.22
27	0.915059	1850.23	37.8281	Older Alluvium	500	40	971.772	1411.18	1085.9	0	1085.9	1840.44	1840.44
28	0.915059	1954.79	38.7477	Older Alluvium	500	40	985.473	1431.08	1109.61	0	1109.61	1900.47	1900.47
29	0.915059	2056.45	39.6793	Older Alluvium	500	40	996.874	1447.63	1129.34	0	1129.34	1956.35	1956.35
30	0.915059	2155.1	40.6237	Older Alluvium	500	40	1006.01	1460.9	1145.16	0	1145.16	2008.14	2008.14
31	0.915059	2250.62	41.5816	Older Alluvium	500	40	1012.92	1470.93	1157.11	0	1157.11	2055.84	2055.84
32	0.915059	2342.85	42.5539	Older Alluvium	500	40	1017.63	1477.77	1165.27	0	1165.27	2099.52	2099.52
33	0.915059	2428.13	43.5417	Older Alluvium	500	40	1019.21	1480.06	1167.99	0	1167.99	2136.59	2136.59
34	0.915059	2401.29	44.5459	Older Alluvium	500	40	989.954	1437.58	1117.36	0	1117.36	2091.75	2091.75
35	0.915059	2319.41	45.5678	Older Alluvium	500	40	947.076	1375.32	1043.16	0	1043.16	2009.19	2009.19
36	0.915059	2233.54	46.6086	Older Alluvium	500	40	904.519	1313.52	969.508	0	969.508	1926.3	1926.3
37	0.915059	2143.43	47.6698	Older Alluvium	500	40	862.281	1252.18	896.413	0	896.413	1843.05	1843.05
38	0.915059	2048.82	48.7531	Older Alluvium	500	40	820.361	1191.3	823.862	0	823.862	1759.41	1759.41
39	0.915059	1949.43	49.8603	Older Alluvium	500	40	778.76	1130.89	751.865	0	751.865	1675.37	1675.37

40	0.915059	1844.9	50.9934	Older Alluvium	500	40	737.485	1070.95	680.435	0	680.435	1590.94	1590.94
41	0.915059	1734.87	52.155	Older Alluvium	500	40	696.544	1011.5	609.582	0	609.582	1506.11	1506.11
42	0.915059	1615.2	53.3478	Older Alluvium	500	40	655.199	951.461	538.03	0	538.03	1418.58	1418.58
43	0.915059	1463.6	54.5749	Older Alluvium	500	40	609.265	884.756	458.535	0	458.535	1315.06	1315.06
44	0.915059	1300.08	55.8402	Older Alluvium	500	40	563.249	817.933	378.899	0	378.899	1208.95	1208.95
45	0.915059	1128.78	57.1482	Older Alluvium	500	40	518.175	752.478	300.892	0	300.892	1103.35	1103.35
46	0.915059	948.86	58.5042	Older Alluvium	500	40	474.062	688.419	224.549	0	224.549	998.277	998.277
47	0.915059	759.278	59.9149	Older Alluvium	500	40	430.892	625.729	149.837	0	149.837	893.612	893.612
48	0.915059	558.75	61.3885	Older Alluvium	500	40	388.544	564.232	76.5486	0	76.5486	788.847	788.847
49	0.915059	345.648	62.9353	Older Alluvium	500	40	346.637	503.376	4.02314	0	4.02314	682.44	682.44
50	0.915059	117.863	64.5688	Older Alluvium	500	40	263.473	382.608	-139.902	0	-139.902	414.193	414.193

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.4513

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.93382	40.0778	15.777	Older Alluvium	500	40	330.442	479.57	-24.3475	0	-24.3475	69.015	69.015
2	0.93382	156.15	16.5428	Older Alluvium	500	40	417.156	605.419	125.634	0	125.634	249.54	249.54
3	0.93382	272.798	17.3116	Older Alluvium	500	40	504.832	732.662	277.276	0	277.276	434.626	434.626
4	0.93382	387.773	18.0836	Older Alluvium	500	40	591.215	858.031	426.685	0	426.685	619.736	619.736
5	0.93382	501.054	18.859	Older Alluvium	500	40	675.222	979.949	571.981	0	571.981	802.622	802.622
6	0.93382	612.617	19.638	Older Alluvium	500	40	755.789	1096.88	711.329	0	711.329	981.019	981.019
7	0.93382	718.752	20.4209	Older Alluvium	500	40	830.013	1204.6	839.708	0	839.708	1148.73	1148.73
8	0.93382	783.549	21.2077	Older Alluvium	500	40	878.839	1275.46	924.155	0	924.155	1265.17	1265.17
9	0.93382	835.824	21.9988	Older Alluvium	500	40	916.938	1330.75	990.051	0	990.051	1360.5	1360.5
10	0.93382	886.272	22.7942	Older Alluvium	500	40	949.436	1377.92	1046.26	0	1046.26	1445.26	1445.26
11	0.93382	934.864	23.5944	Older Alluvium	500	40	976.071	1416.57	1092.33	0	1092.33	1518.65	1518.65
12	0.93382	981.564	24.3995	Older Alluvium	500	40	996.721	1446.54	1128.05	0	1128.05	1580.17	1580.17
13	0.93382	1026.34	25.2097	Older Alluvium	500	40	1011.4	1467.85	1153.44	0	1153.44	1629.57	1629.57
14	0.93382	1069.14	26.0254	Older Alluvium	500	40	1020.26	1480.7	1168.75	0	1168.75	1666.92	1666.92
15	0.93382	1120.93	26.8468	Older Alluvium	500	40	1028.29	1492.36	1182.65	0	1182.65	1703.13	1703.13
16	0.93382	1188.24	27.6741	Older Alluvium	500	40	1038.19	1506.73	1199.78	0	1199.78	1744.24	1744.24
17	0.93382	1253.69	28.5078	Older Alluvium	500	40	1042.68	1513.24	1207.54	0	1207.54	1773.85	1773.85
18	0.93382	1316.99	29.3482	Older Alluvium	500	40	1042.21	1512.56	1206.73	0	1206.73	1792.75	1792.75
19	0.93382	1378.1	30.1955	Older Alluvium	500	40	1037.41	1505.6	1198.43	0	1198.43	1802.12	1802.12

20	0.93382	1436.95	31.0502	Older Alluvium	500	40	1028.97	1493.34	1183.82	0	1183.82	1803.31	1803.31
21	0.93382	1493.48	31.9127	Older Alluvium	500	40	1017.55	1476.77	1164.07	0	1164.07	1797.76	1797.76
22	0.93382	1547.64	32.7833	Older Alluvium	500	40	1003.86	1456.91	1140.4	0	1140.4	1786.93	1786.93
23	0.93382	1599.34	33.6625	Older Alluvium	500	40	988.556	1434.69	1113.92	0	1113.92	1772.27	1772.27
24	0.93382	1650.53	34.5508	Older Alluvium	500	40	972.896	1411.96	1086.84	0	1086.84	1756.76	1756.76
25	0.93382	1748.38	35.4487	Older Alluvium	500	40	972.385	1411.22	1085.95	0	1085.95	1778.23	1778.23
26	0.93382	1864.69	36.3567	Older Alluvium	500	40	977.607	1418.8	1094.98	0	1094.98	1814.6	1814.6
27	0.93382	1978.21	37.2754	Older Alluvium	500	40	982.256	1425.55	1103.03	0	1103.03	1850.64	1850.64
28	0.93382	2088.84	38.2055	Older Alluvium	500	40	986.846	1432.21	1110.96	0	1110.96	1887.69	1887.69
29	0.93382	2196.47	39.1477	Older Alluvium	500	40	991.78	1439.37	1119.5	0	1119.5	1926.87	1926.87
30	0.93382	2300.97	40.1026	Older Alluvium	500	40	997.35	1447.45	1129.13	0	1129.13	1969.05	1969.05
31	0.93382	2402.23	41.0712	Older Alluvium	500	40	1003.74	1456.74	1140.19	0	1140.19	2014.92	2014.92
32	0.93382	2500.08	42.0542	Older Alluvium	500	40	1011.07	1467.36	1152.86	0	1152.86	2064.96	2064.96
33	0.93382	2556.36	43.0527	Older Alluvium	500	40	1008.97	1464.31	1149.22	0	1149.22	2091.83	2091.83
34	0.93382	2486.21	44.0677	Older Alluvium	500	40	974.791	1414.71	1090.11	0	1090.11	2033.68	2033.68
35	0.93382	2402.81	45.1005	Older Alluvium	500	40	939.301	1363.21	1028.73	0	1028.73	1971.33	1971.33
36	0.93382	2315.26	46.1523	Older Alluvium	500	40	904.674	1312.95	968.841	0	968.841	1910.66	1910.66
37	0.93382	2223.33	47.2246	Older Alluvium	500	40	870.614	1263.52	909.928	0	909.928	1850.92	1850.92
38	0.93382	2126.75	48.3191	Older Alluvium	500	40	836.873	1214.55	851.575	0	851.575	1791.49	1791.49
39	0.93382	2025.21	49.4376	Older Alluvium	500	40	803.241	1165.74	793.406	0	793.406	1731.81	1731.81
40	0.93382	1918.37	50.5822	Older Alluvium	500	40	769.525	1116.81	735.089	0	735.089	1671.33	1671.33
41	0.93382	1805.65	51.7554	Older Alluvium	500	40	735.472	1067.39	676.187	0	676.187	1609.31	1609.31
42	0.93382	1665.83	52.96	Older Alluvium	500	40	695.461	1009.32	606.988	0	606.988	1528.56	1528.56
43	0.93382	1505.05	54.1991	Older Alluvium	500	40	650.695	944.354	529.56	0	529.56	1431.74	1431.74
44	0.93382	1336.98	55.4766	Older Alluvium	500	40	604.119	876.758	449.003	0	449.003	1327.23	1327.23
45	0.93382	1160.88	56.797	Older Alluvium	500	40	554.803	805.185	363.705	0	363.705	1211.43	1211.43
46	0.93382	975.896	58.1657	Older Alluvium	500	40	501.46	727.769	271.445	0	271.445	1079.14	1079.14
47	0.93382	780.946	59.5893	Older Alluvium	500	40	442.365	642.004	169.234	0	169.234	922.904	922.904
48	0.93382	574.714	61.0761	Older Alluvium	500	40	375.248	544.597	53.1487	0	53.1487	732.24	732.24
49	0.93382	355.531	62.6365	Older Alluvium	500	40	297.196	431.32	-81.8497	0	-81.8497	492.395	492.395
50	0.93382	121.234	64.2841	Older Alluvium	500	40	204.543	296.853	-242.101	0	-242.101	182.607	182.607

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.45217

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	85.9932	25.9973	0	0	0
2	86.9082	26.2701	400.461	430.826	47.092
3	87.8233	26.5562	803.396	864.315	47.092
4	88.7383	26.8556	1204.73	1296.08	47.092
5	89.6534	27.1685	1600.71	1722.08	47.0919
6	90.5685	27.4951	1987.86	2138.59	47.092
7	91.4835	27.8356	2362.99	2542.17	47.092
8	92.3986	28.1902	2723.12	2929.6	47.0919
9	93.3136	28.5591	3066.06	3298.55	47.092
10	94.2287	28.9426	3390.92	3648.04	47.092
11	95.1438	29.341	3696.94	3977.26	47.0919
12	96.0588	29.7544	3983.49	4285.55	47.092
13	96.9739	30.1832	4250.07	4572.34	47.092
14	97.8889	30.6277	4496.24	4837.18	47.092
15	98.804	31.0882	4721.69	5079.72	47.092
16	99.7191	31.565	4925.23	5298.69	47.092
17	100.634	32.0586	5104.19	5491.22	47.092
18	101.549	32.5692	5257.76	5656.43	47.092
19	102.464	33.0974	5385.29	5793.64	47.092
20	103.379	33.6436	5486.28	5902.28	47.092
21	104.294	34.2082	5560.29	5981.91	47.092
22	105.209	34.7918	5607.02	6032.18	47.092
23	106.124	35.3949	5626.25	6052.87	47.092
24	107.04	36.0181	5617.88	6043.86	47.092
25	107.955	36.662	5581.9	6005.16	47.092
26	108.87	37.3274	5511.21	5929.1	47.092
27	109.785	38.0149	5396.21	5805.38	47.092
28	110.7	38.7254	5235.74	5632.74	47.0919
29	111.615	39.4598	5028.81	5410.13	47.092
30	112.53	40.2189	4774.58	5136.62	47.092
31	113.445	41.0039	4472.33	4811.45	47.092
32	114.36	41.8158	4121.51	4434.03	47.092
33	115.275	42.6559	3721.71	4003.91	47.092
34	116.19	43.5255	3273.76	3522	47.092
35	117.105	44.4262	2812.43	3025.68	47.0919
36	118.02	45.3595	2356.88	2535.59	47.0919
37	118.935	46.3275	1910.53	2055.4	47.092
38	119.85	47.3321	1476.99	1588.99	47.0921
39	120.765	48.3756	1060.09	1140.47	47.0919
40	121.68	49.4607	663.911	714.252	47.0919
41	122.596	50.5905	292.832	315.036	47.092
42	123.511	51.7682	-48.4149	-52.0861	47.092
43	124.426	52.998	-353.228	-380.012	47.092
44	125.341	54.2845	-605.512	-651.425	47.092
45	126.256	55.633	-796.422	-856.812	47.092
46	127.171	57.05	-918.297	-987.928	47.092
47	128.086	58.5435	-962.495	-1035.48	47.0921
48	129.001	60.123	-919.039	-988.726	47.092
49	129.916	61.8006	-775.972	-834.811	47.092
50	130.831	63.5915	-518.052	-557.334	47.092
51	131.746	65.5159	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.4513

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	85.8084	25.9234	0	0	0
2	86.7422	26.1872	309.85	24.6044	4.54019

3	87.676	26.4646	642.221	101.793	9.00654
4	88.6099	26.7556	993.34	235.392	13.3315
5	89.5437	27.0605	1358.7	427.317	17.4586
6	90.4775	27.3795	1733.4	677.406	21.3454
7	91.4113	27.7127	2112.23	983.339	24.9641
8	92.3451	28.0604	2489.73	1340.61	28.3005
9	93.279	28.4228	2860.31	1742.63	31.3517
10	94.2128	28.8	3220.08	2182.01	34.1226
11	95.1466	29.1925	3565.64	2650.47	36.6248
12	96.0804	29.6003	3893.91	3138.93	38.8727
13	97.0142	30.0239	4202.22	3637.88	40.8829
14	97.9481	30.4635	4488.31	4137.7	42.6725
15	98.8819	30.9195	4750.43	4628.93	44.2578
16	99.8157	31.3922	4986.23	5101.49	45.6546
17	100.75	31.8819	5192.63	5544.54	46.8772
18	101.683	32.3891	5368.53	5949.48	47.9384
19	102.617	32.9141	5513.34	6308.8	48.8494
20	103.551	33.4575	5626.87	6616.26	49.6201
21	104.485	34.0198	5709.34	6866.87	50.2588
22	105.419	34.6013	5761.24	7056.99	50.7722
23	106.352	35.2027	5783.29	7184.23	51.166
24	107.286	35.8246	5776.36	7247.42	51.4444
25	108.22	36.4676	5740.98	7245.95	51.6101
26	109.154	37.1325	5667.33	7167.14	51.6652
27	110.088	37.8198	5550.42	7005.44	51.6102
28	111.022	38.5306	5389.54	6762.09	51.4444
29	111.955	39.2656	5183.79	6439.51	51.166
30	112.889	40.0258	4932.03	6041.29	50.7723
31	113.823	40.8122	4632.86	5572.15	50.2588
32	114.757	41.626	4284.59	5037.96	49.6201
33	115.691	42.4684	3885.19	4445.75	48.8494
34	116.624	43.3408	3443.98	3816.66	47.9383
35	117.558	44.2447	2998.51	3201.72	46.8772
36	118.492	45.1818	2553.65	2612.68	45.6546
37	119.426	46.154	2111.67	2057.66	44.2578
38	120.36	47.1633	1675.05	1544.2	42.6724
39	121.294	48.2121	1246.59	1079.18	40.8829
40	122.227	49.303	829.427	668.611	38.8727
41	123.161	50.4392	427.126	317.499	36.6248
42	124.095	51.6239	43.8692	29.727	34.1227
43	125.029	52.8614	-305.85	-186.337	31.3516
44	125.963	54.1561	-607.909	-327.333	28.3006
45	126.896	55.5136	-852.27	-396.77	24.9641
46	127.83	56.9405	-1025.82	-400.886	21.3453
47	128.764	58.4446	-1110.9	-349.38	17.4585
48	129.698	60.0355	-1083.04	-256.648	13.3315
49	130.632	61.7255	-907.669	-143.867	9.00655
50	131.566	63.5298	-535.009	-42.4837	4.54018
51	132.499	65.4688	0	0	0

Entity Information

Distributed Load

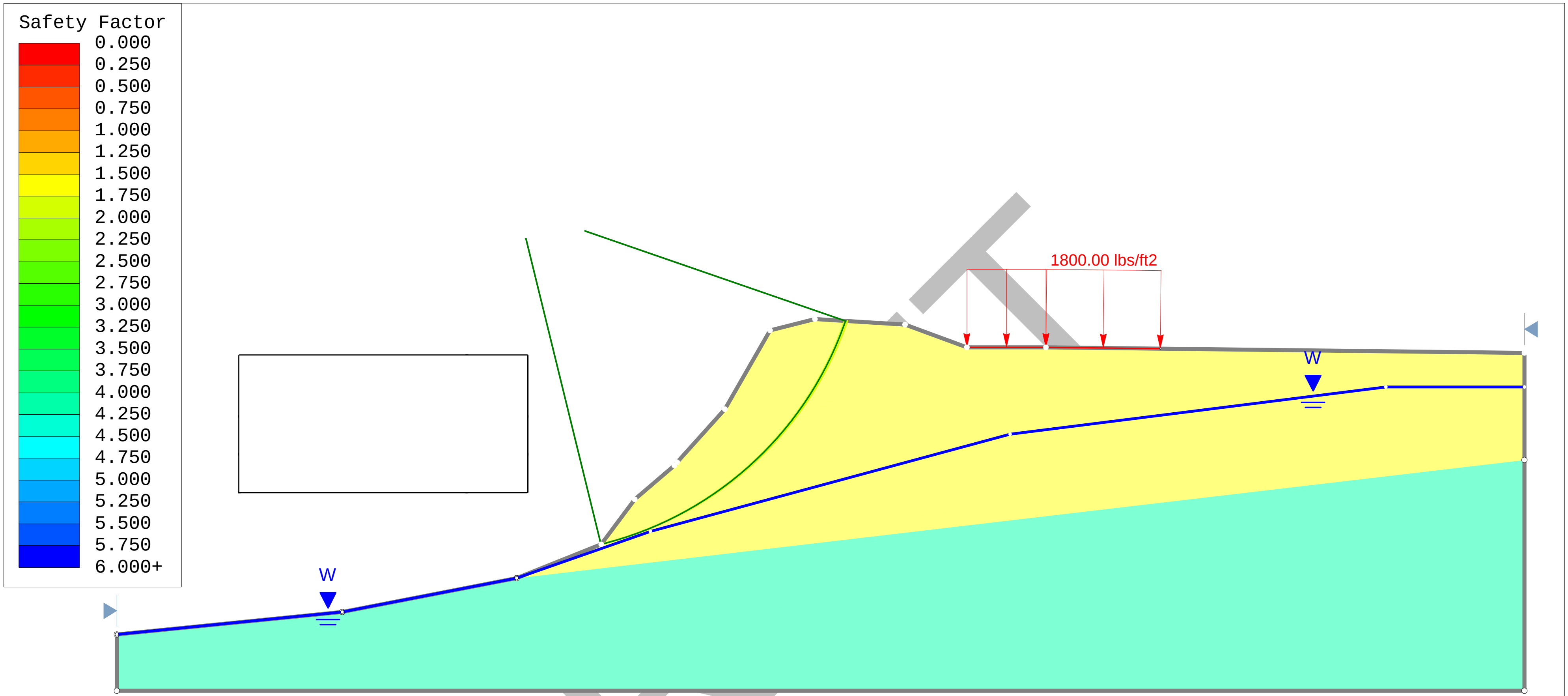
X	Y
185.342	60.7607
165	61
151	61

External Boundary

X	Y
0	0
250	0
250	41
250	60
165	61
151	61
140	65
124	66
116	64
108	50
99.5299	40.5887
99	40
92	34
86	26
71	20
40	14
0	10

Material Boundary

X	Y
71	20
250	41



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Older Alluvium		130	Mohr-Coulomb	500	40	Water Surface	Custom	1
Galice Formation		155	Mohr-Coulomb	3000	23	Water Surface	Custom	1

BAJADA Geosciences, Inc.

Project	Orleans MWC Treatment Plant Improvements		
Analysis Description	Static, dry, with 1,800 psf tank surcharge		
Drawn By J.Bianchin	*Scale* 1:323	*Company*	Bajada Geosciences, Inc.
Date	7/13/2022, 1:30:35 PM	*File Name*	A-A'_Static_ElevatedGW.slim

SLIDEINTERPRET 8.032

Slide Analysis Information

Orleans MWC Treatment Plant Improvements

Project Summary

Slide Modeler Version:	8.032
Compute Time:	00h:00m:05.662s

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
GLE/Morgenstern-Price with interslice force function (Half Sine)
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search

Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

1 Distributed Load present

Distributed Load 1	
Distribution:	Constant
Magnitude [psf]:	1800
Orientation:	Normal to boundary

Materials

Property	Older Alluvium	Galice Formation
Color		
Strength Type	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	130	155
Cohesion [psf]	500	3000
Friction Angle [°]	40	23
Water Surface	Water Table	Water Table
Hu Value	1	1

Global Minimums

Method: spencer

FS	1.779070
Center:	71.301, 85.733
Radius:	61.516
Left Slip Surface Endpoint:	85.993, 25.997
Right Slip Surface Endpoint:	129.450, 65.659
Resisting Moment:	4.42236e+06 lb-ft
Driving Moment:	2.48578e+06 lb-ft
Resisting Horizontal Force:	53401.4 lb
Driving Horizontal Force:	30016.5 lb
Total Slice Area:	484.766 ft2
Surface Horizontal Width:	43.4564 ft
Surface Average Height:	11.1552 ft

Method: gle/morgenstern-price

FS	1.777490
Center:	76.740, 75.370

Radius:	54.330
Left Slip Surface Endpoint:	73.798, 21.119
Right Slip Surface Endpoint:	130.187, 65.613
Resisting Moment:	5.47886e+06 lb-ft
Driving Moment:	3.08235e+06 lb-ft
Resisting Horizontal Force:	76580 lb
Driving Horizontal Force:	43083.1 lb
Total Slice Area:	736.356 ft2
Surface Horizontal Width:	56.3893 ft
Surface Average Height:	13.0584 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 9648
Number of Invalid Surfaces: 2005

Error Codes:

Error Code -108 reported for 5 surfaces
Error Code -111 reported for 1999 surfaces
Error Code -112 reported for 1 surface

Method: gle/morgenstern-price

Number of Valid Surfaces: 11632
Number of Invalid Surfaces: 21

Error Codes:

Error Code -111 reported for 21 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.77907

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.869129	52.2924	14.2357	Older Alluvium	500	40	357.82	636.587	162.778	0	162.778	253.557	253.557
2	0.869129	157.543	15.0724	Older Alluvium	500	40	411.437	731.975	276.457	0	276.457	387.258	387.258
3	0.869129	261.256	15.9125	Older Alluvium	500	40	462.405	822.65	384.519	0	384.519	516.348	516.348
4	0.869129	363.408	16.756	Older Alluvium	500	40	510.808	908.764	487.145	0	487.145	640.94	640.94
5	0.869129	463.98	17.6034	Older Alluvium	500	40	556.727	990.457	584.505	0	584.505	761.145	761.145

6	0.869129	562.949	18.4547	Older Alluvium	500	40	600.236	1067.86	676.752	0	676.752	877.061	877.061
7	0.869129	660.108	19.3103	Older Alluvium	500	40	641.311	1140.94	763.839	0	763.839	988.552	988.552
8	0.869129	728.457	20.1704	Older Alluvium	500	40	666.814	1186.31	817.91	0	817.91	1062.86	1062.86
9	0.869129	775.71	21.0352	Older Alluvium	500	40	681.188	1211.88	848.386	0	848.386	1110.35	1110.35
10	0.869129	821.255	21.9051	Older Alluvium	500	40	694.135	1234.91	875.836	0	875.836	1154.95	1154.95
11	0.869129	865.064	22.7804	Older Alluvium	500	40	705.688	1255.47	900.331	0	900.331	1196.69	1196.69
12	0.869129	907.101	23.6613	Older Alluvium	500	40	715.878	1273.6	921.936	0	921.936	1235.61	1235.61
13	0.869129	947.333	24.5481	Older Alluvium	500	40	724.734	1289.35	940.713	0	940.713	1271.73	1271.73
14	0.869129	985.721	25.4413	Older Alluvium	500	40	732.281	1302.78	956.716	0	956.716	1305.08	1305.08
15	0.869129	1022.24	26.3412	Older Alluvium	500	40	738.553	1313.94	970.013	0	970.013	1335.69	1335.69
16	0.869129	1070.13	27.2481	Older Alluvium	500	40	749.258	1332.98	992.71	0	992.71	1378.57	1378.57
17	0.869129	1127.67	28.1625	Older Alluvium	500	40	763.419	1358.17	1022.73	0	1022.73	1431.43	1431.43
18	0.869129	1183.18	29.0848	Older Alluvium	500	40	775.998	1380.55	1049.4	0	1049.4	1481.05	1481.05
19	0.869129	1236.62	30.0154	Older Alluvium	500	40	787.018	1400.16	1072.77	0	1072.77	1527.44	1527.44
20	0.869129	1287.91	30.9548	Older Alluvium	500	40	796.498	1417.03	1092.86	0	1092.86	1570.59	1570.59
21	0.869129	1337.01	31.9035	Older Alluvium	500	40	804.453	1431.18	1109.74	0	1109.74	1610.54	1610.54
22	0.869129	1383.84	32.8622	Older Alluvium	500	40	810.9	1442.65	1123.4	0	1123.4	1647.24	1647.24
23	0.869129	1428.32	33.8313	Older Alluvium	500	40	815.849	1451.45	1133.9	0	1133.9	1680.71	1680.71
24	0.869129	1470.38	34.8115	Older Alluvium	500	40	819.311	1457.61	1141.24	0	1141.24	1710.92	1710.92
25	0.869129	1509.94	35.8036	Older Alluvium	500	40	821.295	1461.14	1145.44	0	1145.44	1737.86	1737.86
26	0.869129	1561.37	36.8081	Older Alluvium	500	40	826.979	1471.25	1157.49	0	1157.49	1776.34	1776.34
27	0.869129	1655.13	37.8261	Older Alluvium	500	40	846.763	1506.45	1199.44	0	1199.44	1856.88	1856.88
28	0.869129	1749.3	38.8583	Older Alluvium	500	40	865.357	1539.53	1238.87	0	1238.87	1936.09	1936.09
29	0.869129	1840.53	39.9057	Older Alluvium	500	40	881.607	1568.44	1273.31	0	1273.31	2010.6	2010.6
30	0.869129	1928.68	40.9694	Older Alluvium	500	40	895.496	1593.15	1302.77	0	1302.77	2080.37	2080.37
31	0.869129	2013.61	42.0506	Older Alluvium	500	40	907.019	1613.65	1327.19	0	1327.19	2145.32	2145.32
32	0.869129	2095.14	43.1505	Older Alluvium	500	40	916.147	1629.89	1346.56	0	1346.56	2205.39	2205.39
33	0.869129	2173.1	44.2705	Older Alluvium	500	40	922.87	1641.85	1360.81	0	1360.81	2260.47	2260.47
34	0.869129	2247.27	45.4124	Older Alluvium	500	40	927.153	1649.47	1369.88	0	1369.88	2310.48	2310.48
35	0.869129	2300.82	46.5778	Older Alluvium	500	40	924.084	1644.01	1363.38	0	1363.38	2339.82	2339.82
36	0.869129	2239.72	47.7688	Older Alluvium	500	40	887.188	1578.37	1285.15	0	1285.15	2262.51	2262.51
37	0.869129	2153.72	48.9878	Older Alluvium	500	40	843.98	1501.5	1193.55	0	1193.55	2164.02	2164.02
38	0.869129	2062.8	50.2375	Older Alluvium	500	40	800.416	1424	1101.18	0	1101.18	2063.14	2063.14

39	0.869129	1966.56	51.5208	Older Alluvium	500	40	756.489	1345.85	1008.04	0	1008.04	1959.79	1959.79
40	0.869129	1864.56	52.8414	Older Alluvium	500	40	712.197	1267.05	914.13	0	914.13	1853.82	1853.82
41	0.869129	1756.24	54.2035	Older Alluvium	500	40	667.536	1187.59	819.444	0	819.444	1745.12	1745.12
42	0.869129	1640.96	55.6121	Older Alluvium	500	40	622.502	1107.47	723.958	0	723.958	1633.51	1633.51
43	0.869129	1517.95	57.0734	Older Alluvium	500	40	577.086	1026.68	627.67	0	627.67	1518.8	1518.8
44	0.869129	1385.13	58.5948	Older Alluvium	500	40	531.031	944.742	530.023	0	530.023	1399.82	1399.82
45	0.869129	1221.06	60.1857	Older Alluvium	500	40	480.05	854.042	421.931	0	421.931	1259.66	1259.66
46	0.869129	1037.45	61.858	Older Alluvium	500	40	427.394	760.363	310.289	0	310.289	1109.31	1109.31
47	0.869129	840.485	63.6273	Older Alluvium	500	40	374.838	666.863	198.86	0	198.86	954.871	954.871
48	0.869129	627.502	65.5152	Older Alluvium	500	40	322.294	573.384	87.4555	0	87.4555	795.162	795.162
49	0.869129	394.707	67.5518	Older Alluvium	500	40	269.553	479.553	-24.3676	0	-24.3676	628.06	628.06
50	0.869129	136.398	69.7832	Older Alluvium	500	40	206.209	366.861	-158.668	0	-158.668	401.286	401.286

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.77749

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.361652	3.83327	-2.91351	Older Alluvium	500	40	295.181	524.681	29.414	0	29.414	14.391	14.391
2	1.15301	62.1978	-2.11416	Older Alluvium	500	40	315.463	560.733	86.2373	13.8586	72.3787	74.5917	60.7331
3	1.15301	135.873	-0.897699	Older Alluvium	500	40	343.165	609.972	171.875	40.8163	131.059	166.498	125.682
4	1.15301	205.878	0.318359	Older Alluvium	500	40	370.586	658.713	255.393	66.246	189.147	257.452	191.206
5	1.15301	272.213	1.53456	Older Alluvium	500	40	397.257	706.12	335.792	90.1483	245.644	346.435	256.286
6	1.15301	334.876	2.75145	Older Alluvium	500	40	422.717	751.375	412.099	112.522	299.577	432.414	319.892
7	1.15301	393.858	3.96959	Older Alluvium	500	40	446.535	793.712	483.395	133.362	350.033	514.381	381.019
8	1.15301	449.144	5.18953	Older Alluvium	500	40	468.32	832.434	548.844	152.665	396.179	591.378	438.713
9	1.67864	744.57	6.69126	Older Alluvium	500	40	491.626	873.86	619.581	174.032	445.549	677.258	503.226
10	1.13365	559.199	8.18644	Older Alluvium	500	40	511.085	908.449	680.139	193.369	486.77	753.664	560.295
11	1.13365	602.078	9.39628	Older Alluvium	500	40	524.293	931.925	721.82	207.072	514.748	808.581	601.509
12	1.13365	739.799	10.6104	Older Alluvium	500	40	576.973	1025.56	845.579	219.238	626.341	953.665	734.427
13	1.13365	929.416	11.8293	Older Alluvium	500	40	649.557	1154.58	1009.95	229.849	780.098	1145.99	916.144
14	1.13365	1115.31	13.0537	Older Alluvium	500	40	717.573	1275.48	1163.07	238.885	924.184	1329.44	1090.56
15	1.13365	1297.44	14.2841	Older Alluvium	500	40	780.634	1387.57	1304.09	246.324	1057.77	1502.84	1256.52
16	1.13365	1475.73	15.5214	Older Alluvium	500	40	838.48	1490.39	1432.44	252.141	1180.3	1665.31	1413.17
17	1.13365	1620.49	16.7661	Older Alluvium	500	40	879.195	1562.76	1522.86	256.307	1266.55	1787.74	1531.43
18	1.13365	1712.1	18.019	Older Alluvium	500	40	895.848	1592.36	1560.61	258.79	1301.82	1852.02	1593.23

19	1.13365	1798.91	19.281	Older Alluvium	500	40	908.236	1614.38	1587.62	259.557	1328.07	1905.34	1645.79
20	1.13365	1881.57	20.5527	Older Alluvium	500	40	919.549	1634.49	1605.57	253.538	1352.04	1950.34	1696.81
21	1.13365	1959.98	21.8351	Older Alluvium	500	40	927.763	1649.09	1614.68	245.238	1369.44	1986.41	1741.18
22	1.13365	2034.03	23.1291	Older Alluvium	500	40	933.001	1658.4	1615.62	235.092	1380.53	2014.14	1779.04
23	1.13365	2113.66	24.4357	Older Alluvium	500	40	939.116	1669.27	1616.53	223.047	1393.48	2043.24	1820.19
24	1.13365	2218.97	25.756	Older Alluvium	500	40	953.08	1694.09	1632.11	209.045	1423.06	2091.94	1882.89
25	1.13365	2321.57	27.0912	Older Alluvium	500	40	965.209	1715.65	1641.77	193.021	1448.75	2135.51	1942.49
26	1.13365	2419.23	28.4424	Older Alluvium	500	40	975.173	1733.36	1644.76	174.903	1469.86	2172.97	1998.06
27	1.13365	2511.75	29.8112	Older Alluvium	500	40	983.336	1747.87	1641.77	154.613	1487.15	2205.19	2050.57
28	1.13365	2598.93	31.199	Older Alluvium	500	40	990.048	1759.8	1633.43	132.061	1501.37	2233	2100.94
29	1.13365	2680.54	32.6075	Older Alluvium	500	40	995.595	1769.66	1620.27	107.148	1513.12	2257.16	2150.02
30	1.13365	2756.31	34.0385	Older Alluvium	500	40	1000.24	1777.91	1602.72	79.7636	1522.95	2278.36	2198.6
31	1.13365	2855.92	35.4941	Older Alluvium	500	40	1012.61	1799.9	1598.94	49.7817	1549.16	2321.07	2271.29
32	1.13365	3022.48	36.9766	Older Alluvium	500	40	1044.19	1856.03	1633.12	17.0613	1616.06	2419.31	2402.24
33	1.12244	3153.27	38.481	Older Alluvium	500	40	1066.79	1896.2	1663.92	0	1663.92	2511.9	2511.9
34	1.12244	3306.06	40.0098	Older Alluvium	500	40	1079.48	1918.77	1690.82	0	1690.82	2596.93	2596.93
35	1.12244	3451.3	41.5737	Older Alluvium	500	40	1090.08	1937.61	1713.28	0	1713.28	2680.21	2680.21
36	1.12244	3588.45	43.1765	Older Alluvium	500	40	1098.67	1952.88	1731.47	0	1731.47	2762.35	2762.35
37	1.12244	3716.84	44.8226	Older Alluvium	500	40	1105.25	1964.57	1745.41	0	1745.41	2843.83	2843.83
38	1.12244	3785.48	46.5172	Older Alluvium	500	40	1097.64	1951.04	1729.29	0	1729.29	2886.65	2886.65
39	1.12244	3664.23	48.2665	Older Alluvium	500	40	1045.96	1859.18	1619.81	0	1619.81	2792.38	2792.38
40	1.12244	3515.5	50.0779	Older Alluvium	500	40	990.087	1759.87	1501.45	0	1501.45	2684.66	2684.66
41	1.12244	3353.92	51.9607	Older Alluvium	500	40	933.361	1659.04	1381.29	0	1381.29	2574.25	2574.25
42	1.12244	3177.78	53.9265	Older Alluvium	500	40	875.217	1555.69	1258.12	0	1258.12	2459.51	2459.51
43	1.12244	2984.95	55.9899	Older Alluvium	500	40	814.953	1448.57	1130.46	0	1130.46	2338.22	2338.22
44	1.12244	2772.61	58.1703	Older Alluvium	500	40	751.694	1336.13	996.457	0	996.457	2207.41	2207.41
45	1.12244	2530.2	60.4944	Older Alluvium	500	40	682.912	1213.87	850.756	0	850.756	2057.53	2057.53
46	1.12244	2220.62	63	Older Alluvium	500	40	600.94	1068.16	677.109	0	677.109	1856.52	1856.52
47	1.12244	1867.92	65.7447	Older Alluvium	500	40	510.277	907.013	485.059	0	485.059	1617.55	1617.55
48	1.12244	1464.54	68.8242	Older Alluvium	500	40	408.915	726.843	270.341	0	270.341	1325.91	1325.91
49	1.12244	984.387	72.4232	Older Alluvium	500	40	291.832	518.728	22.3191	0	22.3191	943.582	943.582
50	1.12244	360.375	77.0193	Older Alluvium	500	40	150.028	266.674	-278.068	0	-278.068	372.775	372.775

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.77907

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	85.9932	25.9973	0	0	0
2	86.8623	26.2178	274.716	167.153	31.3187
3	87.7314	26.4518	567.16	345.093	31.3188
4	88.6006	26.6996	873.277	531.353	31.3188
5	89.4697	26.9613	1189.21	723.587	31.3189
6	90.3388	27.237	1511.3	919.564	31.3188
7	91.2079	27.5271	1836.06	1117.16	31.3186
8	92.0771	27.8316	2160.13	1314.35	31.3188
9	92.9462	28.1509	2477.83	1507.66	31.3188
10	93.8153	28.4851	2785.58	1694.91	31.3188
11	94.6845	28.8346	3082.04	1875.29	31.3187
12	95.5536	29.1996	3366	2048.07	31.3188
13	96.4227	29.5804	3636.33	2212.56	31.3188
14	97.2918	29.9774	3892.01	2368.13	31.3188
15	98.161	30.3909	4132.11	2514.22	31.3188
16	99.0301	30.8212	4355.79	2650.32	31.3188
17	99.8992	31.2688	4561.86	2775.7	31.3188
18	100.768	31.7341	4748.69	2889.38	31.3188
19	101.637	32.2175	4914.97	2990.55	31.3187
20	102.507	32.7196	5059.5	3078.5	31.3188
21	103.376	33.2409	5181.21	3152.55	31.3188
22	104.245	33.782	5279.09	3212.1	31.3187
23	105.114	34.3434	5352.26	3256.63	31.3188
24	105.983	34.9259	5399.95	3285.64	31.3187
25	106.852	35.5303	5421.49	3298.75	31.3188
26	107.721	36.1572	5416.32	3295.6	31.3187
27	108.591	36.8076	5381.37	3274.34	31.3188
28	109.46	37.4824	5307.03	3229.1	31.3187
29	110.329	38.1826	5190.68	3158.31	31.3188
30	111.198	38.9095	5030.46	3060.82	31.3187
31	112.067	39.6642	4824.59	2935.56	31.3188
32	112.936	40.4481	4571.47	2781.55	31.3188
33	113.805	41.2629	4269.63	2597.89	31.3188
34	114.674	42.1102	3917.76	2383.8	31.3188
35	115.544	42.9919	3514.72	2138.56	31.3188
36	116.413	43.9103	3064.8	1864.8	31.3187
37	117.282	44.8677	2604.44	1584.69	31.3187
38	118.151	45.8671	2144.25	1304.68	31.3186
39	119.02	46.9117	1688.82	1027.58	31.3189
40	119.889	48.0051	1243.25	756.465	31.3187
41	120.758	49.1519	813.193	494.794	31.3188
42	121.627	50.3571	405.037	246.448	31.3188
43	122.497	51.627	26.0439	15.8466	31.3187
44	123.366	52.9691	-315.407	-191.912	31.3188
45	124.235	54.3927	-608.966	-370.531	31.3188
46	125.104	55.9094	-832.201	-506.359	31.3187
47	125.973	57.5343	-965.375	-587.39	31.3188
48	126.842	59.2872	-988.584	-601.512	31.3188
49	127.711	61.1957	-875.72	-532.839	31.3188
50	128.58	63.2993	-590.472	-359.277	31.3187
51	129.45	65.6594	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.77749

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]

1	73.7979	21.1192	0	0	0
2	74.1595	21.1008	107.577	1.35685	0.722623
3	75.3126	21.0582	475.946	25.1137	3.02046
4	76.4656	21.0401	875.774	81.1853	5.29625
5	77.6186	21.0465	1302.56	172.269	7.53388
6	78.7716	21.0774	1751.45	299.955	9.71825
7	79.9246	21.1328	2217.3	464.663	11.8358
8	81.0776	21.2128	2694.85	665.625	13.8743
9	82.2306	21.3176	3178.79	900.921	15.8236
10	83.9093	21.5145	3884.22	1298.52	18.4851
11	85.0429	21.6776	4354.23	1598.21	20.1555
12	86.1766	21.8652	4814.76	1917.84	21.7186
13	87.3102	22.0776	5291	2264.62	23.1716
14	88.4439	22.315	5789.53	2640	24.5128
15	89.5775	22.5778	6299.46	3037.35	25.7415
16	90.7112	22.8665	6810.37	3448.78	26.8577
17	91.8448	23.1813	7312.44	3865.53	27.862
18	92.9785	23.5228	7791.67	4275.58	28.7552
19	94.1121	23.8916	8234.44	4666.15	29.5386
20	95.2458	24.2882	8637.18	5029.68	30.2135
21	96.3795	24.7132	8999.96	5361.03	30.7811
22	97.5131	25.1675	9321.07	5654.55	31.2427
23	98.6468	25.6517	9599.25	5905.37	31.5994
24	99.7804	26.1668	9834.04	6109.76	31.8521
25	100.914	26.7137	10024.7	6264.47	32.0014
26	102.048	27.2936	10169.7	6366.57	32.0479
27	103.181	27.9077	10268.2	6414.16	31.9915
28	104.315	28.5572	10319.5	6406.37	31.8321
29	105.449	29.2438	10323.4	6343.4	31.5694
30	106.582	29.969	10280.1	6226.42	31.2023
31	107.716	30.7347	10189.7	6057.53	30.7305
32	108.85	31.5432	10048	5836.94	30.1525
33	109.983	32.3967	9840.94	5560.3	29.4672
34	111.106	33.289	9556.93	5228.26	28.6815
35	112.228	34.2311	9178.76	4836.97	27.7881
36	113.351	35.2268	8699.76	4391.85	26.7858
37	114.473	36.2799	8112.68	3899.77	25.6736
38	115.595	37.3954	7409.52	3369.09	24.4512
39	116.718	38.579	6598.19	2816.88	23.1185
40	117.84	39.8373	5737.1	2280.31	21.6762
41	118.963	41.1787	4837.35	1772.72	20.1261
42	120.085	42.6133	3906.13	1304.76	18.4708
43	121.208	44.154	2952.67	886.649	16.7143
44	122.33	45.8175	1989.37	527.921	14.8621
45	123.453	47.6257	1033.52	237.108	12.9211
46	124.575	49.6092	114.639	22.0759	10.9
47	125.697	51.8121	-700.674	-108.581	8.80886
48	126.82	54.3032	-1334.74	-155.841	6.65956
49	127.942	57.2007	-1657.84	-129.466	4.46535
50	129.065	60.744	-1408.49	-55.1044	2.24044
51	130.187	65.6133	0	0	0

Entity Information

Water Table

X	Y
0	10
40	14
71	20
94.778	28.284

158.642	45.558
225.384	53.934
250	53.934

Distributed Load

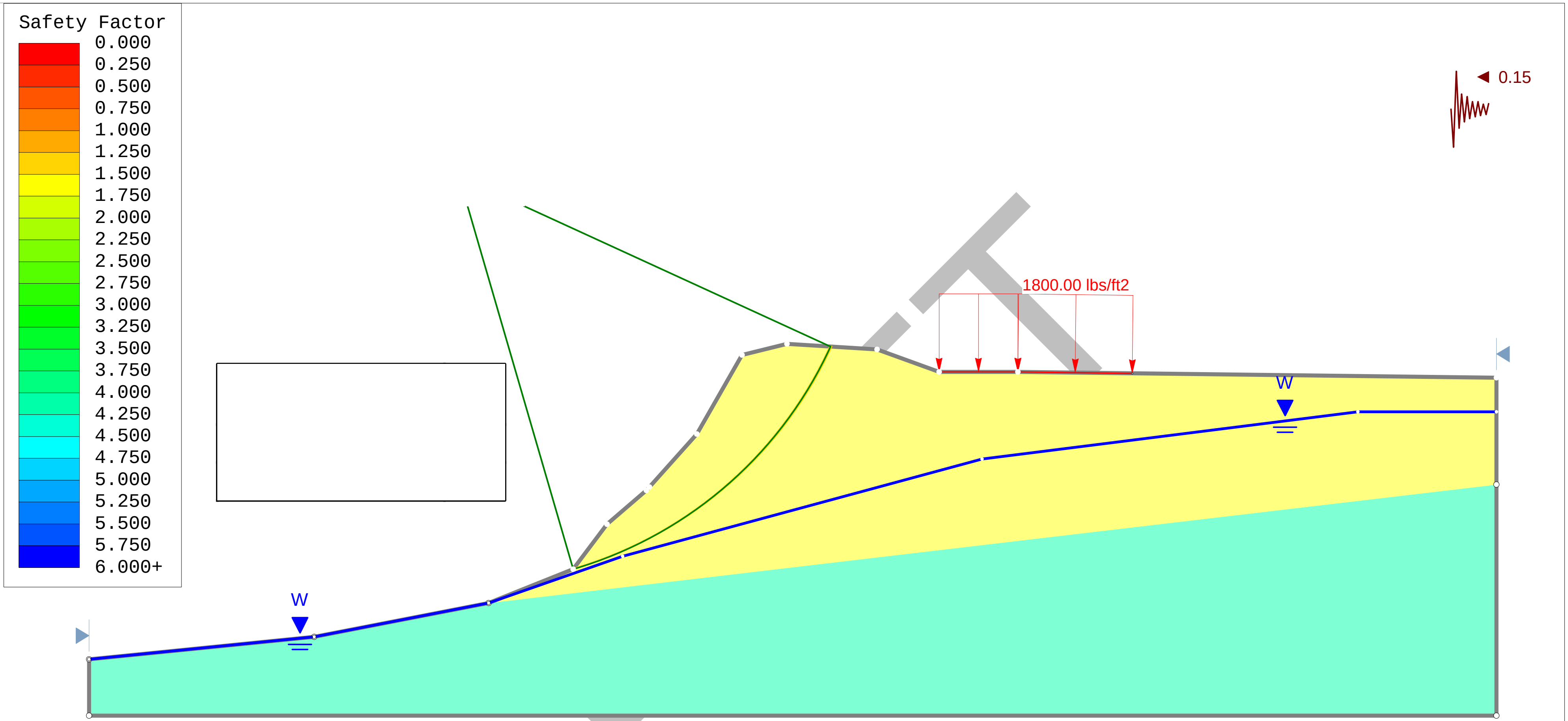
X	Y
185.342	60.7607
165	61
151	61

External Boundary

X	Y
0	0
250	0
250	41
250	60
165	61
151	61
140	65
124	66
116	64
108	50
99.5299	40.5887
99	40
92	34
86	26
71	20
40	14
0	10

Material Boundary

X	Y
71	20
250	41



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Older Alluvium		130	Mohr-Coulomb	500	40	Water Surface	Custom	1
Galice Formation		155	Mohr-Coulomb	3000	23	Water Surface	Custom	1

BAJADA Geosciences, Inc.

SLIDEINTERPRET 8.032

Project	Orleans MWC Treatment Plant Improvements
Analysis Description	Psuedostatic, dry, with 1,800 psf tank surcharge
Drawn By	J.Bianchin
Scale	1:323
Company	Bajada Geosciences, Inc.
Date	7/13/2022, 1:30:35 PM
File Name	A-A'_PS_ElevatedGW.slim

Slide Analysis Information

Orleans MWC Treatment Plant Improvements

Project Summary

Slide Modeler Version:	8.032
Compute Time:	00h:00m:07.438s

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
GLE/Morgenstern-Price with interslice force function (Half Sine)
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search

Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Seismic Load Coefficient (Horizontal): 0.15

Loading

1 Distributed Load present

Distributed Load 1	
Distribution:	Constant
Magnitude [psf]:	1800
Orientation:	Normal to boundary

Materials

Property	Older Alluvium	Galice Formation
Color		
Strength Type	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	130	155
Cohesion [psf]	500	3000
Friction Angle [°]	40	23
Water Surface	Water Table	Water Table
Hu Value	1	1

Global Minimums

Method: spencer

FS	1.452140
Center:	65.689, 95.741
Radius:	72.638
Left Slip Surface Endpoint:	85.997, 25.999
Right Slip Surface Endpoint:	131.741, 65.516
Resisting Moment:	5.05904e+06 lb-ft
Driving Moment:	3.48385e+06 lb-ft
Resisting Horizontal Force:	53370.4 lb
Driving Horizontal Force:	36753 lb
Total Slice Area:	503.797 ft2
Surface Horizontal Width:	45.7436 ft
Surface Average Height:	11.0135 ft

Method: gle/morgenstern-price

FS	1.452040
Center:	66.618, 96.137
Radius:	72.797
Left Slip Surface Endpoint:	85.743, 25.897
Right Slip Surface Endpoint:	132.635, 65.460
Resisting Moment:	5.29448e+06 lb-ft
Driving Moment:	3.64625e+06 lb-ft
Resisting Horizontal Force:	56238.9 lb
Driving Horizontal Force:	38731 lb
Total Slice Area:	532.118 ft2
Surface Horizontal Width:	46.8927 ft
Surface Average Height:	11.3476 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 8441
Number of Invalid Surfaces: 3537

Error Codes:

Error Code -108 reported for 6 surfaces
Error Code -111 reported for 3531 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 11936
Number of Invalid Surfaces: 42

Error Codes:

Error Code -108 reported for 1 surface
Error Code -111 reported for 41 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.45214

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.914872	56.0066	16.6115	Older Alluvium	500	40	557.008	808.854	368.078	0	368.078	534.251	534.251
2	0.914872	167.84	17.3661	Older Alluvium	500	40	614.444	892.259	467.475	0	467.475	659.631	659.631
3	0.914872	278.098	18.1238	Older Alluvium	500	40	667.85	969.812	559.9	0	559.9	778.494	778.494
4	0.914872	386.758	18.8848	Older Alluvium	500	40	717.464	1041.86	645.761	0	645.761	891.191	891.191
5	0.914872	493.801	19.6492	Older Alluvium	500	40	763.501	1108.71	725.432	0	725.432	998.042	998.042
6	0.914872	599.202	20.4174	Older	500	40	806.157	1170.65	799.253	0	799.253	1099.34	1099.34

				Alluvium									
7	0.914872	697.952	21.1894	Older Alluvium	500	40	843.016	1224.18	863.041	0	863.041	1189.85	1189.85
8	0.914872	756.345	21.9654	Older Alluvium	500	40	857.333	1244.97	887.817	0	887.817	1233.6	1233.6
9	0.914872	804.858	22.7457	Older Alluvium	500	40	865.806	1257.27	902.481	0	902.481	1265.47	1265.47
10	0.914872	851.624	23.5305	Older Alluvium	500	40	872.76	1267.37	914.516	0	914.516	1294.56	1294.56
11	0.914872	896.611	24.32	Older Alluvium	500	40	878.264	1275.36	924.041	0	924.041	1320.96	1320.96
12	0.914872	939.787	25.1145	Older Alluvium	500	40	882.38	1281.34	931.164	0	931.164	1344.77	1344.77
13	0.914872	981.116	25.9141	Older Alluvium	500	40	885.167	1285.39	935.989	0	935.989	1366.07	1366.07
14	0.914872	1020.56	26.7192	Older Alluvium	500	40	886.68	1287.58	938.605	0	938.605	1384.93	1384.93
15	0.914872	1066.65	27.5301	Older Alluvium	500	40	890.633	1293.32	945.447	0	945.447	1409.68	1409.68
16	0.914872	1129.21	28.3469	Older Alluvium	500	40	900.938	1308.29	963.279	0	963.279	1449.34	1449.34
17	0.914872	1190.39	29.1702	Older Alluvium	500	40	909.828	1321.2	978.667	0	978.667	1486.53	1486.53
18	0.914872	1249.51	30	Older Alluvium	500	40	917.093	1331.75	991.241	0	991.241	1520.73	1520.73
19	0.914872	1306.52	30.8369	Older Alluvium	500	40	922.79	1340.02	1001.1	0	1001.1	1551.99	1551.99
20	0.914872	1361.37	31.6811	Older Alluvium	500	40	926.968	1346.09	1008.33	0	1008.33	1580.41	1580.41
21	0.914872	1413.98	32.5331	Older Alluvium	500	40	929.673	1350.01	1013.01	0	1013.01	1606.03	1606.03
22	0.914872	1464.32	33.3932	Older Alluvium	500	40	930.949	1351.87	1015.21	0	1015.21	1628.9	1628.9
23	0.914872	1512.29	34.262	Older Alluvium	500	40	930.835	1351.7	1015.02	0	1015.02	1649.09	1649.09
24	0.914872	1557.84	35.1398	Older Alluvium	500	40	929.368	1349.57	1012.48	0	1012.48	1666.62	1666.62
25	0.914872	1632.24	36.0272	Older Alluvium	500	40	937.111	1360.82	1025.88	0	1025.88	1707.41	1707.41
26	0.914872	1742.12	36.9247	Older Alluvium	500	40	955.511	1387.54	1057.72	0	1057.72	1775.78	1775.78
27	0.914872	1849.4	37.8329	Older Alluvium	500	40	971.548	1410.82	1085.48	0	1085.48	1839.98	1839.98
28	0.914872	1953.9	38.7524	Older Alluvium	500	40	985.241	1430.71	1109.17	0	1109.17	1899.98	1899.98
29	0.914872	2055.5	39.6839	Older Alluvium	500	40	996.633	1447.25	1128.89	0	1128.89	1955.84	1955.84
30	0.914872	2154.1	40.6282	Older Alluvium	500	40	1005.76	1460.51	1144.69	0	1144.69	2007.6	2007.6
31	0.914872	2249.56	41.586	Older Alluvium	500	40	1012.67	1470.54	1156.64	0	1156.64	2055.29	2055.29
32	0.914872	2341.74	42.5583	Older Alluvium	500	40	1017.37	1477.37	1164.78	0	1164.78	2098.94	2098.94
33	0.914872	2427.05	43.546	Older Alluvium	500	40	1018.96	1479.68	1167.53	0	1167.53	2136.05	2136.05
34	0.914872	2400.49	44.5501	Older Alluvium	500	40	989.793	1437.32	1117.05	0	1117.05	2091.42	2091.42
35	0.914872	2318.63	45.5719	Older Alluvium	500	40	946.924	1375.07	1042.86	0	1042.86	2008.88	2008.88
36	0.914872	2232.77	46.6126	Older Alluvium	500	40	904.376	1313.28	969.23	0	969.23	1926	1926
37	0.914872	2142.69	47.6737	Older Alluvium	500	40	862.146	1251.96	896.147	0	896.147	1842.76	1842.76
38	0.914872	2048.1	48.7569	Older Alluvium	500	40	820.234	1191.09	823.615	0	823.615	1759.14	1759.14
39	0.914872	1948.73	49.864	Older	500	40	778.641	1130.7	751.637	0	751.637	1675.12	1675.12

				Alluvium									
40	0.914872	1844.23	50.997	Older Alluvium	500	40	737.374	1070.77	680.218	0	680.218	1590.7	1590.7
41	0.914872	1734.22	52.1585	Older Alluvium	500	40	696.442	1011.33	609.381	0	609.381	1505.89	1505.89
42	0.914872	1614.65	53.3512	Older Alluvium	500	40	655.119	951.325	537.867	0	537.867	1418.42	1418.42
43	0.914872	1463.17	54.5782	Older Alluvium	500	40	609.209	884.657	458.416	0	458.416	1314.97	1314.97
44	0.914872	1299.69	55.8434	Older Alluvium	500	40	563.203	817.849	378.798	0	378.798	1208.88	1208.88
45	0.914872	1128.44	57.1513	Older Alluvium	500	40	518.138	752.409	300.809	0	300.809	1103.3	1103.3
46	0.914872	948.576	58.5072	Older Alluvium	500	40	474.034	688.364	224.483	0	224.483	998.255	998.255
47	0.914872	759.051	59.9178	Older Alluvium	500	40	430.872	625.687	149.788	0	149.788	893.614	893.614
48	0.914872	558.583	61.3912	Older Alluvium	500	40	388.532	564.203	76.5141	0	76.5141	788.872	788.872
49	0.914872	345.545	62.9379	Older Alluvium	500	40	346.631	503.357	4.00055	0	4.00055	682.483	682.483
50	0.914872	117.828	64.5713	Older Alluvium	500	40	263.39	382.479	-140.056	0	-140.056	413.926	413.926

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.45204

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.937854	34.988	15.6145	Older Alluvium	500	40	327.962	476.214	-28.3472	0	-28.3472	63.311	63.311
2	0.937854	150.644	16.3824	Older Alluvium	500	40	414.24	601.493	120.955	0	120.955	242.735	242.735
3	0.937854	268.649	17.1534	Older Alluvium	500	40	502.479	729.62	273.65	0	273.65	428.745	428.745
4	0.937854	384.965	17.9276	Older Alluvium	500	40	589.475	855.942	424.195	0	424.195	614.904	614.904
5	0.937854	499.57	18.7051	Older Alluvium	500	40	674.136	978.872	570.697	0	570.697	798.947	798.947
6	0.937854	612.441	19.4863	Older Alluvium	500	40	755.387	1096.85	711.3	0	711.3	978.593	978.593
7	0.937854	720.624	20.2713	Older Alluvium	500	40	830.709	1206.22	841.644	0	841.644	1148.46	1148.46
8	0.937854	787.794	21.0602	Older Alluvium	500	40	880.835	1279.01	928.384	0	928.384	1267.57	1267.57
9	0.937854	840.859	21.8534	Older Alluvium	500	40	919.422	1335.04	995.164	0	995.164	1363.9	1363.9
10	0.937854	892.081	22.6509	Older Alluvium	500	40	952.383	1382.9	1052.19	0	1052.19	1449.63	1449.63
11	0.937854	941.429	23.4532	Older Alluvium	500	40	979.447	1422.2	1099.03	0	1099.03	1523.95	1523.95
12	0.937854	988.868	24.2603	Older Alluvium	500	40	1000.48	1452.74	1135.43	0	1135.43	1586.33	1586.33
13	0.937854	1034.36	25.0726	Older Alluvium	500	40	1015.51	1474.55	1161.43	0	1161.43	1636.54	1636.54
14	0.937854	1077.87	25.8904	Older Alluvium	500	40	1024.65	1487.84	1177.26	0	1177.26	1674.59	1674.59
15	0.937854	1130.21	26.7138	Older Alluvium	500	40	1032.87	1499.76	1191.47	0	1191.47	1711.26	1711.26
16	0.937854	1198.4	27.5432	Older Alluvium	500	40	1043.04	1514.53	1209.07	0	1209.07	1753.04	1753.04
17	0.937854	1264.75	28.379	Older Alluvium	500	40	1047.75	1521.38	1217.23	0	1217.23	1783.26	1783.26
18	0.937854	1328.93	29.2214	Older Alluvium	500	40	1047.46	1520.96	1216.73	0	1216.73	1802.65	1802.65
19	0.937854	1390.9	30.0708	Older	500	40	1042.79	1514.17	1208.64	0	1208.64	1812.41	1812.41

				Alluvium									
20	0.937854	1450.59	30.9275	Older Alluvium	500	40	1034.41	1502	1194.14	0	1194.14	1813.9	1813.9
21	0.937854	1507.95	31.792	Older Alluvium	500	40	1023.02	1485.47	1174.44	0	1174.44	1808.54	1808.54
22	0.937854	1562.9	32.6646	Older Alluvium	500	40	1009.32	1465.58	1150.73	0	1150.73	1797.83	1797.83
23	0.937854	1615.39	33.5459	Older Alluvium	500	40	993.977	1443.3	1124.18	0	1124.18	1783.22	1783.22
24	0.937854	1667.95	34.4362	Older Alluvium	500	40	978.45	1420.75	1097.31	0	1097.31	1768.17	1768.17
25	0.937854	1768.74	35.3361	Older Alluvium	500	40	978.534	1420.87	1097.45	0	1097.45	1791.22	1791.22
26	0.937854	1886.4	36.2462	Older Alluvium	500	40	983.808	1428.53	1106.58	0	1106.58	1827.83	1827.83
27	0.937854	2001.24	37.167	Older Alluvium	500	40	988.498	1435.34	1114.69	0	1114.69	1864.1	1864.1
28	0.937854	2113.17	38.0992	Older Alluvium	500	40	993.123	1442.05	1122.69	0	1122.69	1901.38	1901.38
29	0.937854	2222.08	39.0434	Older Alluvium	500	40	998.096	1449.28	1131.31	0	1131.31	1940.8	1940.8
30	0.937854	2327.84	40.0004	Older Alluvium	500	40	1003.71	1457.43	1141.02	0	1141.02	1983.25	1983.25
31	0.937854	2430.32	40.971	Older Alluvium	500	40	1010.17	1466.81	1152.2	0	1152.2	2029.43	2029.43
32	0.937854	2529.37	41.9562	Older Alluvium	500	40	1017.58	1477.56	1165.02	0	1165.02	2079.84	2079.84
33	0.937854	2578.17	42.9568	Older Alluvium	500	40	1013.25	1471.28	1157.52	0	1157.52	2100.96	2100.96
34	0.937854	2504.26	43.9739	Older Alluvium	500	40	977.981	1420.07	1096.49	0	1096.49	2040.06	2040.06
35	0.937854	2420.5	45.0088	Older Alluvium	500	40	942.356	1368.34	1034.84	0	1034.84	1977.49	1977.49
36	0.937854	2332.56	46.0628	Older Alluvium	500	40	907.615	1317.89	974.728	0	974.728	1916.65	1916.65
37	0.937854	2240.21	47.1373	Older Alluvium	500	40	873.459	1268.3	915.622	0	915.622	1856.8	1856.8
38	0.937854	2143.17	48.2339	Older Alluvium	500	40	839.635	1219.18	857.089	0	857.089	1797.29	1797.29
39	0.937854	2041.14	49.3547	Older Alluvium	500	40	805.93	1170.24	798.766	0	798.766	1737.56	1737.56
40	0.937854	1933.77	50.5015	Older Alluvium	500	40	772.145	1121.19	740.301	0	740.301	1677.04	1677.04
41	0.937854	1819.89	51.677	Older Alluvium	500	40	737.875	1071.42	680.999	0	680.999	1614.54	1614.54
42	0.937854	1676.08	52.8839	Older Alluvium	500	40	696.939	1011.98	610.159	0	610.159	1531.14	1531.14
43	0.937854	1514.33	54.1253	Older Alluvium	500	40	652.023	946.764	532.433	0	532.433	1434.01	1434.01
44	0.937854	1345.24	55.4052	Older Alluvium	500	40	605.289	878.904	451.56	0	451.56	1329.15	1329.15
45	0.937854	1168.07	56.728	Older Alluvium	500	40	555.806	807.053	365.931	0	365.931	1212.97	1212.97
46	0.937854	981.944	58.0992	Older Alluvium	500	40	502.293	729.349	273.328	0	273.328	1080.27	1080.27
47	0.937854	785.792	59.5254	Older Alluvium	500	40	443.026	643.292	170.769	0	170.769	923.641	923.641
48	0.937854	578.284	61.0148	Older Alluvium	500	40	375.745	545.596	54.3397	0	54.3397	732.615	732.615
49	0.937854	357.742	62.5779	Older Alluvium	500	40	297.543	432.044	-80.9865	0	-80.9865	492.49	492.49
50	0.937854	121.988	64.2282	Older Alluvium	500	40	204.765	297.327	-241.536	0	-241.536	182.573	182.573

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.45214

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	85.9973	25.9989	0	0	0
2	86.9121	26.2718	400.374	430.773	47.0946
3	87.827	26.558	803.196	864.178	47.0946
4	88.7419	26.8574	1204.39	1295.84	47.0948
5	89.6568	27.1704	1600.21	1721.71	47.0947
6	90.5716	27.497	1987.2	2138.07	47.0945
7	91.4865	27.8376	2362.14	2541.49	47.0947
8	92.4014	28.1922	2722.08	2928.75	47.0946
9	93.3163	28.5612	3064.84	3297.53	47.0945
10	94.2311	28.9448	3389.5	3646.85	47.0946
11	95.146	29.3432	3695.35	3975.91	47.0945
12	96.0609	29.7566	3981.74	4284.05	47.0946
13	96.9757	30.1855	4248.15	4570.69	47.0946
14	97.8906	30.63	4494.17	4835.39	47.0946
15	98.8055	31.0905	4719.48	5077.8	47.0946
16	99.7204	31.5674	4922.88	5296.65	47.0946
17	100.635	32.0609	5101.72	5489.06	47.0946
18	101.55	32.5716	5255.17	5654.17	47.0946
19	102.465	33.0998	5382.61	5791.28	47.0946
20	103.38	33.646	5483.51	5899.84	47.0946
21	104.295	34.2106	5557.45	5979.39	47.0946
22	105.21	34.7942	5604.12	6029.61	47.0946
23	106.124	35.3973	5623.31	6050.25	47.0946
24	107.039	36.0205	5614.91	6041.22	47.0946
25	107.954	36.6644	5578.93	6002.5	47.0946
26	108.869	37.3298	5508.25	5926.46	47.0946
27	109.784	38.0173	5393.29	5802.77	47.0946
28	110.699	38.7278	5232.88	5630.18	47.0946
29	111.614	39.4621	5026.04	5407.64	47.0946
30	112.529	40.2212	4771.93	5134.23	47.0946
31	113.443	41.0061	4469.82	4809.19	47.0946
32	114.358	41.818	4119.17	4431.92	47.0946
33	115.273	42.658	3719.57	4001.97	47.0945
34	116.188	43.5276	3271.82	3520.23	47.0946
35	117.103	44.4282	2810.62	3024.01	47.0945
36	118.018	45.3615	2355.21	2534.03	47.0946
37	118.933	46.3294	1909.01	2053.95	47.0946
38	119.848	47.3339	1475.63	1587.67	47.0947
39	120.762	48.3774	1058.89	1139.28	47.0944
40	121.677	49.4625	662.872	713.2	47.0946
41	122.592	50.5921	291.961	314.128	47.0946
42	123.507	51.7698	-49.1183	-52.8476	47.0946
43	124.422	52.9995	-353.79	-380.652	47.0946
44	125.337	54.2858	-605.972	-651.98	47.0946
45	126.252	55.6342	-796.792	-857.288	47.0946
46	127.167	57.0511	-918.592	-988.335	47.0946
47	128.081	58.5445	-962.733	-1035.83	47.0946
48	128.996	60.1239	-919.242	-989.035	47.0946
49	129.911	61.8012	-776.163	-835.093	47.0946
50	130.826	63.592	-518.256	-557.605	47.0946
51	131.741	65.5162	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.45204

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	85.7427	25.8971	0	0	0

2	86.6805	26.1592	310.643	24.6249	4.5324
3	87.6184	26.4349	644.307	101.948	8.99131
4	88.5563	26.7244	997.395	235.946	13.3093
5	89.4941	27.0278	1365.37	428.673	17.4303
6	90.432	27.3453	1743.26	680.087	21.3119
7	91.3698	27.6772	2125.82	987.961	24.9263
8	92.3077	28.0236	2507.5	1347.86	28.2594
9	93.2455	28.3847	2882.52	1753.14	31.3078
10	94.1834	28.7609	3246.83	2196.36	34.0769
11	95.1212	29.1522	3596.98	2669.16	36.5775
12	96.0591	29.5591	3929.8	3162.41	38.8245
13	96.9969	29.9818	4242.54	3666.47	40.8341
14	97.9348	30.4206	4532.9	4171.61	42.6232
15	98.8727	30.8758	4799.06	4668.26	44.2085
16	99.8105	31.3477	5038.63	5146.23	45.6053
17	100.748	31.8368	5248.51	5594.57	46.828
18	101.686	32.3435	5427.54	6004.52	47.8893
19	102.624	32.8681	5575.08	6368.47	48.8005
20	103.562	33.4111	5690.91	6680.05	49.5715
21	104.5	33.973	5775.23	6934.18	50.2103
22	105.438	34.5543	5828.52	7127.12	50.7239
23	106.375	35.1556	5851.49	7256.44	51.1178
24	107.313	35.7774	5845	7320.92	51.3962
25	108.251	36.4205	5809.48	7319.78	51.5621
26	109.189	37.0854	5734.79	7239.97	51.6172
27	110.127	37.773	5616.3	7076.38	51.5621
28	111.065	38.484	5453.26	6830.26	51.3962
29	112.003	39.2193	5244.78	6504.07	51.1178
30	112.94	39.98	4989.71	6101.42	50.7239
31	113.878	40.7669	4686.62	5627.11	50.2103
32	114.816	41.5814	4333.79	5087.05	49.5715
33	115.754	42.4245	3929.18	4488.34	48.8005
34	116.692	43.2978	3484.66	3855.09	47.8892
35	117.63	44.2026	3036.68	3236.9	46.828
36	118.568	45.1408	2589.1	2644.39	45.6053
37	119.505	46.1141	2144.15	2085.71	44.2084
38	120.443	47.1246	1704.35	1568.5	42.6231
39	121.381	48.1748	1272.48	1099.7	40.8342
40	122.319	49.2673	851.696	685.381	38.8245
41	123.257	50.4051	445.572	330.64	36.5775
42	124.195	51.5916	58.5518	39.6081	34.0769
43	125.133	52.831	-293.555	-178.539	31.3078
44	126.07	54.1278	-597.91	-321.395	28.2594
45	127.008	55.4875	-844.411	-392.435	24.9264
46	127.946	56.9168	-1019.88	-397.878	21.3119
47	128.884	58.4235	-1106.56	-347.418	17.4303
48	129.822	60.0172	-1079.91	-255.467	13.3094
49	130.76	61.7102	-905.249	-143.236	8.99127
50	131.698	63.5178	-532.668	-42.225	4.5324
51	132.635	65.4603	0	0	0

Entity Information

Water Table

X	Y
0	10
40	14
71	20
94.778	28.284
158.642	45.558

225.384	53.934
250	53.934

Distributed Load

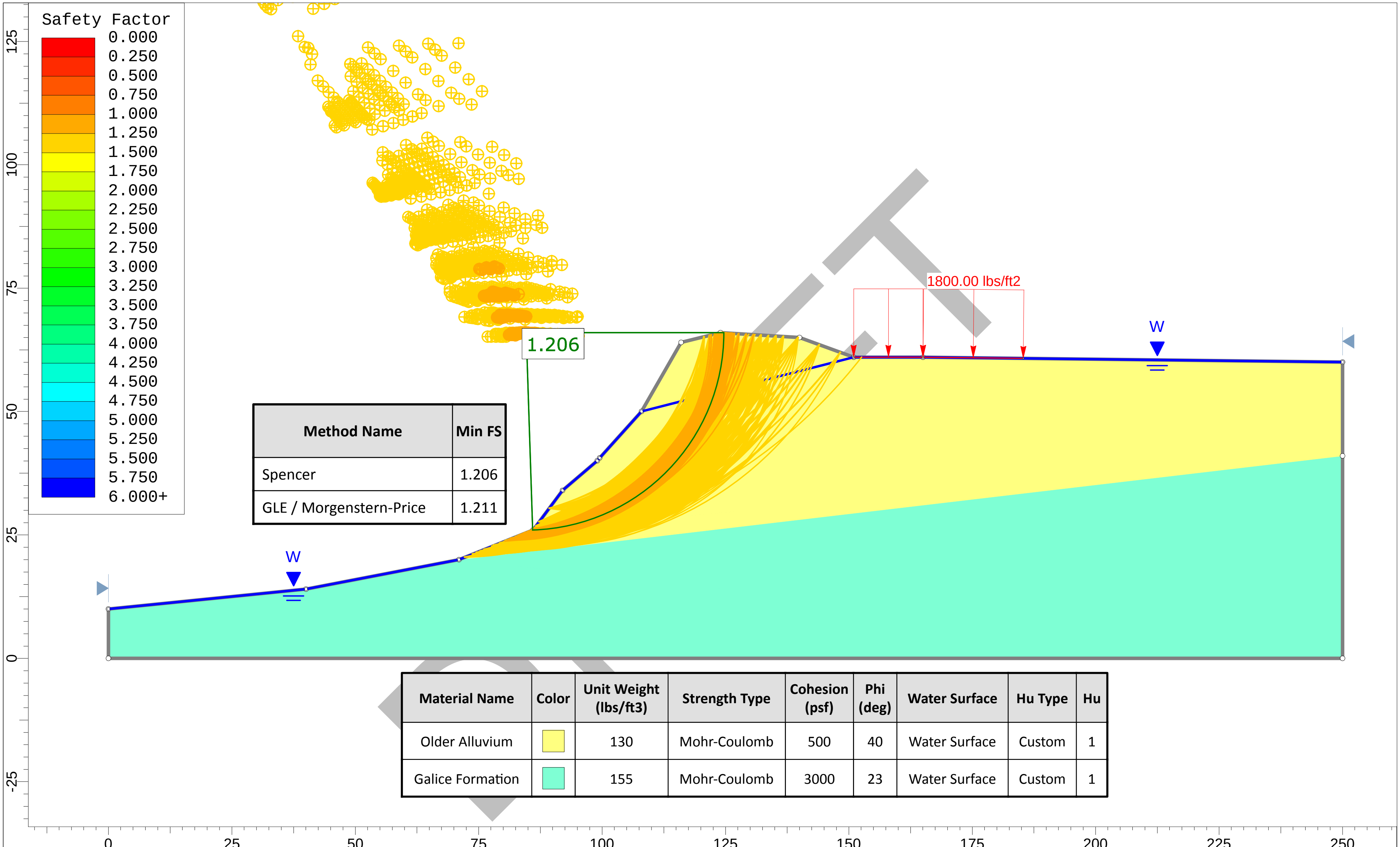
X	Y
185.342	60.7607
165	61
151	61

External Boundary

X	Y
0	0
250	0
250	41
250	60
165	61
151	61
140	65
124	66
116	64
108	50
99.5299	40.5887
99	40
92	34
86	26
71	20
40	14
0	10

Material Boundary

X	Y
71	20
250	41



Method Name	Min FS
Spencer	1.206
GLE / Morgenstern-Price	1.211

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Older Alluvium		130	Mohr-Coulomb	500	40	Water Surface	Custom	1
Galice Formation		155	Mohr-Coulomb	3000	23	Water Surface	Custom	1

BAJADA Geosciences, Inc.

SLIDEINTERPRET 8.032

Project	Orlens MWC Treatment Plant Improvements		
Analysis Description	Static, groundwater at surface, with 1,800 psf tank surcharge		
Drawn By	J.Bianchin	*Scale* 1:323	*Company* Bajada Geosciences, Inc.
Date	7/13/2022, 1:30:35 PM		*File Name* A-A'_Static_FullGW.slim

Slide Analysis Information

Orlens MWC Treatment Plant Improvements

Project Summary

Slide Modeler Version:	8.032
Compute Time:	00h:00m:06.33s

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
GLE/Morgenstern-Price with interslice force function (Half Sine)
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search

Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

1 Distributed Load present

Distributed Load 1	
Distribution:	Constant
Magnitude [psf]:	1800
Orientation:	Normal to boundary

Materials

Property	Older Alluvium	Galice Formation
Color		
Strength Type	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	130	155
Cohesion [psf]	500	3000
Friction Angle [°]	40	23
Water Surface	Water Table	Water Table
Hu Value	1	1

Global Minimums

Method: spencer

FS	1.205900
Center:	84.641, 65.960
Radius:	40.007
Left Slip Surface Endpoint:	85.934, 25.974
Right Slip Surface Endpoint:	124.647, 65.960
Resisting Moment:	1.96178e+06 lb-ft
Driving Moment:	1.62683e+06 lb-ft
Resisting Horizontal Force:	34995.6 lb
Driving Horizontal Force:	29020.4 lb
Total Slice Area:	514.598 ft2
Surface Horizontal Width:	38.713 ft
Surface Average Height:	13.2926 ft

Method: gle/morgenstern-price

FS	1.211120
Center:	84.437, 65.972

Radius:	40.011
Left Slip Surface Endpoint:	85.978, 25.991
Right Slip Surface Endpoint:	124.447, 65.972
Resisting Moment:	1.94961e+06 lb-ft
Driving Moment:	1.60976e+06 lb-ft
Resisting Horizontal Force:	34539.1 lb
Driving Horizontal Force:	28518.3 lb
Total Slice Area:	506.832 ft2
Surface Horizontal Width:	38.4691 ft
Surface Average Height:	13.175 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	10195
Number of Invalid Surfaces:	634

Error Codes:

Error Code -108 reported for 15 surfaces
Error Code -111 reported for 619 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces:	10762
Number of Invalid Surfaces:	67

Error Codes:

Error Code -108 reported for 2 surfaces
Error Code -111 reported for 65 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.2059

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.766906	43.518	2.40279	Older Alluvium	500	40	394.625	475.878	-1.67621	27.0714	-28.7476	14.8827	-12.1887
2	0.766906	141.257	3.50264	Older Alluvium	500	40	431.653	520.531	112.877	88.4094	24.4676	139.298	50.8887
3	0.766906	237.784	4.60379	Older Alluvium	500	40	467.667	563.96	225.049	148.825	76.2238	262.708	113.883
4	0.766906	332.83	5.70665	Older Alluvium	500	40	502.468	605.926	334.551	208.313	126.238	384.763	176.45
5	0.766906	426.389	6.81163	Older Alluvium	500	40	536.072	646.449	441.402	266.871	174.531	505.435	238.564
6	0.766906	518.45	7.91917	Older Alluvium	500	40	568.494	685.547	545.617	324.491	221.126	624.696	300.205
7	0.766906	609.002	9.02969	Older	500	40	599.745	723.233	647.205	381.167	266.038	742.514	361.347

				Alluvium									
8	0.766906	697.882	10.1436	Older Alluvium	500	40	629.721	759.381	746.008	436.89	309.118	858.674	421.784
9	0.766906	764.018	11.2615	Older Alluvium	500	40	650.082	783.934	816.569	478.19	338.379	946.014	467.824
10	0.766906	813.548	12.3837	Older Alluvium	500	40	663.346	799.929	866.632	509.19	357.442	1012.28	503.09
11	0.766906	861.505	13.5108	Older Alluvium	500	40	675.702	814.829	914.405	539.206	375.199	1076.76	537.555
12	0.766906	907.866	14.6432	Older Alluvium	500	40	687.152	828.637	959.877	568.223	391.654	1139.42	571.197
13	0.766906	952.609	15.7815	Older Alluvium	500	40	697.695	841.35	1003.03	596.228	406.805	1200.22	603.988
14	0.766906	995.707	16.9262	Older Alluvium	500	40	707.328	852.967	1043.85	623.202	420.649	1259.11	635.905
15	0.766906	1037.13	18.0779	Older Alluvium	500	40	716.048	863.482	1082.31	649.128	433.182	1316.05	666.917
16	0.766906	1076.85	19.2373	Older Alluvium	500	40	723.849	872.89	1118.38	673.987	444.393	1370.98	696.991
17	0.766906	1114.82	20.4048	Older Alluvium	500	40	730.726	881.182	1152.03	697.754	454.275	1423.85	726.1
18	0.766906	1160.02	21.5814	Older Alluvium	500	40	740.051	892.427	1193.71	726.036	467.676	1486.44	760.404
19	0.766906	1213.79	22.7675	Older Alluvium	500	40	752.232	907.116	1244.88	759.702	485.178	1560.59	800.885
20	0.766906	1265.71	23.9641	Older Alluvium	500	40	763.337	920.508	1293.33	792.196	501.139	1632.62	840.425
21	0.766906	1315.71	25.1718	Older Alluvium	500	40	773.344	932.575	1339.02	823.488	515.528	1702.46	878.971
22	0.766906	1363.73	26.3917	Older Alluvium	500	40	782.232	943.294	1381.84	853.542	528.294	1770	916.457
23	0.766906	1409.7	27.6246	Older Alluvium	500	40	789.983	952.64	1421.75	882.319	539.436	1835.18	952.861
24	0.766906	1453.57	28.8716	Older Alluvium	500	40	796.57	960.584	1458.68	909.775	548.902	1897.89	988.117
25	0.766906	1495.26	30.1337	Older Alluvium	500	40	801.969	967.094	1492.53	935.865	556.663	1958.04	1022.18
26	0.766906	1534.67	31.4122	Older Alluvium	500	40	806.146	972.132	1523.2	960.536	562.668	2015.51	1054.98
27	0.766906	1571.73	32.7083	Older Alluvium	500	40	809.07	975.657	1550.6	983.73	566.868	2070.18	1086.45
28	0.766906	1606.32	34.0236	Older Alluvium	500	40	810.697	977.62	1574.59	1005.38	569.212	2121.9	1116.52
29	0.766906	1639.61	35.3596	Older Alluvium	500	40	811.756	978.897	1596.15	1025.42	570.727	2172.17	1146.75
30	0.766906	1703.2	36.7181	Older Alluvium	500	40	843.901	1017.66	1630.91	1013.99	616.922	2260.35	1246.36
31	0.766906	1778.51	38.1011	Older Alluvium	500	40	886.787	1069.38	1668.17	989.618	678.556	2363.53	1373.91
32	0.766906	1850.81	39.5108	Older Alluvium	500	40	926.583	1117.37	1699.12	963.366	735.752	2463.23	1499.86
33	0.766906	1919.92	40.9497	Older Alluvium	500	40	963.141	1161.45	1723.4	935.113	788.29	2559.17	1624.05
34	0.766906	1985.61	42.4208	Older Alluvium	500	40	996.29	1201.43	1740.66	904.727	835.931	2651.06	1746.33
35	0.766906	2047.66	43.9272	Older Alluvium	500	40	1025.83	1237.05	1750.44	872.057	878.38	2738.55	1866.5
36	0.766906	2105.77	45.4729	Older Alluvium	500	40	1051.52	1268.03	1752.22	836.925	915.3	2821.25	1984.32
37	0.766906	2159.62	47.0622	Older Alluvium	500	40	1073.08	1294.03	1745.42	799.126	946.292	2898.67	2099.54
38	0.766906	2208.82	48.7005	Older Alluvium	500	40	1090.19	1314.66	1729.29	758.417	970.869	2970.24	2211.83
39	0.766906	2252.91	50.3941	Older Alluvium	500	40	1102.43	1329.42	1702.97	714.505	988.461	3035.29	2320.79
40	0.766906	2254.96	52.1506	Older	500	40	1091.34	1316.04	1639.56	667.037	972.524	3044	2376.96

				Alluvium									
41	0.766906	2174.69	53.9795	Older Alluvium	500	40	1038.78	1252.67	1512.57	615.578	896.994	2941.26	2325.68
42	0.766906	2084.77	55.8928	Older Alluvium	500	40	981.77	1183.92	1374.64	559.581	815.059	2824.32	2264.73
43	0.766906	1986.48	57.9058	Older Alluvium	500	40	920.948	1110.57	1225.99	498.339	727.653	2694.44	2196.1
44	0.766906	1878.32	60.0392	Older Alluvium	500	40	855.601	1031.77	1064.66	430.92	633.737	2548.94	2118.02
45	0.766906	1758.23	62.3212	Older Alluvium	500	40	784.746	946.325	887.943	356.036	531.907	2384.01	2027.97
46	0.766906	1623.25	64.7931	Older Alluvium	500	40	706.955	852.517	691.946	271.83	420.116	2193.83	1922
47	0.766906	1468.77	67.519	Older Alluvium	500	40	620.007	747.667	470.578	175.419	295.159	1968.81	1793.39
48	0.766906	1286.89	70.6096	Older Alluvium	500	40	520.073	627.156	213.397	61.8588	151.538	1691.02	1629.16
49	0.950762	1269.91	74.8739	Older Alluvium	500	40	365.68	440.973	-70.3456	0	-70.3456	1282.47	1282.47
50	0.950762	537.607	83.7419	Older Alluvium	500	40	70.7546	85.323	-494.192	0	-494.192	151.023	151.023

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.21112

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.777565	48.4652	2.76523	Older Alluvium	500	40	421.207	510.132	41.9732	29.8979	12.0753	62.3174	32.4195
2	0.777565	148.671	3.88066	Older Alluvium	500	40	460.091	557.225	159.971	91.7739	68.1975	191.181	99.4074
3	0.777565	247.367	4.99757	Older Alluvium	500	40	497.308	602.3	274.617	152.7	121.917	318.104	165.404
4	0.777565	344.518	6.11639	Older Alluvium	500	40	532.883	645.385	385.936	212.672	173.264	443.039	230.367
5	0.777565	440.114	7.23755	Older Alluvium	500	40	566.857	686.532	493.985	271.685	222.3	565.973	294.288
6	0.777565	534.145	8.36151	Older Alluvium	500	40	599.268	725.786	598.814	329.732	269.082	686.895	357.163
7	0.777565	626.599	9.48872	Older Alluvium	500	40	630.152	763.19	700.462	386.805	313.657	805.786	418.981
8	0.777565	716.239	10.6197	Older Alluvium	500	40	658.574	797.612	797.576	442.895	354.681	921.058	478.163
9	0.777565	778.438	11.7548	Older Alluvium	500	40	676.002	818.719	860.372	480.536	379.836	1001.04	520.503
10	0.777565	828.634	12.8946	Older Alluvium	500	40	687.644	832.819	908.16	511.523	396.637	1065.58	554.061
11	0.777565	877.18	14.0397	Older Alluvium	500	40	698.228	845.638	953.406	541.491	411.915	1128.01	586.516
12	0.777565	924.052	15.1905	Older Alluvium	500	40	707.766	857.19	996.108	570.426	425.682	1188.28	617.852
13	0.777565	969.225	16.3476	Older Alluvium	500	40	716.268	867.487	1036.27	598.312	437.954	1246.36	648.052
14	0.777565	1012.67	17.5116	Older Alluvium	500	40	723.74	876.536	1073.87	625.13	448.737	1302.22	677.093
15	0.777565	1054.35	18.6832	Older Alluvium	500	40	730.186	884.343	1108.9	650.86	458.042	1355.82	704.957
16	0.777565	1094.23	19.8628	Older Alluvium	500	40	735.61	890.912	1141.35	675.481	465.871	1407.1	731.619
17	0.777565	1132.92	21.0514	Older Alluvium	500	40	740.462	896.788	1171.84	698.968	472.873	1456.84	757.872
18	0.777565	1183.48	22.2495	Older Alluvium	500	40	748.818	906.909	1215.51	730.573	484.937	1521.85	791.279
19	0.777565	1237.68	23.458	Older Alluvium	500	40	758.211	918.285	1262.53	764.032	498.494	1591.54	827.512
20	0.777565	1289.9	24.6776	Older	500	40	766.382	928.181	1306.56	796.269	510.286	1658.69	862.419

				Alluvium								
21	0.777565	1340.09	25.9093	Older Alluvium	500	40	773.325	936.589	1347.56	827.248	520.309	1723.22	895.969
22	0.777565	1388.17	27.154	Older Alluvium	500	40	779.026	943.494	1385.46	856.931	528.532	1785.04	928.106
23	0.777565	1434.08	28.4127	Older Alluvium	500	40	783.473	948.88	1420.23	885.275	534.953	1844.07	958.799
24	0.777565	1477.75	29.6865	Older Alluvium	500	40	786.649	952.726	1451.77	912.232	539.534	1900.22	987.986
25	0.777565	1519.09	30.9768	Older Alluvium	500	40	788.531	955.006	1480	937.749	542.251	1953.36	1015.61
26	0.777565	1558	32.2847	Older Alluvium	500	40	789.098	955.692	1504.85	961.769	543.077	2003.4	1041.63
27	0.777565	1594.38	33.6118	Older Alluvium	500	40	788.318	954.748	1526.17	984.227	541.948	2050.17	1065.94
28	0.777565	1628.11	34.9597	Older Alluvium	500	40	786.16	952.134	1543.88	1005.05	538.832	2093.53	1088.48
29	0.777565	1670.62	36.3301	Older Alluvium	500	40	792.801	960.177	1565.17	1016.76	548.41	2148.18	1131.42
30	0.777565	1746.27	37.7251	Older Alluvium	500	40	833.92	1009.98	1600.33	992.562	607.771	2245.44	1252.88
31	0.777565	1821.43	39.1469	Older Alluvium	500	40	873.34	1057.72	1631.12	966.458	664.661	2342.05	1375.59
32	0.777565	1893.3	40.5981	Older Alluvium	500	40	909.405	1101.4	1655.05	938.33	716.722	2434.45	1496.12
33	0.777565	1961.68	42.0815	Older Alluvium	500	40	941.97	1140.84	1671.76	908.043	763.721	2522.35	1614.3
34	0.777565	2026.32	43.6005	Older Alluvium	500	40	970.865	1175.83	1680.87	875.446	805.428	2605.43	1729.99
35	0.777565	2086.92	45.1589	Older Alluvium	500	40	995.886	1206.14	1681.9	840.36	841.54	2683.33	1842.97
36	0.777565	2143.16	46.7612	Older Alluvium	500	40	1016.79	1231.46	1674.3	802.578	871.723	2755.61	1953.03
37	0.777565	2194.63	48.4128	Older Alluvium	500	40	1033.3	1251.45	1657.4	761.854	895.545	2821.75	2059.9
38	0.777565	2240.86	50.1199	Older Alluvium	500	40	1045.05	1265.68	1630.4	717.894	912.504	2881.15	2163.26
39	0.777565	2272.31	51.8904	Older Alluvium	500	40	1047.39	1268.52	1586.22	670.342	915.881	2921.55	2251.21
40	0.777565	2210.24	53.7337	Older Alluvium	500	40	1004.43	1216.49	1472.64	618.758	853.879	2841.7	2222.94
41	0.777565	2118.79	55.662	Older Alluvium	500	40	948.458	1148.7	1335.67	562.59	773.083	2724.08	2161.49
42	0.777565	2018.77	57.6908	Older Alluvium	500	40	889.425	1077.2	1189.01	501.126	687.883	2595.44	2094.31
43	0.777565	1908.64	59.8407	Older Alluvium	500	40	826.791	1001.34	1030.9	433.426	597.477	2453.8	2020.37
44	0.777565	1786.31	62.1404	Older Alluvium	500	40	759.807	920.217	858.985	358.189	500.796	2296.46	1938.27
45	0.777565	1648.73	64.6314	Older Alluvium	500	40	687.392	832.514	669.814	273.54	396.274	2119.51	1845.97
46	0.777565	1491.18	67.3786	Older Alluvium	500	40	607.883	736.219	458.083	176.568	281.515	1916.89	1740.33
47	0.777565	1305.58	70.4938	Older Alluvium	500	40	518.434	627.886	214.684	62.2762	152.408	1678.19	1615.92
48	0.641193	907.873	73.808	Older Alluvium	500	40	411.475	498.345	-1.97179	0	-1.97179	1415.07	1415.07
49	0.641193	707.745	77.5916	Older Alluvium	500	40	283.697	343.591	-186.401	0	-186.401	1103.03	1103.03
50	0.641193	298.245	84.8643	Older Alluvium	500	40	84.3649	102.176	-474.109	0	-474.109	464.582	464.582

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.2059

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	85.9343	25.9737	0	0	0
2	86.7012	26.0059	301.778	-30.1778	-5.71059
3	87.4681	26.0528	626.514	-62.6514	-5.71059
4	88.235	26.1146	970.187	-97.0187	-5.71059
5	89.0019	26.1912	1328.73	-132.873	-5.71059
6	89.7688	26.2828	1698.16	-169.816	-5.71059
7	90.5358	26.3895	2074.62	-207.462	-5.71059
8	91.3027	26.5114	2454.3	-245.43	-5.71059
9	92.0696	26.6486	2833.41	-283.341	-5.71059
10	92.8365	26.8013	3205.76	-320.576	-5.71059
11	93.6034	26.9697	3567.01	-356.701	-5.71059
12	94.3703	27.154	3915.15	-391.515	-5.71059
13	95.1372	27.3544	4248.19	-424.819	-5.71059
14	95.9041	27.5711	4564.24	-456.424	-5.71059
15	96.671	27.8045	4861.43	-486.143	-5.71059
16	97.4379	28.0548	5137.96	-513.796	-5.71059
17	98.2048	28.3224	5392.1	-539.21	-5.71059
18	98.9717	28.6077	5622.15	-562.215	-5.71059
19	99.7386	28.9111	5825.86	-582.586	-5.71059
20	100.506	29.2329	6000.32	-600.032	-5.71059
21	101.272	29.5738	6143.09	-614.309	-5.71059
22	102.039	29.9342	6251.78	-625.178	-5.71059
23	102.806	30.3148	6323.99	-632.399	-5.71059
24	103.573	30.7161	6357.38	-635.738	-5.71059
25	104.34	31.139	6349.61	-634.961	-5.71059
26	105.107	31.5842	6298.36	-629.836	-5.71059
27	105.874	32.0525	6201.35	-620.135	-5.71059
28	106.641	32.545	6056.28	-605.628	-5.71059
29	107.408	33.0628	5860.89	-586.089	-5.71059
30	108.175	33.607	5612.92	-561.292	-5.71059
31	108.941	34.179	5325.26	-532.526	-5.71059
32	109.708	34.7803	5000.12	-500.012	-5.71059
33	110.475	35.4127	4634	-463.4	-5.71059
34	111.242	36.0782	4223.51	-422.351	-5.71059
35	112.009	36.779	3765.42	-376.542	-5.71059
36	112.776	37.5177	3256.68	-325.668	-5.71059
37	113.543	38.2974	2694.5	-269.45	-5.71059
38	114.31	39.1216	2076.39	-207.639	-5.71059
39	115.077	39.9946	1400.32	-140.032	-5.71059
40	115.844	40.9214	664.849	-66.4849	-5.71059
41	116.611	41.9083	-118.864	11.8864	-5.71059
42	117.377	42.9631	-920.031	92.0031	-5.71059
43	118.144	44.0955	-1726.04	172.604	-5.71059
44	118.911	45.3183	-2521.07	252.107	-5.71059
45	119.678	46.6488	-3283.34	328.334	-5.71059
46	120.445	48.1108	-3981.56	398.156	-5.71059
47	121.212	49.7401	-4568.38	456.838	-5.71059
48	121.979	51.5933	-4966.41	496.641	-5.71059
49	122.746	53.7722	-5033.74	503.374	-5.71059
50	123.697	57.2895	-4439.69	443.969	-5.71059
51	124.647	65.9595	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.21112

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	85.9781	25.9912	0	0	0
2	86.7557	26.0288	326.134	0	0
3	87.5332	26.0815	675.659	0	0

4	88.3108	26.1495	1043.91	0	0
5	89.0884	26.2329	1426.35	0	0
6	89.8659	26.3316	1818.6	0	0
7	90.6435	26.4459	2216.41	0	0
8	91.4211	26.5759	2615.65	0	0
9	92.1986	26.7217	3011.76	0	0
10	92.9762	26.8835	3398.49	0	0
11	93.7538	27.0615	3771.84	0	0
12	94.5313	27.2559	4129.7	0	0
13	95.3089	27.467	4470.06	0	0
14	96.0865	27.6951	4790.99	0	0
15	96.864	27.9404	5090.61	0	0
16	97.6416	28.2034	5367.15	0	0
17	98.4191	28.4843	5618.86	0	0
18	99.1967	28.7836	5844.25	0	0
19	99.9743	29.1017	6040.2	0	0
20	100.752	29.4391	6204.11	0	0
21	101.529	29.7964	6333.58	0	0
22	102.307	30.1741	6426.25	0	0
23	103.085	30.5729	6479.8	0	0
24	103.862	30.9935	6491.94	0	0
25	104.64	31.4368	6460.44	0	0
26	105.417	31.9036	6383.11	0	0
27	106.195	32.3949	6257.77	0	0
28	106.972	32.9117	6082.31	0	0
29	107.75	33.4554	5854.64	0	0
30	108.527	34.0272	5576.48	0	0
31	109.305	34.6287	5262.67	0	0
32	110.083	35.2616	4909.7	0	0
33	110.86	35.9281	4514.31	0	0
34	111.638	36.6302	4073.39	0	0
35	112.415	37.3707	3584.1	0	0
36	113.193	38.1526	3043.86	0	0
37	113.97	38.9795	2450.48	0	0
38	114.748	39.8556	1802.23	0	0
39	115.526	40.7863	1098.03	0	0
40	116.303	41.7776	340.468	0	0
41	117.081	42.8374	-438.806	0	0
42	117.858	43.9757	-1221.21	0	0
43	118.636	45.2052	-1991.15	0	0
44	119.413	46.5434	-2727.42	0	0
45	120.191	48.0144	-3399.89	0	0
46	120.969	49.6543	-3963.49	0	0
47	121.746	51.5203	-4345.33	0	0
48	122.524	53.7154	-4413.21	0	0
49	123.165	55.9235	-4144.87	0	0
50	123.806	58.8378	-3419.63	0	0
51	124.447	65.972	0	0	0

Entity Information

Water Table

X	Y
0	10
40	14
71	20
86	26
92	34
99	40
99.5299	40.5887

108	50
151	61
165	61
250	60

Distributed Load

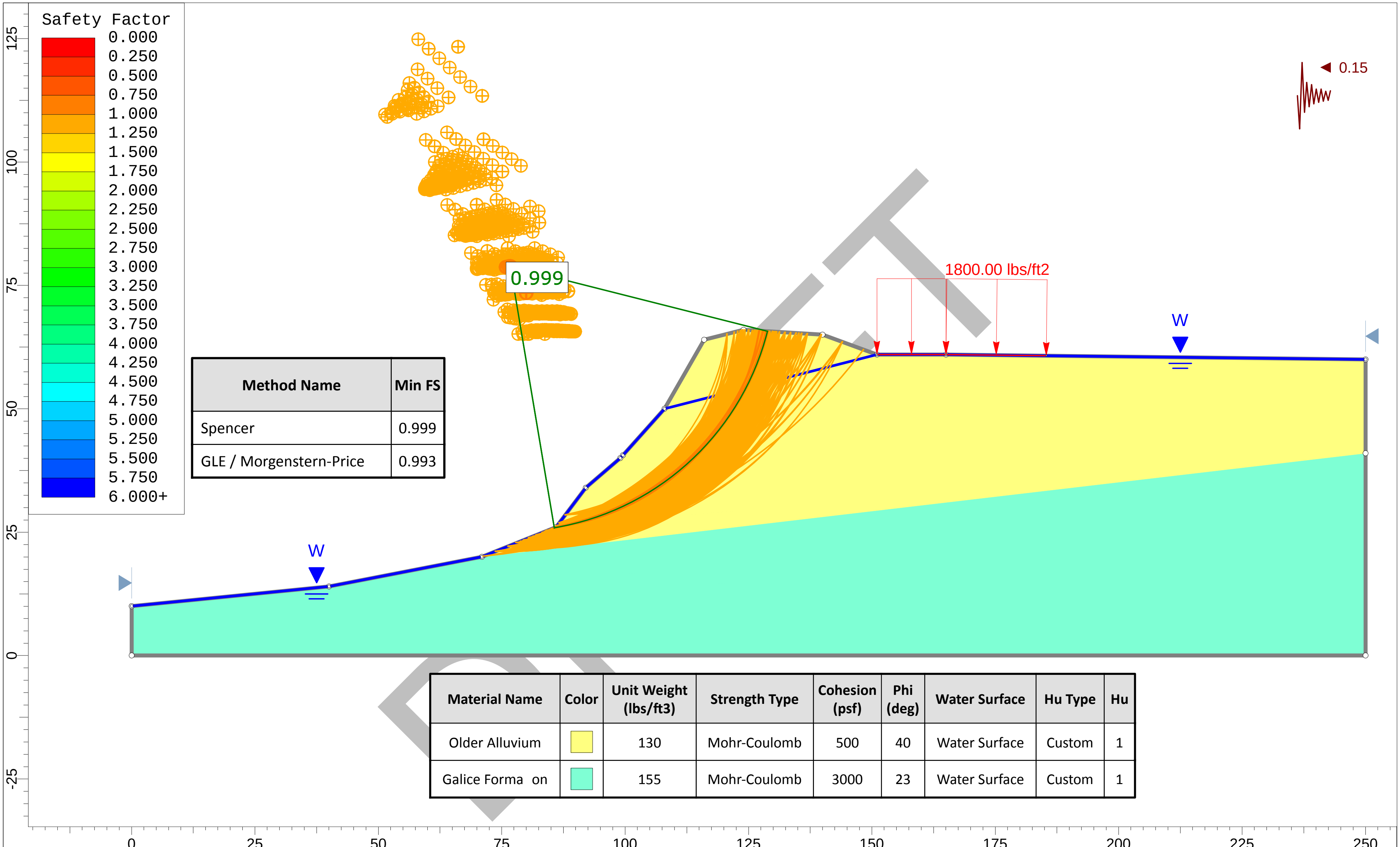
X	Y
185.342	60.7607
165	61
151	61

External Boundary

X	Y
0	0
250	0
250	41
250	60
165	61
151	61
140	65
124	66
116	64
108	50
99.5299	40.5887
99	40
92	34
86	26
71	20
40	14
0	10

Material Boundary

X	Y
71	20
250	41



Method Name	Min FS
Spencer	0.999
GLE / Morgenstern-Price	0.993

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Older Alluvium		130	Mohr-Coulomb	500	40	Water Surface	Custom	1
Galice Forma on		155	Mohr-Coulomb	3000	23	Water Surface	Custom	1

BAJADA Geosciences, Inc.

SLIDEINTERPRET 8.032

Project	Orlens MWC Treatment Plant Improvements
Analysis Description	Pseudostatic, groundwater at surface, with 1,800 psf tank surcharge
Drawn By	J.Bianchin
Scale	1:323
Company	Bajada Geosciences, Inc.
Date	7/13/2022, 1:30:35 PM
File Name	A-A'_PS_FullGW.slim

Slide Analysis Information

Orlens MWC Treatment Plant Improvements

Project Summary

Slide Modeler Version:	8.032
Compute Time:	00h:00m:07.804s

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
GLE/Morgenstern-Price with interslice force function (Half Sine)
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Auto Refine Search
Divisions along slope:	20

Circles per division:	10
Number of iterations:	10
Divisions to use innext iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Seismic Load Coefficient (Horizontal): 0.15

Loading

1 Distributed Load present

Distributed Load 1	
Distribution:	Constant
Magnitude [psf]:	1800
Orientation:	Normal to boundary

Materials

Property	Older Alluvium	Galice Formation
Color		
Strength Type	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	130	155
Cohesion [psf]	500	3000
Friction Angle [°]	40	23
Water Surface	Water Table	Water Table
Hu Value	1	1

Global Minimums

Method: spencer

FS	0.998704
Center:	76.733, 78.889
Radius:	53.778
Left Slip Surface Endpoint:	85.632, 25.853
Right Slip Surface Endpoint:	128.867, 65.696
Resisting Moment:	2.6083e+06 lb-ft
Driving Moment:	2.61168e+06 lb-ft
Resisting Horizontal Force:	36057.2 lb
Driving Horizontal Force:	36104 lb
Total Slice Area:	519.532 ft2
Surface Horizontal Width:	43.2349 ft
Surface Average Height:	12.0165 ft

Method: gle/morgenstern-price

FS	0.992600

Center:	79.257, 73.410
Radius:	47.860
Left Slip Surface Endpoint:	86.023, 26.030
Right Slip Surface Endpoint:	126.515, 65.843
Resisting Moment:	2.15809e+06 lb-ft
Driving Moment:	2.17418e+06 lb-ft
Resisting Horizontal Force:	32913.8 lb
Driving Horizontal Force:	33159.2 lb
Total Slice Area:	485.549 ft2
Surface Horizontal Width:	40.4922 ft
Surface Average Height:	11.9912 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 10670
Number of Invalid Surfaces: 1988

Error Codes:

Error Code -108 reported for 3 surfaces
Error Code -111 reported for 1985 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 12582
Number of Invalid Surfaces: 76

Error Codes:

Error Code -108 reported for 2 surfaces
Error Code -111 reported for 74 surfaces

Error Codes

The following errors were encountered during the computation:

-108 =Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 =safety factor equation did not converge

Slice Data

Global Minimum Query (spencer) - Safety Factor: 0.998704

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.864216	25.8088	9.99292	Older Alluvium	500	40	1013.25	1011.94	619.879	9.77165	610.108	798.414	788.643
2	0.864216	129.127	10.9293	Older Alluvium	500	40	1028.88	1027.54	700.419	71.7168	628.702	899.094	827.377
3	0.864216	239.007	11.8686	Older Alluvium	500	40	1049.83	1048.47	786.392	132.746	653.646	1007.03	874.28
4	0.864216	347.223	12.8112	Older Alluvium	500	40	1064.79	1063.41	864.293	192.851	671.442	1106.43	913.574
5	0.864216	453.755	13.7573	Older Alluvium	500	40	1074.37	1072.97	934.863	252.021	682.842	1197.9	945.882
6	0.864216	558.584	14.7072	Older Alluvium	500	40	1079.13	1077.74	998.762	310.244	688.518	1282.01	971.77
7	0.864216	661.688	15.6613	Older	500	40	1079.6	1078.2	1056.58	367.51	689.07	1359.26	991.746

				Alluvium									
8	0.864216	753.823	16.6199	Older Alluvium	500	40	1070.73	1069.34	1098.94	420.426	678.515	1418.55	998.119
9	0.864216	810.308	17.5833	Older Alluvium	500	40	1053.15	1051.78	1107.64	450.056	657.589	1441.39	991.329
10	0.864216	861.854	18.5519	Older Alluvium	500	40	1031.07	1029.74	1110	478.686	631.314	1456.03	977.345
11	0.864216	911.568	19.526	Older Alluvium	500	40	1008.12	1006.82	1110.3	506.298	604.003	1467.81	961.513
12	0.864216	959.418	20.506	Older Alluvium	500	40	984.446	983.17	1108.69	532.874	575.819	1476.88	944.005
13	0.864216	1005.37	21.4923	Older Alluvium	500	40	960.168	958.924	1105.32	558.396	546.925	1483.39	924.996
14	0.864216	1049.38	22.4853	Older Alluvium	500	40	935.409	934.197	1100.3	582.842	517.453	1487.47	904.632
15	0.864216	1091.42	23.4856	Older Alluvium	500	40	910.274	909.094	1093.73	606.188	487.539	1489.25	883.064
16	0.864216	1134.91	24.4934	Older Alluvium	500	40	887.199	886.049	1088.93	628.846	460.08	1493.12	864.277
17	0.864216	1194.81	25.5094	Older Alluvium	500	40	863.354	862.235	1095.31	663.615	431.694	1507.28	843.668
18	0.864216	1255.28	26.5341	Older Alluvium	500	40	840.867	839.777	1102.13	697.204	404.93	1522	824.796
19	0.864216	1313.58	27.5681	Older Alluvium	500	40	817.65	816.59	1106.88	729.582	377.295	1533.75	804.172
20	0.864216	1369.64	28.6118	Older Alluvium	500	40	793.809	792.78	1109.64	760.716	348.92	1542.65	781.931
21	0.864216	1423.38	29.6661	Older Alluvium	500	40	769.441	768.444	1110.49	790.568	319.919	1548.77	758.198
22	0.864216	1474.75	30.7315	Older Alluvium	500	40	744.632	743.667	1109.49	819.098	290.397	1552.18	733.081
23	0.864216	1523.66	31.8089	Older Alluvium	500	40	719.462	718.53	1106.7	846.264	260.437	1552.94	706.676
24	0.864216	1570.03	32.8989	Older Alluvium	500	40	694.001	693.102	1102.15	872.016	230.131	1551.1	679.082
25	0.864216	1613.75	34.0026	Older Alluvium	500	40	668.314	667.448	1095.86	896.303	199.562	1546.69	650.389
26	0.864216	1655.17	35.1208	Older Alluvium	500	40	642.704	641.871	1088.15	919.069	169.079	1540.2	621.127
27	0.864216	1731.19	36.2545	Older Alluvium	500	40	663.948	663.088	1106.12	911.758	194.364	1593.03	681.272
28	0.864216	1828.38	37.405	Older Alluvium	500	40	711.505	710.583	1136.12	885.161	250.961	1680.21	795.046
29	0.864216	1922.45	38.5734	Older Alluvium	500	40	755.166	754.187	1159.77	856.833	302.932	1762.03	905.2
30	0.864216	2013.26	39.7612	Older Alluvium	500	40	795.103	794.073	1177.15	826.69	350.46	1838.69	1012
31	0.864216	2100.62	40.9698	Older Alluvium	500	40	831.473	830.395	1188.39	794.637	393.753	1910.41	1115.77
32	0.864216	2184.36	42.201	Older Alluvium	500	40	864.409	863.289	1193.52	760.568	432.949	1977.34	1216.78
33	0.864216	2264.25	43.4568	Older Alluvium	500	40	894.032	892.873	1192.57	724.364	468.206	2039.69	1315.33
34	0.864216	2340.06	44.7391	Older Alluvium	500	40	920.44	919.247	1185.53	685.892	499.641	2097.63	1411.74
35	0.864216	2411.5	46.0506	Older Alluvium	500	40	943.72	942.497	1172.35	644.997	527.351	2151.33	1506.33
36	0.864216	2424.32	47.3941	Older Alluvium	500	40	942.858	941.636	1127.82	601.505	526.318	2152.96	1551.45
37	0.864216	2341.82	48.7727	Older Alluvium	500	40	907.031	905.855	1038.89	555.213	483.679	2073.99	1518.78
38	0.864216	2252.45	50.1904	Older Alluvium	500	40	872.545	871.414	948.517	505.886	442.631	1995.42	1489.53
39	0.864216	2157.11	51.6515	Older Alluvium	500	40	840	838.911	857.146	453.247	403.899	1918.92	1465.67
40	0.864216	2055.22	53.1614	Older Alluvium	500	40	809.482	808.433	764.543	396.968	367.575	1845.08	1448.11

41	0.864216	1946.05	54.7265	Older Alluvium	500	40	781.131	780.119	670.484	336.652	333.832	1774.8	1438.15
42	0.864216	1828.75	56.3547	Older Alluvium	500	40	755.156	754.177	574.73	271.814	302.916	1709.38	1437.57
43	0.864216	1702.22	58.0558	Older Alluvium	500	40	731.873	730.924	477.056	201.851	275.205	1650.84	1448.99
44	0.864216	1565.08	59.8424	Older Alluvium	500	40	711.755	710.833	377.256	125.995	251.261	1602.26	1476.26
45	0.864216	1409.99	61.7309	Older Alluvium	500	40	694.232	693.332	273.646	43.2415	230.404	1564.64	1521.4
46	0.869029	1223.8	63.7497	Older Alluvium	500	40	645.944	645.107	172.932	0	172.932	1482.76	1482.76
47	0.869029	1008.22	65.9317	Older Alluvium	500	40	571.954	571.213	84.8685	0	84.8685	1365.39	1365.39
48	0.869029	768.703	68.3202	Older Alluvium	500	40	502.915	502.263	2.69686	0	2.69686	1267.76	1267.76
49	0.869029	496.561	70.9952	Older Alluvium	500	40	441.283	440.711	-70.6573	0	-70.6573	1210.57	1210.57
50	0.869029	175.484	74.1078	Older Alluvium	500	40	389.78	389.275	-131.957	0	-131.957	1237.08	1237.08

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.9926

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	0.802179	49.4339	8.61287	Older Alluvium	500	40	491.876	488.236	15.5582	29.5774	-14.0192	90.0605	60.4831
2	0.802179	147.574	9.58548	Older Alluvium	500	40	578.246	573.967	176.452	88.3012	88.1504	274.104	185.803
3	0.802179	244.25	10.5609	Older Alluvium	500	40	665.868	660.941	337.953	146.15	191.803	462.096	315.946
4	0.802179	339.451	11.5394	Older Alluvium	500	40	753.18	747.606	498.2	203.115	295.085	651.975	448.86
5	0.802179	433.161	12.5214	Older Alluvium	500	40	838.371	832.167	655.049	259.188	395.861	841.239	582.051
6	0.802179	525.363	13.507	Older Alluvium	500	40	919.498	912.694	806.188	314.359	491.829	1027.06	712.7
7	0.802179	616.039	14.4968	Older Alluvium	500	40	994.586	987.226	949.271	368.617	580.654	1206.43	837.812
8	0.802179	699.176	15.4911	Older Alluvium	500	40	1056.84	1049.02	1075.09	420.792	654.297	1368	947.208
9	0.802179	750.963	16.4901	Older Alluvium	500	40	1102.31	1094.15	1157.43	449.351	708.077	1483.74	1034.39
10	0.802179	797.101	17.4943	Older Alluvium	500	40	1134.55	1126.15	1223.19	476.959	746.227	1580.79	1103.83
11	0.802179	841.622	18.5041	Older Alluvium	500	40	1156.81	1148.24	1276.15	503.599	772.55	1663.3	1159.7
12	0.802179	884.499	19.5199	Older Alluvium	500	40	1168.63	1159.98	1315.8	529.255	786.543	1730.09	1200.83
13	0.802179	925.701	20.5421	Older Alluvium	500	40	1169.94	1161.29	1342	553.909	788.086	1780.4	1226.49
14	0.802179	965.195	21.5713	Older Alluvium	500	40	1161	1152.41	1355.05	577.541	777.511	1814.05	1236.51
15	0.802179	1002.94	22.6077	Older Alluvium	500	40	1142.39	1133.93	1355.62	600.129	755.494	1831.33	1231.21
16	0.802179	1038.91	23.6521	Older Alluvium	500	40	1114.96	1106.71	1344.7	621.651	723.047	1833.02	1211.37
17	0.802179	1080.24	24.7048	Older Alluvium	500	40	1081.56	1073.56	1329.72	646.179	683.542	1827.29	1181.12
18	0.802179	1133.42	25.7665	Older Alluvium	500	40	1043.45	1035.72	1316.65	678.201	638.452	1820.32	1142.12
19	0.802179	1185.01	26.8379	Older Alluvium	500	40	999.421	992.025	1295.45	709.075	586.377	1801.13	1092.05
20	0.802179	1234.64	27.9194	Older Alluvium	500	40	950.749	943.713	1267.56	738.767	528.794	1771.37	1032.6

21	0.802179	1282.22	29.0119	Older Alluvium	500	40	898.996	892.343	1234.81	767.242	467.571	1733.38	966.137
22	0.802179	1327.71	30.1161	Older Alluvium	500	40	845.676	839.418	1198.97	794.462	404.507	1689.51	895.045
23	0.802179	1371.04	31.2327	Older Alluvium	500	40	792.202	786.34	1161.63	820.385	341.246	1642.02	821.64
24	0.802179	1412.12	32.3628	Older Alluvium	500	40	739.84	734.365	1124.27	844.965	279.309	1593.12	748.151
25	0.802179	1450.87	33.5071	Older Alluvium	500	40	689.676	684.572	1088.12	868.153	219.964	1544.73	676.574
26	0.802179	1487.2	34.6668	Older Alluvium	500	40	642.605	637.85	1054.17	889.892	164.28	1498.58	608.69
27	0.802179	1521	35.8429	Older Alluvium	500	40	599.328	594.893	1023.21	910.121	113.09	1456.14	546.022
28	0.802179	1561.89	37.0368	Older Alluvium	500	40	570.111	565.892	1002.89	924.367	78.5247	1433.08	508.709
29	0.802179	1639.54	38.2498	Older Alluvium	500	40	601.918	597.463	1014.71	898.557	116.148	1489.22	590.658
30	0.802179	1718.5	39.4834	Older Alluvium	500	40	636.536	631.826	1028.11	871.012	157.103	1552.52	681.512
31	0.802179	1794.41	40.7392	Older Alluvium	500	40	671.58	666.61	1040.2	841.641	198.558	1618.65	777.009
32	0.802179	1867.09	42.0193	Older Alluvium	500	40	707.051	701.819	1050.86	810.338	240.519	1687.92	877.582
33	0.802179	1936.35	43.3257	Older Alluvium	500	40	742.897	737.4	1059.91	776.986	282.926	1760.61	983.627
34	0.802179	2001.96	44.6609	Older Alluvium	500	40	779.012	773.247	1067.1	741.451	325.647	1836.94	1095.49
35	0.802179	2063.66	46.0275	Older Alluvium	500	40	815.234	809.201	1072.08	703.58	368.496	1917.09	1213.51
36	0.802179	2121.17	47.4289	Older Alluvium	500	40	851.347	845.047	1074.41	663.198	411.209	2001.18	1337.98
37	0.802179	2174.14	48.8687	Older Alluvium	500	40	887.068	880.504	1073.57	620.099	453.47	2089.31	1469.21
38	0.802179	2197.25	50.3512	Older Alluvium	500	40	911.616	904.87	1056.55	574.045	482.505	2156.6	1582.55
39	0.802179	2122.97	51.8816	Older Alluvium	500	40	898.035	891.39	991.189	524.75	466.439	2135.74	1610.99
40	0.802179	2034.12	53.4661	Older Alluvium	500	40	881.189	874.668	918.388	471.875	446.513	2107.77	1635.9
41	0.802179	1938.59	55.1122	Older Alluvium	500	40	863.577	857.187	840.688	415.006	425.682	2079.16	1664.15
42	0.802179	1835.53	56.8294	Older Alluvium	500	40	844.023	837.777	756.172	353.628	402.544	2047.42	1693.79
43	0.802179	1723.85	58.6294	Older Alluvium	500	40	821.16	815.083	662.593	287.093	375.5	2009.42	1722.33
44	0.802179	1602.15	60.5278	Older Alluvium	500	40	793.366	787.495	557.184	214.562	342.622	1961.04	1746.48
45	0.802179	1468.54	62.5453	Older Alluvium	500	40	758.646	753.032	436.459	134.908	301.551	1896.63	1761.72
46	0.802179	1320.42	64.711	Older Alluvium	500	40	714.451	709.164	295.84	46.5685	249.272	1808.02	1761.45
47	0.897996	1279.01	67.2236	Older Alluvium	500	40	630.729	626.062	150.235	0	150.235	1652.41	1652.41
48	0.897996	1024.3	70.1992	Older Alluvium	500	40	504.013	500.283	0.337085	0	0.337085	1400.22	1400.22
49	0.897996	693.55	73.7018	Older Alluvium	500	40	352.041	349.436	-179.435	0	-179.435	1024.6	1024.6
50	0.897996	255.502	78.2603	Older Alluvium	500	40	170.298	169.038	-394.426	0	-394.426	425.052	425.052

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 0.998704

Slice	X	Y	Interslice	Interslice	Interslice

Number	coordinate [ft]	coordinate - Bottom [ft]	Normal Force [lbs]	Shear Force [lbs]	Force Angle [degrees]
1	85.6321	25.8528	0	0	0
2	86.4963	26.0051	776.116	709.653	42.4387
3	87.3605	26.172	1527.72	1396.89	42.4386
4	88.2247	26.3536	2254.99	2061.88	42.4386
5	89.089	26.5501	2951.9	2699.11	42.4387
6	89.9532	26.7617	3613.15	3303.73	42.4386
7	90.8174	26.9886	4234.03	3871.45	42.4387
8	91.6816	27.2309	4810.4	4398.46	42.4387
9	92.5458	27.4888	5337.82	4880.72	42.4387
10	93.41	27.7627	5821.73	5323.19	42.4387
11	94.2743	28.0527	6260.27	5724.17	42.4387
12	95.1385	28.3592	6653.21	6083.46	42.4387
13	96.0027	28.6824	7000.47	6400.98	42.4387
14	96.8669	29.0227	7302.1	6676.78	42.4387
15	97.7311	29.3804	7558.31	6911.05	42.4387
16	98.5953	29.7559	7769.4	7104.07	42.4387
17	99.4596	30.1497	7936.03	7256.42	42.4387
18	100.324	30.562	8050.14	7360.76	42.4387
19	101.188	30.9936	8111.87	7417.21	42.4387
20	102.052	31.4448	8121	7425.56	42.4387
21	102.916	31.9162	8077.47	7385.75	42.4387
22	103.781	32.4084	7981.29	7297.81	42.4387
23	104.645	32.9222	7832.62	7161.87	42.4387
24	105.509	33.4582	7631.71	6978.17	42.4387
25	106.373	34.0173	7378.92	6747.03	42.4387
26	107.238	34.6003	7074.71	6468.87	42.4387
27	108.102	35.2081	6719.63	6144.19	42.4387
28	108.966	35.8419	6331.87	5789.64	42.4387
29	109.83	36.5028	5920.77	5413.75	42.4387
30	110.694	37.192	5484.72	5015.03	42.4387
31	111.559	37.911	5022.43	4592.33	42.4387
32	112.423	38.6615	4533.02	4144.83	42.4387
33	113.287	39.4452	4016	3672.09	42.4387
34	114.151	40.264	3471.29	3174.03	42.4387
35	115.015	41.1204	2899.3	2651.02	42.4387
36	115.88	42.0169	2300.94	2103.9	42.4387
37	116.744	42.9565	1691.18	1546.36	42.4388
38	117.608	43.9428	1098.03	1004	42.4387
39	118.472	44.9797	529.586	484.235	42.4387
40	119.337	46.0721	-5.44259	-4.97652	42.4387
41	120.201	47.2257	-497.167	-454.592	42.4387
42	121.065	48.4475	-934.185	-854.186	42.4387
43	121.929	49.746	-1303.14	-1191.55	42.4388
44	122.793	51.132	-1588.13	-1452.13	42.4387
45	123.658	52.6194	-1769.82	-1618.26	42.4387
46	124.522	54.2265	-1822.01	-1665.98	42.4387
47	125.391	55.9887	-1749.81	-1599.96	42.4386
48	126.26	57.9343	-1569.85	-1435.42	42.4388
49	127.129	60.1203	-1254.65	-1147.21	42.4388
50	127.998	62.6435	-767.931	-702.169	42.4387
51	128.867	65.6958	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 0.9926

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	86.0227	26.0302	0	0	0
2	86.8248	26.1517	385.772	22.9256	3.40096
3	87.627	26.2872	804.183	95.3966	6.76512
4	88.4292	26.4367	1251.83	222.03	10.0576
5	89.2314	26.6005	1724.28	405.921	13.2471

6	90.0335	26.7787	2215.99	648.299	16.3071
7	90.8357	26.9714	2720.39	948.224	19.2166
8	91.6379	27.1788	3229.95	1302.38	21.9603
9	92.4401	27.4011	3734.91	1704.3	24.528
10	93.2423	27.6386	4232.79	2148.76	26.9145
11	94.0444	27.8914	4715.24	2626.43	29.1182
12	94.8466	28.1599	5175.54	3127.14	31.141
13	95.6488	28.4442	5607.33	3639.62	32.9869
14	96.451	28.7448	6004.78	4151.92	34.6614
15	97.2532	29.062	6362.79	4651.91	36.171
16	98.0553	29.396	6677.08	5127.71	37.5227
17	98.8575	29.7474	6944.35	5568.18	38.7236
18	99.6597	30.1164	7160.31	5961.64	39.7806
19	100.462	30.5036	7318.58	6294.98	40.7
20	101.264	30.9095	7417.78	6559.91	41.4879
21	102.066	31.3346	7457.41	6749.98	42.1494
22	102.868	31.7794	7437.82	6860.79	42.689
23	103.671	32.2447	7360.03	6889.95	43.1106
24	104.473	32.7312	7225.6	6836.99	43.4171
25	105.275	33.2395	7036.51	6703.25	43.6106
26	106.077	33.7706	6794.94	6491.69	43.6925
27	106.879	34.3254	6503.18	6206.67	43.6636
28	107.681	34.9049	6163.5	5853.75	43.5235
29	108.484	35.5102	5780.09	5441.4	43.2712
30	109.286	36.1425	5375.94	4996.5	42.905
31	110.088	36.8034	4949.97	4523.46	42.4222
32	110.89	37.4944	4501.51	4027.57	41.8195
33	111.692	38.2171	4029.83	3514.52	41.0925
34	112.495	38.9737	3534.13	2990.45	40.2367
35	113.297	39.7665	3013.62	2461.89	39.2461
36	114.099	40.598	2467.46	1935.77	38.1149
37	114.901	41.4712	1894.87	1419.41	36.8362
38	115.703	42.3897	1295.13	920.498	35.4029
39	116.505	43.3577	675.034	452.031	33.8079
40	117.308	44.3801	64.5222	40.388	32.0447
41	118.11	45.4629	-527.197	-305.692	30.107
42	118.912	46.6133	-1091.5	-580.116	27.99
43	119.714	47.8405	-1616.9	-777.848	25.691
44	120.516	49.1562	-2087.7	-895.196	23.2094
45	121.319	50.5757	-2481.68	-930.279	20.5489
46	122.121	52.1196	-2766.49	-883.809	17.7171
47	122.923	53.8175	-2893	-760.405	14.7267
48	123.821	55.9562	-2839.04	-562.859	11.2139
49	124.719	58.4504	-2540.35	-337.124	7.55942
50	125.617	61.5216	-1776.75	-118.181	3.80544
51	126.515	65.8428	0	0	0

Entity Information

Water Table

X	Y
0	10
40	14
71	20
86	26
92	34
99	40
99.5299	40.5887
108	50
151	61

165	61
250	60

Distributed Load

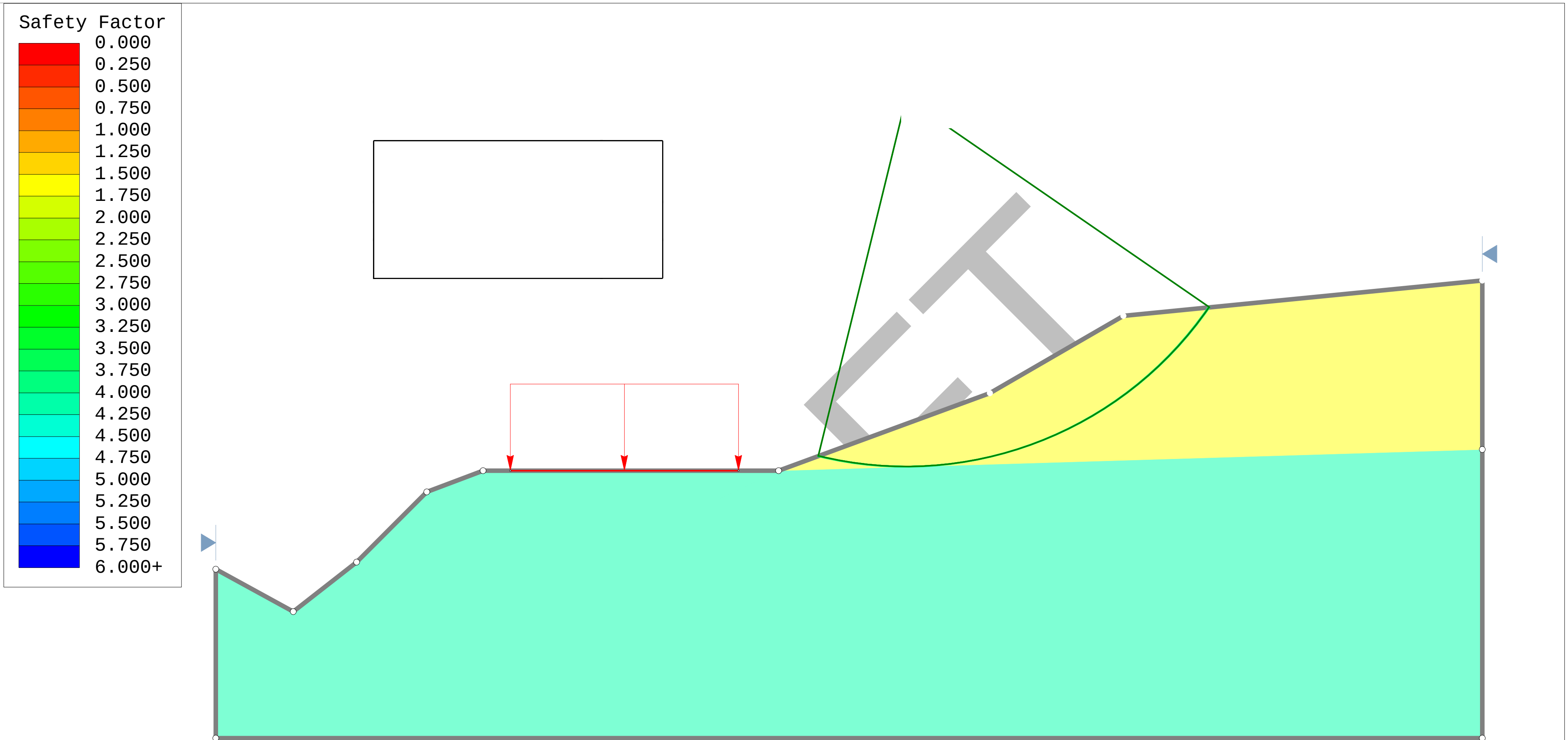
X	Y
185.342	60.7607
165	61
151	61

External Boundary

X	Y
0	0
250	0
250	41
250	60
165	61
151	61
140	65
124	66
116	64
108	50
99.5299	40.5887
99	40
92	34
86	26
71	20
40	14
0	10

Material Boundary

X	Y
71	20
250	41



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Older Alluvium		130	Mohr-Coulomb	500	40	None	0
Galice Formation		155	Mohr-Coulomb	3000	23	None	0

Bajada Geosciences, Inc.

SLIDEINTERPRET 8.032

Project	Orleans MWC Treatment Plant Improvements		
Analysis Description	Static, dry, with 1,000 psf building surcharge		
Drawn By	J.Bianchin	*Scale*	1:258
Company	Bajada Geosciences, Inc.		
Date	7/13/2022, 2:14:35 PM	*File Name*	B-B'_Static_Dry.slim

Slide Analysis Information

Orleans MWC Treatment Plant Improvements

Project Summary

Slide Modeler Version:	8.032
Compute Time:	00h:00m:05.294s

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
GLE/Morgenstern-Price with interslice force function (Half Sine)
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular

Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

1 Distributed Load present

Distributed Load 1	
Distribution:	Constant
Magnitude [psf]:	1000
Orientation:	Normal to boundary

Materials

Property	Older Alluvium	Galice Formation
Color		
Strength Type	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	130	155
Cohesion [psf]	500	3000
Friction Angle [°]	40	23
Water Surface	None	None
Ru Value	0	0

Global Minimums

Method: spencer

FS	3.999510
Center:	98.091, 90.920
Radius:	52.360
Left Slip Surface Endpoint:	85.630, 40.064
Right Slip Surface Endpoint:	141.197, 61.196
Resisting Moment:	3.99556e+06 lb-ft
Driving Moment:	999011 lb-ft
Resisting Horizontal Force:	68389 lb
Driving Horizontal Force:	17099.3 lb
Total Slice Area:	420.146 ft2
Surface Horizontal Width:	55.5667 ft
Surface Average Height:	7.5611 ft

Method: gle/morgenstern-price

FS	3.996950
Center:	98.091, 90.920
Radius:	52.360
Left Slip Surface Endpoint:	85.630, 40.064
Right Slip Surface Endpoint:	141.197, 61.196
Resisting Moment:	3.993e+06 lb-ft
Driving Moment:	999011 lb-ft
Resisting Horizontal Force:	68388.3 lb
Driving Horizontal Force:	17110.1 lb
Total Slice Area:	420.146 ft2
Surface Horizontal Width:	55.5667 ft
Surface Average Height:	7.5611 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 11435
Number of Invalid Surfaces: 857

Error Codes:

Error Code -108 reported for 1 surface
Error Code -111 reported for 853 surfaces
Error Code -112 reported for 3 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 12290
Number of Invalid Surfaces: 2

Error Codes:

Error Code -108 reported for 1 surface
Error Code -112 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 3.99951

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.1007	47.2724	-13.1496	Older Alluvium	500	40	153.324	613.22	134.931	0	134.931	99.1113	99.1113
2	1.1007	140.037	-11.9156	Older Alluvium	500	40	173.586	694.26	231.511	0	231.511	194.881	194.881
3	1.1007	229.267	-10.6873	Older Alluvium	500	40	192.516	769.968	321.735	0	321.735	285.403	285.403
4	1.1007	315.005	-9.46387	Older	500	40	210.18	840.616	405.93	0	405.93	370.894	370.894

				Alluvium									
5	1.1007	397.293	-8.24481	Older Alluvium	500	40	226.64	906.45	484.388	0	484.388	451.548	451.548
6	1.1007	476.164	-7.02949	Older Alluvium	500	40	241.953	967.692	557.373	0	557.373	527.539	527.539
7	1.1007	551.648	-5.81734	Older Alluvium	500	40	256.167	1024.54	625.124	0	625.124	599.025	599.025
8	1.1007	623.768	-4.6078	Older Alluvium	500	40	269.328	1077.18	687.855	0	687.855	666.148	666.148
9	1.1007	692.543	-3.40032	Older Alluvium	500	40	281.476	1125.77	745.761	0	745.761	729.037	729.037
10	1.1007	757.99	-2.19435	Older Alluvium	500	40	292.65	1170.46	799.02	0	799.02	787.807	787.807
11	1.1007	820.117	-0.989351	Older Alluvium	500	40	302.883	1211.38	847.792	0	847.792	842.562	842.562
12	1.1007	878.931	0.215211	Older Alluvium	500	40	312.204	1248.66	892.224	0	892.224	893.397	893.397
13	1.64581	1416.22	1.71836	Older Alluvium	500	40	322.497	1289.83	941.285	0	941.285	950.96	950.96
14	1.10034	1010.9	3.22226	Older Alluvium	500	40	331.669	1326.51	985	0	985	1003.67	1003.67
15	1.10034	1058.08	4.42909	Older Alluvium	500	40	338.009	1351.87	1015.22	0	1015.22	1041.4	1041.4
16	1.10034	1101.93	5.63789	Older Alluvium	500	40	343.547	1374.02	1041.61	0	1041.61	1075.53	1075.53
17	1.10034	1142.42	6.84922	Older Alluvium	500	40	348.298	1393.02	1064.27	0	1064.27	1106.1	1106.1
18	1.10034	1179.53	8.06364	Older Alluvium	500	40	352.281	1408.95	1083.25	0	1083.25	1133.16	1133.16
19	1.10034	1213.23	9.28171	Older Alluvium	500	40	355.51	1421.86	1098.64	0	1098.64	1156.74	1156.74
20	1.10034	1243.49	10.504	Older Alluvium	500	40	357.997	1431.81	1110.49	0	1110.49	1176.87	1176.87
21	1.10034	1270.27	11.7312	Older Alluvium	500	40	359.755	1438.84	1118.87	0	1118.87	1193.58	1193.58
22	1.10034	1295.59	12.9639	Older Alluvium	500	40	361.168	1444.49	1125.6	0	1125.6	1208.75	1208.75
23	1.10034	1341.66	14.2027	Older Alluvium	500	40	366.211	1464.67	1149.64	0	1149.64	1242.33	1242.33
24	1.10034	1391.12	15.4483	Older Alluvium	500	40	371.689	1486.57	1175.75	0	1175.75	1278.47	1278.47
25	1.10034	1436.88	16.7015	Older Alluvium	500	40	376.339	1505.17	1197.91	0	1197.91	1310.83	1310.83
26	1.10034	1478.88	17.9629	Older Alluvium	500	40	380.167	1520.48	1216.16	0	1216.16	1339.41	1339.41
27	1.10034	1517.03	19.2334	Older Alluvium	500	40	383.177	1532.52	1230.51	0	1230.51	1364.2	1364.2
28	1.10034	1551.25	20.5138	Older Alluvium	500	40	385.375	1541.31	1240.99	0	1240.99	1385.18	1385.18
29	1.10034	1581.45	21.8051	Older Alluvium	500	40	386.76	1546.85	1247.59	0	1247.59	1402.32	1402.32
30	1.10034	1607.51	23.1081	Older Alluvium	500	40	387.337	1549.16	1250.34	0	1250.34	1415.62	1415.62
31	1.10034	1629.31	24.4238	Older Alluvium	500	40	387.1	1548.21	1249.21	0	1249.21	1425	1425
32	1.10034	1646.73	25.7535	Older Alluvium	500	40	386.047	1544	1244.2	0	1244.2	1430.43	1430.43
33	1.10034	1659.62	27.0982	Older Alluvium	500	40	384.177	1536.52	1235.28	0	1235.28	1431.86	1431.86
34	1.10034	1667.82	28.4593	Older Alluvium	500	40	381.484	1525.75	1222.44	0	1222.44	1429.22	1429.22
35	1.10034	1671.15	29.8381	Older Alluvium	500	40	377.959	1511.65	1205.63	0	1205.63	1422.42	1422.42
36	1.10034	1669.4	31.2363	Older Alluvium	500	40	373.591	1494.18	1184.82	0	1184.82	1411.39	1411.39

37	1.10034	1662.36	32.6554	Older Alluvium	500	40	368.372	1473.31	1159.95	0	1159.95	1396.03	1396.03
38	1.10034	1649.77	34.0976	Older Alluvium	500	40	362.288	1448.97	1130.94	0	1130.94	1376.21	1376.21
39	1.10034	1631.08	35.5647	Older Alluvium	500	40	355.284	1420.96	1097.56	0	1097.56	1351.59	1351.59
40	1.10034	1562.54	37.0592	Older Alluvium	500	40	341.086	1364.18	1029.88	0	1029.88	1287.46	1287.46
41	1.10034	1455.75	38.5838	Older Alluvium	500	40	321.667	1286.51	937.328	0	937.328	1193.96	1193.96
42	1.10034	1342.02	40.1415	Older Alluvium	500	40	301.661	1206.49	841.968	0	841.968	1096.36	1096.36
43	1.10034	1220.88	41.7359	Older Alluvium	500	40	281.054	1124.08	743.747	0	743.747	994.473	994.473
44	1.10034	1091.76	43.3709	Older Alluvium	500	40	259.834	1039.21	642.605	0	642.605	888.068	888.068
45	1.10034	954.007	45.0513	Older Alluvium	500	40	237.986	951.828	538.468	0	538.468	776.881	776.881
46	1.10034	806.844	46.7827	Older Alluvium	500	40	215.494	861.871	431.261	0	431.261	660.6	660.6
47	1.10034	649.343	48.5718	Older Alluvium	500	40	192.34	769.266	320.899	0	320.899	538.849	538.849
48	1.10034	480.377	50.4267	Older Alluvium	500	40	168.504	673.935	207.288	0	207.288	411.168	411.168
49	1.10034	298.552	52.3575	Older Alluvium	500	40	143.965	575.79	90.3228	0	90.3228	276.979	276.979
50	1.10034	102.116	54.377	Older Alluvium	500	40	118.675	474.64	-30.2223	0	-30.2223	135.4	135.4

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 3.99695

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.1007	47.2724	-13.1496	Older Alluvium	500	40	141.84	566.927	79.761	0	79.761	46.6244	46.6244
2	1.1007	140.037	-11.9156	Older Alluvium	500	40	161.662	646.154	174.18	0	174.18	140.066	140.066
3	1.1007	229.267	-10.6873	Older Alluvium	500	40	181.074	723.742	266.645	0	266.645	232.472	232.472
4	1.1007	315.005	-9.46387	Older Alluvium	500	40	199.967	799.259	356.643	0	356.643	323.31	323.31
5	1.1007	397.293	-8.24481	Older Alluvium	500	40	218.234	872.27	443.654	0	443.654	412.032	412.032
6	1.1007	476.164	-7.02949	Older Alluvium	500	40	235.766	942.345	527.166	0	527.166	498.095	498.095
7	1.1007	551.648	-5.81734	Older Alluvium	500	40	252.461	1009.08	606.693	0	606.693	580.971	580.971
8	1.1007	623.768	-4.6078	Older Alluvium	500	40	268.225	1072.08	681.782	0	681.782	660.164	660.164
9	1.1007	692.543	-3.40032	Older Alluvium	500	40	282.973	1131.03	752.031	0	752.031	735.218	735.218
10	1.1007	757.99	-2.19435	Older Alluvium	500	40	296.632	1185.62	817.093	0	817.093	805.727	805.727
11	1.1007	820.117	-0.989351	Older Alluvium	500	40	309.141	1235.62	876.681	0	876.681	871.342	871.342
12	1.1007	878.931	0.215211	Older Alluvium	500	40	320.456	1280.85	930.576	0	930.576	931.78	931.78
13	1.64581	1416.22	1.71836	Older Alluvium	500	40	332.729	1329.9	989.039	0	989.039	999.021	999.021
14	1.10034	1010.9	3.22226	Older Alluvium	500	40	343.31	1372.19	1039.43	0	1039.43	1058.76	1058.76
15	1.10034	1058.08	4.42909	Older Alluvium	500	40	350.297	1400.12	1072.72	0	1072.72	1099.85	1099.85
16	1.10034	1101.93	5.63789	Older	500	40	356.062	1423.16	1100.18	0	1100.18	1135.33	1135.33

				Alluvium									
17	1.10034	1142.42	6.84922	Older Alluvium	500	40	360.636	1441.45	1121.97	0	1121.97	1165.29	1165.29
18	1.10034	1179.53	8.06364	Older Alluvium	500	40	364.059	1455.13	1138.28	0	1138.28	1189.86	1189.86
19	1.10034	1213.23	9.28171	Older Alluvium	500	40	366.38	1464.4	1149.33	0	1149.33	1209.21	1209.21
20	1.10034	1243.49	10.504	Older Alluvium	500	40	367.656	1469.5	1155.41	0	1155.41	1223.58	1223.58
21	1.10034	1270.27	11.7312	Older Alluvium	500	40	367.948	1470.67	1156.8	0	1156.8	1233.21	1233.21
22	1.10034	1295.59	12.9639	Older Alluvium	500	40	367.695	1469.66	1155.59	0	1155.59	1240.24	1240.24
23	1.10034	1341.66	14.2027	Older Alluvium	500	40	370.92	1482.55	1170.95	0	1170.95	1264.83	1264.83
24	1.10034	1391.12	15.4483	Older Alluvium	500	40	374.476	1496.76	1187.89	0	1187.89	1291.38	1291.38
25	1.10034	1436.88	16.7015	Older Alluvium	500	40	377.163	1507.5	1200.69	0	1200.69	1313.85	1313.85
26	1.10034	1478.88	17.9629	Older Alluvium	500	40	379.044	1515.02	1209.65	0	1209.65	1332.54	1332.54
27	1.10034	1517.03	19.2334	Older Alluvium	500	40	380.185	1519.58	1215.09	0	1215.09	1347.73	1347.73
28	1.10034	1551.25	20.5138	Older Alluvium	500	40	380.648	1521.43	1217.29	0	1217.29	1359.71	1359.71
29	1.10034	1581.45	21.8051	Older Alluvium	500	40	380.485	1520.78	1216.52	0	1216.52	1368.74	1368.74
30	1.10034	1607.51	23.1081	Older Alluvium	500	40	379.747	1517.83	1213.01	0	1213.01	1375.05	1375.05
31	1.10034	1629.31	24.4238	Older Alluvium	500	40	378.479	1512.76	1206.96	0	1206.96	1378.83	1378.83
32	1.10034	1646.73	25.7535	Older Alluvium	500	40	376.712	1505.7	1198.55	0	1198.55	1380.28	1380.28
33	1.10034	1659.62	27.0982	Older Alluvium	500	40	374.475	1496.76	1187.89	0	1187.89	1379.5	1379.5
34	1.10034	1667.82	28.4593	Older Alluvium	500	40	371.785	1486.01	1175.08	0	1175.08	1376.6	1376.6
35	1.10034	1671.15	29.8381	Older Alluvium	500	40	368.654	1473.49	1160.16	0	1160.16	1371.62	1371.62
36	1.10034	1669.4	31.2363	Older Alluvium	500	40	365.083	1459.22	1143.15	0	1143.15	1364.57	1364.57
37	1.10034	1662.36	32.6554	Older Alluvium	500	40	361.064	1443.16	1124.01	0	1124.01	1355.41	1355.41
38	1.10034	1649.77	34.0976	Older Alluvium	500	40	356.582	1425.24	1102.66	0	1102.66	1344.06	1344.06
39	1.10034	1631.08	35.5647	Older Alluvium	500	40	351.57	1405.21	1078.79	0	1078.79	1330.16	1330.16
40	1.10034	1562.54	37.0592	Older Alluvium	500	40	339.498	1356.95	1021.28	0	1021.28	1277.66	1277.66
41	1.10034	1455.75	38.5838	Older Alluvium	500	40	322.149	1287.61	938.642	0	938.642	1195.66	1195.66
42	1.10034	1342.02	40.1415	Older Alluvium	500	40	304.149	1215.67	852.903	0	852.903	1109.4	1109.4
43	1.10034	1220.88	41.7359	Older Alluvium	500	40	285.362	1140.58	763.407	0	763.407	1017.98	1017.98
44	1.10034	1091.76	43.3709	Older Alluvium	500	40	265.623	1061.68	669.383	0	669.383	920.315	920.315
45	1.10034	954.007	45.0513	Older Alluvium	500	40	244.737	978.201	569.897	0	569.897	815.073	815.073
46	1.10034	806.844	46.7827	Older Alluvium	500	40	222.466	889.184	463.811	0	463.811	700.569	700.569
47	1.10034	649.343	48.5718	Older Alluvium	500	40	198.519	793.471	349.745	0	349.745	574.697	574.697
48	1.10034	480.377	50.4267	Older Alluvium	500	40	172.54	689.633	225.996	0	225.996	434.759	434.759

49	1.10034	298.552	52.3575	Older Alluvium	500	40	144.083	575.894	90.4466	0	90.4466	277.256	277.256
50	1.10034	102.116	54.377	Older Alluvium	500	40	112.589	450.012	-59.5731	0	-59.5731	97.5561	97.5561

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 3.99951

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	85.6299	40.0643	0	0	0
2	86.7306	39.8071	203.4	62.5175	17.0855
3	87.8313	39.5749	448.169	137.751	17.0855
4	88.932	39.3671	726.827	223.4	17.0855
5	90.0326	39.1837	1032.57	317.373	17.0855
6	91.1333	39.0242	1359.2	417.767	17.0855
7	92.234	38.8884	1701.07	522.845	17.0855
8	93.3347	38.7763	2053.03	631.025	17.0855
9	94.4354	38.6876	2410.39	740.865	17.0855
10	95.5361	38.6222	2768.88	851.049	17.0854
11	96.6368	38.58	3124.58	960.379	17.0855
12	97.7375	38.561	3473.96	1067.76	17.0854
13	98.8382	38.5651	3813.79	1172.22	17.0855
14	100.484	38.6145	4297.89	1321.01	17.0855
15	101.584	38.6765	4601.69	1414.39	17.0855
16	102.685	38.7617	4886.95	1502.07	17.0855
17	103.785	38.8703	5151.69	1583.44	17.0855
18	104.885	39.0025	5394.14	1657.96	17.0855
19	105.986	39.1584	5612.77	1725.16	17.0855
20	107.086	39.3382	5806.24	1784.62	17.0855
21	108.186	39.5422	5973.46	1836.02	17.0855
22	109.287	39.7707	6113.52	1879.07	17.0855
23	110.387	40.024	6225.66	1913.54	17.0855
24	111.487	40.3025	6308.32	1938.94	17.0855
25	112.588	40.6066	6359.63	1954.71	17.0855
26	113.688	40.9367	6378.09	1960.39	17.0855
27	114.788	41.2935	6362.41	1955.57	17.0855
28	115.889	41.6774	6311.49	1939.92	17.0855
29	116.989	42.0891	6224.46	1913.17	17.0855
30	118.089	42.5293	6100.67	1875.12	17.0855
31	119.19	42.9988	5939.66	1825.63	17.0855
32	120.29	43.4985	5741.24	1764.64	17.0854
33	121.39	44.0293	5505.42	1692.16	17.0855
34	122.491	44.5923	5232.5	1608.28	17.0855
35	123.591	45.1888	4923.02	1513.15	17.0854
36	124.691	45.8199	4577.83	1407.05	17.0854
37	125.792	46.4872	4198.08	1290.33	17.0854
38	126.892	47.1924	3785.28	1163.45	17.0854
39	127.992	47.9374	3341.31	1027	17.0856
40	129.093	48.7241	2868.61	881.705	17.0855
41	130.193	49.555	2388.01	733.984	17.0854
42	131.294	50.4329	1918.96	589.817	17.0855
43	132.394	51.3609	1469.48	451.663	17.0855
44	133.494	52.3425	1048.56	322.288	17.0855
45	134.595	53.3819	666.385	204.822	17.0855
46	135.695	54.4843	334.598	102.843	17.0855
47	136.795	55.6553	66.6092	20.4732	17.0855
48	137.896	56.9021	-121.94	-37.4798	17.0855
49	138.996	58.2335	-212.565	-65.3346	17.0855
50	140.096	59.6601	-183.069	-56.2686	17.0855

51	141.197	61.1957	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 3.99695

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	85.6299	40.0643	0	0	0
2	86.7306	39.8071	176.443	4.08948	1.32773
3	87.8313	39.5749	394.623	18.2572	2.6489
4	88.932	39.3671	649.076	44.8989	3.95705
5	90.0326	39.1837	934.349	85.7866	5.24586
6	91.1333	39.0242	1245.02	142.057	6.50931
7	92.234	38.8884	1575.76	214.214	7.74152
8	93.3347	38.7763	1921.35	302.152	8.93715
9	94.4354	38.6876	2276.7	405.182	10.0912
10	95.5361	38.6222	2636.97	522.09	11.1991
11	96.6368	38.58	2997.54	651.19	12.2566
12	97.7375	38.561	3354.06	790.395	13.26
13	98.8382	38.5651	3702.51	937.301	14.2061
14	100.484	38.6145	4200.62	1165.55	15.5078
15	101.584	38.6765	4513.52	1319.77	16.2991
16	102.685	38.7617	4807.07	1471.94	17.0248
17	103.785	38.8703	5078.88	1619.24	17.6832
18	104.885	39.0025	5326.93	1758.95	18.2732
19	105.986	39.1584	5549.58	1888.55	18.7937
20	107.086	39.3382	5745.56	2005.73	19.2437
21	108.186	39.5422	5913.89	2108.48	19.6227
22	109.287	39.7707	6053.94	2195.09	19.9301
23	110.387	40.024	6165.32	2264.17	20.1654
24	111.487	40.3025	6246.87	2314.33	20.3286
25	112.588	40.6066	6297.2	2344.31	20.4192
26	113.688	40.9367	6315.3	2353.33	20.4374
27	114.788	41.2935	6300.34	2340.95	20.383
28	115.889	41.6774	6251.69	2307.13	20.2561
29	116.989	42.0891	6168.86	2252.21	20.0568
30	118.089	42.5293	6051.48	2176.93	19.7854
31	119.19	42.9988	5899.3	2082.36	19.4422
32	120.29	43.4985	5712.14	1969.94	19.0277
33	121.39	44.0293	5489.93	1841.42	18.5424
34	122.491	44.5923	5232.66	1698.89	17.9871
35	123.591	45.1888	4940.41	1544.7	17.3627
36	124.691	45.8199	4613.34	1381.47	16.6704
37	125.792	46.4872	4251.69	1212.07	15.9118
38	126.892	47.1924	3855.85	1039.56	15.0885
39	127.992	47.9374	3426.34	867.161	14.2026
40	129.093	48.7241	2963.99	698.284	13.2565
41	130.193	49.555	2488.47	540.446	12.2532
42	131.294	50.4329	2018.5	399.523	11.1959
43	132.394	51.3609	1561.32	277.784	10.0883
44	133.494	52.3425	1125.57	176.954	8.9345
45	134.595	53.3819	721.676	98.0765	7.73914
46	135.695	54.4843	362.437	41.3409	6.50724
47	136.795	55.6553	63.789	5.85488	5.24421
48	137.896	56.9021	-154.118	-10.6575	3.9558
49	138.996	58.2335	-265.376	-12.2736	2.64803
50	140.096	59.6601	-236.062	-5.46952	1.3273
51	141.197	61.1957	0	0	0

Entity Information

Distributed Load

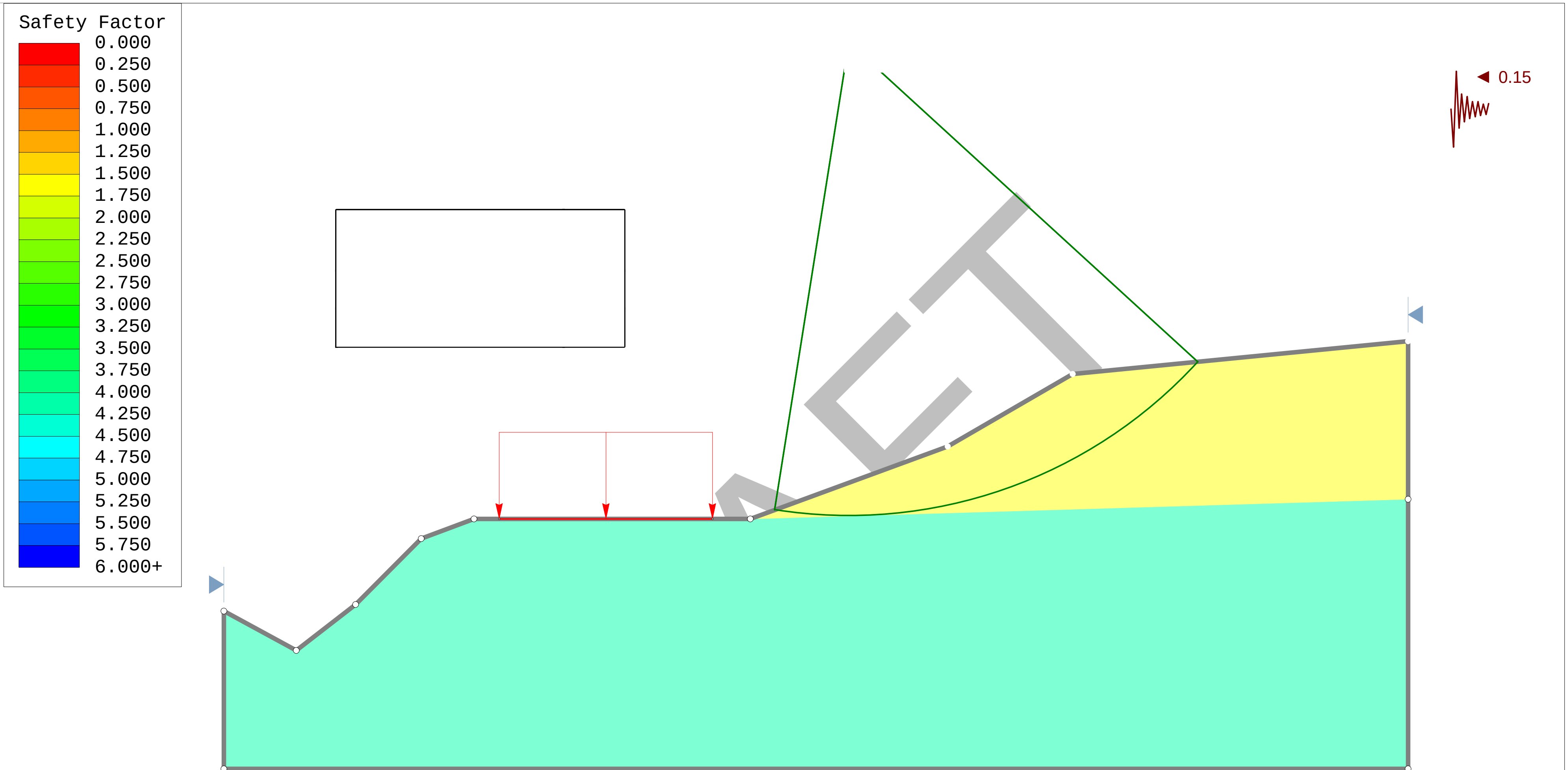
X	Y
74.2707	38
41.8575	38

External Boundary

X	Y
0	0
180	0
180	41
180	65
129	60
110	49
80	38
38	38
30	35
20	25
11	18
0	24

Material Boundary

X	Y
80	38
180	41



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Older Alluvium		130	Mohr-Coulomb	500	40	None	0
Galice Formation		155	Mohr-Coulomb	3000	23	None	0

BAJADA Geosciences, Inc.

SLIDEINTERPRET 8.032

Project Orleans MWC Treatment Plant Improvements

Analysis Description Pseudostatic, dry, with 1,000 psf building surcharge

Drawn By J.Bianchin | *Scale* 1:276 | *Company* Bajada Geosciences, Inc.

Date 7/13/2022, 2:14:35 PM | *File Name* B-B'_PS_Dry.slim

Slide Analysis Information

Orleans MWC Treatment Plant Improvements

Project Summary

Slide Modeler Version:	8.032
Compute Time:	00h:00m:06.459s

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
GLE/Morgenstern-Price with interslice force function (Half Sine)
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular

Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Seismic Load Coefficient (Horizontal): 0.15

Loading

1 Distributed Load present

Distributed Load 1	
Distribution:	Constant
Magnitude [psf]:	1000
Orientation:	Normal to boundary

Materials

Property	Older Alluvium	Galice Formation
Color		
Strength Type	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	130	155
Cohesion [psf]	500	3000
Friction Angle [°]	40	23
Water Surface	None	None
Ru Value	0	0

Global Minimums

Method: spencer

FS	2.867000
Center:	94.960, 110.375
Radius:	71.899
Left Slip Surface Endpoint:	83.711, 39.361
Right Slip Surface Endpoint:	148.030, 61.866
Resisting Moment:	6.14571e+06 lb-ft
Driving Moment:	2.1436e+06 lb-ft
Resisting Horizontal Force:	78597.6 lb
Driving Horizontal Force:	27414.6 lb
Total Slice Area:	495.875 ft2
Surface Horizontal Width:	64.3191 ft
Surface Average Height:	7.70961 ft

Method: gle/morgenstern-price

FS	2.865680
Center:	94.960, 110.375
Radius:	71.899
Left Slip Surface Endpoint:	83.711, 39.361
Right Slip Surface Endpoint:	148.030, 61.866
Resisting Moment:	6.14288e+06 lb-ft
Driving Moment:	2.1436e+06 lb-ft
Resisting Horizontal Force:	78584.3 lb
Driving Horizontal Force:	27422.6 lb
Total Slice Area:	495.875 ft2
Surface Horizontal Width:	64.3191 ft
Surface Average Height:	7.70961 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 11842
Number of Invalid Surfaces: 1486

Error Codes:

Error Code -108 reported for 7 surfaces
Error Code -111 reported for 1479 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 13320
Number of Invalid Surfaces: 8

Error Codes:

Error Code -111 reported for 7 surfaces
Error Code -112 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 2.867

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.24849	52.2891	-8.49842	Older Alluvium	500	40	230.797	661.696	192.702	0	192.702	158.215	158.215
2	1.24849	155.056	-7.49369	Older Alluvium	500	40	257.915	739.441	285.355	0	285.355	251.429	251.429
3	1.24849	254.211	-6.49127	Older Alluvium	500	40	283.11	811.675	371.439	0	371.439	339.227	339.227

4	1.24849	349.778	-5.49085	Older Alluvium	500	40	306.488	878.702	451.319	0	451.319	421.857	421.857
5	1.24849	441.777	-4.4921	Older Alluvium	500	40	328.148	940.799	525.324	0	525.324	499.544	499.544
6	1.24849	530.225	-3.49472	Older Alluvium	500	40	348.175	998.218	593.753	0	593.753	572.49	572.49
7	1.24849	615.133	-2.49839	Older Alluvium	500	40	366.651	1051.19	656.881	0	656.881	640.883	640.883
8	1.24849	696.511	-1.50283	Older Alluvium	500	40	383.648	1099.92	714.956	0	714.956	704.89	704.89
9	1.24849	774.367	-0.507713	Older Alluvium	500	40	399.233	1144.6	768.205	0	768.205	764.667	764.667
10	1.24849	848.703	0.487246	Older Alluvium	500	40	413.467	1185.41	816.843	0	816.843	820.359	820.359
11	1.84037	1378.66	1.71836	Older Alluvium	500	40	429.161	1230.4	870.462	0	870.462	883.337	883.337
12	1.28189	1045.55	2.96344	Older Alluvium	500	40	443.359	1271.11	918.971	0	918.971	941.923	941.923
13	1.28189	1110.91	3.9869	Older Alluvium	500	40	453.54	1300.3	953.757	0	953.757	985.368	985.368
14	1.28189	1172.42	5.01164	Older Alluvium	500	40	462.527	1326.07	984.464	0	984.464	1025.02	1025.02
15	1.28189	1230.09	6.03799	Older Alluvium	500	40	470.363	1348.53	1011.24	0	1011.24	1060.99	1060.99
16	1.28189	1283.88	7.06629	Older Alluvium	500	40	477.085	1367.8	1034.21	0	1034.21	1093.35	1093.35
17	1.28189	1333.77	8.09688	Older Alluvium	500	40	482.728	1383.98	1053.49	0	1053.49	1122.17	1122.17
18	1.28189	1379.74	9.13011	Older Alluvium	500	40	487.325	1397.16	1069.19	0	1069.19	1147.51	1147.51
19	1.28189	1421.75	10.1664	Older Alluvium	500	40	490.905	1407.42	1081.42	0	1081.42	1169.45	1169.45
20	1.28189	1459.76	11.206	Older Alluvium	500	40	493.496	1414.85	1090.28	0	1090.28	1188.04	1188.04
21	1.28189	1503.83	12.2493	Older Alluvium	500	40	497.209	1425.5	1102.96	0	1102.96	1210.91	1210.91
22	1.28189	1576.56	13.2968	Older Alluvium	500	40	506.593	1452.4	1135.03	0	1135.03	1254.76	1254.76
23	1.28189	1647.68	14.3489	Older Alluvium	500	40	515.321	1477.43	1164.85	0	1164.85	1296.68	1296.68
24	1.28189	1714.6	15.4059	Older Alluvium	500	40	522.899	1499.15	1190.75	0	1190.75	1334.83	1334.83
25	1.28189	1777.26	16.4683	Older Alluvium	500	40	529.351	1517.65	1212.78	0	1212.78	1369.26	1369.26
26	1.28189	1835.61	17.5366	Older Alluvium	500	40	534.695	1532.97	1231.04	0	1231.04	1400.01	1400.01
27	1.28189	1889.57	18.6112	Older Alluvium	500	40	538.95	1545.17	1245.58	0	1245.58	1427.08	1427.08
28	1.28189	1939.05	19.6927	Older Alluvium	500	40	542.135	1554.3	1256.47	0	1256.47	1450.5	1450.5
29	1.28189	1983.96	20.7815	Older Alluvium	500	40	544.266	1560.41	1263.75	0	1263.75	1470.29	1470.29
30	1.28189	2024.21	21.8782	Older Alluvium	500	40	545.354	1563.53	1267.46	0	1267.46	1486.45	1486.45
31	1.28189	2059.69	22.9835	Older Alluvium	500	40	545.41	1563.69	1267.66	0	1267.66	1498.98	1498.98
32	1.28189	2090.29	24.0978	Older Alluvium	500	40	544.447	1560.93	1264.37	0	1264.37	1507.89	1507.89
33	1.28189	2115.88	25.2219	Older Alluvium	500	40	542.473	1555.27	1257.62	0	1257.62	1513.14	1513.14
34	1.28189	2136.33	26.3566	Older Alluvium	500	40	539.491	1546.72	1247.44	0	1247.44	1514.73	1514.73
35	1.28189	2151.47	27.5024	Older Alluvium	500	40	535.511	1535.31	1233.84	0	1233.84	1512.64	1512.64
36	1.28189	2124.45	28.6604	Older	500	40	524.43	1503.54	1195.98	0	1195.98	1482.62	1482.62

				Alluvium									
37	1.28189	2026.99	29.8312	Older Alluvium	500	40	501.94	1439.06	1119.13	0	1119.13	1406.95	1406.95
38	1.28189	1922.47	31.016	Older Alluvium	500	40	478.793	1372.7	1040.05	0	1040.05	1327.92	1327.92
39	1.28189	1811.89	32.2157	Older Alluvium	500	40	455.201	1305.06	959.433	0	959.433	1246.26	1246.26
40	1.28189	1695.01	33.4315	Older Alluvium	500	40	431.169	1236.16	877.323	0	877.323	1161.97	1161.97
41	1.28189	1571.58	34.6645	Older Alluvium	500	40	406.705	1166.02	793.737	0	793.737	1074.98	1074.98
42	1.28189	1441.3	35.9162	Older Alluvium	500	40	381.819	1094.67	708.707	0	708.707	985.262	985.262
43	1.28189	1303.84	37.188	Older Alluvium	500	40	356.52	1022.14	622.264	0	622.264	892.76	892.76
44	1.28189	1158.84	38.4817	Older Alluvium	500	40	330.822	948.467	534.462	0	534.462	797.437	797.437
45	1.28189	1005.89	39.799	Older Alluvium	500	40	304.742	873.695	445.352	0	445.352	699.244	699.244
46	1.28189	844.526	41.142	Older Alluvium	500	40	278.299	797.883	355.003	0	355.003	598.138	598.138
47	1.28189	674.235	42.5132	Older Alluvium	500	40	251.519	721.104	263.502	0	263.502	494.083	494.083
48	1.28189	494.417	43.9152	Older Alluvium	500	40	224.434	643.451	170.958	0	170.958	387.05	387.05
49	1.28189	304.391	45.351	Older Alluvium	500	40	197.084	565.041	77.5125	0	77.5125	277.027	277.027
50	1.28189	103.367	46.8243	Older Alluvium	500	40	169.802	486.822	-15.705	0	-15.705	165.27	165.27

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.86568

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.24849	52.2891	-8.49842	Older Alluvium	500	40	197.42	565.743	78.3498	0	78.3498	48.8507	48.8507
2	1.24849	155.056	-7.49369	Older Alluvium	500	40	226.2	648.216	176.637	0	176.637	146.883	146.883
3	1.24849	254.211	-6.49127	Older Alluvium	500	40	254.491	729.289	273.256	0	273.256	244.3	244.3
4	1.24849	349.778	-5.49085	Older Alluvium	500	40	282.095	808.394	367.53	0	367.53	340.413	340.413
5	1.24849	441.777	-4.4921	Older Alluvium	500	40	308.81	884.95	458.766	0	458.766	434.505	434.505
6	1.24849	530.225	-3.49472	Older Alluvium	500	40	334.437	958.389	546.286	0	546.286	525.862	525.862
7	1.24849	615.133	-2.49839	Older Alluvium	500	40	358.786	1028.17	629.444	0	629.444	613.789	613.789
8	1.24849	696.511	-1.50283	Older Alluvium	500	40	381.683	1093.78	707.642	0	707.642	697.629	697.629
9	1.24849	774.367	-0.507713	Older Alluvium	500	40	402.973	1154.79	780.35	0	780.35	776.779	776.779
10	1.24849	848.703	0.487246	Older Alluvium	500	40	422.523	1210.82	847.118	0	847.118	850.711	850.711
11	1.84037	1378.66	1.71836	Older Alluvium	500	40	443.986	1272.32	920.414	0	920.414	933.733	933.733
12	1.28189	1045.55	2.96344	Older Alluvium	500	40	462.982	1326.76	985.292	0	985.292	1009.26	1009.26
13	1.28189	1110.91	3.9869	Older Alluvium	500	40	476.139	1364.46	1030.22	0	1030.22	1063.41	1063.41
14	1.28189	1172.42	5.01164	Older Alluvium	500	40	487.198	1396.15	1068	0	1068	1110.72	1110.72
15	1.28189	1230.09	6.03799	Older Alluvium	500	40	496.185	1421.91	1098.69	0	1098.69	1151.17	1151.17

16	1.28189	1283.88	7.06629	Older Alluvium	500	40	503.156	1441.88	1122.49	0	1122.49	1184.87	1184.87
17	1.28189	1333.77	8.09688	Older Alluvium	500	40	508.188	1456.3	1139.68	0	1139.68	1211.98	1211.98
18	1.28189	1379.74	9.13011	Older Alluvium	500	40	511.385	1465.47	1150.6	0	1150.6	1232.78	1232.78
19	1.28189	1421.75	10.1664	Older Alluvium	500	40	512.867	1469.71	1155.66	0	1155.66	1247.63	1247.63
20	1.28189	1459.76	11.206	Older Alluvium	500	40	512.767	1469.42	1155.31	0	1155.31	1256.9	1256.9
21	1.28189	1503.83	12.2493	Older Alluvium	500	40	513.3	1470.95	1157.14	0	1157.14	1268.58	1268.58
22	1.28189	1576.56	13.2968	Older Alluvium	500	40	519.085	1487.53	1176.89	0	1176.89	1299.57	1299.57
23	1.28189	1647.68	14.3489	Older Alluvium	500	40	523.938	1501.44	1193.48	0	1193.48	1327.5	1327.5
24	1.28189	1714.6	15.4059	Older Alluvium	500	40	527.508	1511.67	1205.66	0	1205.66	1351.02	1351.02
25	1.28189	1777.26	16.4683	Older Alluvium	500	40	529.951	1518.67	1214.01	0	1214.01	1370.67	1370.67
26	1.28189	1835.61	17.5366	Older Alluvium	500	40	531.427	1522.9	1219.04	0	1219.04	1386.98	1386.98
27	1.28189	1889.57	18.6112	Older Alluvium	500	40	532.08	1524.77	1221.28	0	1221.28	1400.46	1400.46
28	1.28189	1939.05	19.6927	Older Alluvium	500	40	532.052	1524.69	1221.18	0	1221.18	1411.6	1411.6
29	1.28189	1983.96	20.7815	Older Alluvium	500	40	531.459	1522.99	1219.15	0	1219.15	1420.83	1420.83
30	1.28189	2024.21	21.8782	Older Alluvium	500	40	530.408	1519.98	1215.56	0	1215.56	1428.55	1428.55
31	1.28189	2059.69	22.9835	Older Alluvium	500	40	528.995	1515.93	1210.74	0	1210.74	1435.1	1435.1
32	1.28189	2090.29	24.0978	Older Alluvium	500	40	527.288	1511.04	1204.91	0	1204.91	1440.75	1440.75
33	1.28189	2115.88	25.2219	Older Alluvium	500	40	525.348	1505.48	1198.28	0	1198.28	1445.74	1445.74
34	1.28189	2136.33	26.3566	Older Alluvium	500	40	523.214	1499.37	1191	0	1191	1450.23	1450.23
35	1.28189	2151.47	27.5024	Older Alluvium	500	40	520.914	1492.77	1183.14	0	1183.14	1454.34	1454.34
36	1.28189	2124.45	28.6604	Older Alluvium	500	40	512.275	1468.02	1153.64	0	1153.64	1433.64	1433.64
37	1.28189	2026.99	29.8312	Older Alluvium	500	40	492.661	1411.81	1086.65	0	1086.65	1369.16	1369.16
38	1.28189	1922.47	31.016	Older Alluvium	500	40	472.68	1354.55	1018.41	0	1018.41	1302.61	1302.61
39	1.28189	1811.89	32.2157	Older Alluvium	500	40	452.412	1296.47	949.196	0	949.196	1234.27	1234.27
40	1.28189	1695.01	33.4315	Older Alluvium	500	40	431.717	1237.16	878.514	0	878.514	1163.52	1163.52
41	1.28189	1571.58	34.6645	Older Alluvium	500	40	410.438	1176.18	805.845	0	805.845	1089.67	1089.67
42	1.28189	1441.3	35.9162	Older Alluvium	500	40	388.398	1113.03	730.573	0	730.573	1011.89	1011.89
43	1.28189	1303.84	37.188	Older Alluvium	500	40	365.398	1047.12	652.027	0	652.027	929.259	929.259
44	1.28189	1158.84	38.4817	Older Alluvium	500	40	341.209	977.797	569.416	0	569.416	840.648	840.648
45	1.28189	1005.89	39.799	Older Alluvium	500	40	315.566	904.312	481.841	0	481.841	744.751	744.751
46	1.28189	844.526	41.142	Older Alluvium	500	40	288.161	825.777	388.246	0	388.246	639.998	639.998
47	1.28189	674.235	42.5132	Older Alluvium	500	40	258.631	741.155	287.398	0	287.398	524.499	524.499
48	1.28189	494.417	43.9152	Older	500	40	226.553	649.227	177.842	0	177.842	395.974	395.974

				Alluvium									
49	1.28189	304.391	45.351	Older Alluvium	500	40	191.423	548.557	57.8675	0	57.8675	251.651	251.651
50	1.28189	103.367	46.8243	Older Alluvium	500	40	152.651	437.449	-74.5454	0	-74.5454	88.1499	88.1499

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 2.867

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	83.7111	39.3607	0	0	0
2	84.9596	39.1742	316.338	146.077	24.7863
3	86.2081	39.01	662.04	305.714	24.7863
4	87.4566	38.8679	1030.24	475.737	24.7862
5	88.7051	38.7479	1414.69	653.27	24.7864
6	89.9536	38.6498	1809.76	835.703	24.7863
7	91.2021	38.5736	2210.32	1020.67	24.7863
8	92.4506	38.5191	2611.73	1206.03	24.7863
9	93.6991	38.4863	3009.79	1389.85	24.7864
10	94.9476	38.4753	3400.72	1570.37	24.7863
11	96.196	38.4859	3781.1	1746.02	24.7863
12	98.0364	38.5411	4316.28	1993.15	24.7863
13	99.3183	38.6075	4666.97	2155.09	24.7863
14	100.6	38.6968	4996.67	2307.34	24.7863
15	101.882	38.8092	5303.22	2448.9	24.7864
16	103.164	38.9448	5584.72	2578.89	24.7864
17	104.446	39.1037	5839.55	2696.56	24.7863
18	105.728	39.2861	6066.35	2801.29	24.7863
19	107.01	39.4921	6263.99	2892.56	24.7864
20	108.292	39.722	6431.61	2969.96	24.7863
21	109.573	39.9759	6568.55	3033.19	24.7863
22	110.855	40.2542	6673.56	3081.68	24.7863
23	112.137	40.5572	6742.8	3113.66	24.7863
24	113.419	40.8851	6774.45	3128.27	24.7863
25	114.701	41.2383	6767.15	3124.9	24.7863
26	115.983	41.6173	6719.75	3103.01	24.7863
27	117.265	42.0224	6631.35	3062.19	24.7863
28	118.547	42.454	6501.29	3002.13	24.7863
29	119.829	42.9128	6329.13	2922.63	24.7863
30	121.11	43.3993	6114.65	2823.59	24.7863
31	122.392	43.9141	5857.87	2705.02	24.7863
32	123.674	44.4578	5559.06	2567.03	24.7863
33	124.956	45.0311	5218.7	2409.87	24.7864
34	126.238	45.6349	4837.54	2233.86	24.7864
35	127.52	46.2701	4416.59	2039.47	24.7863
36	128.802	46.9374	3957.09	1827.29	24.7864
37	130.084	47.6381	3472.91	1603.7	24.7863
38	131.366	48.3732	2989.83	1380.63	24.7863
39	132.648	49.1439	2513.81	1160.82	24.7864
40	133.929	49.9516	2050.74	946.981	24.7863
41	135.211	50.7979	1606.91	742.033	24.7864
42	136.493	51.6844	1189.07	549.084	24.7864
43	137.775	52.6128	804.445	371.473	24.7863
44	139.057	53.5854	460.815	212.793	24.7863
45	140.339	54.6044	166.576	76.9209	24.7864
46	141.621	55.6724	-69.1807	-31.9459	24.7863
47	142.903	56.7923	-236.584	-109.248	24.7862
48	144.185	57.9675	-324.868	-150.016	24.7863
49	145.466	59.2018	-322.253	-148.808	24.7863

50	146.748	60.4995	-215.786	-99.6445	24.7863
51	148.03	61.8657	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.86568

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	83.7111	39.3607	0	0	0
2	84.9596	39.1742	253.574	8.64727	1.95312
3	86.2081	39.01	542.103	36.9044	3.89448
4	87.4566	38.8679	860.935	87.6416	5.81258
5	88.7051	38.7479	1205.23	162.877	7.69643
6	89.9536	38.6498	1570.02	263.735	9.53563
7	91.2021	38.5736	1950.22	390.432	11.3209
8	92.4506	38.5191	2340.77	542.289	13.0437
9	93.6991	38.4863	2736.63	717.768	14.6966
10	94.9476	38.4753	3132.87	914.541	16.2735
11	96.196	38.4859	3524.78	1129.58	17.769
12	98.0364	38.5411	4085.33	1472.16	19.8168
13	99.3183	38.6075	4457.38	1722.48	21.1282
14	100.6	38.6968	4809.86	1976.84	22.3425
15	101.882	38.8092	5139.29	2230.21	23.4586
16	103.164	38.9448	5442.7	2477.55	24.4753
17	104.446	39.1037	5717.58	2714	25.3926
18	105.728	39.2861	5961.97	2934.99	26.2103
19	107.01	39.4921	6174.37	3136.37	26.929
20	108.292	39.722	6353.75	3314.47	27.5491
21	109.573	39.9759	6499.56	3466.22	28.071
22	110.855	40.2542	6610.8	3588.71	28.4956
23	112.137	40.5572	6684.05	3678.12	28.8232
24	113.419	40.8851	6718.06	3732.24	29.0545
25	114.701	41.2383	6712.08	3749.69	29.1898
26	115.983	41.6173	6665.68	3729.8	29.2293
27	117.265	42.0224	6578.65	3672.63	29.1731
28	118.547	42.454	6450.97	3578.92	29.021
29	119.829	42.9128	6282.77	3450.1	28.7728
30	121.11	43.3993	6074.25	3288.21	28.4283
31	122.392	43.9141	5825.72	3095.85	27.9867
32	123.674	44.4578	5537.5	2876.2	27.4475
33	124.956	45.0311	5209.92	2632.9	26.8103
34	126.238	45.6349	4843.33	2370.03	26.0743
35	127.52	46.2701	4438.03	2092.08	25.2391
36	128.802	46.9374	3994.33	1803.88	24.3044
37	130.084	47.6381	3524.89	1515.89	23.2703
38	131.366	48.3732	3054.44	1242.57	22.1369
39	132.648	49.1439	2587.87	988.492	20.9054
40	133.929	49.9516	2130.09	757.536	19.5772
41	135.211	50.7979	1686.52	553.023	18.1547
42	136.493	51.6844	1263.26	377.583	16.6412
43	137.775	52.6128	867.276	233.046	15.0407
44	139.057	53.5854	506.563	120.295	13.3588
45	140.339	54.6044	190.473	39.1047	11.6018
46	141.621	55.6724	-69.961	-12.0564	9.77776
47	142.903	56.7923	-261.571	-36.2751	7.89551
48	144.185	57.9675	-368.478	-38.5022	5.96518
49	145.466	59.2018	-371.346	-25.9527	3.9978
50	146.748	60.4995	-246.394	-8.62692	2.00526
51	148.03	61.8657	0	0	0

Entity Information

Distributed Load

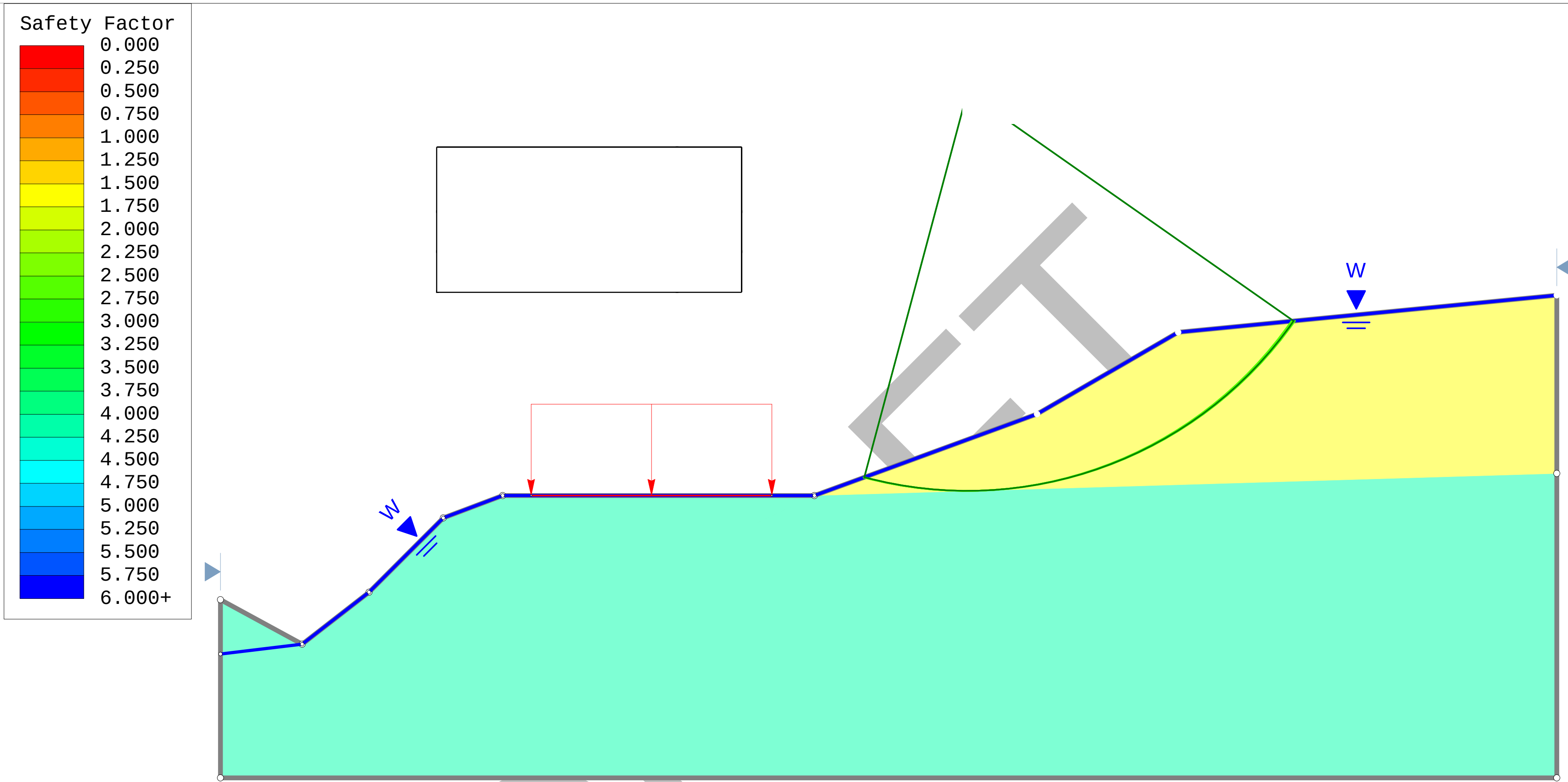
X	Y
74.2707	38
41.8575	38

External Boundary

X	Y
0	0
180	0
180	41
180	65
129	60
110	49
80	38
38	38
30	35
20	25
11	18
0	24

Material Boundary

X	Y
80	38
180	41



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Older Alluvium		130	Mohr-Coulomb	500	40	Water Surface	Custom	1
Galice Forma on		155	Mohr-Coulomb	3000	23	Water Surface	Custom	1

BAJADA Geosciences, Inc.	*Project* Orleans MWC Treatment Plant Improvements		
	Analysis Description Static, elevated groundwater, with 1,000 psf building surcharge		
	Drawn By J.Bianchin	*Scale* 1:258	*Company* Bajada Geosciences, Inc.
SLIDEINTERPRET 8.032	*Date* 7/13/2022, 2:14:35 PM		*File Name* B-B'_Static_FullGW.slim

Slide Analysis Information

Orleans MWC Treatment Plant Improvements

Project Summary

Slide Modeler Version:	8.032
Compute Time:	00h:00m:04.969s

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
GLE/Morgenstern-Price with interslice force function (Half Sine)
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular

Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

1 Distributed Load present

Distributed Load 1	
Distribution:	Constant
Magnitude [psf]:	1000
Orientation:	Normal to boundary

Materials

Property	Older Alluvium	Galice Formation
Color		
Strength Type	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	130	155
Cohesion [psf]	500	3000
Friction Angle [°]	40	23
Water Surface	Water Table	Water Table
Hu Value	1	1

Global Minimums

Method: spencer

FS	2.704980
Center:	100.592, 92.305
Radius:	53.669
Left Slip Surface Endpoint:	86.713, 40.462
Right Slip Surface Endpoint:	144.557, 61.525
Resisting Moment:	3.02683e+06 lb-ft
Driving Moment:	1.11898e+06 lb-ft
Resisting Horizontal Force:	51016.1 lb
Driving Horizontal Force:	18860 lb
Total Slice Area:	478.62 ft2
Surface Horizontal Width:	57.8439 ft
Surface Average Height:	8.27433 ft

Method: gle/morgenstern-price

FS	2.705980
Center:	100.592, 92.305
Radius:	53.669
Left Slip Surface Endpoint:	86.713, 40.462
Right Slip Surface Endpoint:	144.557, 61.525
Resisting Moment:	3.02794e+06 lb-ft
Driving Moment:	1.11898e+06 lb-ft
Resisting Horizontal Force:	51014.2 lb
Driving Horizontal Force:	18852.4 lb
Total Slice Area:	478.62 ft2
Surface Horizontal Width:	57.8439 ft
Surface Average Height:	8.27433 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 12838
Number of Invalid Surfaces: 444

Error Codes:

Error Code -108 reported for 5 surfaces
Error Code -111 reported for 436 surfaces
Error Code -112 reported for 3 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 13280
Number of Invalid Surfaces: 2

Error Codes:

Error Code -108 reported for 1 surface
Error Code -112 reported for 1 surface

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 2.70498

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.13038	51.7223	-14.3637	Older Alluvium	500	40	234.886	635.361	183.278	21.9614	161.317	123.128	101.167
2	1.13038	153.258	-13.1213	Older Alluvium	500	40	251.994	681.638	281.544	65.077	216.467	222.805	157.728
3	1.13038	251.005	-11.8851	Older Alluvium	500	40	267.641	723.963	373.493	106.584	266.909	317.165	210.581
4	1.13038	345.017	-10.6545	Older	500	40	281.93	762.614	459.476	146.504	312.972	406.437	259.933

				Alluvium									
5	1.13038	435.341	-9.42883	Older Alluvium	500	40	294.952	797.838	539.809	184.859	354.95	490.827	305.968
6	1.13038	522.021	-8.20753	Older Alluvium	500	40	306.787	829.852	614.768	221.666	393.102	570.519	348.853
7	1.13038	605.09	-6.98997	Older Alluvium	500	40	317.507	858.851	684.603	256.94	427.663	645.674	388.734
8	1.13038	684.581	-5.77558	Older Alluvium	500	40	327.178	885.011	749.534	290.695	458.839	716.441	425.746
9	1.13038	760.518	-4.56379	Older Alluvium	500	40	335.858	908.489	809.759	322.94	486.819	782.95	460.01
10	1.13038	832.922	-3.35404	Older Alluvium	500	40	343.598	929.425	865.455	353.686	511.769	845.318	491.632
11	1.13038	901.809	-2.14579	Older Alluvium	500	40	350.446	947.949	916.779	382.937	533.842	903.648	520.711
12	1.13038	967.188	-0.938493	Older Alluvium	500	40	356.444	964.175	963.879	410.7	553.179	958.04	547.34
13	1.13038	1029.07	0.268388	Older Alluvium	500	40	361.633	978.209	1006.89	436.975	569.91	1008.58	571.604
14	1.58519	1540.26	1.71836	Older Alluvium	500	40	366.778	992.127	1052.89	466.393	586.497	1063.89	597.5
15	1.15455	1188.82	3.18217	Older Alluvium	500	40	371.019	1003.6	1094.42	494.249	600.169	1115.05	620.797
16	1.15455	1240.85	4.41755	Older Alluvium	500	40	373.739	1010.96	1124.81	515.879	608.934	1153.69	637.806
17	1.15455	1289.12	5.65499	Older Alluvium	500	40	375.755	1016.41	1151.38	535.946	615.43	1188.58	652.637
18	1.15455	1333.6	6.89509	Older Alluvium	500	40	377.091	1020.02	1174.18	554.439	619.738	1219.78	665.338
19	1.15455	1374.27	8.13844	Older Alluvium	500	40	377.771	1021.86	1193.28	571.348	621.936	1247.31	675.959
20	1.15455	1411.1	9.38567	Older Alluvium	500	40	377.817	1021.99	1208.74	586.658	622.078	1271.19	684.528
21	1.15455	1459.99	10.6374	Older Alluvium	500	40	379.331	1026.08	1233.91	606.95	626.961	1305.16	698.207
22	1.15455	1525.71	11.8943	Older Alluvium	500	40	382.791	1035.44	1272.42	634.307	638.11	1353.04	718.736
23	1.15455	1587.53	13.157	Older Alluvium	500	40	385.515	1042.81	1306.9	660.009	646.895	1397.02	737.012
24	1.15455	1645.31	14.4263	Older Alluvium	500	40	387.5	1048.18	1337.33	684.032	653.297	1437.01	752.98
25	1.15455	1698.99	15.7028	Older Alluvium	500	40	388.763	1051.6	1363.71	706.348	657.363	1473.01	766.66
26	1.15455	1748.48	16.9874	Older Alluvium	500	40	389.318	1053.1	1386.08	726.926	659.158	1505.02	778.092
27	1.15455	1793.72	18.2809	Older Alluvium	500	40	389.178	1052.72	1404.44	745.731	658.709	1533	787.273
28	1.15455	1834.59	19.5841	Older Alluvium	500	40	388.356	1050.5	1418.78	762.725	656.056	1556.95	794.222
29	1.15455	1871.01	20.8979	Older Alluvium	500	40	386.863	1046.46	1429.11	777.865	651.246	1576.82	798.958
30	1.15455	1902.85	22.2234	Older Alluvium	500	40	384.709	1040.63	1435.4	791.104	644.294	1592.58	801.473
31	1.15455	1929.99	23.5615	Older Alluvium	500	40	381.901	1033.03	1437.63	802.387	635.247	1604.18	801.79
32	1.15455	1952.29	24.9134	Older Alluvium	500	40	378.448	1023.69	1435.77	811.657	624.109	1611.54	799.886
33	1.15455	1969.59	26.2803	Older Alluvium	500	40	374.355	1012.62	1429.77	818.848	610.923	1614.63	795.78
34	1.15455	1981.71	27.6634	Older Alluvium	500	40	369.629	999.839	1419.57	823.887	595.682	1613.33	789.44
35	1.15455	1988.46	29.0644	Older Alluvium	500	40	364.275	985.356	1405.12	826.694	578.421	1607.57	780.878
36	1.15455	1989.62	30.4846	Older Alluvium	500	40	358.295	969.182	1386.33	827.177	559.151	1597.25	770.074

37	1.15455	1975.57	31.9259	Older Alluvium	500	40	349.724	945.996	1356.75	825.237	531.517	1574.66	749.42
38	1.15455	1892.96	33.3902	Older Alluvium	500	40	337.212	912.152	1278.18	786.991	491.187	1500.45	713.455
39	1.15455	1792.44	34.8796	Older Alluvium	500	40	322.339	871.921	1188.44	745.201	443.238	1413.14	667.934
40	1.15455	1685.16	36.3965	Older Alluvium	500	40	307.287	831.204	1095.31	700.6	394.714	1321.84	621.237
41	1.15455	1570.72	37.9437	Older Alluvium	500	40	292.072	790.048	998.689	653.022	345.667	1226.42	573.397
42	1.15455	1448.67	39.5242	Older Alluvium	500	40	276.717	748.514	898.444	602.279	296.165	1126.75	524.469
43	1.15455	1318.48	41.1415	Older Alluvium	500	40	261.249	706.674	794.455	548.153	246.302	1022.69	474.538
44	1.15455	1179.54	42.7999	Older Alluvium	500	40	245.702	664.619	686.578	490.39	196.188	914.099	423.709
45	1.15455	1031.14	44.504	Older Alluvium	500	40	230.117	622.462	574.638	428.693	145.945	800.804	372.111
46	1.15455	872.436	46.2595	Older Alluvium	500	40	214.548	580.347	458.465	362.711	95.7537	682.659	319.948
47	1.15455	702.41	48.0733	Older Alluvium	500	40	199.062	538.46	337.857	292.023	45.8343	559.508	267.485
48	1.15455	519.835	49.9535	Older Alluvium	500	40	183.752	497.045	212.596	216.118	-3.52171	431.223	215.105
49	1.15455	323.193	51.9105	Older Alluvium	500	40	168.737	456.43	82.4399	134.365	-51.9251	297.719	163.354
50	1.15455	110.573	53.957	Older Alluvium	500	40	154.434	417.742	-52.0627	45.9685	-98.0312	160.163	114.194

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.70598

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.13038	51.7223	-14.3637	Older Alluvium	500	40	210.416	569.382	104.648	21.9614	82.6861	50.7639	28.8025
2	1.13038	153.258	-13.1213	Older Alluvium	500	40	228.242	617.618	205.249	65.077	140.172	152.046	86.9691
3	1.13038	251.005	-11.8851	Older Alluvium	500	40	245.897	665.392	303.69	106.584	197.106	251.938	145.354
4	1.13038	345.017	-10.6545	Older Alluvium	500	40	263.209	712.239	399.44	146.504	252.936	349.923	203.419
5	1.13038	435.341	-9.42883	Older Alluvium	500	40	280.008	757.696	491.97	184.859	307.111	445.47	260.611
6	1.13038	522.021	-8.20753	Older Alluvium	500	40	296.129	801.318	580.763	221.666	359.097	538.05	316.384
7	1.13038	605.09	-6.98997	Older Alluvium	500	40	311.414	842.681	665.331	256.94	408.391	627.15	370.21
8	1.13038	684.581	-5.77558	Older Alluvium	500	40	325.723	881.399	745.229	290.695	454.534	712.283	421.588
9	1.13038	760.518	-4.56379	Older Alluvium	500	40	338.927	917.131	820.058	322.94	497.118	793.004	470.064
10	1.13038	832.922	-3.35404	Older Alluvium	500	40	350.92	949.582	889.48	353.686	535.794	868.914	515.228
11	1.13038	901.809	-2.14579	Older Alluvium	500	40	361.613	978.517	953.21	382.937	570.273	939.661	556.724
12	1.13038	967.188	-0.938493	Older Alluvium	500	40	370.94	1003.76	1011.05	410.7	600.351	1004.97	594.275
13	1.13038	1029.07	0.268388	Older Alluvium	500	40	378.858	1025.18	1062.87	436.975	625.891	1064.64	627.665
14	1.58519	1540.26	1.71836	Older Alluvium	500	40	386.385	1045.55	1116.55	466.393	650.158	1128.14	661.75
15	1.15455	1188.82	3.18217	Older Alluvium	500	40	392.071	1060.93	1162.75	494.249	668.497	1184.54	690.295
16	1.15455	1240.85	4.41755	Older	500	40	395.195	1069.39	1194.45	515.879	678.572	1224.98	709.102

				Alluvium									
17	1.15455	1289.12	5.65499	Older Alluvium	500	40	396.914	1074.04	1220.06	535.946	684.117	1259.36	723.419
18	1.15455	1333.6	6.89509	Older Alluvium	500	40	397.295	1075.07	1239.79	554.439	685.347	1287.83	733.39
19	1.15455	1374.27	8.13844	Older Alluvium	500	40	396.422	1072.71	1253.88	571.348	682.53	1310.57	739.22
20	1.15455	1411.1	9.38567	Older Alluvium	500	40	394.39	1067.21	1262.63	586.658	675.974	1327.82	741.164
21	1.15455	1459.99	10.6374	Older Alluvium	500	40	393.381	1064.48	1279.67	606.95	672.725	1353.56	746.61
22	1.15455	1525.71	11.8943	Older Alluvium	500	40	393.941	1066	1308.84	634.307	674.529	1391.81	757.504
23	1.15455	1587.53	13.157	Older Alluvium	500	40	393.488	1064.77	1333.07	660.009	673.066	1425.06	765.046
24	1.15455	1645.31	14.4263	Older Alluvium	500	40	392.119	1061.07	1352.68	684.032	668.647	1453.55	769.518
25	1.15455	1698.99	15.7028	Older Alluvium	500	40	389.957	1055.22	1368.03	706.348	661.682	1477.66	771.315
26	1.15455	1748.48	16.9874	Older Alluvium	500	40	387.125	1047.55	1379.47	726.926	652.548	1497.74	770.812
27	1.15455	1793.72	18.2809	Older Alluvium	500	40	383.743	1038.4	1387.37	745.731	641.643	1514.14	768.413
28	1.15455	1834.59	19.5841	Older Alluvium	500	40	379.927	1028.07	1392.06	762.725	629.331	1527.22	764.498
29	1.15455	1871.01	20.8979	Older Alluvium	500	40	375.782	1016.86	1393.83	777.865	615.966	1537.31	759.448
30	1.15455	1902.85	22.2234	Older Alluvium	500	40	371.406	1005.02	1392.96	791.104	601.854	1544.7	753.599
31	1.15455	1929.99	23.5615	Older Alluvium	500	40	366.888	992.791	1389.67	802.387	587.286	1549.67	747.282
32	1.15455	1952.29	24.9134	Older Alluvium	500	40	362.301	980.38	1384.15	811.657	572.491	1552.43	740.768
33	1.15455	1969.59	26.2803	Older Alluvium	500	40	357.71	967.956	1376.53	818.848	557.686	1553.17	734.324
34	1.15455	1981.71	27.6634	Older Alluvium	500	40	353.164	955.655	1366.91	823.887	543.026	1552.04	728.154
35	1.15455	1988.46	29.0644	Older Alluvium	500	40	348.701	943.578	1355.33	826.694	528.636	1549.13	722.437
36	1.15455	1989.62	30.4846	Older Alluvium	500	40	344.344	931.787	1341.76	827.177	514.583	1544.47	717.292
37	1.15455	1975.57	31.9259	Older Alluvium	500	40	338.119	914.942	1319.75	825.237	494.511	1530.42	705.183
38	1.15455	1892.96	33.3902	Older Alluvium	500	40	328.38	888.589	1250.09	786.991	463.099	1466.54	679.545
39	1.15455	1792.44	34.8796	Older Alluvium	500	40	316.576	856.649	1170.24	745.201	425.041	1390.92	645.72
40	1.15455	1685.16	36.3965	Older Alluvium	500	40	304.771	824.705	1087.57	700.6	386.969	1312.24	611.637
41	1.15455	1570.72	37.9437	Older Alluvium	500	40	292.832	792.398	1001.49	653.022	348.468	1229.81	576.79
42	1.15455	1448.67	39.5242	Older Alluvium	500	40	280.605	759.312	911.318	602.279	309.039	1142.83	540.551
43	1.15455	1318.48	41.1415	Older Alluvium	500	40	267.909	724.956	816.248	548.153	268.095	1050.3	502.149
44	1.15455	1179.54	42.7999	Older Alluvium	500	40	254.531	688.755	715.341	490.39	224.951	951.038	460.648
45	1.15455	1031.14	44.504	Older Alluvium	500	40	240.219	650.028	607.489	428.693	178.796	843.585	414.892
46	1.15455	872.436	46.2595	Older Alluvium	500	40	224.673	607.961	491.374	362.711	128.663	726.149	363.438
47	1.15455	702.41	48.0733	Older Alluvium	500	40	207.532	561.577	365.408	292.023	73.3845	596.488	304.465
48	1.15455	519.835	49.9535	Older Alluvium	500	40	188.354	509.683	227.658	216.118	11.5399	451.76	235.642

49	1.15455	323.193	51.9105	Older Alluvium	500	40	166.599	450.813	75.746	134.365	-58.619	288.297	153.932
50	1.15455	110.573	53.957	Older Alluvium	500	40	141.587	383.132	-93.3091	45.9685	-139.278	101.262	55.2932

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 2.70498

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	86.7132	40.4615	0	0	0
2	87.8436	40.172	318.61	87.6712	15.3852
3	88.974	39.9085	677.692	186.479	15.3852
4	90.1044	39.6706	1069.14	294.192	15.3851
5	91.2347	39.458	1485.59	408.787	15.3852
6	92.3651	39.2703	1920.39	528.429	15.3852
7	93.4955	39.1072	2367.47	651.451	15.3852
8	94.6259	38.9686	2821.31	776.335	15.3852
9	95.7563	38.8543	3276.91	901.701	15.3852
10	96.8867	38.7641	3729.69	1026.29	15.3852
11	98.017	38.6978	4175.49	1148.96	15.3852
12	99.1474	38.6555	4610.52	1268.67	15.3852
13	100.278	38.637	5031.36	1384.47	15.3852
14	101.408	38.6422	5434.88	1495.5	15.3852
15	102.993	38.6898	5966.32	1641.74	15.3852
16	104.148	38.754	6324.5	1740.3	15.3852
17	105.302	38.8432	6655.75	1831.45	15.3852
18	106.457	38.9575	6958.02	1914.62	15.3852
19	107.612	39.0971	7229.53	1989.33	15.3852
20	108.766	39.2622	7468.74	2055.16	15.3852
21	109.921	39.4531	7674.35	2111.74	15.3852
22	111.075	39.6699	7844.81	2158.64	15.3852
23	112.23	39.9131	7977.41	2195.13	15.3852
24	113.384	40.183	8069.87	2220.57	15.3852
25	114.539	40.48	8120.14	2234.4	15.3852
26	115.693	40.8046	8126.42	2236.13	15.3852
27	116.848	41.1573	8087.1	2225.31	15.3852
28	118.003	41.5387	8000.85	2201.58	15.3852
29	119.157	41.9494	7866.53	2164.62	15.3852
30	120.312	42.3903	7683.26	2114.19	15.3852
31	121.466	42.862	7450.4	2050.11	15.3852
32	122.621	43.3655	7167.57	1972.29	15.3852
33	123.775	43.9017	6834.65	1880.68	15.3852
34	124.93	44.4718	6451.8	1775.33	15.3852
35	126.084	45.077	6019.48	1656.37	15.3852
36	127.239	45.7187	5538.5	1524.02	15.3852
37	128.393	46.3984	5010.01	1378.59	15.3852
38	129.548	47.1178	4437.84	1221.15	15.3852
39	130.703	47.8788	3854.55	1060.65	15.3852
40	131.857	48.6836	3270.29	899.88	15.3852
41	133.012	49.5347	2692.91	741.003	15.3852
42	134.166	50.4349	2131.16	586.426	15.3852
43	135.321	51.3874	1594.87	438.858	15.3852
44	136.475	52.3961	1095.22	301.37	15.3852
45	137.63	53.4652	644.915	177.46	15.3852
46	138.784	54.5999	258.584	71.154	15.3852
47	139.939	55.8064	-46.7865	-12.8741	15.3851
48	141.093	57.0919	-251.256	-69.1375	15.3852
49	142.248	58.4656	-331.107	-91.11	15.3852
50	143.403	59.9386	-257.693	-70.909	15.3852

51	144.557	61.5252	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.70598

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	86.7132	40.4615	0	0	0
2	87.8436	40.172	268.452	5.5779	1.19032
3	88.974	39.9085	580.869	24.0931	2.37513
4	90.1044	39.6706	931.435	57.7688	3.54901
5	91.2347	39.458	1314.29	108.207	4.70661
6	92.3651	39.2703	1723.57	176.374	5.84278
7	93.4955	39.1072	2153.43	262.599	6.95258
8	94.6259	38.9686	2598.12	366.592	8.03136
9	95.7563	38.8543	3051.99	487.47	9.07475
10	96.8867	38.7641	3509.6	623.807	10.0787
11	98.017	38.6978	3965.71	773.688	11.0394
12	99.1474	38.6555	4415.38	934.782	11.9536
13	100.278	38.637	4853.95	1104.41	12.8182
14	101.408	38.6422	5277.13	1279.65	13.6305
15	102.993	38.6898	5837.32	1528.91	14.6772
16	104.148	38.754	6215.93	1708.5	15.3687
17	105.302	38.8432	6566.26	1882.64	15.9983
18	106.457	38.9575	6885.62	2048.1	16.5649
19	107.612	39.0971	7171.82	2201.8	17.0669
20	108.766	39.2622	7423.08	2340.95	17.5032
21	109.921	39.4531	7638.05	2463.09	17.8733
22	111.075	39.6699	7815.32	2565.96	18.1763
23	112.23	39.9131	7952.45	2647.22	18.4116
24	113.384	40.183	8047.57	2705.02	18.579
25	114.539	40.48	8099.12	2737.96	18.6782
26	115.693	40.8046	8105.88	2745.09	18.7089
27	116.848	41.1573	8066.87	2725.97	18.6712
28	118.003	41.5387	7981.34	2680.62	18.5652
29	119.157	41.9494	7848.76	2609.55	18.3909
30	120.312	42.3903	7668.73	2513.75	18.1487
31	121.466	42.862	7441.02	2394.63	17.8389
32	122.621	43.3655	7165.48	2254.07	17.4622
33	123.775	43.9017	6842.06	2094.33	17.0192
34	124.93	44.4718	6470.8	1918.04	16.5106
35	126.084	45.077	6051.8	1728.21	15.9377
36	127.239	45.7187	5585.24	1528.12	15.3016
37	128.393	46.3984	5071.37	1321.38	14.6041
38	129.548	47.1178	4512.86	1112.37	13.8468
39	130.703	47.8788	3941.16	912.186	13.0317
40	131.857	48.6836	3365.32	725.24	12.1615
41	133.012	49.5347	2792.02	554.803	11.2389
42	134.166	50.4349	2229	403.751	10.267
43	135.321	51.3874	1685.31	274.451	9.24937
44	136.475	52.3961	1171.72	168.636	8.18987
45	137.63	53.4652	701.189	87.2479	7.09277
46	138.784	54.5999	289.558	30.2434	5.96274
47	139.939	55.8064	-43.5319	-3.65905	4.80467
48	141.093	57.0919	-273.368	-17.3128	3.62379
49	142.248	58.4656	-368.35	-15.6032	2.42558
50	143.403	59.9386	-287.329	-6.09759	1.21573
51	144.557	61.5252	0	0	0

Entity Information

Water Table

X	Y
0	16.6765
11	18
20	25
30	35
38	38
80	38
110	49
129	60
180	65

Distributed Load

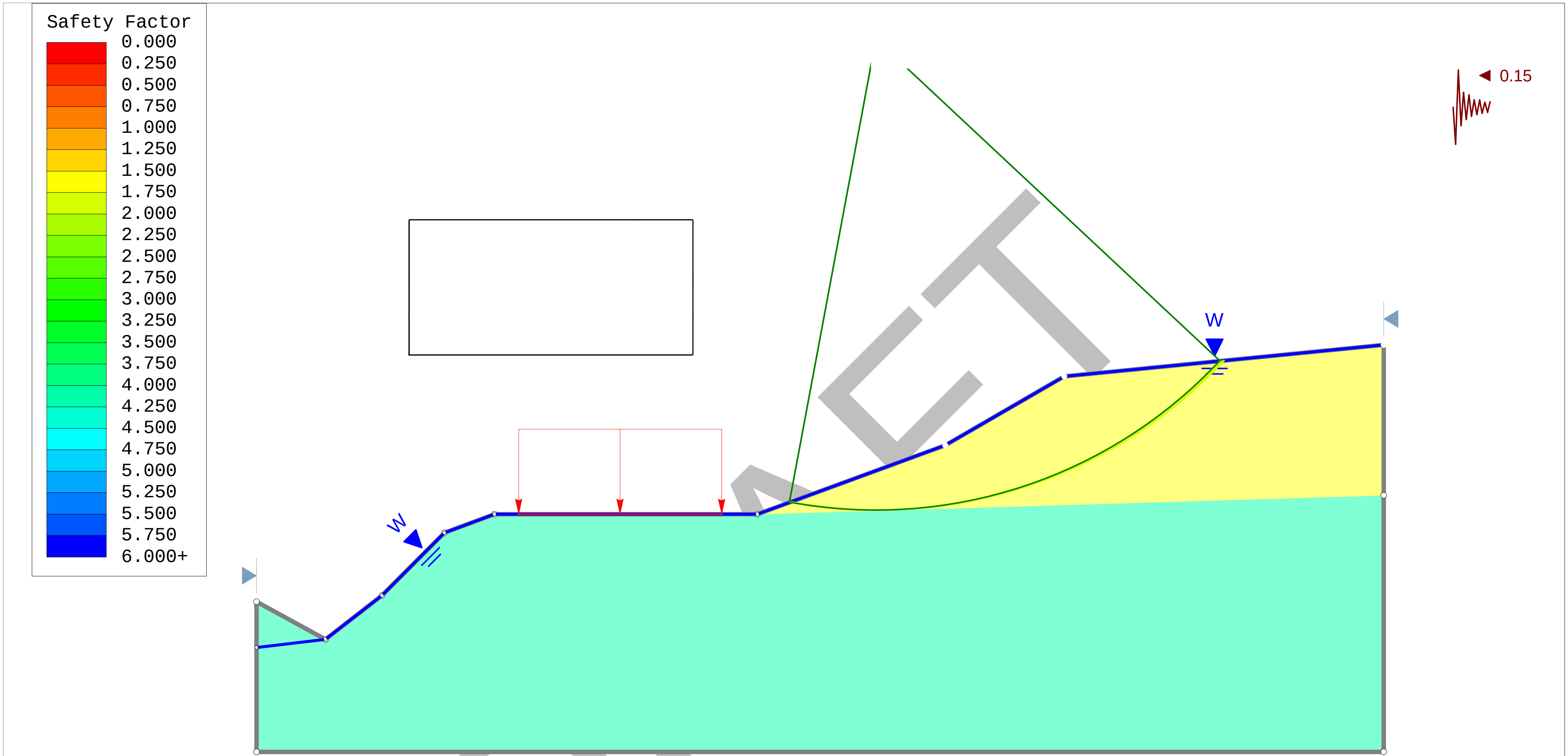
X	Y
74.2707	38
41.8575	38

External Boundary

X	Y
0	0
180	0
180	41
180	65
129	60
110	49
80	38
38	38
30	35
20	25
11	18
0	24

Material Boundary

X	Y
80	38
180	41



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type	Hu
Older Alluvium		130	Mohr-Coulomb	500	40	Water Surface	Custom	1
Galice Formation		155	Mohr-Coulomb	3000	23	Water Surface	Custom	1

BAJADA Geosciences, Inc.

SLIDEINTERPRET 8.032

Project	Orleans MWC Treatment Plant Improvements
Analysis Description	Pseudostatic, elevated groundwater, with 1,000 psf building surcharge
Drawn By	J.Bianchin
Scale	1:285
Company	Bajada Geosciences, Inc.
Date	7/13/2022, 2:14:35 PM
File Name	B-B'_PS_FullGW.slim

Slide Analysis Information

Orleans MWC Treatment Plant Improvements

Project Summary

Slide Modeler Version:	8.032
Compute Time:	00h:00m:04.924s

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical

Analysis Methods Used
GLE/Morgenstern-Price with interslice force function (Half Sine)
Spencer

Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular

Search Method:	Auto Refine Search
Divisions along slope:	20
Circles per division:	10
Number of iterations:	10
Divisions to use in next iteration:	50%
Composite Surfaces:	Disabled
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Seismic Load Coefficient (Horizontal): 0.15

Loading

1 Distributed Load present

Distributed Load 1	
Distribution:	Constant
Magnitude [psf]:	1000
Orientation:	Normal to boundary

Materials

Property	Older Alluvium	Galice Formation
Color		
Strength Type	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	130	155
Cohesion [psf]	500	3000
Friction Angle [°]	40	23
Water Surface	Water Table	Water Table
Hu Value	1	1

Global Minimums

Method: spencer

FS	1.912560
Center:	98.910, 113.879
Radius:	75.285
Left Slip Surface Endpoint:	85.104, 39.871
Right Slip Surface Endpoint:	153.880, 62.439
Resisting Moment:	4.93521e+06 lb-ft
Driving Moment:	2.58042e+06 lb-ft
Resisting Horizontal Force:	60901.2 lb
Driving Horizontal Force:	31842.8 lb
Total Slice Area:	599.611 ft2
Surface Horizontal Width:	68.776 ft
Surface Average Height:	8.71832 ft

Method: gle/morgenstern-price

FS	1.909460
Center:	98.910, 113.879
Radius:	75.285
Left Slip Surface Endpoint:	85.104, 39.871
Right Slip Surface Endpoint:	153.880, 62.439
Resisting Moment:	4.92721e+06 lb-ft
Driving Moment:	2.58042e+06 lb-ft
Resisting Horizontal Force:	60878.3 lb
Driving Horizontal Force:	31882.5 lb
Total Slice Area:	599.611 ft2
Surface Horizontal Width:	68.776 ft
Surface Average Height:	8.71832 ft

Valid/Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 13239
Number of Invalid Surfaces: 224

Error Codes:

Error Code -108 reported for 1 surface
Error Code -111 reported for 223 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 13455
Number of Invalid Surfaces: 8

Error Codes:

Error Code -111 reported for 8 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.91256

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.37077	66.4004	-10.0373	Older Alluvium	500	40	376.446	719.975	285.406	23.2497	262.156	218.776	195.526
2	1.37077	196.883	-8.97944	Older Alluvium	500	40	400.358	765.709	385.6	68.9406	316.659	322.336	253.396
3	1.37077	322.749	-7.92469	Older Alluvium	500	40	421.787	806.693	478.517	113.015	365.502	419.804	306.789
4	1.37077	444.037	-6.87264	Older Alluvium	500	40	440.93	843.305	564.621	155.486	409.135	511.477	355.991
5	1.37077	560.778	-5.82292	Older Alluvium	500	40	457.964	875.883	644.326	196.366	447.96	597.622	401.256

6	1.37077	673.002	-4.77516	Older Alluvium	500	40	473.045	904.726	717.997	235.663	482.334	678.481	442.818
7	1.37077	780.73	-3.72899	Older Alluvium	500	40	486.315	930.106	785.965	273.386	512.579	754.27	480.884
8	1.37077	883.982	-2.68407	Older Alluvium	500	40	497.9	952.263	848.528	309.542	538.986	825.186	515.644
9	1.37077	982.77	-1.64004	Older Alluvium	500	40	507.915	971.417	905.947	344.134	561.813	891.405	547.271
10	1.37077	1077.1	-0.596553	Older Alluvium	500	40	516.463	987.766	958.464	377.167	581.297	953.086	575.919
11	1.37077	1166.99	0.446734	Older Alluvium	500	40	523.637	1001.49	1006.29	408.642	597.648	1010.37	601.731
12	1.96997	1825.03	1.71836	Older Alluvium	500	40	530.545	1014.7	1058.08	444.683	613.395	1073.99	629.311
13	1.36125	1357.66	2.98705	Older Alluvium	500	40	535.873	1024.89	1104.27	478.732	625.535	1132.23	653.497
14	1.36125	1431.23	4.02504	Older Alluvium	500	40	538.919	1030.72	1137.15	504.673	632.481	1175.08	670.402
15	1.36125	1500.4	5.06435	Older Alluvium	500	40	540.932	1034.57	1166.14	529.066	637.073	1214.08	685.011
16	1.36125	1565.17	6.10534	Older Alluvium	500	40	541.968	1036.55	1191.34	551.904	639.433	1249.31	697.403
17	1.36125	1625.51	7.14835	Older Alluvium	500	40	542.079	1036.76	1212.87	573.181	639.685	1280.85	707.67
18	1.36125	1682.8	8.19376	Older Alluvium	500	40	541.767	1036.16	1231.86	592.884	638.972	1309.87	716.981
19	1.36125	1770.36	9.24191	Older Alluvium	500	40	545.111	1042.56	1270.85	624.256	646.595	1359.55	735.293
20	1.36125	1868.35	10.2932	Older Alluvium	500	40	549.743	1051.42	1315.96	658.81	657.154	1415.8	756.992
21	1.36125	1961.77	11.348	Older Alluvium	500	40	553.268	1058.16	1356.93	691.75	665.184	1467.97	776.22
22	1.36125	2050.56	12.4067	Older Alluvium	500	40	555.733	1062.87	1393.86	723.06	670.805	1516.12	793.059
23	1.36125	2134.68	13.4698	Older Alluvium	500	40	557.182	1065.64	1426.83	752.722	674.106	1560.28	807.563
24	1.36125	2214.06	14.5376	Older Alluvium	500	40	557.657	1066.55	1455.9	780.712	675.19	1600.51	819.8
25	1.36125	2288.64	15.6105	Older Alluvium	500	40	557.196	1065.67	1481.15	807.009	674.142	1636.83	829.824
26	1.36125	2358.34	16.6891	Older Alluvium	500	40	555.835	1063.07	1502.62	831.587	671.037	1669.27	837.681
27	1.36125	2423.08	17.7739	Older Alluvium	500	40	553.608	1058.81	1520.37	854.416	665.959	1697.84	843.425
28	1.36125	2482.78	18.8653	Older Alluvium	500	40	550.546	1052.95	1534.45	875.466	658.985	1722.57	847.107
29	1.36125	2537.33	19.9638	Older Alluvium	500	40	546.68	1045.56	1544.87	894.703	650.17	1743.46	848.754
30	1.36125	2586.64	21.07	Older Alluvium	500	40	542.037	1036.68	1551.68	912.089	639.587	1760.51	848.416
31	1.36125	2630.58	22.1846	Older Alluvium	500	40	536.645	1026.37	1554.88	927.585	627.298	1773.72	846.13
32	1.36125	2664.59	23.308	Older Alluvium	500	40	529.392	1012.49	1551.91	941.145	610.763	1779.99	838.843
33	1.36125	2611.83	24.441	Older Alluvium	500	40	514.828	984.639	1498.54	920.972	577.572	1732.53	811.553
34	1.36125	2523.04	25.5843	Older Alluvium	500	40	496.506	949.597	1425.47	889.663	535.811	1663.19	773.53
35	1.36125	2428.31	26.7387	Older Alluvium	500	40	478.2	914.586	1350.34	856.259	494.084	1591.26	734.998
36	1.36125	2327.46	27.9049	Older Alluvium	500	40	459.929	879.641	1273.13	820.698	452.437	1516.7	696.007
37	1.36125	2220.29	29.0838	Older Alluvium	500	40	441.712	844.801	1193.83	782.911	410.921	1439.52	656.611
38	1.36125	2106.6	30.2763	Older	500	40	423.572	810.107	1112.39	742.82	369.57	1359.67	616.851

				Alluvium									
39	1.36125	1986.14	31.4836	Older Alluvium	500	40	405.532	775.605	1028.8	700.344	328.453	1277.15	576.804
40	1.36125	1858.65	32.7066	Older Alluvium	500	40	387.619	741.345	943.015	655.389	287.626	1191.92	536.536
41	1.36125	1723.84	33.9466	Older Alluvium	500	40	369.863	707.385	855.006	607.855	247.151	1103.98	496.126
42	1.36125	1581.4	35.205	Older Alluvium	500	40	352.296	673.788	764.739	557.627	207.112	1013.3	455.676
43	1.36125	1430.97	36.4832	Older Alluvium	500	40	334.957	640.625	672.172	504.581	167.591	919.875	415.294
44	1.36125	1272.14	37.7829	Older Alluvium	500	40	317.887	607.978	577.261	448.578	128.683	823.688	375.11
45	1.36125	1104.49	39.1059	Older Alluvium	500	40	301.136	575.941	479.963	389.459	90.5036	724.741	335.282
46	1.36125	927.497	40.4542	Older Alluvium	500	40	284.761	544.622	380.228	327.049	53.1786	623.043	295.994
47	1.36125	740.605	41.8302	Older Alluvium	500	40	268.826	514.146	278.006	261.148	16.8581	518.619	257.471
48	1.36125	543.167	43.2364	Older Alluvium	500	40	253.409	484.66	173.247	191.528	-18.2814	411.517	219.989
49	1.36125	334.444	44.6759	Older Alluvium	500	40	238.602	456.34	65.8966	117.929	-52.0324	301.814	183.885
50	1.36125	113.581	46.1521	Older Alluvium	500	40	224.265	428.92	-44.661	40.0488	-84.7098	188.809	148.76

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.90946

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	1.37077	66.4004	-10.0373	Older Alluvium	500	40	300.591	573.966	111.399	23.2497	88.149	58.1949	34.9452
2	1.37077	196.883	-8.97944	Older Alluvium	500	40	331.365	632.729	227.121	68.9406	158.18	174.759	105.819
3	1.37077	322.749	-7.92469	Older Alluvium	500	40	361.913	691.059	340.71	113.015	227.695	290.332	177.317
4	1.37077	444.037	-6.87264	Older Alluvium	500	40	391.882	748.283	451.378	155.486	295.892	404.145	248.659
5	1.37077	560.778	-5.82292	Older Alluvium	500	40	420.904	803.699	558.3	196.366	361.934	515.376	319.01
6	1.37077	673.002	-4.77516	Older Alluvium	500	40	448.608	856.599	660.641	235.663	424.978	623.166	387.503
7	1.37077	780.73	-3.72899	Older Alluvium	500	40	474.636	906.298	757.596	273.386	484.21	726.662	453.276
8	1.37077	883.982	-2.68407	Older Alluvium	500	40	498.65	952.153	848.397	309.542	538.855	825.02	515.478
9	1.37077	982.77	-1.64004	Older Alluvium	500	40	520.354	993.595	932.374	344.134	588.24	917.475	573.341
10	1.37077	1077.1	-0.596553	Older Alluvium	500	40	539.492	1030.14	1008.97	377.167	631.799	1003.35	626.181
11	1.37077	1166.99	0.446734	Older Alluvium	500	40	555.868	1061.41	1077.7	408.642	669.059	1082.04	673.393
12	1.96997	1825.03	1.71836	Older Alluvium	500	40	571.718	1091.67	1149.81	444.683	705.126	1166.96	722.278
13	1.36125	1357.66	2.98705	Older Alluvium	500	40	583.473	1114.12	1210.61	478.732	731.88	1241.06	762.326
14	1.36125	1431.23	4.02504	Older Alluvium	500	40	589.678	1125.97	1250.67	504.673	746	1292.17	787.493
15	1.36125	1500.4	5.06435	Older Alluvium	500	40	593.033	1132.37	1282.7	529.066	753.633	1335.25	806.188
16	1.36125	1565.17	6.10534	Older Alluvium	500	40	593.669	1133.59	1306.98	551.904	755.078	1370.48	818.579
17	1.36125	1625.51	7.14835	Older Alluvium	500	40	591.766	1129.95	1323.93	573.181	750.749	1398.15	824.965

18	1.36125	1682.8	8.19376	Older Alluvium	500	40	587.996	1122.76	1335.06	592.884	742.171	1419.72	826.838
19	1.36125	1770.36	9.24191	Older Alluvium	500	40	586.568	1120.03	1363.18	624.256	738.92	1458.62	834.363
20	1.36125	1868.35	10.2932	Older Alluvium	500	40	585.313	1117.63	1394.87	658.81	736.062	1501.17	842.359
21	1.36125	1961.77	11.348	Older Alluvium	500	40	582.08	1111.46	1420.46	691.75	728.711	1537.28	845.529
22	1.36125	2050.56	12.4067	Older Alluvium	500	40	577.182	1102.11	1440.62	723.06	717.562	1567.59	844.534
23	1.36125	2134.68	13.4698	Older Alluvium	500	40	570.936	1090.18	1456.07	752.722	703.347	1592.82	840.098
24	1.36125	2214.06	14.5376	Older Alluvium	500	40	563.658	1076.28	1467.5	780.712	686.788	1613.67	832.954
25	1.36125	2288.64	15.6105	Older Alluvium	500	40	555.652	1060.99	1475.58	807.009	668.567	1630.83	823.818
26	1.36125	2358.34	16.6891	Older Alluvium	500	40	547.207	1044.87	1480.94	831.587	649.35	1644.99	813.407
27	1.36125	2423.08	17.7739	Older Alluvium	500	40	538.591	1028.42	1484.16	854.416	629.743	1656.81	802.395
28	1.36125	2482.78	18.8653	Older Alluvium	500	40	530.045	1012.1	1485.76	875.466	610.297	1666.88	791.413
29	1.36125	2537.33	19.9638	Older Alluvium	500	40	521.785	996.328	1486.2	894.703	591.5	1675.74	781.041
30	1.36125	2586.64	21.07	Older Alluvium	500	40	513.996	981.455	1485.87	912.089	573.779	1683.89	771.805
31	1.36125	2630.58	22.1846	Older Alluvium	500	40	506.835	967.781	1485.06	927.585	557.479	1691.74	764.155
32	1.36125	2664.59	23.308	Older Alluvium	500	40	499.298	953.389	1481.47	941.145	540.328	1696.59	755.443
33	1.36125	2611.83	24.441	Older Alluvium	500	40	486.174	928.33	1431.44	920.972	510.466	1652.4	731.425
34	1.36125	2523.04	25.5843	Older Alluvium	500	40	470.493	898.387	1364.44	889.663	474.78	1589.71	700.044
35	1.36125	2428.31	26.7387	Older Alluvium	500	40	455.77	870.275	1297.54	856.259	441.277	1527.15	670.892
36	1.36125	2327.46	27.9049	Older Alluvium	500	40	441.864	843.722	1230.33	820.698	409.629	1464.33	643.632
37	1.36125	2220.29	29.0838	Older Alluvium	500	40	428.609	818.412	1162.38	782.911	379.47	1400.78	617.871
38	1.36125	2106.6	30.2763	Older Alluvium	500	40	415.819	793.989	1093.18	742.82	350.36	1335.93	593.114
39	1.36125	1986.14	31.4836	Older Alluvium	500	40	403.283	770.053	1022.18	700.344	321.837	1269.15	568.811
40	1.36125	1858.65	32.7066	Older Alluvium	500	40	390.772	746.163	948.757	655.389	293.368	1199.69	544.303
41	1.36125	1723.84	33.9466	Older Alluvium	500	40	378.03	721.834	872.228	607.855	264.373	1126.7	518.845
42	1.36125	1581.4	35.205	Older Alluvium	500	40	364.779	696.531	791.847	557.627	234.22	1049.22	491.591
43	1.36125	1430.97	36.4832	Older Alluvium	500	40	350.711	669.669	706.784	504.581	202.203	966.138	461.557
44	1.36125	1272.14	37.7829	Older Alluvium	500	40	335.488	640.601	616.14	448.578	167.562	876.211	427.633
45	1.36125	1104.49	39.1059	Older Alluvium	500	40	318.736	608.614	518.9	389.459	129.441	777.985	388.526
46	1.36125	927.497	40.4542	Older Alluvium	500	40	300.04	572.914	413.944	327.049	86.8952	669.788	342.739
47	1.36125	740.605	41.8302	Older Alluvium	500	40	278.932	532.61	300.011	261.148	38.8634	549.67	288.522
48	1.36125	543.167	43.2364	Older Alluvium	500	40	254.888	486.699	175.677	191.528	-15.8511	415.338	223.81
49	1.36125	334.444	44.6759	Older Alluvium	500	40	227.308	434.035	39.3145	117.929	-78.6145	264.065	146.136
50	1.36125	113.581	46.1521	Older	500	40	195.498	373.296	-110.951	40.0488	-151	92.5721	52.5233

Alluvium

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.91256

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	85.104	39.8715	0	0	0
2	86.4747	39.6288	575.981	236.068	22.2865
3	87.8455	39.4122	1179.49	483.417	22.2864
4	89.2163	39.2214	1801.31	738.273	22.2864
5	90.587	39.0562	2433.2	997.253	22.2864
6	91.9578	38.9164	3067.73	1257.32	22.2864
7	93.3286	38.8019	3698.28	1515.75	22.2864
8	94.6993	38.7126	4318.89	1770.11	22.2864
9	96.0701	38.6483	4924.22	2018.21	22.2865
10	97.4409	38.6091	5509.51	2258.09	22.2864
11	98.8116	38.5948	6070.5	2488.01	22.2864
12	100.182	38.6055	6603.42	2706.43	22.2864
13	102.152	38.6646	7313.66	2997.53	22.2864
14	103.514	38.7356	7761.99	3181.28	22.2865
15	104.875	38.8314	8172.95	3349.71	22.2864
16	106.236	38.952	8544.53	3502	22.2864
17	107.597	39.0976	8875.01	3637.45	22.2864
18	108.959	39.2683	9163	3755.48	22.2864
19	110.32	39.4644	9407.57	3855.72	22.2864
20	111.681	39.6859	9603.54	3936.04	22.2864
21	113.042	39.9331	9747.28	3994.95	22.2864
22	114.404	40.2063	9836.43	4031.49	22.2864
23	115.765	40.5057	9868.93	4044.81	22.2864
24	117.126	40.8318	9842.97	4034.17	22.2864
25	118.487	41.1848	9757.05	3998.95	22.2864
26	119.849	41.5651	9609.89	3938.64	22.2864
27	121.21	41.9732	9400.52	3852.83	22.2864
28	122.571	42.4096	9128.21	3741.22	22.2864
29	123.932	42.8747	8792.47	3603.62	22.2864
30	125.294	43.3692	8393.11	3439.94	22.2864
31	126.655	43.8936	7930.16	3250.2	22.2864
32	128.016	44.4487	7403.94	3034.53	22.2864
33	129.377	45.0352	6815.68	2793.43	22.2864
34	130.739	45.6539	6198.54	2540.49	22.2864
35	132.1	46.3056	5567.79	2281.98	22.2865
36	133.461	46.9914	4929.3	2020.29	22.2864
37	134.822	47.7123	4289.29	1757.98	22.2864
38	136.184	48.4695	3654.39	1497.76	22.2864
39	137.545	49.2642	3031.74	1242.57	22.2865
40	138.906	50.0978	2428.93	995.502	22.2864
41	140.267	50.9719	1854.15	759.93	22.2864
42	141.629	51.8883	1316.24	539.466	22.2865
43	142.99	52.8487	824.741	338.023	22.2864
44	144.351	53.8554	390.008	159.846	22.2864
45	145.712	54.9106	23.3261	9.56027	22.2864
46	147.074	56.0171	-262.962	-107.776	22.2865
47	148.435	57.1778	-455.291	-186.603	22.2865
48	149.796	58.3962	-538.682	-220.781	22.2865
49	151.157	59.6761	-496.495	-203.49	22.2864
50	152.519	61.0221	-310.131	-127.108	22.2864
51	153.88	62.4392	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.90946

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	85.104	39.8715	0	0	0
2	86.4747	39.6288	429.432	13.3148	1.77592
3	87.8455	39.4122	903.676	55.9281	3.54149
4	89.2163	39.2214	1416.76	131.095	5.28661
5	90.587	39.0562	1962.34	240.994	7.00141
6	91.9578	38.9164	2533.68	386.658	8.67681
7	93.3286	38.8019	3123.8	567.927	10.3042
8	94.6993	38.7126	3725.5	783.448	11.8759
9	96.0701	38.6483	4331.49	1030.7	13.3849
10	97.4409	38.6091	4934.52	1306.1	14.8254
11	98.8116	38.5948	5527.45	1605.05	16.1921
12	100.182	38.6055	6103.45	1922.18	17.481
13	102.152	38.6646	6888.9	2397.58	19.1897
14	103.514	38.7356	7394.13	2730.51	20.2682
15	104.875	38.8314	7862.99	3059.46	21.2608
16	106.236	38.952	8291.09	3377.87	22.1665
17	107.597	39.0976	8674.78	3679.39	22.9841
18	108.959	39.2683	9011.11	3958.1	23.7133
19	110.32	39.4644	9298.05	4208.74	24.3538
20	111.681	39.6859	9529.65	4424.6	24.9054
21	113.042	39.9331	9701.95	4600.23	25.3682
22	114.404	40.2063	9812.61	4731.44	25.7424
23	115.765	40.5057	9859.93	4815	26.0281
24	117.126	40.8318	9842.78	4848.68	26.2255
25	118.487	41.1848	9760.54	4831.29	26.3346
26	119.849	41.5651	9613	4762.64	26.3555
27	121.21	41.9732	9400.33	4643.56	26.2884
28	122.571	42.4096	9122.97	4475.82	26.133
29	123.932	42.8747	8781.56	4262.09	25.8894
30	125.294	43.3692	8376.9	4005.88	25.5574
31	126.655	43.8936	7909.88	3711.44	25.1367
32	128.016	44.4487	7381.42	3383.74	24.6273
33	129.377	45.0352	6793.1	3028.63	24.0292
34	130.739	45.6539	6178.07	2666.09	23.3422
35	132.1	46.3056	5551.31	2306.99	22.5666
36	133.461	46.9914	4918.13	1957.44	21.7028
37	134.822	47.7123	4284.04	1623.2	20.7514
38	136.184	48.4695	3654.79	1309.58	19.7136
39	137.545	49.2642	3036.53	1021.37	18.5909
40	138.906	50.0978	2435.89	762.678	17.3854
41	140.267	50.9719	1860.11	536.886	16.0998
42	141.629	51.8883	1317.29	346.506	14.7375
43	142.99	52.8487	816.507	193.058	13.3029
44	144.351	53.8554	368.153	76.9174	11.8009
45	145.712	54.9106	-15.8037	-2.85421	10.2375
46	147.074	56.0171	-321.414	-48.7208	8.61943
47	148.435	57.1778	-532.269	-64.9236	6.95431
48	149.796	58.3962	-628.894	-57.793	5.25052
49	151.157	59.6761	-587.982	-36.1387	3.5171
50	152.519	61.0221	-381.397	-11.7434	1.76361
51	153.88	62.4392	0	0	0

Entity Information

Water Table

X	Y

0	16.6765
11	18
20	25
30	35
38	38
80	38
110	49
129	60
180	65

Distributed Load

X	Y
74.2707	38
41.8575	38

External Boundary

X	Y
0	0
180	0
180	41
180	65
129	60
110	49
80	38
38	38
30	35
20	25
11	18
0	24

Material Boundary

X	Y
80	38
180	41

Appendix E

Preliminary Engineering Report

WATERWORKS ENGINEERS

ORLEANS MUTUAL WATER COMPANY
WATER TREATMENT IMPROVEMENT PROJECT
PRELIMINARY ENGINEERING REPORT-*DRAFT*

Date: January 14, 2021

By: Joe Riess, P.E.

Contents

1. Background

The Orleans Mutual Water Company (OMWC) owns and operates a surface water diversion off Crawford Creek (with DWR water right) in Humboldt County, a redwood raw water storage tank, an in-line filtration plant and a water distribution system. The diversion from Crawford Creek is located on US Forest Service Lands and the storage tank and treatment plant are located on a parcel owned by the Karuk Tribe. The water system serves 34 residential connections. Water flows by gravity from a side channel cut into the creek, into a perforated 10-inch stainless steel pipe, through a 6-inch PVC raw water supply pipe, and into the 20,000-gallon redwood raw water tank. Sodium hypochlorite is continuously injected into a static mixer at the tank's inlet piping (pre-chlorination) at a dose of approximately 0.5 mg/L by a diaphragm metering pump at the treatment plant. The maximum water level in the tank is equal to the water level at the diversion, so flow to the tank is self-limiting.

Water from the tank flows by gravity down a hill to the existing in-line filtration facility which includes two 36-inch diameter multi-media pressure filters. At the maximum allowed filter loading rate of 3 gpm/sq. ft, the maximum allowed treatment capacity of the plant is approximately 42 gpm. Flow through the filter system is not controlled and records indicate that flows have reached as high as 65 gpm on days of high demand. Coagulant is injected to the raw water immediately upstream of the filters via a diaphragm metering pump at a constant rate.

Two 2 hp booster pumps run continuously to supply water at 30 to 90 psi to the distribution system. Two pressure regulators in the distribution system regulate the pressure down to 60 psi for 7 connections. A small 12-volt battery backup system with inverter provides standby power for the plant controls and chemical pumps. No standby power is available for the booster pumps. During a power outage, the minimum pressure is approximately 20 psi.

2. Purpose

On November 15, 2013, the California Department of Public Health (now the State Water Resources Control Board (SWRCB) Division of Drinking water, or DDW) issued a letter to the OMWC stating that the State had adopted EPA's Enhanced Surface Water Treatment Rules (ESWTR). Under these new rules, in-line filtration is not an approved filtration technology and grandfathering in older in-line systems is no longer allowed. The State required the OMWC to either (1) demonstrate that the existing filter system can comply with the new rules, (2) upgrade the filter system to direct filtration by adding a flocculation step upstream of the filters, or (3) replace the filter system with an approved filtration technology. Subsequently, on August 29, 2016 the DDW issued an inspection letter to the OMWC noting several deficiencies that must be addressed, most notably for (1) compliance with the ESWTR as described above, (2) implementation of operational measures or improvements to reduce filter loading rate during peak demands to 3 gallons per minute per square foot (gpm/sf) or less, and (3) inadequate disinfection.

This project is funded by Proposition 1 (Project No. 1200566-001P) through the California SWRCB and includes the planning and design for an upgraded surface water treatment plant to comply with current Federal and State requirements, and address the deficiencies noted by DDW in the previous inspections. Due to the age, condition and composition of the existing system, a new treatment system will be required to be replace the existing system in its entirety. Additionally, a new finished water storage tank will need to be provided for disinfection contact time and storage. In addition to the treatment and storage upgrades, new water meters will be added at each connection to promote water conservation and reduce the size of the replacement treatment plant.

The purpose of the Preliminary Engineering Report (PER) is to describe the proposed improvements, the easements that will be necessary to be acquired from the Karuk Tribe, permitting requirements, and preliminary capital and operation and maintenance (O&M) cost estimates for project.

3. Water Demands and System Sizing

This section summarizes the existing permitting water right and the basis for sizing the new treatment and storage systems.

3.1. Water Rights

Water rights for the division off Crawford Creek were originally permitted in 1965 and held by the subdivision developer (Delaney) under Permit No. 14952. In 2015, the Karuk Tribe applied for and took ownership as the Primary Owner of the water right (effective 12/2/2015). The water right states that the amount of water diverted from the creek is limited to the amount actually beneficially used for the stated purposes and shall not exceed:

> *ELEVEN-HUNDREDTHS (0.11) CUBIC FOOT PER SECOND, TO BE DIVERTED FROM JUNE 1 TO OCTOBER 31 OF EACH YEAR FOR IRRIGATION AND DOMESTIC PURPOSES. SO LONG AS THERE IS NO INTERFERENCE WITH OTHER WATER RIGHTS, JUNIOR, AS WELL AS SENIOR, LICENSEE MAY INCREASE HIS RATE OF DIVERSION TO A MAXIMUM OF 0.67 CUBIC FOOT PER SECOND; PROVIDED THAT THE TOTAL QUANTITY DIVERTED IN ANY 30-DAY PERIOD DOES NOT EXCEED 7 ACRE-FEET. THE MAXIMUM AMOUNT DIVERTED UNDER THIS LICENSE SHALL NOT EXCEED 35 ACRE-FEET PER YEAR.*

Per the water right, the peak diversion rate is 0.11 cubic feet per second (cfs), or 49 gallons per minute (gpm), although the diversion rate may be increase to as high as 0.67 cfs, or 300 gpm.

According to water production records, and as noted in the letters from DDW, the peak diversion rate of 49 gpm has been exceeded several times in the past 10 years. Additionally, the maximum diversion of 35 acre-feet per year (11.4 million gallons per year) was exceeded in 2010, 2014, 2015 and 2017.

3.2. Treatment Plant Sizing

To stay within the current water right diversion rate, the new water treatment system will be sized to treat a maximum flow rate of 49 gpm, plus a backwash recycle flow rate of 5 gpm, for a **total treatment capacity of 54 gpm**.

3.3. Storage Tank Sizing

The new storage tank will be sized to hold the volume of water equivalent to the maximum day demand (MDD) flow plus fire storage volume.

A maximum diversion rate of 35 acre-feet per year is equivalent to an average day demand (ADD) of 31,246 gallons per day (gpd). Per California Code of Regulations Title 22 Water Works Standards, the MDD should be estimated as 2.25 times the ADD. Therefore, the MDD for the water system that correlates with the permitted diversion amount is estimated at 70,300 gpm. This estimate of MDD is reasonable, since the total volume treated by a 49 gpm treatment system in a day is 70,560. Additionally, the OMWC reported maximum daily production rates of 60,000 gpd in 2007 through 2012 and no significant increase in housing units has since occurred.

Since this project does not include a new development that would need to comply with current fire code, the fire flow and duration used for tank sizing is a practical consideration rather than a regulatory mandate. Since the existing distribution system cannot support a fire flow of 1,000 gpm (likely for a new subdivision of this type per current fire code), and due to limited space at the proposed tank site, the recommended fire flow and duration is 500 gpm for 2 hours. This results in a fire storage volume of 60,000 gallons.

With an MDD of 70,300 gallons and a fire storage volume of 60,000 gallons, **the proposed capacity of the new storage tank is 130,300 gallons**.

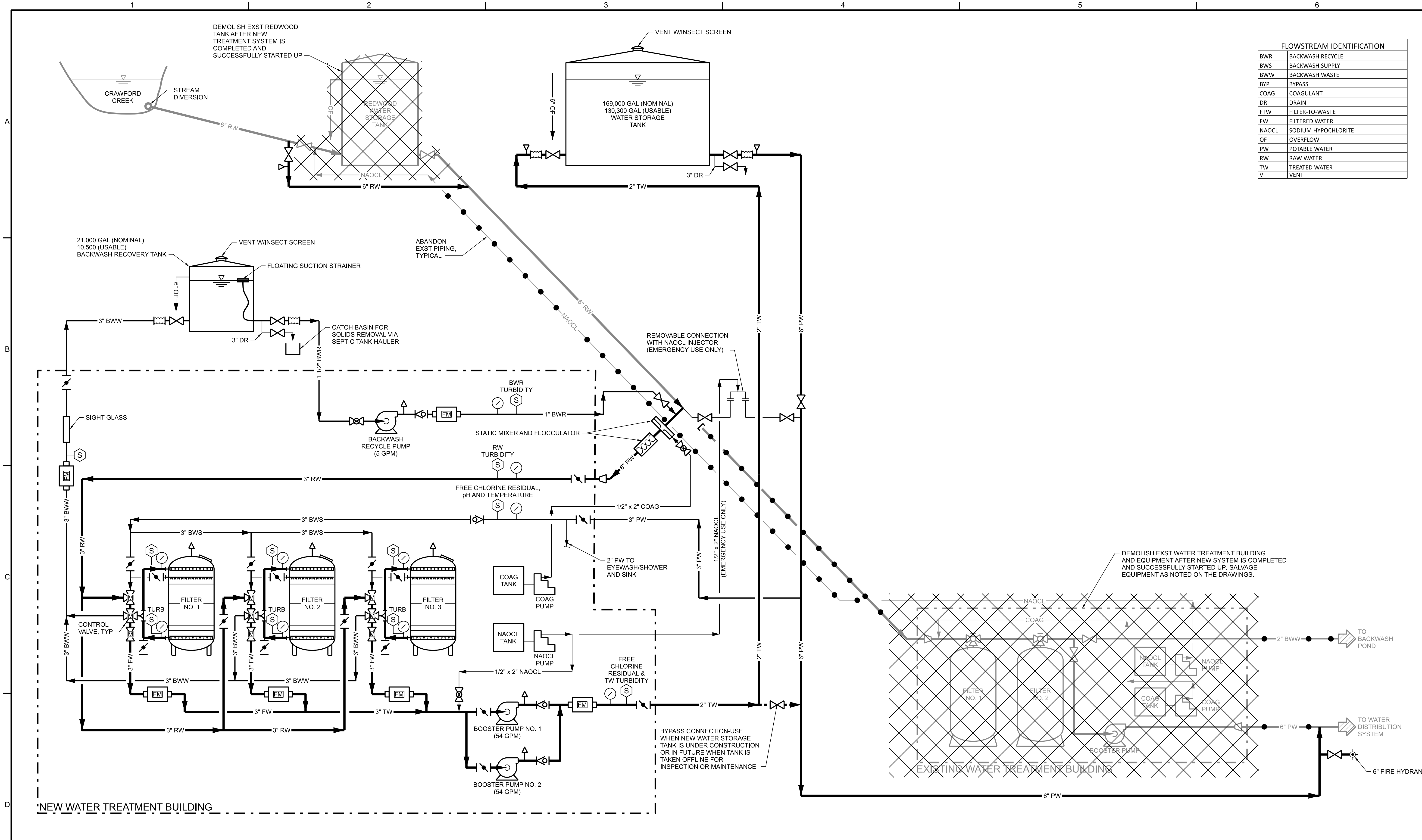
4. Source and Finished Water Quality

The water source for the OMWC water system is via a submerged perforated pipe off a side channel of Crawford Creek. Raw water turbidity is measured daily by OMWC's operator and reported to DDW monthly. Based on review of these reports, the Crawford Creek water quality is very good, with turbidity typically below 0.5 nephelometric turbidity unit (NTU). The finished (filtered) water turbidity is generally below 0.2 NTU. During heavy storms the turbidity has, at times, exceeded 5 NTU. The few occasions where finished water turbidity exceeded the 0.3 NTU limit, when not associated with a storm event, were reportedly due to measurement error. That said, it appears that although the existing treatment system uses an unapproved treatment technology (in-line) at rates sometimes above the maximum loading rate, it has consistently met the turbidity requirements.

5. Proposed Improvements

The proposed improvements included under this project include a new direct-filtration surface water treatment plant with backwash recycling, new water storage tank, and new water meters for each water service, as described below and as shown on the process flow diagram for the project (Figure 1). The goal of the new treatment system is to reliably produce water with a turbidity less than 0.3 NTU 95-percent of the time and never above 1 NTU, using approved filtration and disinfection technologies. The goal of the new storage system is to provide water storage equal to the maximum day demand plus fire flow. The design will focus on keeping the treatment process as simple to operate as possible, and as reliable and robust as possible.

Several alternative locations were initially identified for the new water treatment plant and storage tank and reviewed with the Karuk Tribe and OMWC. After reviewing each alternative, it was determined that the desired location for the new treatment plant is in a flat area to the southwest of the existing treatment plant. This area is in the same general area as the existing water treatment plant which was heavily disturbed by past mining activities that washed much of the topsoil away and is accessible via the existing unimproved access road. Other sites identified had a higher likelihood of impacting cultural resources and were farther away from the diversion and storage tank locations. The desired location for the new storage tank is in place of the existing redwood storage tank and within an area previously excavated for future tanks. As with the water treatment plant location, the tank site has low likelihood of impacting cultural resources due to previous activities. See Figure 2 for the overall site plan of the proposed improvements, which includes the general location and size of proposed easements that the OMWC will need to secure from the Karuk Tribe before construction can commence.



FLOWSTREAM IDENTIFICATION	
BWR	BACKWASH RECYCLE
BWS	BACKWASH SUPPLY
BWW	BACKWASH WASTE
BYP	BYPASS
COAG	COAGULANT
DR	DRAIN
FTW	FILTER-TO-WASTE
FW	FILTERED WATER
NAOCL	SODIUM HYPOCHLORITE
OF	OVERFLOW
PW	POTABLE WATER
RW	RAW WATER
TW	TREATED WATER
V	VENT

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

NO	DATE	REVISION	BY	APVD

PRELIMINARY NOT FOR CONSTRUCTION

DESIGN J. RIESS
DRAWN J. RIESS
CHECKED X. XXXXXX
APPROVED X. XXXXXX

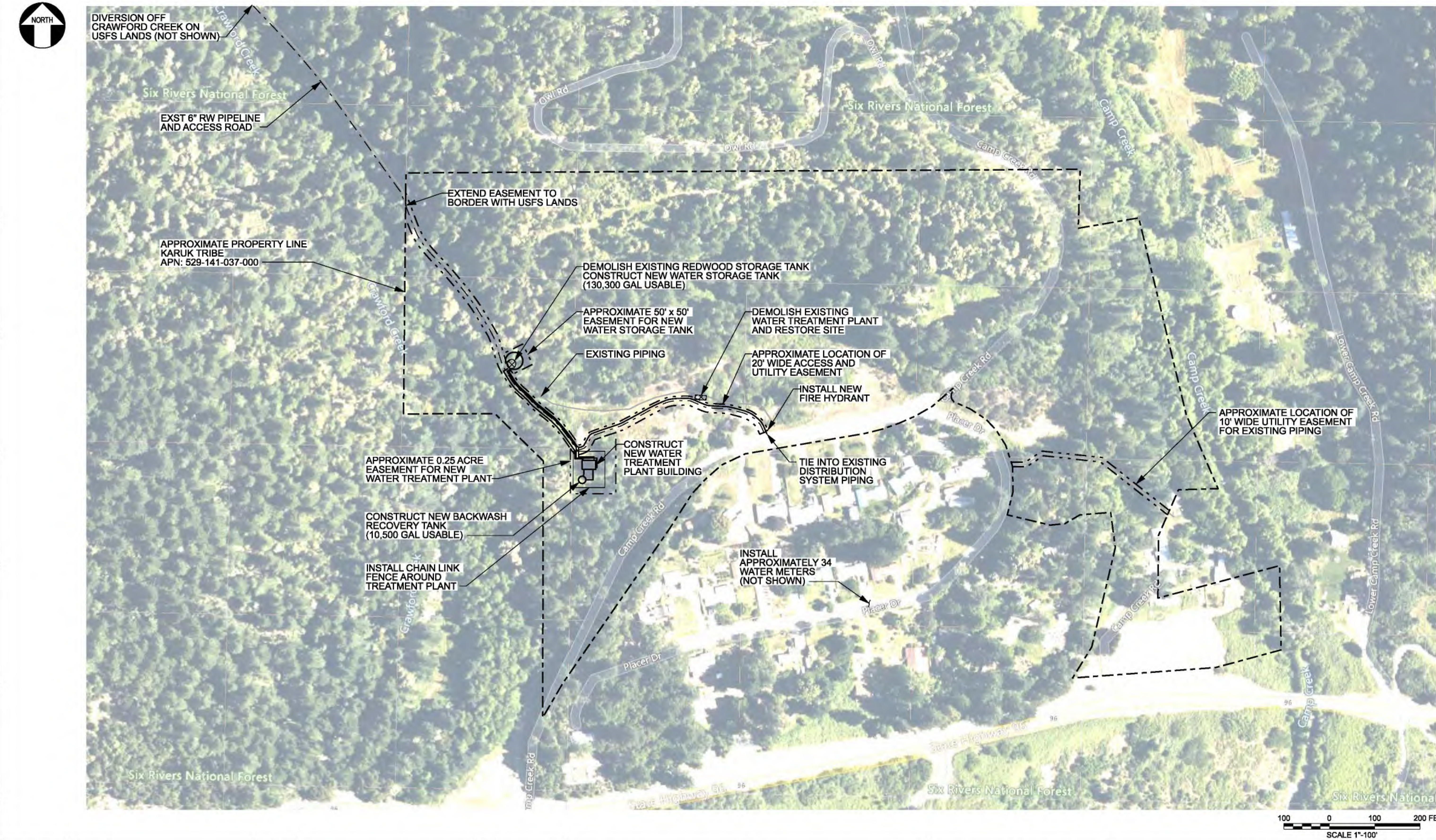
WATERWORKS ENGINEERS
REDDING, CA

ORLEANS MUTUAL WATER COMPANY
WATER TREATMENT AND STORAGE IMPROVEMENTS PROJECT
ORLEANS, CALIFORNIA

####
FIGURE 1
PROCESS FLOW DIAGRAM

DATE JANUARY 2021
PROJECT NO. 19-013
DRAWING NO. G-00X
SHEET NO. 1

FILENAME: L:\CAD\Projects\19-013 Orleans WTP System Upgrade\Deliverables\19013D-G017.dgn
PLOT DATE: 1/14/2021
PLOT TIME: 6:25:34 AM



VERIFY SCALE	NO	DATE	REVISION	BY	APVD
BAR IS ONE INCH ON ORIGINAL DRAWING 0 1" IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY					

PRELIMINARY NOT FOR CONSTRUCTION

XX-XX-XX

DESIGN J. RIESS
DRAWN J. RIESS
CHECKED X. XXXXXX
APPROVED X. XXXXXX

WATERWORKS ENGINEERS
REDDING, CA

ORLEANS MUTUAL WATER COMPANY
WATER TREATMENT AND STORAGE IMPROVEMENTS PROJECT
ORLEANS, CALIFORNIA

CIVIL
FIGURE 2
OVERALL SITE PLAN

DATE JANUARY 2021
PROJECT NO. 19-013
DRAWING NO. C-001
SHEET NO. 2

FILENAME: L:\CAD\Projects\19-013 Orleans WTP System Upgrade\Deliverables\Site Plan.dgn
PLOT DATE: 1/14/2021
PLOT TIME: 6:29:59 AM

5.1. New Water Treatment and Storage System

The new water treatment system will have a maximum design treatment capacity of 54 gpm (49 gpm maximum diversion rate plus 5 gpm backwash recycle) with one filter offline for backwash or maintenance. A new building will be constructed to house the new treatment equipment at a site mutually agreed upon by the Karuk Tribe and OMWC. The new treatment system will include the following processes and will comply with the EPA's Enhanced Surface Water Treatment Rules for treatment system design and operation.

- Emergency Raw Water Bypass Connection
- Coagulation
- Flocculation
- Pressure Filtration
- Disinfection (chlorination)
- Backwash Recycling
- Booster Pumping
- Instrumentation and Controls
- Ancillary systems

The design criteria for the proposed improvements are summarized in Table 1, below.

Table 1: Design Criteria for Proposed Improvements

Item	Value
Water Source	Surface water, Crawford Creek
Raw Water Peak Design Flow	49 gpm
Maximum Day Demand Flow	70,300 gpd
Backwash Recycle Peak Design Flow	5 gpm
Peak Treatment Design Flow	54 gpm
Fire Storage Volume	60,000 gal (500 gpm for 2 hours)
Emergency Raw Water Bypass Connection	
Type	Removable 6-in pipe spool with isolation valves each side and injection quill for sodium hypochlorite
Coagulation	
No. Metering Pumps	1 installed + 1 shelf spare
Metering Pump Type	Solenoid actuated diaphragm
Metering Pump Capacity	6 gpd
Metering Pump Control	Flow paced
Flash Mixing Type	6-in static, wafer
Contact Time at Peak Design Flow	20 seconds
In-Pipe Flocculation	
Type	In-pipe
Pipe Size	6-in dia x 115-ft long
Flocculator Type	6-in low-headloss static mixer
Contact Time at Peak Design Flow	3 minutes
Pressure Filtration	
No. Filters	3
Filter Diameter	3.5-ft
Surface Area per Filter (Total)	9.6 sf (28.9)
Filter Loading Rate:	

Item	Value
With All Filters Online With 1 Filter Offline	1.9 gpm/sf 2.8 gpm/sf
Backwash Rate	15 gpm/sf
Surface Wash Rate	2 gpm/sf
Disinfection	
Chemical Type	12.5% sodium hypochlorite
No. Metering Pumps	1 installed + 1 shelf spare
Metering Pump Type	Solenoid actuated diaphragm
Metering Pump Capacity	6 gpd
Metering Pump Control	Flow paced
Contact Time Provided By	Water storage tank
Water Storage Tank	
Type	Bolted steel
Size	34.2-ft dia x 24.7-ft tall side shell
Nominal Volume	169,500 gal
Usable Volume	130,300 gal
Backwash Recycling	
Backwash Recycle Tank:	
Size	16-ft dia x 14-ft tall
Settling Depth Reserved	3-ft
Nominal Volume	21,000 gal
Usable Volume	10,500 gal
Backwash Recycle Pump:	
No. Pumps	1 installed + 1 shelf spare
Pump Type	End-suction centrifugal
Pump Capacity	5 gpm
Motor Size	Fractional Hp
Pump Control	Constant speed
Booster Pumping	
No. Pumps	2 (1 duty + 1 standby)
Pump Type	End-suction centrifugal
Pump Capacity	54 gpm
Motor Size	1 Hp, 240v, single phase
Pump Control	Constant speed
Treatment Building	
Building Size	20-ft x 30-ft (600 sf)
Construction Type	CMU block w/metal roof
Ancillary Systems	
HVAC	Exhaust fan and electric heater
Communications	Internet
Electrical Service	New underground electrical
Backup Power	Solar with battery
Site Security at Water Treatment Plant	Chain link fence
Site Security at Water Storage Tank	Anti-climb ladder

5.1.1. Emergency Raw Water Bypass Connection

An emergency raw water bypass connection will be provided near the new water treatment plant to allow the water treatment plant to be bypassed in the event of an emergency (Figure 3). This connection will consist of a buried 6-inch gate valve on the raw water pipeline and two buried 6-inch gate valves on the potable water pipeline, with a removable section of exposed piping between the valves. The removable section will have an injection port to allow sodium hypochlorite to be dosed when this connection is in use. This removable section will be stored in the treatment plant building, and the ends of the connection will be sealed with blind flanges or Victaulic-style (grooved coupling) caps. In the event of an emergency such as catastrophic treatment plant failure or fire when more volume is required than the treatment system can produce, the water storage tank would be isolated with one gate valve and the bypass connection installed, potentially with sodium hypochlorite injection if feasible at that time.

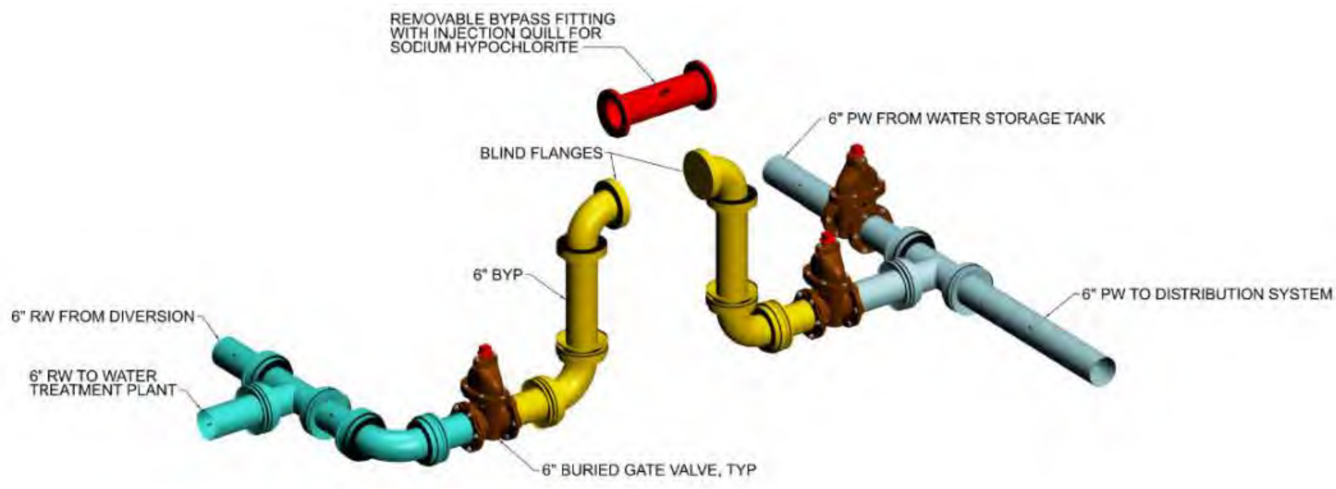


Figure 3: Emergency Raw Water Bypass Connection

5.1.2. Coagulation

Two 5-gallon samples of the Crawford Creek source water were collected on November 7, 2020 by OMWC and sent to Guy Schott with DDW for jar testing, along with a small amount of the coagulant the system currently uses (CalChem CC 2135). The turbidity of the source water, as measured by the OMWC, was 0.3 NTU which is low but not unusual for the water system. The turbidity of the water as measured by DDW was 0.11 NTU. The difference may be due to different sampling techniques.

DDW performed a series of jar tests on the samples using the CC 2135 coagulant and Advanced Coagulant ADVFloc-CTC-00011 polyaluminum chloride. Jar tests were performed with each coagulant at different dosages, flash mixing times and flocculation times. A summary of the methodology followed, and results of the jar test are included in Appendix A. Based on the results of the jar tests, both coagulants performed equally well, resulting in filtered turbidity down to 0.08 and ultraviolet absorption (UVA) reduction as high as 62.5 percent. UVA reduction is often used as a surrogate for coagulant performance in addition to filterability. Both coagulants achieved approximately the same degree of filterability, with the ADVFloc coagulant providing a higher level of UVA reduction and the best filtration and UVA reduction were obtained with flash mixing for 20 seconds and gentle flocculation for 120 seconds. Elimination of the flocculation step had negligible impact on treatability with the ADVFloc coagulant, whereas performance decreased by eliminating the flash mixing step. Elimination of the flocculation step resulted in reduced performance with the CC 2135 coagulant.

The proposed coagulant system design is based on results of the jar tests using either the coagulant currently in use (CC 2135) at an average dose of 1 mg/L, the ADVFloc coagulant at an average dose of 10 mg/L, or other similar. The coagulation storage and feed system will be similar to the existing system and will include a solenoid operated diaphragm metering pump drawing from a small batch tank that contains the coagulant. Coagulant will be injected into the raw water upstream of the flocculation process at a wafer static mixer (Westfall Model 2800) for flash mixing of the coagulant with the raw water. The static mixer will be installed approximately 15-ft upstream of the flocculation process to provide 20 seconds of contact time following mixing per the jar test results.

Due to the relatively small flow being treated, the CC 2135 coagulant will be diluted at a 10:1 ratio (9 gallons of water to 1 gallon coagulant) to allow the metering pump to operate at a higher speed which results in more reliable delivery of the chemical. At a maximum dose of 2 mg/L using the CC 2135 coagulant, 10:1 dilution of the coagulant, and a treatment rate of 54 gpm, the design feed rate for the metering pump is 1.2 gpd (3.2 mL/min). At a maximum dose of 20 mg/L using the ADVFloc coagulant, no dilution of the coagulant, and a treatment rate of 54 gpm, the design feed rate of the metering pump is also 1.2 gpd (3.2 mL/min). To meet the intended range of coagulant flows, a diaphragm metering pump with a capacity of 0.06 to 6.0 gpd is recommended (Pulsafeeder Pulsatron Series E Plus, or equal).

The coagulant will be stored in a 15-gallon container to allow the coagulant and water to be routinely added for the correct dilution, if required. The metering pump will be mounted on or adjacent to the tank and will be automatically controlled to be flow paced directly from the plant's effluent flowmeter. An on-the-shelf metering pump will be provided for redundancy.

5.1.3. Flocculation

As described above, gentle flocculation for 120 seconds (2 minutes) resulted in low filtrate turbidity in the jar tests. To accomplish this, and to keep the treatment system from being overly complicated with additional valves, controls, and backwash waste generation, in-pipe flocculation (aka "flow-through flocculation") is recommended to meet DDW's requirements for a flocculation step for direct filtration. In-pipe flocculation allows the coagulated particles to come into contact with one another to form larger particles, or "floc," without any equipment with moving parts or controls.

The alignment for the existing 6-inch diameter pipeline from the existing storage tank plus a new 6-inch pipeline from that pipe and the new treatment plant is approximately 330-ft long. At 54 gpm, the pipeline velocity would be 0.6 ft/s and the contact time would be 8.8 minutes. If only the last 115-ft of this pipeline is used for flocculation, the contact time would be 3 minutes (1.5 times that evaluated in the jar test).

For this project, a 6-inch pipeline flocculator will be installed 115-ft upstream of the treatment building. The flocculator will then be. The flocculator is a low-headloss static mixer design to introduce a gentle rolling pattern to the flow profile to promote flocculation in this section of piping, prior to filtration, as shown in Figure 4. In the section of pipe following the flocculator, flow is turbulent since the Reynolds number is greater than 3,000 (Re=19,000) meaning that the particles in suspension will continue to collide and agglomerate due to the tortuous flow path, but not be sheared since the mixing intensity is low. See Appendix B for the completed pipeline flocculation calculations developed by DDW that show the overall mixing intensity (G-Value) of 13,846 for this concept is within an acceptable range of 10,000 to 100,000 for flow-through pipeline flocculation.

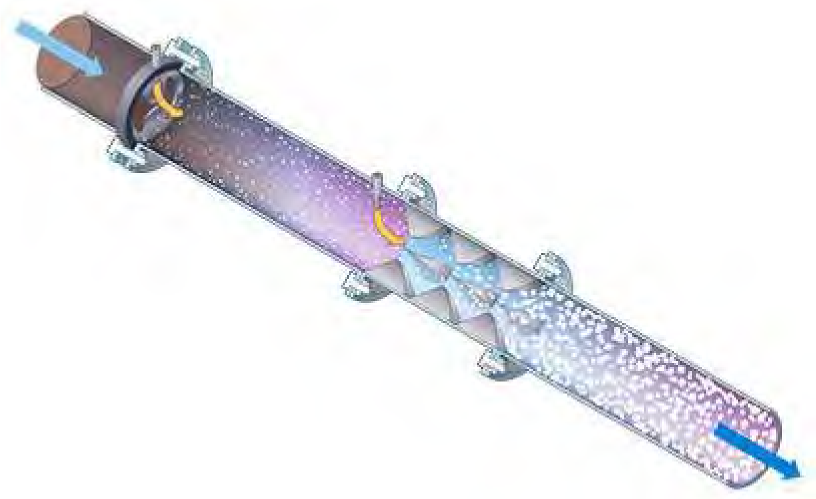


Figure 4: Coagulation/Flocculation Static Mixer (Westfall Mfg)

5.1.4. Pressure Filtration

Filtration will be accomplished with three (3) new 3.5-ft diameter vertical multi-media pressure filters operated in parallel to replace the two existing 3-ft diameter filters. Each filter will have a surface area of 9.6 square feet (sf). At a maximum design flow rate of 54 gpm, with one unit out of service for backwash or maintenance, the hydraulic loading rate will be 2.8 gpm/sf. With all filters online at peak flow, the hydraulic loading rate will be 1.9 gpm/sf. The maximum hydraulic loading rate for multi-media filters of this type is 3 gpm/sf.

The backwash loading rate will be between 12 and 15 gpm/sf, depending on water temperature. At a backwash loading rate of 15 gpm/sf, the backwash supply flow is 144 gpm per filter. Backwash water will be provided to the system from the distribution system (gravity fed by water storage tank) at approximately 25 psi. A check valve will be installed on the backwash supply pipe to prevent cross contamination.

Each filter will consist of the following components:

- 3.5-ft diameter x 5-ft tall sideshell pressure vessel with top manway rated to 150 psi (total height approx. 8'-2", not including air release valve)
- Inlet distributors
- Surface wash system
- Stainless steel underdrain system
- Graded gravel media support (3 layer, 12-inches total)
- Filter Media (18-inches sand plus 12-inches anthracite)
- Inlet and outlet flanges
- Multi-port control valves and controllers (Clack
- Air release valves
- Sample taps with inlet and outlet pressure gauges
- Support stands
- Interior and exterior coatings

The filters will be installed in a new building to protect against freezing and vandalism. See Figure 5 for a preliminary layout of the new treatment equipment in the building (walls and roof not shown for clarity).

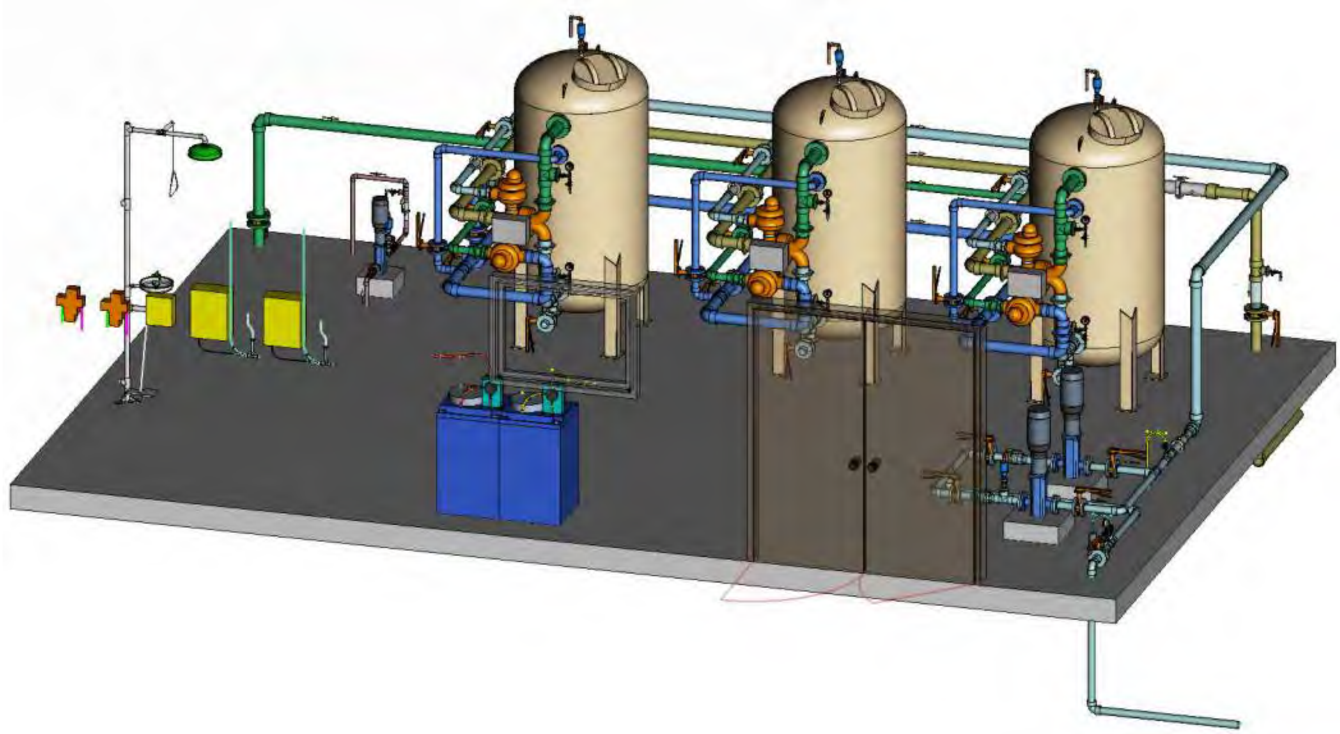


Figure 5: Preliminary Layout of Treatment Plant Building

5.1.5. Disinfection

Disinfection will be accomplished by injecting sodium hypochlorite into the water following filtration and prior to booster pumping which will effectively mix the chemical with the filtered water. Chlorinated water will be conveyed by the booster pump to the new storage tank via a new 2-inch diameter PVC pipeline (approx. 330-ft long) which will provide approximately 1 minute of effective contact time. The sodium hypochlorite storage and feed system will be like that described above for coagulation and will include a 15-gallon tank and solenoid operated diaphragm metering pump. The tank will be sealed and vented to the outside to minimize issues with off gassing of chlorine which would result in corrosion inside the building. Due to the relatively small flow being treated and to minimize issues with off gassing of chlorine, the sodium hypochlorite will be diluted at a 10:1 ratio (9 gallons of water to 1 gallon sodium hypochlorite) to allow the metering pump to operate at a higher speed which results in more reliable delivery of the chemical. At a maximum dose of 1 mg/L, 10:1 dilution of the sodium hypochlorite, and a treatment rate of 54 gpm, the design feed rate for the metering pump is 0.52 gpd (1.4 mL/min). To meet the intended range of sodium hypochlorite flows, a diaphragm metering pump with a capacity of 0.06 to 6.0 gpd is recommended (Pulsafeeder Pulsatron Series E Plus, or equal). This pump is the same model as recommended for coagulant, but with an auto-degassing head. An on-the-shelf metering pump will be provided for redundancy.

As described below, the new water storage tank will be 34.2-ft diameter x 24.7-ft tall. The tank is anticipated to be operated at a water depth between 8.75-ft and 19.83-ft. The volume below 8.75-ft is reserved for fire storage volume. Assuming a baffle factor of 0.1 for an unbaffled circular tank with separate inlets and outlets, and a free chlorine residual of 0.6 mg/L leaving the tank, the new storage tank will provide the necessary contact time (CT) down to the minimum operating water level of between 8.75 feet as shown in Table 2 below.

Table 2: Contact Time (CT) Compliance for Inactivation of Giardia by Free Chlorine

Water Storage Tank Volume:	6,858	Gallons/Ft
Short-Circuiting Factor for Tank:	0.10	t_{10}/T
Transmission Pipe (Finished Water) Diameter:	2.00	inch
Pipe Length:	330	ft
Pipe Volume:	53.9	Gallons
Required Log Inactivation of Giardia:	1	Log

	Water Storage Tank Data								CT Results				
Alt No.	Flow Rate, gpm	Minimum Temperature, °C	Maximum pH	Minimum Chlorine Residual, mg/L	Minimum Tank Level, ft	Effective Tank Vol., gal	Effective Pipeline Vol., gal	Effective Contact Time, minutes	Required CT	Calculated CT_{10}	CT Ratio (CT_{calc}/CT_{req})	Inactivation Ratio ($CT_{calc}/CT_{99.9}$)	Calculated Log Inactivation
1	54	5.0	8.0	0.60	8.75	6,001	54	112.1	68	67	1.0	0.33	0.99
2	54	8.5	8.0	0.60	14.29	9,802	54	182.5	56	110	1.9	0.65	1.95
3	54	20.0	8.0	0.60	19.83	13,602	54	252.9	26	152	5.9	1.98	5.94

5.1.6. Water Storage Tank

As described above, the new water storage tank will be sized to include 70,300 gallons for MDD storage plus 60,000 gallons for fire volume storage, for a total usable capacity of 130,300 gallons. The tank will be bolted steel with factory-finished fusion epoxy coated panels, with a diameter of 34.2-ft and sideshell height of 24.7-ft. The tank will be supported by a reinforced concrete ringwall foundation and constructed in the same location as the existing redwood tank. The maximum operating water level in the tank will be similar to that of the existing redwood tank and will be able to serve the community water via gravity. Separate inlet and outlet piping will be provided, with an internal standpipe on the inlet to provide a constant water level for the booster pumps to pump to and also enhance the flow pattern across the tank to minimize short-circuiting. The tank will have a top manway with interior ladder for access and inspection. An exterior ladder will be provided with anti-climb features to prevent unauthorized access to the top of the tank. A side manway will be provided for access for maintenance.

5.1.7. Backwash Recycling

Backwash waste flows from the filters will be conveyed to a new 16-ft diameter x 14-ft tall, bolted steel tank outside of the new treatment building. Solids will settle to the bottom of the tank and, after a preset settling time, the clear water at the top of the tank will be pumped to the treatment system for treatment. A floating suction strainer and flexible hose in the backwash tank will be used to draw water off the top of the water column and conveyed via a backwash recycle pump (located in the treatment building) back to the treatment process, upstream of the coagulant addition point. The backwash pump will be fractional horsepower and sized for a maximum flow of 5 gpm (10% of feed rate when not recycling backwash). The bottom 3-ft of the tank will be reserved for solids accumulation. A valve at the bottom of the tank will allow the tank to be periodically drained into a small catch basin with an air gap, from which a septic hauler can remove the solids and haul them away for disposal. Sample taps on the side of the tank will allow the operator to gauge the depth of solids in the tank and determine when solids removal is necessary.

The backwash recycle pump will have a capacity of 5 gpm at 60 ft total dynamic head (TDH). An on-the-shelf pump will be provided for redundancy.

5.1.8. Booster Pumping

Chlorinated water will be pumped to the new storage tank via two new 1 HP booster pumps in a Duty/Standby arrangement. The pumps will be controlled by VFDs that will allow the speed to be adjusted to set the desired pumping rate. The pumps will be manually rotated at regular intervals to exercise the pumps and result in even runtimes on each pump. The pumps will each have a capacity of 60 gpm at 60 ft TDH.

5.1.9. Instrumentation and Controls

The following online instruments will be provided under this project to monitor the treatment process and storage tank level.

- Raw water turbidimeter
- Individual filter effluent turbidimeters (1 per filter)
- Combined filter effluent turbidimeter
- Backwash recycle turbidimeter
- Controllers for motorized multi-port filter valves
- Treated water free chlorine residual analyzer
- Potable water free chlorine residual analyzer with pH and temperature probe (for CT compliance)
- Filter effluent flowmeters (1 per filter)
- Treated water flowmeter
- Backwash waste flowmeter
- Backwash recycle flowmeter
- Low and High level switches in Storage Tank
- Low and High level switches in Backwash Recycle Tank
- Level transducer in Storage Tank
- Level transducer in Backwash Recycle Tank
- Booster Pump High pressure switch
- Backwash Recycle Pump pressure switch
- Building intrusion switch

The intent is to design the control system such that a complicated custom programmable logic controller (PLC) is not necessary. Rather, an XIO web-based control system is recommended to monitor, control, and log the operation of the new treatment facility and provide remote access to the facility for monitoring purposes. The treatment process will be called to run on a Start level setpoint in the storage tank and will shut off when the tank level reaches a Stop level setpoint. Backwashes will be able to be triggered automatically by the valve controllers, but it is more likely that they will be triggered manually be an operator while onsite, approximately once per week per filter. Coagulant and sodium hypochlorite metering pumps will be controlled by the plant effluent flowmeters to be flow paced which will inherently shut them down when the plant is not running. The control system will have the ability to shut the treatment process down when raw water turbidity is high, to allow the system to use stored water and "ride out the storm" to minimize the solids loading the filters and ensure turbidity requirements are met.

5.1.10. Alarms

Alarms will be provided for the following conditions, which will be sent out via the control system (by text, telephone, email or combination thereof).

- High turbidity (from each turbidimeter)
- Low and High free chlorine residual (from each analyzer)
- Low and High Backwash Recycle Tank Level
- Low and High Storage Tank Level
- High treated water flow
- Backwash failure (each filter)
- Building intrusion

5.1.11.Treatment Building

The new filters, pumps, controls, and analyzers will be housed in a new 20-ft x 30-ft (600 sf) building. The building will be supported by a reinforced slab foundation. The walls will be concrete masonry unit (CMU) block, supporting open web steel trusses with a metal roof to safeguard against wildfires.

5.1.12.Ancillary Systems

The following ancillary systems will be provided to support the new water treatment and storage system.

5.1.12.1. HVAC

A small electric heater will be installed in the building to keep the interior temperature above freezing. A small exhaust fan will be provided adjacent to the sodium hypochlorite system to vent any chlorine gases to the outside to prevent interior corrosion.

5.1.12.2. Communications

An internet connection will be provided at the new water treatment plant building for monitoring the new treatment equipment. It is anticipated that a local internet service provider (ISP) is available and capable of providing this service to the site.

5.1.12.3. Electrical Service

A new underground electrical service from Pacific Gas and Electric (PG&E) will be provided to the site, via the proposed access road off Camp Creek Road. A new pole or pad mount transformer will be provided to support the new system.

5.1.12.4. Solar/Battery Backup Power System

Due to the remote location of the site and frequent and sustained power outages, a battery backup system with solar panels is recommended. For this project, the Tesla Powerwall (or equal) with solar panels installed on the roof the building of externally mounted is recommended. The cost for the solar system is slightly higher than a traditional engine generator system, but no fuel is required, and it uses a renewable technology. Also, fuel deliveries to the area may be cutoff due to road closures making a solar-based backup system more reliable. It is also likely that the solar system can recoup costs via net metering (providing power back to the utility).

5.1.12.5. Security Fencing

The new water treatment plant building, and backwash recycle tank will be protected by a chain link fence with barbed wire. A 3-ft wide person door and 12-ft wide double gate will be provided for access.

5.2. Water Meters

Approximately 34 water meters will be installed at each developed property, in the location of the service connection shutoff valve. The new water meters will meet current California fire code requirements and will likely be 1” meters. All meters will be radio-read capable, likely via a portable receiver rather than an automated meter reading (AMR) system typical of larger water systems to reduce complexity.

6. Permitting Requirements

Permitting for this project will be required to comply with the California Environmental Quality Act (CEQA) and Humboldt County's use and building requirements.

6.1. CEQA Compliance

Section 60101 of the Title 22 of the California Code of Regulations (CCR) lists specific activities within Categorical Exemption classes. This list includes construction of the new water treatment plant, demolition of the existing treatment plant and storage tank, and installation of water meters. However, the construction of the new water storage tank does not qualify for a Categorical Exemption since the capacity is greater than 100,000 gallons. Therefore, it is anticipated that an Initial Study and Negative Declaration or Mitigated Negative Declaration will be required for this project. We anticipate that the State Water Resources Control Board will be the CEQA lead agency for the project.

6.2. Humboldt County Use and Building Permits

The property upon which the proposed water treatment plant and water storage tank are located is zoned as U-Unclassified according to Humboldt County's GIS webpage. Permitting uses on a U-zoned parcel include:

- One-family dwelling
- General agriculture
- Rooming, and boarding of not more than two (2) persons
- Manufactured home

All other uses may be permitted upon the granting of a Use Permit from the Humboldt County Planning Commission. Therefore, a use permit for the site will need to be secured prior to construction.

In addition to the use permit, a building permit is anticipated to be required for the new treatment plant structures and the new water storage tank.

7. Construction Phasing

The existing water treatment system will remain online and operational until the new water treatment system is completed and fully tested. At that time, the redwood tank will be demolished, and the new water storage tank constructed in its place. The new booster pumps will provide filtered, chlorinated water directly to the distribution system (similar to operation of the existing system). However, CT requirements will likely not be met due to insufficient contact time in the piping between the water treatment plant and the first customer's connection. Therefore, a boil water notice may be necessary until the new water storage tank is constructed, fully tested, and brought online. From the time the redwood tank is demolished to the time the new storage tank is brought online is estimated to be between 1 and 2 months. During this time, bottled water may be brought in for customers for potable purposes.

During installation of the water meters, service to each property will be temporarily shut off for up to 4 hours. Property owners will be notified in advance of the shutdown.

8. Estimated Construction, Permitting, Easement and Construction Services Costs

The estimated construction cost for this project is $1.7 million (Table 3). This estimate has an expected accuracy with a low range of -10% to -20% and a high range of +10% to +30% (Class 3 estimate). Including permits, easements, engineering services during construction and construction administration, the total estimated project cost is $2.1 million (not including planning costs already secured). See Appendix C for the detailed cost estimate.

Table 3: Estimated Construction, Permitting, Easement and Construction Services Costs

Item		Cost
A-Construction Cost[1]	$	1,698,000
B-Permitting	$	50,000
C-Easements	$	20,000
D-Engineering Services During Construction (6% of A)	$	84,900
E-Construction Management (15% of A)[2]	$	254,700
Total Estimated Cost	**$**	**2,107,600**

Notes:
1. Class 3 estimate. Includes 30% design contigency for undefined items.
2. Assumes 1-year construction period with inspector onsite 2 days/week

9. Estimated O&M Costs

The estimated annual cost to operate and maintain (O&M) the water treatment system is approximately $31,000 per year (Table 4). With 34 active connections, this results in an estimated cost of $75 per month. See Appendix D for the detailed O&M cost estimate.

Table 4: Estimated Operation and Maintenance (O&M) Costs

Item		Cost
Electricity	$	600
Chemicals	$	296
Maintenance	$	7,182
Operations Personnel	$	18,200
Management and Regulatory Compliance	$	2,080
Internet and Web-Based Controls	$	2,340
Total Annual O&M Cost	**$**	**30,698**
No. Active Connections		34
Estimated Monthly Cost per Connection	**$**	**75**

Appendix A – Jar Testing

Orleans Mutual Water Company
Humboldt County
Inline Filtration
Jar Test

by Guy Schott, P.E.

November 11, 2020

Orleans MWC, November 11, 2020
Source Water Characteristics

<u>Source: Crawford Creek</u>

pH: 8.0

Alkalinity: 61 mg/L as $CaCO_3$

Turbidity: 0.11 NTU

UVT: 97.9%

UVA: 0.008/cm

<u>0.4 um Filtered</u>

Turbidity: 0.08 NTU

UVT: 97.8%

UVA: 0.009/cm

Using the P200 UVT/UVA analyzer;
calibrated with organic free water.

UVT/UVA, pathlength 10 mm

UV transmittance (UVT) is a measurement of the amount of ultraviolet light (commonly at 254 nm due to its germicidal effect) that passes through a water sample compared to the amount of light that passes through a pure water sample. The measurement is expressed as a percentage, % UVT.

$\%UVT = 10^{(-UVA)} \times 100\%$

UV absorbance (UVA) is calculated as a relative measure of the amount of light absorbed by a water sample compared with the amount of light absorbed by a pure water sample.

$UVA = -\log(\%UVT/100)$

Applied Coagulants for Jar Testing

CalChem CC 2135

30-35% Aluminum Chlorohydrate

30-35% Water

35% polyamines (80% water, 20% active polyamines)

SG = 1.2-1.34

Max dose: 71 mg/L as product; equivalent to max dose 5 mg/L polyamines

Product dose 14.2 mgL = 1 mg/L polyamine

BWS, Inc.
Advanced Coagulant
AdvFloc-CTC-00011
Polyaluminum Chloride
12.55% Al_2O_3
64.9% Basicity
SG = 1.299
Max dose: 250 mg/L as product

Gregory F. Nieckarz, Ph.D.
Principal Consultant
SWS Consulting, LLC.
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gregn.swsc@gmail.com

Laboratory Charge Analyzer

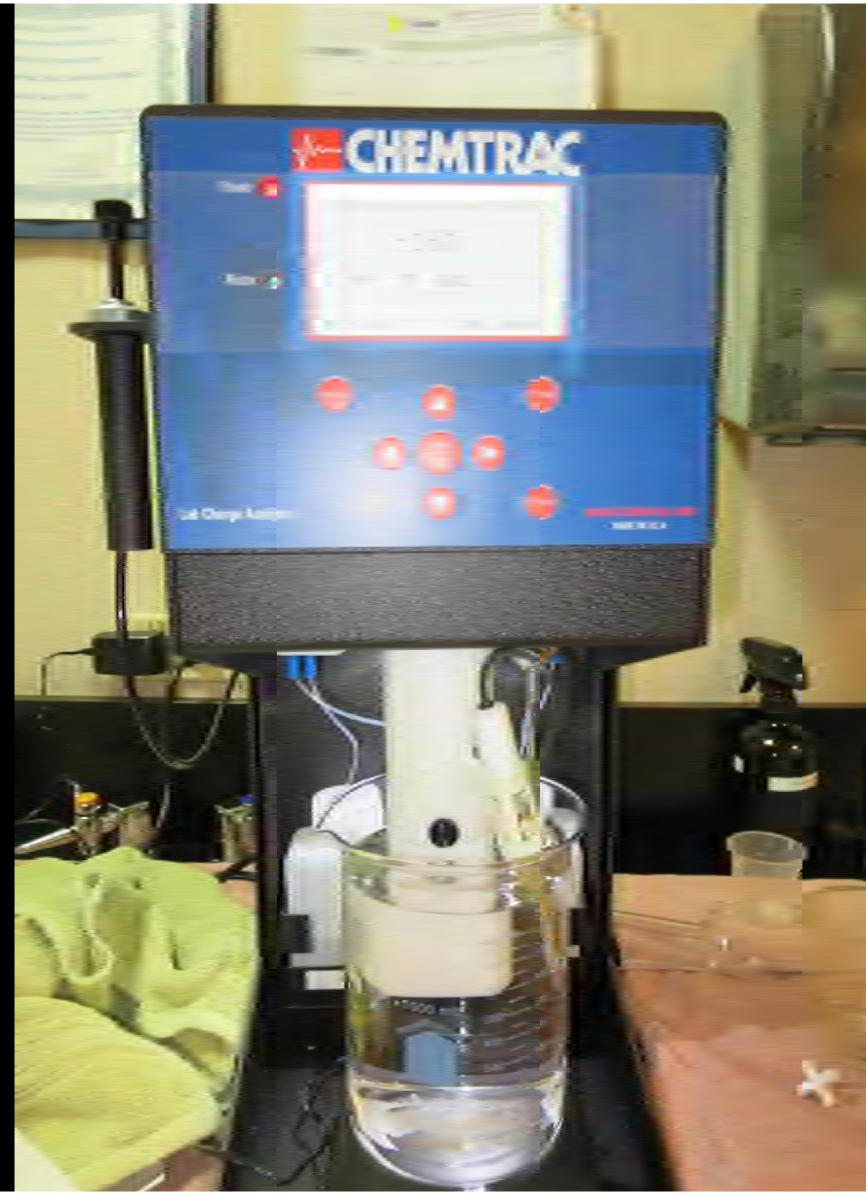
- LCA: Used to determine coagulant demand of a source water entering the treatment plant.

- pH adjusted to 7.5 with Acetic Acid

- Source pH: 8.0

- LCA #1:
- CC 2135: 1.8 mg/L as product

- LCA #2:
- Adv Coagulant: 36 mg/L as product



Coagulant Information

- Unless stated otherwise, all coagulant doses are reported as Product (100% strength).
- Preparation of coagulant stock solutions are generally 1.0 or 0.1 percent strength using 100 and/or 200 mL volumetric flasks.
- Finnpipette F2 variable volume pipette, capacity 100-1000 micro liters is used for stock solution preparation and coagulant aid jar test dosing.
- Finnpipette F2 variable volume pipette, capacity 0.5-5 mL is used for primary coagulant jar test dosing.

Orleans MWC: Jar Test 1-8 Results
Source: Crawford Creek

Jar #	200 RPM Flash Mix Duration seconds	10 RPM Floc Mix seconds	CC 2135 mg/L	Filtrate NTU	Filtrate %UVT	Filtrate UVA/cm	%UVA Reduction
J1	20	120	1.0	0.08	98.4	0.006	25.0
J2	20	120	1.5	0.14	98.0	0.008	0
J3	20	120	2.0	0.15	97.6	0.010	0
J4	20	120	2.5	0.15	97.6	0.010	0
J5	20	120	0.6	0.13	98.0	0.008	0
J6	20	120	0.8	0.09	98.3	0.007	12.5
J7	20	120	1.0	0.09	98.5	0.006	25.0
J8	20	120	1.2	0.14	98.1	0.008	0

Orleans MWC: Jar Test 9-16 Results
Source: Crawford Creek

Jar #	200 RPM Flash Mix Duration seconds	10 RPM Floc Mix seconds	Adv Coag. mg/L	Filtrate NTU	Filtrate %UVT	Filtrate UVA/cm	%UVA Reduction
J9	20	120	20	0.12	98.9	0.004	50.0
J10	20	120	25	0.10	98.9	0.004	50.0
J11	20	120	30	0.11	98.9	0.004	50.0
J12	20	120	35	0.09	99.1	0.003	62.5
J13	20	120	10	0.08	98.9	0.004	50.0
J14	20	120	15	0.11	98.6	0.006	25.0
J15	20	120	35	0.07	99.2	0.003	62.5
J16	20	120	40	0.10	99.1	0.003	62.5

Orleans MWC: Jar Test 17-24 Results
Source: Crawford Creek; Flash Mix 200 RPM (20 seconds)

Jar #	10 RPM Floc Mix seconds	CC 2135 mg/L	Adv Coag. mg/L	Filtrate NTU	Filtrate %UVT	Filtrate UVA/cm	%UVA Reduction
J17	120	0	4	0.13	97.3	0.011	0
J18	120	0	6	0.12	97.5	0.011	0
J19	120	0	8	0.12	97.6	0.010	0
J20	120	0	10	0.13	97.4	0.011	0
J21	120	0	20	0.13	98.4	0.007	12.5
J22	120	0	25	0.09	98.3	0.007	12.5
J23	120	0	35	0.09	98.5	0.006	25.0
J24	120	1.0	0	0.08	98.0	0.008	0

Orleans MWC: Jar Test 25-28 Results
Source: Crawford Creek

Jar #	200 RPM Flash Mix Duration seconds	10 RPM Floc Mix seconds	Adv Coag. mg/L	Filtrate NTU	Filtrate %UVT	Filtrate UVA/cm	%UVA Reduction
J25	20	0	25	0.08	98.6	0.006	25.0
J26	20	0	35	0.08	98.4	0.006	25.0
J27	20	120	35	0.08	98.5	0.006	25.0
J28	0	120	35	0.10	98.4	0.006	25.0

Orleans MWC: Jar Test 29-32 Results
Source: Crawford Creek

Jar #	200 RPM Flash Mix Duration seconds	10 RPM Floc Mix seconds	CC 2135 mg/L	Filtrate NTU	Filtrate %UVT	Filtrate UVA/cm	%UVA Reduction
J29	20	0	0.8	0.11	98.0	0.008	0
J30	20	0	1.0	0.15	97.8	0.009	0
J31	20	120	1.0	0.15	97.8	0.009	0
J32	0	120	1.0	0.15	97.7	0.009	0

Jar Testing for 1-Liter Jars: Procedures for Most Treatment Plants

1. Fill jars with source water prior to coagulant injection and set paddle speed at 30 rpm
2. Add chemicals (i.e., NaOCl, primary coagulant, coagulant aid) to each jar
3. Flash mix for 15-30 seconds (200 rpm)
4. Slow mix for 5 minutes (20-30 rpm)
5. Settled for 5 minutes. Syringe 25 mL from each jar taken 1-inch below surface (25 mL/12 sec rate). For this study, 25 mL was taken at end of floc period.
6. Filtered through 1.2 um isopore membrane into cuvette drip rate, 15 mL/(50-90 sec)
7. Measure filtrate turbidity, chlorine residual and %UVT/UVA
8. Measure settled water turbidity after 25 minutes of total setting
9. Record all data

Jar Test
Filterability Test Equipment

- Turbidity Instrument

- Syringe w/Luer-Lock Tip, 30 cc
(part#: 2225800, by Hach)

- Swinnex Filter Holder, 25 mm
(part#: SX0002500)

- Isopore Membrane Filter, 1.2 um absolute pore size,
Φ= 25 mm , thickness: 24 um,
hydrophilic polycarbonate membrane
(part #: RTTP02500)

Go to Sigma-Aldrich for laboratory supplies
http://www.sigmaaldrich.com/united-states.html

Isopore Membrane Information

Categories	Information
trade name	Isopore
filter color	White
chemistry	Polycarbonate (PC)
water flow rate	Avg. 175 mL/min x cm² (typical results @ 10 psi)
media	Isopore®
wettability	Hydrophilic
porosity	14.7%
pore size	1.2 µm
bubble point at 23 °C	1.0 bar, air with water
thickness	24 µm
filter diameter (ø)	25 mm
material size	polycarbonate, Hydrophilic, 1.2 µm, 25 mm, white, plain, 100

Isopore Membrane Background Information

The Isopore membrane is a polycarbonate, track-etched screen filter recommended for all analyses in which the sample is viewed on the surface of the membrane. The Isopore membrane is composed of polycarbonate film, which has a smooth, glass-like surface for clearer sample observation. The unique manufacturing process of the membrane ensures a precise pore diameter and a consistent pore size for accurate separation of samples by size. Matched-weight filters are not usually required because of low, constant tar and ash weights.

Features & Benefits:
Membrane structure retains particles on the surface, simplifying counting and analysis

Jar Test - Filterability Test

- Syringe ~ 25 mL from jar (after 5-minutes of settling)
- Filter-to-waste 3-5 mL
- Filter directly into clean cuvette
- Measure turbidity
- Note: Take several readings before recording final NTU results. Micro bubbles can adhere to glass causing false NTU readings. To remove bubbles, tilt cuvette up to 90 degrees.

Contact

- Guy Schott, P.E.
- State Water Resources Control Board
- Division of Drinking Water
- Santa Rosa, CA

Go to Stock Solution/Dose calculations/Jar Test Results for tools to download

www.waterboards.ca.gov/drinking_water/programs/districts/mendocino_district.html

- Email: Guy Schott - Guy.Schott@waterboards.ca.gov
- Office Number: 707-576-2732

Appendix B – Pipeline Flocculation Calculations

Project No. 19-013
Project Title: Orleans Mutual Water Company WTP Upgrade Project - Pipeline Flocculator Calcs
Input By: Joe Riess, PE
Date: 1/21/2021

Pipeline Flocculator Program - Version 5.0 (make entry into blue areas)

Pipe Length	115	feet				
Flow	55	gpm	0.122541	cfs	0.0792	MGD
Pipe Diameter	6	inches	0.6241	ft/sec		
Water Temp	5	°C	41.0	F		
Total Headloss	6.4	inches, for total pipeline		Calculate Headloss	• Manually Inputted Headloss	
Volume	22.6	ft^3				
GPM/Ft^2	280	calculated				
u	3.1805E-05	viscosity of water (lb*s/f^2)				
ρ	1.94	density of water (slugs/ft^3)				
ν	1.6394E-05	Kinematic viscosity of water (ft^2/s)				
Reynolds #, R	19,034	1.90E+04				
Absolute Roughness (e)	0.0000050	ft				
Relative Roughness	0.000010	e/D				
f (friction factor)	0.026230	64/R =	0.0034			
Headloss	0.437848	inches	0.03649	feet		
contact time	184	seconds	3.1	minutes	OK. Greater than 120 seconds.	
HP	0.0073720	HP/ft^2	0.037545			
ft^3/sec	0.12254083					
G (1/sec)	75.1	OK. Between 10,000 and 100,000.				
Gt (overall)	**13,846**	for flow-through pipeline flocculator, Gt should be 10^4 - 10^5 (10,000 - 100,000)				

Material	Absolute Roughness (e)	
Drawing tubing	0.000005	(ft)
Welded steel	0.00015	(ft)
Galvanized iron	0.0005	(ft)
Cast iron	0.00085	(ft)
Concrete	0.001- 0.01	(ft)

Sumarry of Results

	Flow gpm	Flow, ft/sec	G (1/sec)	Gt	Contact Time, min	Pipe Size, inches	Pipe Length, feet	Reynolds #	Headloss, inches	Friction Factor, f	Temp, °C
Save	55.0	0.62	75	13,846	3.1	6	115	19,034	6.36	0.02623	5
Save	55.0	0.62	#DIV/0!	#DIV/0!	0.0	6	0	19,034	0.00	0.02623	5
Save	55.0	0.62	#DIV/0!	#DIV/0!	0.0	6	0	19,034	0.00	0.02623	5
		Sum:	**#DIV/0!**	**#DIV/0!**	**3.1**		**115**		**6.4**		

Appendix C – Construction, Permitting, Easements and Construction Services Cost Estimate

Summary of Construction, Permitting, Easements and Construction Services Costs

WWE Project No. 19-013
Project Name: Orleans Mutual Water Company Water Treatment and Storage Improvements Project
Design Stage: Preliminary
Prepared By: Joe Riess, P.E.
Prepared Date: 1/13/2021

WATERWORKS ENGINEERS

Item	Cost
A-Construction Cost[1]	$ 1,698,000
B-Permitting	$ 50,000
C-Easements	$ 20,000
D-Engineering Services During Construction (6% of A)	$ 84,900
E-Construction Management (15% of A)[2]	$ 254,700
Total Estimated Cost	**$ 2,107,600**

Notes:
1. Class 3 estimate. Includes 30% design contigency for undefined items.
2. Assumes 1-year construction period with inspector onsite 2 days/week.

	Primary Characteristic	*Secondary Characteristic*			
ESTIMATE CLASS	**LEVEL OF PROJECT DEFINITION** Expressed as % of complete definition	**END USAGE** Typical purpose of estimate	**METHODOLOGY** Typical estimating method	**EXPECTED ACCURACY RANGE** Typical variation in low and high ranges [a]	**PREPARATION EFFORT** Typical degree of effort relative to least cost index of 1 [b]
Class 5	0% to 2%	Concept Screening	Capacity Factored, Parametric Models, Judgment, or Analogy	L: -20% to -50% H: +30% to +100%	1
Class 4	1% to 15%	Study or Feasibility	Equipment Factored or Parametric Models	L: -15% to -30% H: +20% to +50%	2 to 4
Class 3	10% to 40%	Budget, Authorization, or Control	Semi-Detailed Unit Costs with Assembly Level Line Items	L: -10% to -20% H: +10% to +30%	3 to 10
Class 2	30% to 70%	Control or Bid/ Tender	Detailed Unit Cost with Forced Detailed Take-Off	L: -5% to -15% H: +5% to +20%	4 to 20
Class 1	50% to 100%	Check Estimate or Bid/Tender	Detailed Unit Cost with Detailed Take-Off	L: -3% to -10% H: +3% to +15%	5 to 100

Notes: [a] The state of process technology and availability of applicable reference cost data affect the range markedly. The +/- value represents typical percentage variation of actual costs from the cost estimate after application of contingency (typically at a 50% level of confidence) for given scope.
[b] If the range index value of "1" represents 0.005% of project costs, then an index value of 100 represents 0.5%. Estimate preparation effort is highly dependent upon the size of the project and the quality of estimating data and tools.

Construction Cost Estimate-PRELIMINARY

WWE Project No.	19-013
Project Name:	Orleans Mutual Water Company Water Treatment and Storage Improvements Project
Design Stage:	Preliminary
Prepared By:	Joe Riess, P.E.
Prepared Date:	1/13/2021

Division	Division Name		Total
00 00 00	*Procurement and Contracting Requirements*	*$*	*-*
01 00 00	*General Requirements*	*$*	*-*
02 00 00	Existing Conditions	$	10,200
03 00 00	Concrete	$	41,481
04 00 00	Masonry	$	150,000
05 00 00	Metals	$	10,000
06 00 00	*Woods, Plastics, and Composites*	*$*	*-*
07 00 00	Thermal and Moisture Protection	$	5,000
08 00 00	Openings	$	1,500
09 00 00	Finishes	$	3,000
10 00 00	Specialties	$	500
11 00 00	*Equipment*	*$*	*-*
12 00 00	Furnishings	$	1,000
13 00 00	Special Construction	$	20,000
14 00 00	*Conveying Equipment*	*$*	*-*
21 00 00	*Fire Suppression*	*$*	*-*
22 00 00	Plumbing	$	1,000
23 00 00	Heating, Ventilating, and Air Conditioning (HVAC)	$	1,000
25 00 00	*Integrated Automation*	*$*	*-*
26 00 00	Electrical	$	27,000
27 00 00	Communications	$	5,000
28 00 00	*Electronic Safety and Security*	*$*	*-*
31 00 00	Earthwork	$	54,918
32 00 00	Exterior Improvements	$	13,000
33 00 00	Utilities	$	230,000
34 00 00	*Transportation*	*$*	*-*
35 00 00	*Waterway and Marine Construction*	*$*	*-*
40 00 00	Process Integration	$	303,120
41 00 00	*Material Processing and Handling Equipment*	*$*	*-*
42 00 00	*Process Heating, Cooling, and Drying Equipment*	*$*	*-*
43 00 00	Process Gas and Liquid Handling, Purification, and Storage Equipment	$	14,000
44 00 00	*Pollution and Waste Control Equipment*	*$*	*-*
45 00 00	*Industry-Specific Manufacturing Equipment*	*$*	*-*
46 00 00	Water and Wastewater Equipment	$	10,000
48 00 00	*Electrical Power Generation*	*$*	*35,000*

A - Subtotal (Sum Divisions 00 - 48):			**$**	**936,719**
B - Design Contingency	30%	of (A)	$	281,016
C - Contractor Overhead	8%	of (A+B)	$	97,419
D - Contractor Profit	7%	of (A+B)	$	85,241
E - Taxes, Bonds, and Insurance	8%	of (A+B)	$	97,419
F - Contingency	10%	of (A+B+C+D+E)	$	149,781
G - Escalation	3%	of (A+B+C+D+E+F)	$	49,428
TOTAL ESTIMATED CONSTRUCTION COST			**$**	**1,698,000**

Division 00 00 00 - Procurement and Contracting Requirements									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 00 00 00 TOTAL									**$ -**

Division 01 00 00 - General Requirements									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 01 00 00 TOTAL									**$ -**

Division 02 00 00 - Existing Conditions									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
Surveying	1	LS	$ 7,000	$ 1,000				$ -	$ 1,000
(E) WTP Demolition	1	LS	$ 2,000	$ 2,000	72	hr	$100	$ 7,200	$ 9,200
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 02 00 00 TOTAL									**$ 10,200**

Division 03 00 00 - Concrete									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
WTP Slab	22.2	cy	$800.00	$ 17,778				$ -	$ 17,778
BW Tank Slab	29.6	cy	$800.00	$ 23,704				$ -	$ 23,704
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 03 00 00 TOTAL									**$ 41,481**

Division 04 00 00 - Masonry									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
WTP Building	600	sf	$ 250	$ 150,000				$ -	$ 150,000
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 04 00 00 TOTAL									**$ 150,000**

Division 05 00 00 - Metals									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
Steel Trusses	1	LS	$ 8,000	$ 8,000				$ -	$ 8,000
Metal Roof Decking	1	LS	$ 2,000	$ 2,000				$ -	$ 2,000
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 05 00 00 TOTAL									**$ 10,000**

Division 06 00 00 - Woods, Plastics, and Composites									
GENERAL - Description	Material				Labor				Total
	Qty	Unit	$/Unit	$	Qty	Unit	$/Unit	$	$
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 06 00 00 TOTAL									**$ -**

Division 07 00 00 - Thermal and Moisture Protection									
GENERAL - Description	Material				Labor				Total
	Qty	Unit	$/Unit	$	Qty	Unit	$/Unit	$	$
Roof Insulation	1	LS	$ 1,000.00	$ 1,000				$ -	$ 1,000
Metal Roofing	1	LS	$ 4,000.00	$ 4,000				$ -	$ 4,000
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 07 00 00 TOTAL									**$ 5,000**

Division 08 00 00 - Openings									
GENERAL - Description	Material				Labor				Total
	Qty	Unit	$/Unit	$	Qty	Unit	$/Unit	$	$
4'x8' Door	1	LS	$ 1,000	$ 1,000				$ -	$ 1,000
4'x6' Window	1	LS	$ 500	$ 500				$ -	$ 500
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 08 00 00 TOTAL									**$ 1,500**

Division 09 00 00 - Finishes									
GENERAL - Description	Material				Labor				Total
	Qty	Unit	$/Unit	$	Qty	Unit	$/Unit	$	$
Painting	1	LS	$ 3,000	$ 3,000				$ -	$ 3,000
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 09 00 00 TOTAL									**$ 3,000**

Division 10 00 00 - Specialties									
GENERAL - Description	Material				Labor				Total
	Qty	Unit	$/Unit	$	Qty	Unit	$/Unit	$	$
Identification Devices	1	LS	$ 500	$ 500				$ -	$ 500
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
Installation				$ -				$ -	$ -
DIV 10 00 00 TOTAL									**$ 500**

Division 11 00 00 - Equipment									
GENERAL - Description	Material				Labor				Total
	Qty	Unit	$/Unit	$	Qty	Unit	$/Unit	$	$
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
Installation				$ -				$ -	$ -
DIV 11 00 00 TOTAL									**$ -**

Division 12 00 00 - Furnishings									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
Misc Furnishing	1	LS	$ 1,000	$ 1,000				$ -	$ 1,000
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
Installation				$ -				$ -	$ -
DIV 12 00 00 TOTAL									**$ 1,000**

Division 13 00 00 - Special Construction									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
Cathodic Protection System	2	LS	$ 10,000	$ 20,000				$ -	$ 20,000
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
Installation				$ -				$ -	$ -
DIV 13 00 00 TOTAL									**$ 20,000**

Division 14 00 00 - Conveying Equipment									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
	1			$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 14 00 00 TOTAL									**$ -**

Division 21 00 00 - Fire Suppression									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 21 00 00 TOTAL									**$ -**

Division 22 00 00 - Plumbing									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
Plumbing Specialties	1	LS	$ 1,000	$ 1,000				$ -	$ 1,000
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 22 00 00 TOTAL									**$ 1,000**

Division 23 00 00 - Heating, Ventilating, and Air Conditioning (HVAC)									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
Exhaust Fan	1	LS	$ 500	$ 500				$ -	$ 500
Elec. Heater	1	LS	$ 500	$ 500				$ -	$ 500
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 23 00 00 TOTAL									**$ 1,000**

Division 25 00 00 - Integrated Automation									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 25 00 00 TOTAL									**$ -**

Division 26 00 00 - Electrical									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
Electrical Service to Site	1	LS	$ 15,000	$ 15,000				$ -	$ 15,000
Building Electrical	1	LS	$ 5,000	$ 5,000				$ -	$ 5,000
Booster Pump VFD	1	LS	$ 4,000.00	$ 4,000				$ -	$ 4,000
Backwash Recycle Pump VFD	1	LS	$ 3,000.00	$ 3,000				$ -	$ 3,000
				$ -				$ -	$ -
DIV 26 00 00 TOTAL									**$ 27,000**

Division 27 00 00 - Communications									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
Internet to Site (underground)	1	LS	$ 5,000	$ 5,000				$ -	$ 5,000
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 27 00 00 TOTAL									**$ 5,000**

Division 28 00 00 - Electronic Safety and Security									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 28 00 00 TOTAL									**$ -**

Division 31 00 00 - Earthwork									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
Structural Excavation	60.4	CY	$ 25	$ 1,511				$ -	$ 1,511
Structural Backfill	60.4	CY	$ 15	$ 907				$ -	$ 907
Pipe Trenching (bedrock exc.)	525	LF	$ 100	$ 52,500				$ -	$ 52,500
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 31 00 00 TOTAL									**$ 54,918**

Division 32 00 00 - Exterior Improvements									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
Chainlink fencing and gates	260	LF	$ 50	$ 13,000				$ -	$ 13,000
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 32 00 00 TOTAL									**$ 13,000**

Division 33 00 00 - Utilities									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
Backwash Recovery Tank	1	LS	$ 60,000	$ 60,000				$ -	$ 60,000
Water Storage Tank	1	LS	$ 126,000	$ 126,000				$ -	$ 126,000
Water Meters	40	EA	$ 1,100.00	$ 44,000				$ -	$ 44,000
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 33 00 00 TOTAL									**$ 230,000**

Division 34 00 00 - Transportation									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 34 00 00 TOTAL									**$ -**

Division 35 00 00 - Waterway and Marine Construction									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 35 00 00 TOTAL									**$ -**

Division 40 00 00 - Process Interconnections									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
6" RW Piping-yard	160	LF	$ 72	$ 11,520				$ -	$ 11,520
2" TW Piping-yard	300	LF	$ 24	$ 7,200				$ -	$ 7,200
6" PW Piping-yard	700	LF	$ 72	$ 50,400				$ -	$ 50,400
Bypass Connection and Valves	1	LS	$ 5,000	$ 5,000				$ -	$ 5,000
Fire Hydrant Assembly	1	LS	$ 6,000	$ 6,000				$ -	$ 6,000
Piping Specialties	1	LS	$ 3,000	$ 3,000				$ -	$ 3,000
Interior Mechanical-Misc Piping	1	LS	$ 20,000	$ 20,000				$ -	$ 20,000
Pipe Supports	1	LS	$ 10,000	$ 10,000				$ -	$ 10,000
Process Control System (XiO)	1	LS	$ 50,000	$ 50,000				$ -	$ 50,000
Turbidimeters	6	EA	$ 4,000	$ 24,000				$ -	$ 24,000
Flowmeters	6	EA	$ 1,000	$ 6,000				$ -	$ 6,000
Free Chlorine Analyzers	2	EA	$ 5,000	$ 10,000				$ -	$ 10,000
Filtration System	1	LS	$ 100,000	$ 100,000				$ -	$ 100,000
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 40 00 00 TOTAL									**$ 303,120**

Division 41 00 00 - Material Processing and Handling Equipment									
GENERAL - Description	**Material**				**Labor**				**Total**
	Qty	**Unit**	**$/Unit**	**$**	**Qty**	**Unit**	**$/Unit**	**$**	**$**
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
Installation				$ -				$ -	$ -
DIV 41 00 00 TOTAL									**$ -**

Division 42 00 00 - Process Heating, Cooling, and Drying Equipment									
GENERAL - Description	Material				Labor				Total
	Qty	Unit	$/Unit	$	Qty	Unit	$/Unit	$	$
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 42 00 00 TOTAL									$ -

Division 43 00 00 - Process Gas and Liquid Handling, Purification, and Storage Equipment									
GENERAL - Description	Material				Labor				Total
	Qty	Unit	$/Unit	$	Qty	Unit	$/Unit	$	$
Booster Pump	2	EA	$ 4,000	$ 8,000				$ -	$ 8,000
Backwash Supply Pump	2	EA	$ 3,000	$ 6,000				$ -	$ 6,000
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 43 00 00 TOTAL									$ 14,000

Division 44 00 00 - Pollution and Waste Control Equipment									
GENERAL - Description	Material				Labor				Total
	Qty	Unit	$/Unit	$	Qty	Unit	$/Unit	$	$
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 44 00 00 TOTAL									$ -

Division 45 00 00 - Industry-Specific Manufacturing Equipment									
GENERAL - Description	Material				Labor				Total
	Qty	Unit	$/Unit	$	Qty	Unit	$/Unit	$	$
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 45 00 00 TOTAL									$ -

Division 46 00 00 - Water and Wastewater Equipment									
GENERAL - Description	Material				Labor				Total
	Qty	Unit	$/Unit	$	Qty	Unit	$/Unit	$	$
Coagulant Pump	2	EA	$ 2,500	$ 5,000				$ -	$ 5,000
Sodium Hypochlorite Pump	2	EA	$ 2,500	$ 5,000				$ -	$ 5,000
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 46 00 00 TOTAL									$ 10,000

Division 48 00 00 - Electrical Power Generation									
GENERAL - Description	Material				Labor				Total
	Qty	Unit	$/Unit	$	Qty	Unit	$/Unit	$	$
Solar Backup Power System	1	LS	$ 35,000	$ 35,000				$ -	$ 35,000
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
				$ -				$ -	$ -
DIV 48 00 00 TOTAL									$ 35,000

Appendix D – O&M Cost Estimate

O&M Cost Estimate

WWE Project No.	19-013
Project Name:	OMWC Water Treatment and Storage Improvements Project
Design Stage:	Preliminary
Prepared By:	Joe Riess, P.E.
Prepared Date:	1/13/2021

Item		Value
Electricity:		
Electricity Cost per Month	$	50
Electricity Cost per Year	**$**	**600**
Chemicals:		
Coagulant lbs per Year	$	237
Cost per Pound	$	0.65
Coag Cost per Year	***$***	***154***
NaOCl gal per Year		113
Cost per Gallon	$	1.25
NaOCl Cost per Year	***$***	***141***
Total Chemical Cost per Year	**$**	**296**
Maintenance:		
Major Equipment Capital Cost	$	359,120
% of Major Equipment		2%
Maintenance Cost per Year	**$**	**7,182**
Operations Personnel:		
Days per Week		5
Hours per Day		2
Weeks per Year		52
Hours per Year		520
Labor Rate	$	35
Labor Cost per Year	**$**	**18,200**
Management and Regulatory Compliance:		
Days per Week		1
Hours per Day		2
Weeks per Year		52
Hours per Year		104
Labor Rate	$	20
Labor Cost per Year	**$**	**2,080**
Internet and Web-based Controls:		
Internet cost per Month	$	75
XiO cost per Month	$	120
Internet and Web-Based Controls Cost per Year	**$**	**2,340**

Annual O&M Cost Estimate Summary:

Item		Cost
Electricity	$	600
Chemicals	$	296
Maintenance	$	7,182
Operations Personnel	$	18,200
Management and Regulatory Compliance	$	2,080
Internet and Web-Based Controls	$	2,340
Total Annual O&M Cost	**$**	**30,698**
No. Active Connections		34
Estimated Monthly Cost per Connection	**$**	**75**

Appendix F

Mitigation Monitoring and Reporting Program

MITIGATION MONITORING AND REPORTING PROGRAM
ORLEANS MUTUAL WATER COMPANY WATER TREATMENT PLANT UPGRADE

Purpose of Mitigation Monitoring and Reporting Program: The California Environmental Quality Act (CEQA), Public Resources Code Section 21081.6, requires that a Mitigation Monitoring and Reporting Program (MMRP) be established upon completing findings. CEQA stipulates that "the public agency shall adopt a reporting or monitoring program for the changes to the project which it has adopted or made a condition of project approval in order to mitigate or avoid significant effects on the environment. The reporting or monitoring program shall be designed to ensure compliance during project implementation."

This MMRP has been prepared in compliance with Section 21081.6 of CEQA to ensure that all required mitigation measures are implemented and completed according to schedule and maintained in a satisfactory manner during the construction and operation of the Project, as required. A table (attached) has been prepared to assist the responsible parties in implementing the MMRP. The table identifies individual mitigation measures, monitoring/mitigation timing, the responsible person/agency for implementing the measure, and space to confirm implementation of the mitigation measures. The numbering of mitigation measures follows the numbering sequence found in the Initial Study and Mitigated Negative Declaration.

The State Water Resources Control Board (SWRCB) is the lead agency for the Project under CEQA and shall administer and implement the MMRP. The SWRCB is responsible for review of all monitoring reports, enforcement actions, and document disposition. The SWRCB shall rely on information provided by the Project site observers/monitors (e.g., construction manager, project manager, biologist, archaeologist, etc.) as accurate and up-to-date and shall provide personnel to field check mitigation measure status, as required.

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<table>
<tr><th rowspan="2">Mitigation Measure</th><th rowspan="2">Monitoring / Mitigation Timing</th><th rowspan="2">Reporting / Responsible Party</th><th colspan="2">Verification of Compliance</th></tr>
<tr><th>Initials</th><th>Date</th></tr>
<tr><td colspan="5">BIOLOGICAL RESOURCES</td></tr>
<tr><td>BIO-01: Avoid and Minimize Impacts to Special Status Plants
Prior to any construction-related ground disturbance occurring in areas of suitable habitat for special status plants, focused surveys shall be completed to determine the presence or absence of these species in the Study Area. The surveys shall be floristic in nature and shall be seasonally timed to coincide with the blooming period of these species (March to July; coast fawn lily), (May to September; white flowered rein orchid) and (June and August; Marble Mountain campion). If special-status species are not found during the focused surveys, then no further action is required.
If special-status plants are documented on the site, a report shall be submitted to CNDDB to document the status of the species on the site. If the Project is designed to avoid impacts to special-status plant individuals and habitat, no further mitigation for these species would be necessary.
If special-status plants are documented on the site and Project impacts to these species are anticipated, consultation with CDFW shall be conducted to develop a mitigation strategy. The proponent shall notify CDFW, providing a complete description of the location, size, and condition of the occurrence, and the extent of proposed direct and indirect impacts to it. The Project proponent shall comply with any mitigation requirements imposed by CDFW. Mitigation requirements could include but are not limited to, development of a plan to relocate the special-status plants (seed) to a suitable location outside of the impact area and monitoring the relocated population to demonstrate transplant success or preservation of this species or its habitat at an on or off-site location.</td><td>Prior to initiation of Project activities/ construction</td><td>Project Applicant; Qualified Biologist.</td><td></td><td></td></tr>
<tr><td>BIO-02: Avoid Impacts to Nesting and Migratory Birds
If ground disturbance including vegetation clearing and grubbing activities commence during the avian breeding season (February 1 through August 31), a qualified biologist</td><td>No more than 14 days prior to initiation of Project activities/</td><td>Qualified Biologist.</td><td></td><td></td></tr>
</table>

should conduct a pre-construction nesting bird survey no more than 14 days prior to initiation of Project activities and again immediately prior to construction. The survey area should include suitable raptor nesting habitat within 500 feet of the Project boundary (inaccessible areas outside of the survey area can be surveyed from the site or from public roads using binoculars or spotting scopes). Pre-construction surveys are not required in areas where Project activities have been continuous since prior to February 1, as determined by a qualified biologist. Areas that have been inactive for more than 14 days during the avian breeding season should be re-surveyed prior to resumption of Project activities. If no active nests are identified, no further mitigation is required. If active nests are identified, the following measure should be implemented: • A suitable nest buffer depending on species and surrounding land uses shall be established by a qualified biologist around active nests and no construction activities within the buffer shall be allowed until a qualified biologist has determined that the nest is no longer active (i.e., the nestlings have fledged and are no longer reliant on the nest, or the nest has failed). Encroachment into the buffer may occur at the discretion of a qualified biologist. Any encroachment into the buffer shall be monitored by a qualified biologist to determine whether nesting birds are being impacted. Specifically, surveys for bald and golden eagle nests shall be conducted within 2 miles of any construction areas supporting suitable nesting habitat and important eagle roost sites and foraging areas. Surveys shall be conducted in accordance with the USFWS Interim Golden Eagle Inventory and Monitoring Protocols, and CDFW's Bald Eagle Breeding Survey Instructions, or current guidance. If an active eagle's nest is found, project disturbance shall not occur within 0.5 mile of the active nest site during the breeding season (December 30 through July 1) or any disturbance if that action is shown to disturb the nesting birds. The 0.5 mile no disturbance buffer shall be maintained throughout the breeding season or until the young have fledged and are no longer dependent upon the nest or parental care for survival.	construction			
CULTURAL RESOURCES				

CUL-01: Cultural Resource Monitoring During Ground Disturbing Activities Due to the presence of numerous prehistoric and historic era cultural resources within the APE, a qualified archaeologist that meets the Secretary of the Interior's Professional Qualification Standards for prehistoric and historical archaeology shall be retained to conduct Cultural Resource Monitoring during initial ground disturbing activities associated with the Project (including but not limited to grubbing, grading, shearing, and excavation). The on-site archaeologist shall then be able to examine newly exposed soils for cultural remains and or changes in colors in exposed soils that might indicate the presence of archaeological materials. The Cultural Resource Monitor will also ensure that construction activities will not adversely impact any known features of the three historical resources described above. This Cultural Resource Monitor shall have "stop work" authority in the event that they believe they have encountered cultural materials or if the Project has impacted archaeological features associated with the three historical resources described above. The SWRCB will be notified and consulted immediately if cultural materials are encountered or if impacts to archaeological features occur. The Cultural Resource Monitor shall take daily notes and photographs documenting the construction activities observed and any cultural resources that are encountered. At the conclusion of the Project, the Cultural Resource Monitor shall also provide a final monitoring report which summarizes the construction activities observed and any cultural concerns that were noted during the construction effort.	During initial ground disturbing activities.	Qualified Archaeologist; Cultural Resource Monitor.		
CUL-02: Native American Monitoring During Ground Disturbing Activities Due to the presence of the NRHP listed Karuk Panamenik Ceremonial District and the contributing elements of this district within the APE, a qualified Native American Monitor from the Karuk Tribe shall be retained to conduct monitoring during initial ground disturbing activities associated with the Project (including but not limited to grubbing, grading, shearing, and excavation). This Native American Monitor would then be able to examine newly exposed soils for cultural remains and or changes in colors in exposed soils that might indicate the presence of archaeological materials or other culturally sensitive materials. This Monitor shall have "stop work" authority in the event that they believe they have encountered cultural or otherwise sensitive materials and shall take daily notes and photographs documenting the construction activities observed and any cultural resources that are encountered. At the conclusion of the Project, this Monitor shall also provide a final monitoring report which	During initial ground disturbing activities.	Native American Monitor (Karuk Tribe).		

summarizes the construction activities observed and any cultural concerns that were noted during the construction effort.				
CUL-03: Unanticipated Discoveries In the event that cultural resources are exposed during any future ground-disturbing activities, construction activities shall be halted in the immediate vicinity of the discovery. If the site cannot be avoided during the remainder of construction, an archaeologist who meets the Secretary of the Interior's Professional Qualifications Standards shall then be retained to evaluate the find's significance under CRHR criteria. The SWRCB will be consulted regarding the evaluation. If the discovery proves to be significant, additional work, such as data recovery excavation, may be warranted and shall be discussed in consultation with the SWRCB.	Immediately upon discovery.	SWRCB; Qualified Archaeologist.		
CUL-04: Treatment of Human Remains If human remains are identified, the specific procedures outlined by the NAHC, in accordance with Section 7050.5 of the California Health and Safety Code and Section 5097.98 of the Public Resources Code would be followed. 1. All excavation activities within 60-feet of the remains shall immediately stop, and the area shall be protected with flagging or by posting a monitor or construction worker to ensure that no additional disturbance occurs. 2. The construction manager or their authorized representative shall contact the County Coroner and the State Water Resources Control Board. 3. The coroner shall have two working days to examine the remains after being notified in accordance with HSC 7050.5. If the coroner determines that the remains are Native American and are not subject to the coroner's authority, the coroner shall notify NAHC of the discovery within 24 hours. 4. NAHC shall immediately notify the Most Likely Descendant (MLD), who shall have 48 hours after being granted access to the location of the remains to inspect them and make recommendations for treatment of them. Work shall be suspended in the area of the find until the landowner, in consultation with the MLD and the State Water Resources Control Board, approves the proposed	Immediately upon discovery.	SWRCB; county Coroner; landowner; Qualified Archaeologist		

treatment of human remains. 5. If the coroner determines that the human remains are neither subject to the coroner's authority nor of Native American origin, then the Cultural Resource Monitor, in consultation with the landowner and the State Water Resources Control Board, shall determine mitigation measures appropriate to the discovery.				
GEOLOGY AND SOILS				
GEO-01: Recommendations in the Geotechnical Report Prior to construction, the applicant shall implement all recommendations regarding geotechnical aspects of Project design and construction presented in the Geotechnical Report prepared by Bajada Geosciences, Inc. (Bajada Geosciences, Inc. 2022).	Prior to construction.	Project Applicant.		
GEO-02: Consult of Corrosion Expert Prior to construction, the applicant shall consult a corrosion specialist to assess the soil at the proposed water treatment building and backwash reclaim tank and the soil at the proposed water storage tank. After the assessment of the soil on the Project site, corrosion protection measures prepared by the corrosion specialist shall be implemented to mitigate potential soil instability due to corrosion.	Prior to construction.	Project Applicant; Corrosion Specialist.		
GEO-03: Identification of Paleontological Resource During Project Construction In the event a paleontological or other geologically sensitive resources (such as fossils or fossil formations) are identified during any phase of Project construction, all excavations within 100-ft of the find shall be temporarily halted until the find is examined by a qualified paleontologist, in accordance with Society of Vertebrate Paleontology standards. The paleontologist shall notify the appropriate representative at Humboldt County who shall coordinate with the paleontologist as to any necessary investigation of the find. If the find is determined to be significant under CEQA, the County shall implement those measures which may include avoidance, preservation in place, or other appropriate measures, as outlined in Public Resources Code Section 21083.2.	Immediately upon discovery.	Humboldt County; Qualified Paleontologist.		
NOISE				
NOI-01: Construction Related Noise	During construction	Project		

The following shall be implemented during construction activities: • The operation of tools or equipment used in construction, drilling, repair, alternation, or demolition shall occur between the hours of 8 a.m. and 5 p.m. Monday through Friday, and between 9 a.m. and 5 p.m. on Saturdays. • No heavy equipment related to construction activities shall be allowed on Sundays or holidays. • All stationery and construction equipment shall be maintained in good working order and fitted with factor approved muffler systems.	activities.	Applicant.		

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