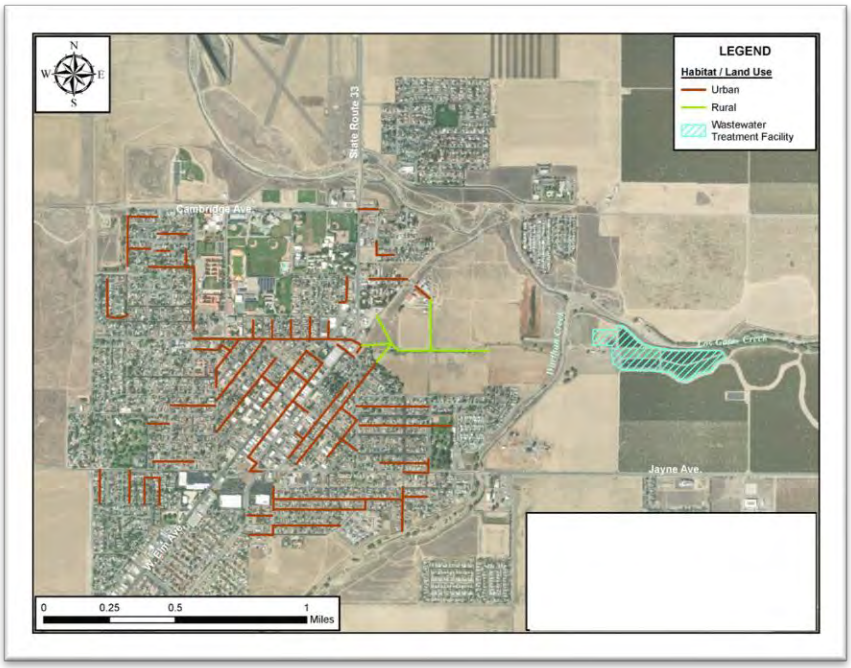


MITIGATED NEGATIVE DECLARATION

City of Coalinga Sanitary Sewer Collection System and Wastewater Treatment Plant Improvements Project

August 2026

PREPARED FOR:

City of Coalinga
155 W. Durian
Coalinga, CA 93210

PREPARED BY:

Crawford & Bowen Planning, Inc.
113 N. Church Street, Suite 310
Visalia, CA 93291

Initial Study/Mitigated Negative Declaration

City of Coalinga – Sanitary Sewer Collection System and Wastewater Treatment Plant Improvements Project

Prepared for:

City of Coalinga
155 W. Durian
Coalinga, CA 93210

Contact: Anthony Uribe
Phone: (559) 935-1533 ext. 181

Prepared by:

Crawford & Bowen Planning, Inc.
113 N. Church Street, Suite 310
Visalia, CA 93291

Contact: Travis Crawford, AICP
(559) 840-4414

August 2026

TABLE OF CONTENTS

CHAPTER ONE - INTRODUCTION
1.1 Project Summary 1-1
1.2 Document Format 1-1

CHAPTER TWO – PROJECT DESCRIPTION
2.1 Project Background 2-1
2.2 Location 2-2
2.3 Setting and Surrounding Land Uses 2-2
2.4 Project Description 2-5
2.5 Objectives 2-6
2.6 Other Required Approvals 2-6

CHAPTER THREE – INITIAL STUDY CHECKLIST 3-1
3.1 Environmental Checklist Form 3-1
3.2 Environmental Factors Potentially Affected 3-3
3.3 Determination 3-3

CHAPTER FOUR - MMRP 4-1

CHAPTER FIVE – PREPARERS 5-1

LIST OF FIGURES
1 – Regional Location Map 2-3
2 – Project Site Map 2-4

LIST OF TABLES
1 – Proposed Project Construction Emissions 3-12
2 – Typical Construction Noise Levels 3-59
3 – Typical Construction Vibration Levels 3-60

APPENDICES
A- Draft Preliminary Engineering Report – *City of Coalinga Sanitary Sewer Collection System and WWTP Improvements*
B- Air Emission Output Files
C- Biological Evaluation
D- Phase I Cultural Resource Survey (Confidential portions under separate cover)

Chapter 1

INTRODUCTION

INTRODUCTION

1.1 Project Summary

This document is the Initial Study/Mitigated Negative Declaration describing the potential environmental effects of a sanitary sewer collection system and WWTP improvements Project, which will replace or rehabilitate deteriorated gravity sewer mains throughout the City in order to provide adequate sewer services to all customers within the City's service area. More specifically, the proposed Project intends to rehabilitate approximately 30,815 LF (linear feet) of gravity sewer mains using trenchless construction methods, replace approximately 19,801 LF of gravity sewer mains via conventional construction methods, and make miscellaneous repairs and improvements to the City's Wastewater Treatment Plant (WWTP). Refer to Chapter Two – Project Description for more information.

The City of Coalinga (City) will act as the Lead Agency for this project pursuant to the *California Environmental Quality Act (CEQA)* and the *CEQA Guidelines.*

The Project is expected to be funded with Clean Water State Revolving Fund (CWSRF) funds administered through the California State Water Resources Control Board (Water Board). One requirement of CWSRF funding is that the CSD will be required to comply with the Water Board's environmental requirements, including CEQA-Plus. CEQA-Plus involves additional environmental analysis of certain topics to include federal thresholds, rules and regulations (for topics such as air, biology, cultural, etc.). In addition to this Mitigated Negative Declaration, the CSD is preparing a separate Environmental Package for submittal to the Water Board which includes the CEQA-Plus analysis.

1.2 Document Format

This IS/MND contains five chapters, and appendices. Section 1, Introduction, provides an overview of the project and the CEQA environmental documentation process. Chapter 2, Project Description, provides a detailed description of project objectives and components. Chapter 3, Initial Study Checklist, presents the CEQA checklist and environmental analysis for all impact areas, mandatory findings of significance, and feasible mitigation measures. If the proposed Project does not have the potential to significantly impact a given issue area, the relevant section provides a brief discussion of the reasons why no impacts are expected. If the Project could have a potentially significant impact on a resource, the issue area discussion provides a description of potential impacts, and appropriate mitigation measures and/or permit requirements that would

reduce those impacts to a less than significant level. Chapter 4, Mitigation Monitoring and Reporting Program, provides the proposed mitigation measures, completion timeline, and person/agency responsible for implementation and Chapter 5, List of Preparers, provides a list of key personnel involved in the preparation of the IS/MND.

Environmental impacts are separated into the following categories:

Potentially Significant Impact. This category is applicable if there is substantial evidence that an effect may be significant, and no feasible mitigation measures can be identified to reduce impacts to a less than significant level. If there are one or more "Potentially Significant Impact" entries when the determination is made, an EIR is required.

Less Than Significant After Mitigation Incorporated. This category applies where the incorporation of mitigation measures would reduce an effect from a "Potentially Significant Impact" to a "Less Than Significant Impact." The lead agency must describe the mitigation measure(s), and briefly explain how they would reduce the effect to a less than significant level (mitigation measures from earlier analyses may be cross-referenced).

Less Than Significant Impact. This category is identified when the project would result in impacts below the threshold of significance, and no mitigation measures are required.

No Impact. This category applies when a project would not create an impact in the specific environmental issue area. "No Impact" answers do not require a detailed explanation if they are adequately supported by the information sources cited by the lead agency, which show that the impact does not apply to the specific project (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 will not expose sensitive receptors to pollutants, based on a project-specific screening analysis.)

Regardless of the type of CEQA document that must be prepared, the basic purpose of the CEQA process as set forth in the CEQA Guidelines Section 15002(a) is to:

(1) Inform governmental decision makers and the public about the potential, significant environmental effects of proposed activities.
(2) Identify ways that environmental damage can be avoided or significantly reduced.
(3) Prevent significant, avoidable damage to the environment by requiring changes in projects through the use of alternatives or mitigation measures when the governmental agency finds the changes to be feasible.

(4) Disclose to the public the reasons why a governmental agency approved the project in the manner the agency chose if significant environmental effects are involved.

According to Section 15070(b), a Mitigated Negative Declaration is appropriate if it is determined that:

(1) Revisions in the project plans or proposals made by or agreed to by the applicant before a proposed mitigated negative declaration and initial study are released for public review would avoid the effects or mitigate the effects to a point where clearly no significant effects would occur, and

(2) There is no substantial evidence, in light of the whole record before the agency, that the project as revised may have a significant effect on the environment.

The Initial Study contained in Section Three of this document has determined that with mitigation measures and features incorporated into the Project design and operation, the environmental impacts are less than significant and therefore a Mitigated Negative Declaration will be adopted.

Chapter 2

PROJECT DESCRIPTION

Project Description

2.1 Project Background

The City of Coalinga (City) is located near the eastern foothills of the Diablo Range and to the west of the Central San Joaquin Valley in western Fresno County. The City is generally bounded by Lucile Avenue to the south, West Gale Avenue to the north, Monterey Street to the west and Springbrook Street to the East. The City of Fresno is located approximately 60 miles to the northeast and the City of Avenal is located approximately 18 miles to the southeast.

As a public agency, the City provides sewer service to residential, commercial, and industrial customers within their service area. The City's boundary encompasses approximately 6 square miles, of which 2.1 square miles are urbanized. The Sphere of Influence (SOI) encompasses 3.6 square miles.

The City owns and operates a citywide sewer collection system and a WWTP under Waste Discharge Requirements (WDR) No. 94-184. The current WDRs limit the volume of average monthly discharge to 1.34 million gallons per day. The sewer collection system currently serves 3,369 residences and 318 businesses. The WWTP site is located approximately one mile east of the City. The WWTP consists of screening, primary clarification, and secondary treatment (aerated facultative lagoons followed by stabilization lagoons). Undisinfected secondary effluent is pumped year-round to irrigate fodder crops such as alfalfa, Sudan grass, oat hay and pasture. The City maintains sewer assets in accordance with industry standard practices by performing preventive Maintenance on mechanical equipment and pipelines.

The City's sewer collection system is aged and some of the older portions of the system experience frequent blockages, overflows and require cleaning or removal of roots. The physical condition of some of these sewer lines is believed to be very poor, likely beyond their life expectancy, and needs to be replaced. Beyond the required Maintenance and repair activities, there has not been any major replacement or rehabilitation of the City's sewer collection system to date.

A condition survey of the sewer collection system was conducted to document the system's existing condition, identify deficiencies, and estimate the useful life of the sewer mains. The current physical condition of the system's components was assessed through site visits, discussion with City staff, and a comprehensive closed-circuit television (CCTV) inspection. As part of this PER, the City conducted a comprehensive CCTV inspection on the older portions of the sewer collection system.

The Project is being partially funded by the Clean Water State Revolving Fund (CWSRF).

2.2 Location

Coalinga is located near the eastern foothills of the Diablo Range and to the west of the Central San Joaquin Valley in western Fresno County (See Figure 1). The City is generally bounded by Lucile Avenue to the south, West Gale Avenue to the north, Monterey Street to the west and Springbrook Street to the East. The City of Fresno is located approximately 60 miles to the northeast and the City of Avenal is located approximately 18 miles to the southeast. The sewer pipeline improvements will occur within the City boundaries.

The segments of the sewer collection system recommended for replacement have been selected based on sorted NASSCO ratings and the condition of the existing sewer mains. It is recommended that the City rehabilitate approximately 30,815 LF of gravity sewer mains using trenchless construction methods, replace approximately 19,801 LF of gravity sewer mains via conventional construction methods before failure occurs. See Figure 2 for the specific locations of the sewer pipe segment replacements and rehabilitation.

In addition to the sewer collection system, several miscellaneous improvements and repairs are needed at the City's WWTP in order to improve treatment operations. Existing WWTP facilities are located approximately one mile east of the City at 30500 Jayne Avenue, Coalinga, CA 93210.

2.3 Setting and Surrounding Land Use

The Project site related to sewer pipe improvements consists of the City's existing public right-of-way, which are primarily paved streets throughout the residential neighborhoods, commercial and industrial areas of Coalinga. The Project site related to existing WWTP improvements consists of agriculture to the east, south and west, and Los Gatos Creek to the north.

Figure 1 – Regional Location Map

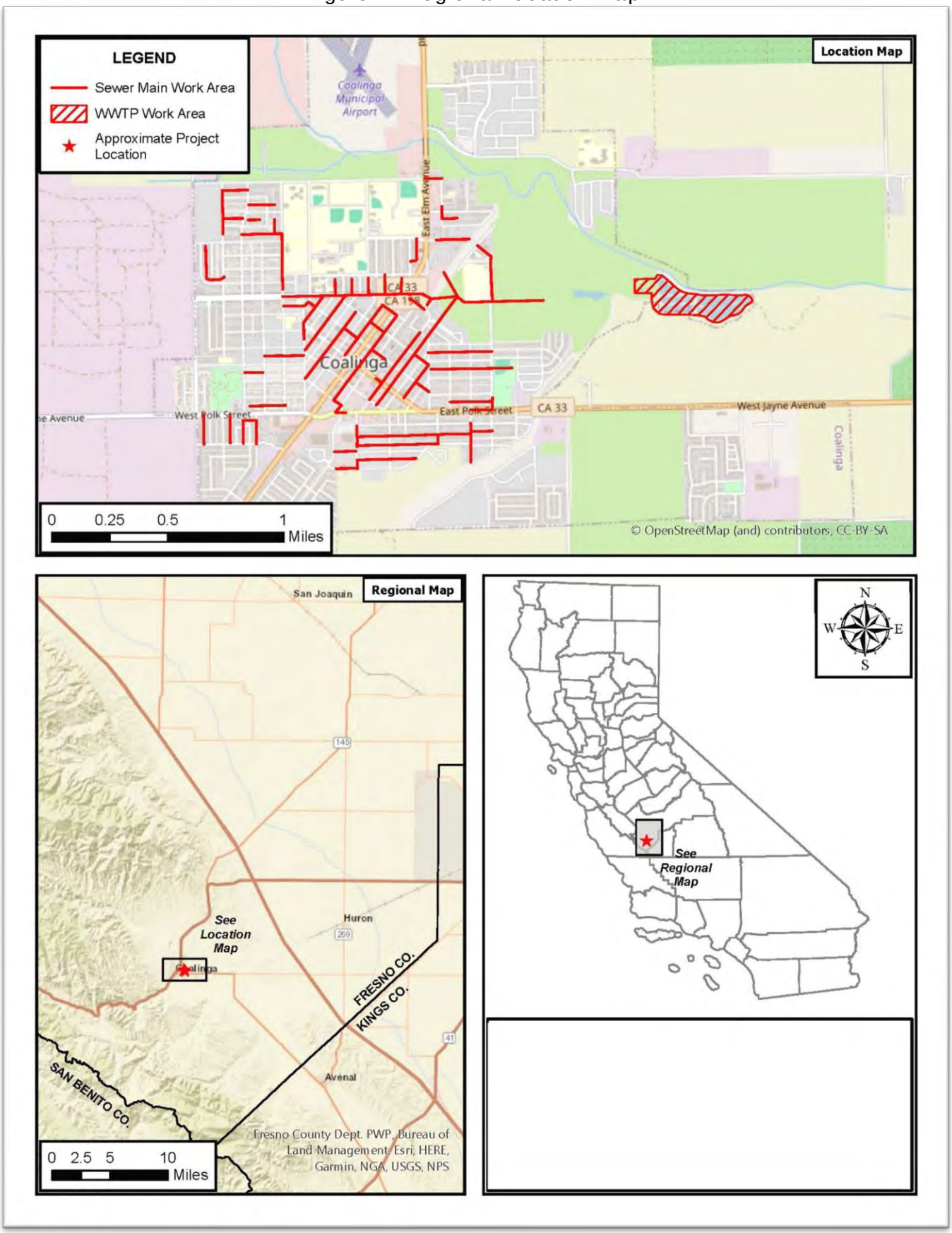
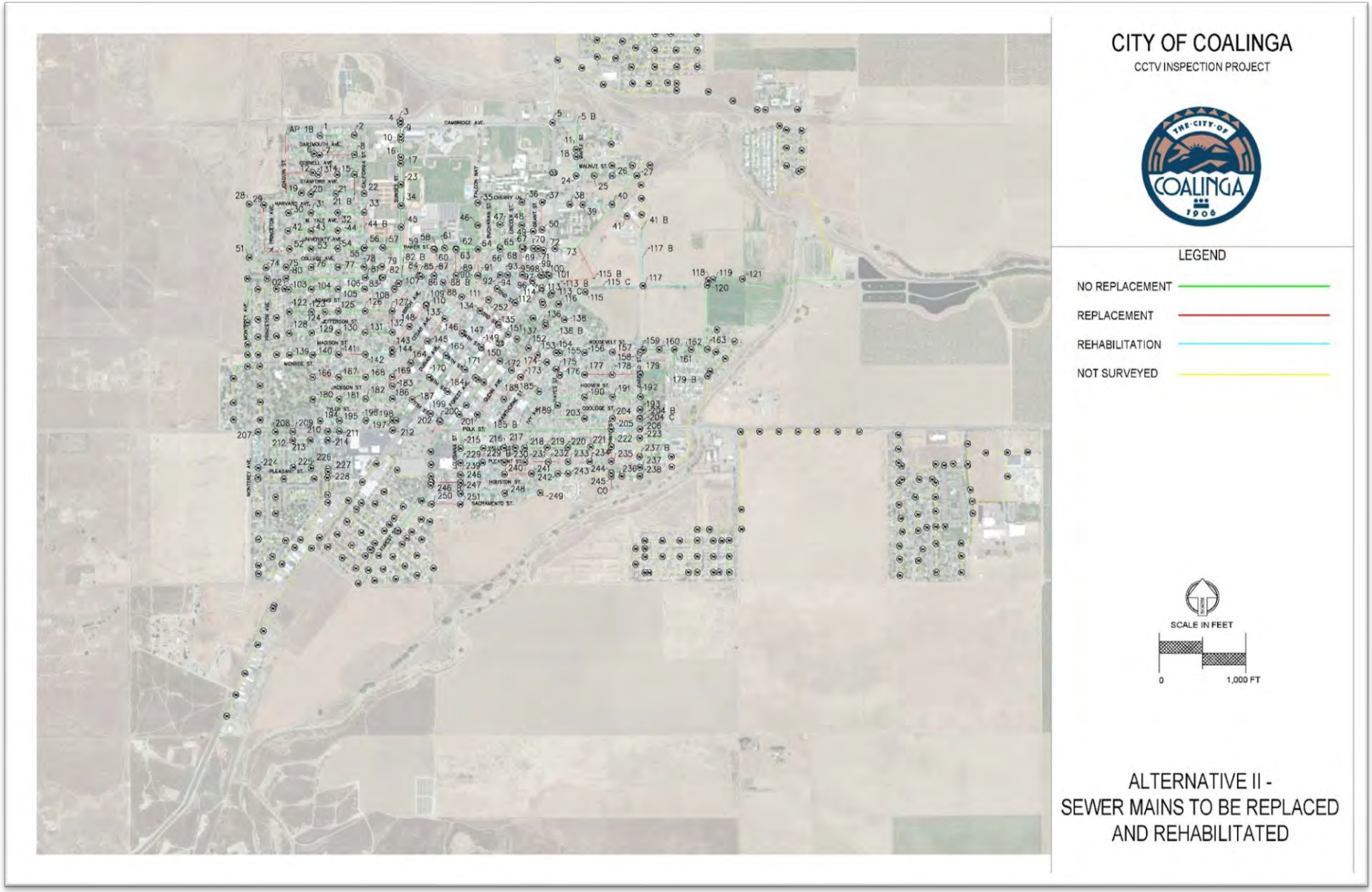


Figure 2 – Project Site Map
Proposed Sewer Collection System Improvements to be Replaced and Rehabilitated



2.4 Project Description

AM Consulting Engineers, Inc. prepared the *City of Coalinga – Sanitary Sewer Collection System and Wastewater Treatment Plant Improvements* Preliminary Engineering Report (December 2023) to provide a comprehensive evaluation of the Coalinga existing sewer collection system and provide recommendations that will address the needed sewer and WWTP improvements for the City. Please refer to that document, in Appendix A for specific project characteristics. A summary of Project activities is included herein.

The City proposes to rehabilitate approximately 30,815 LF of gravity sewer mains using trenchless construction methods, replace approximately 19,801 LF of gravity sewer mains via conventional construction methods, and provide miscellaneous repairs and improvements to the District's Wastewater Treatment Plant (WWTP). This Project will involve construction and operation of the following components:

1. **Sewer Main Replacement**: For this proposed Project, it is recommended that approximately 19,801 LF of gravity sewer mains be replaced with new sewer pipes before failure occurs. These replacements are recommended where the sags are greater than 60 percent of pipe diameter, broken pipe sections with visible voids and blockages, and severe pipe offsets. Where possible, replacements are limited to only those sections of pipe where the defects are found rather than replacing the entire stretch of pipe between two manholes. See Figure 2 for locations of pipe replacement.

2. **Sewer Main Rehabilitation**: Trenchless sewer rehabilitation is recommended for approximately 30,815 LF of sewer mains where applicable in order to reduce surface disturbance over traditional dig and replace methods, reduce the number of traffic and pedestrian detours, spare tree removal, decrease construction noise, and reduce air pollution from construction equipment. Cured-in-Place Pipe (also known as CIPP) rehabilitation is proposed for the pipe stretches that have mild defects and sag less than 60% of pipe diameter. See Figure 2 for locations of pipe rehabilitation.

3. **Improvements to Wastewater Treatment Plant:** The City's WWTP will be upgraded to an extended aeration system with biological nutrient removal with filtration and disinfection. The improvements will include a new aeration tank, two clarifiers, and five percolation ponds. The percolation ponds will be developed within the footprints of the facility's existing ponds, which comprise two aerated lagoons and three stabilization ponds. The existing ponds will be decommissioned and dewatered, following which heavy equipment will be used to remove

the clay liners from the bottom of each pond, converting their function to evaporation/percolation. The upgraded WWTP will not require off-site effluent disposal; therefore, current effluent disposal practices on adjacent City-owned property would be discontinued following project implementation. The purpose of upgrading the existing WWTP to an extended aeration activated system with biological nutrient removal facility is to lower the nitrogen concentration of the effluent before it is discharged to percolate the underground aquifer. Currently, the existing WWTP is not protective of the current beneficial use of the groundwater and is not consistent with RWQCB's policy of beneficial reuse. By upgrading the WWTP to include secondary/tertiary treatment and discharging the higher effluent quality to percolation ponds on site, the City will provide an incidental recharge of the groundwater aquifer, which will ultimately help demonstrate groundwater sustainability. By removing nitrogen, treated effluent will be allowed to percolate and be protective of the groundwater's beneficial uses.

Project Schedule

Approval of the CWSRF construction application is expected to take at nine months after submission to the SWRCB. After approval, the Project engineer can begin the Project design. Once the plans and specifications and construction documents have been prepared, bidding can begin, followed by construction. Construction time is expected to be one year.

2.5 Objectives

The primary objectives of the proposed Project are as follows:

- To provide adequate and safe sewer services to its customers.
- To prevent system failures and potential contamination associated with significant deterioration of the existing sewer infrastructure.
- To improve existing wastewater treatment abilities in the City's system with the most cost-effective methods available that meet the City's overall system performance and regulatory compliance requirements, but also to accommodate potential population growth in the Coalinga area.

2.6 Other Required Approvals

The proposed Project will include, but not be limited to, the following regulatory requirements:

- The adoption of a Mitigated Negative Declaration by the City of Coalinga.
- Regional Water Quality Control Board approval.
- State Water Board approval.

Chapter 3

IMPACT ANALYSIS

Initial Study Checklist

3.1 Environmental Checklist Form

Project title:

City of Coalinga – Sanitary Sewer Collection System and Wastewater Treatment Plant Improvements Project

Lead agency name and address:

City of Coalinga
155 W. Durian
Coalinga, CA 93210

Contact person and phone number:

Anthony Uribe
(559) 935-1533 ext. 181

Project location:

See Section 2.1

Project sponsor's name/address:

City of Coalinga
155 W. Durian
Coalinga, CA 93210

General plan designation:

Various, area-wide sewer improvement project

Zoning:

Various, area-wide sewer improvement project

Description of project:

See Section 2.3

Surrounding land uses/setting:

See Section 2.2

Other public agencies whose approval or consultation is required (e.g., permits, financing approval, participation agreements):

See Section 2.5

California Native American Tribal Consultation:

Have California Native American tribes traditionally and culturally affiliated with the project area requested consultation pursuant to Public Resources Code section 21080.3.1? If so, has consultation begun or is there a plan for consultation that includes, for example, the determination of significance of impacts to tribal cultural resources, procedures regarding confidentiality, etc.?

In accordance with Assembly Bill (AB) 52, potentially affected Tribes were formally notified of this Project and were given the opportunity to request consultation on the Project. The Native American Heritage Commission was contacted, requesting a contact list of applicable Native American Tribes, which was provided. Letters were provided to the listed Tribes, notifying them of the Project and requesting consultation, if desired. See Section 3.17 – Tribal Cultural Resources for more information.

3.2 Environmental Factors Potentially Affected

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact" as indicated by the checklist on the following pages.

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

3.3 Determination

Based on 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.

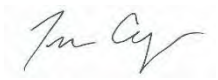
☒ I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the

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 1) 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.



July 31, 2026

Travis Crawford, AICP

Date

Crawford & Bowen Planning, Inc.

Environmental Consultant for the City of Coalinga

I. AESTHETICS

Except as provided in Public Resources Code Section 21099, would the project:	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
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. In non-urbanized areas, ssubstantially 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 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?	☐	☐	☒	☐

RESPONSES

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?

Less Than Significant Impact. A scenic vista is defined as a viewpoint that provides expansive views of highly valued landscape for the benefit of the general public. The Coastal Range and foothills are the primary natural and visual resources in the proposed Project region. Views of the mountains and hills are afforded only during clear conditions due to poor air quality in the valley. Distant views of the mountains and hills would largely be unaffected by the development of the Project because of the

nature of the Project, distance and limited visibility of these features from the Project site. The Project will not impact views of a protected scenic vista or resource from surrounding vantage points.

The proposed Project would not damage any trees, rock outcroppings or historic buildings within a State scenic highway corridor. Therefore, there is a ***less than significant impact.***

Mitigation Measures: None are required.

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 regulations governing scenic quality?

Less than Significant Impact. Improvements proposed by the City consist of the rehabilitation of approximately 30,815 linear feet (LF) of gravity sewer mains using trenchless construction methods, replacement of approximately 19,801 LF of gravity sewer mains via conventional construction methods, and provision of miscellaneous repairs and improvements to the City's Wastewater Treatment Plant (WWTP), see Chapter Two – Project Description. Views of surrounding areas associated with the sewer mains will not be impacted by the Project, since all of the finished work will be below grade or at-grade. The proposed WWTP improvements will be constructed or implemented on the current WWTP site, which is surrounded by fencing. There are no residences or businesses adjacent to the site, however, the WWTP will be viewable from travelers on surrounding roadways. Implementation of the proposed Project will alter the visual character of the existing WWTP site through the construction of additional buildings or structures as proposed by the City. The previously described improvements to the WWTP are not expected to create a visually degraded character or quality to the Project site or to the properties near and around the Project site, as the site has previously been developed with WWTP structures.

Construction activities will be seen by the residences and businesses within the immediate vicinity and by vehicles driving in the City; however, construction activities will be temporary.

As such, the proposed Project will not substantially degrade the existing visual character or quality of the area or its surroundings and will not conflict with applicable zoning and regulations governing scenic quality. The impact will be ***less than significant***.

Mitigation Measures: None are required.

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

Less Than Significant Impact. Currently the sources of light in the Project area are from security lights and vehicles traveling along surrounding roads. The Project will not introduce new lighting beyond the lighting types that currently exist at the WWTP. Additional night lighting sources on the Project site, especially any unshielded light, would result in spillover light that could impact surrounding adjacent uses. The City will require lighting systems to be shielded to direct light to ground surfaces and orient light away from adjacent properties. Accordingly, the proposed Project would not create substantial new sources of light or glare. There is a ***less than significant impact.***

Mitigation Measures: None are required.

II. AGRICULTURE AND FOREST RESOURCES

Would the project:

	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
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?	☐	☐	☐	☒

RESPONSES

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?

No Impact. Improvements proposed by the City consist of the rehabilitation of approximately 30,815 linear feet (LF) of gravity sewer mains using trenchless construction methods, replacement of approximately 19,801 LF of gravity sewer mains via conventional construction methods, and provision of miscellaneous repairs and improvements to the City's WWTP. The sewer mains and associated infrastructure will largely occur within the existing right of way and will be installed underground. The Project areas where the sewer main replacements and repairs will occur are characterized as Urban / Built Up Land by the Department of Conservation's Farmland Mapping & Monitoring Program (FMMP). The area associated with the proposed WWTP improvements is also characterized as Urban / Built Up Land by the FMMP. There are no farmlands on or adjacent to the site that would be impacted and no Williamson Act parcels will be affected. No conversion of forestland, as defined under Public Resource Code or General Code, as referenced above, would occur as a result of the proposed Project.

All improvements will take place within an area that is built up with rural and urban uses or is otherwise not characterized as farmland. As such, the proposed Project does not have the potential to result in the conversion of Farmland to non-agricultural uses or forestland uses to non-forestland. There is ***no impact***.

Mitigation Measures: None are required.

III. AIR QUALITY

Would the project:	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
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 or adversely affecting a substantial number of people)?	☐	☐	☒	☐

RESPONSES

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?

Less than Significant Impact. The San Joaquin Valley Air Basin (SJVAB) is designated nonattainment of state and federal health-based air quality standards for ozone and $PM_{2.5}$. The SJVAB is designated nonattainment of state PM_{10}.[1] To meet Federal Clean Air Act (CAA) requirements, the SJVAPCD has multiple air quality attainment plan (AQAP) documents, including:

[1] San Joaquin Valley Air Pollution Control District. Ambient Air Quality Standards & Attainment Status. https://www.valleyair.org/air-quality-information/ambient-air-quality-standards-valley-attainmnet-status/. Accessed July 2026.

Ozone Plans such as 2022 Ozone Plan for the San Joaquin Valley, 2016 Plan for the 2008 8-Hour Ozone Standard, 1-Hour Ozone Attainment Request, 2013 Plan for the Revoked 1-Hour Ozone Standard, 2007 Plan for the 1997 8-Hour Ozone Standard, and 2004 Extreme Ozone Attainment Demonstration Plan.

As well as Particulate Matter Plans such as, Particulate Matter (PM) Sources, 2024 Plan for the 2012 PM2.5 Standard, 2018 PM2.5 Plan for the San Joaquin Valley, 2016 Moderate Area Plan for the 2012 PM2.5 Standard, 2015 Plan for the 1997 PM2.5 Standard, 2012 PM2.5 Plan, 2008 PM2.5 Plan, 2006 PM2.5 Plan and 2003 PM2.5 Plan.

Because of the region's non-attainment status for ozone, $PM_{2.5}$, and PM_{10}, if the project-generated emissions of either of the ozone precursor pollutants (ROG or NOx), PM_{10}, or $PM_{2.5}$ were to exceed the SJVAPCD's significance thresholds, then the project uses would be considered to conflict with the attainment plans. In addition, if the project uses were to result in a change in land use and corresponding increases in vehicle miles traveled, they may result in an increase in vehicle miles traveled that is unaccounted for in regional emissions inventories contained in regional air quality control plans.

As discussed below, predicted construction and operational emissions would not exceed the SJVAPCD's significance thresholds for ROG, NOx, PM_{10}, and $PM_{2.5}$. As a result, the Project uses would not conflict with emissions inventories contained in regional air quality attainment plans, and would not result in a significant contribution to the region's air quality non-attainment status. Additionally, the Project would comply with all applicable rules and regulations.

The nonattainment pollutants for the SJVAPCD are ozone, PM_{10} and $PM_{2.5}$. Therefore, the pollutants of concern for this impact are ozone precursors, regional PM_{10}, and $PM_{2.5}$. Ozone is a regional pollutant formed by chemical reactions in the atmosphere, and the Project's incremental increase in ozone precursor generation is used to determine the potential air quality impacts, as set forth in the GAMAQI. The annual significance thresholds to be used for the Project emissions are as follows[2]:

Pollutant/ Precursor	Construction Emissions (tpy)	Operational Emissions (permitted) (tpy)	Operational Emissions (non-permitted) (tpy)
CO	100	100	100
NOx	10	10	10
ROG	10	10	10
SOx	27	27	27
PM_{10}	15	15	15
$PM_{2.5}$	15	15	15

[2] San Joaquin Valley Air Pollution Control District. March 19, 2015. Guide for Assessing and Mitigating Air Quality Impacts. https://www.valleyair.org/media/g4nl3p0g/gamaqi.pdf. Page 80. Accessed March 2026.

The proposed WWTP and sewer main improvements will generate minimal emissions once they are constructed. The estimated annual construction emissions are shown below. The Sacramento Metropolitan Air Quality Management District's Road Construction Emissions Model was utilized to estimate emissions generated from Project construction. Modeling results are summarized in Table 1 and the full Road Construction Emissions Model output files are provided in Appendix B.

Table 1
Proposed Project Construction Emissions

Pollutant/ Precursor	Construction Emissions (tpy)	Threshold/ Exceed?
CO	2.00	100/N
NOx	1.41	10/N
ROG	0.19	10/N
SOx	0.01	27/N
PM_{10}	0.09	15/N
$PM_{2.5}$	0.06	15/N
CO_2e	372.73	n/a

As shown in Table 1, construction emissions would be below the SJVAPCD's threshold for annual construction emissions. However, the SJVAPCD has implemented Regulation VIII measures for dust control related to construction projects, which are applicable to the Project and will be enforced by the City and the City's contractor.

The nearest sensitive receptors to the proposed Project site are the residential houses located along the proposed pipeline alignments. Construction would take place within the vicinity of sensitive receptors, however, construction emissions would be below SJVAPCD thresholds and would be temporary in nature. Therefore, the relatively small amount of emissions generated and the short duration of the construction period would not expose sensitive receptors to substantial pollutant concentrations.

Because the Project will not exceed any established air emission thresholds, does not result in a cumulatively considerable net increase of any criteria pollutant, and does not significantly impact sensitive receptors, the impact is determined to be ***less than significant.***

Mitigation Measures: None are required.

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

Less Than Significant Impact. During construction, the various diesel-powered vehicles and equipment in use on-site could create localized odors. These odors would be temporary and are not likely to be

noticeable for extended periods of time beyond the Project site. In addition, once the Project is operational, there would be no new source of odors from the Project since all sewer disposal will occur via underground pipelines. Therefore, the impact is ***less than significant.***

Mitigation Measures: None are required.

IV. BIOLOGICAL RESOURCES

Would the project:

	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
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 Game 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 Game or U.S. 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?	☐	☒	☐	☐

IV. BIOLOGICAL RESOURCES

Would the project:	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
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?	☐	☐	☐	☒

RESPONSES

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 Game 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 Game or U.S. Fish and Wildlife Service?

Less Than Significant Impact With Mitigation. A Biological Evaluation (BE) was prepared for the proposed Project in May 2026 by Live Oak Associates, Inc. (LOA). The BE is included as Appendix C. As part of the BE, the California Natural Diversity Data Base (CNDDB), the California Native Plant Society's Inventory of Rare and Endangered Plants, and the USFWS special status species lists were queried for records of special-status plant and animal species in the Project area. In addition, field surveys were conducted as described herein. The results of the BE are summarized as follows:

Environmental Setting

Urban

The sewer main work area is largely confined to municipal Coalinga and includes portions of streets, alleys, parking lots, residential and commercial properties, ruderal areas, and park lands that are collectively classified as "urban." The streets, alleys, and parking lots are developed features that are in most cases paved and entirely barren of vegetation. The residential properties are characterized by homes, outbuildings, and ornamental vegetation including trees, shrubs, turf, and other landscaping features. The project site's one commercial property is a motel; the portion of the property that falls within project boundaries is a landscaped strip with densely-spaced ornamental trees. The ruderal areas are disturbed roadside habitats that, at the time of LOA's survey, were characterized by unmaintained turf and/or common weeds. The park land is a portion of George E. Olsen Memorial Park that, at the time of the survey, contained maintained turf, ornamental trees, and fencing.

The project site's urban lands are of low habitat value for most native wildlife, given high levels of ambient disturbance and, in most areas, a lack of vegetative cover. Wildlife species expected to be found here would be those that are attracted to urban areas and/or tolerate disturbance, and those that are associated with adjacent lands and use or pass through urban areas incidentally.

Reptiles that could be found in the project site's urban lands include the western fence lizard (*Sceloporus occidentalisi*), California alligator lizard (*Elgaria multicarinata multicarinata*), and gopher snake (*Pituophis melanoleucus*). Amphibians are unlikely due to an absence of nearby breeding habitat.

A number of disturbance-tolerant avian species are likely to forage and nest in the site's urban lands. Trees and shrubs could support nesting by American robins (*Turdus migratorius*), Anna's hummingbirds (*Calypte anna*), northern mockingbirds (*Mimus polyglottos*), and mourning doves (*Zenaida macroura*), among other species. Mourning doves may also nest in ground vegetation. The site's residential structures could potentially be used for nesting by the house finch (*Haemorhous mexicanus*). All of the aforementioned birds may also forage in the site's urban lands, as could winter migrants such as the savannah sparrow (*Passerculus sandwichensis*) and yellow-rumped warbler (*Dendroica coronata*).

Small mammal species likely to occur in the project site's urban lands include the deer mouse (*Peromyscus maniculatus),* house mouse (*Mus musculus*), and Norway rat (*Rattus norvegicus*), among others. Burrowing rodent activity is expected to be limited due to the preponderance of pavement in this land use type, as well as regular maintenance practices in most of the unpaved areas. Less-maintained areas could support California ground squirrels (*Otospermophilus beecheyi*) and Botta's pocket gophers (*Thomomys bottae*).

Disturbance-tolerant mammalian predators such as raccoons (*Procyon lotor*) and striped skunks (*Mephitis mephitis*) are expected to occasionally forage on or pass through the site's urban lands. Various bat species may roost in trees and buildings within this land use type and may forage on or over these areas.

Rural

The sewer main work area also includes lands outside of municipal Coalinga that, while all human-altered in some form, experience lower levels of ambient disturbance than the urban land use type and are of higher value for native wildlife species. These include portions of ruderal or fallow fields, unpaved roads, an irrigation ditch, and the minimally maintained margins of these uses. While the roads were barren of vegetation, the fields and margins were characterized by sparse to dense growth of common weeds such as foxtail barley (*Hordeum murinum*), ripgut brome (*Bromus diandrus*), red-stemmed filaree (*Erodium cicutarium*), and cheeseweed (*Malva parviflora*), among others. Where the sewer main alignment crossed and then paralleled an irrigation ditch between urban Coalinga and the WWTP, several native trees including valley oak (*Quercus lobata*) and willow (*Salix* sp.) overhung the work area.

The project site's rural lands may be used by a variety of native wildlife species associated with agricultural and other open habitats. Reptiles that could be found in the project site's rural areas include the side-blotched lizard (*Uta stansburiana*), western whiptail (*Aspidoscelis tigris*), common kingsnake (*Lampropeltis californiae*), and gopher snake. Common amphibians such as the Sierran treefrog (*Pseudacris sierra*) and western toad (*Anaxyrus boreas*) may breed in nearby irrigation ditches and subsequently disperse through the site's rural lands.

Birds expected to nest within the project site's rural lands include common ground-nesting species such as the western meadowlark (*Sturnella neglecta*), killdeer (*Charadrius vociferus*), and mourning dove. Foraging species would include the western kingbird (*Tyrannus verticalis*) in the summer, savannah sparrow and American pipit (*Anthus rubescens*) in the winter, and American crow (*Corvus brachyrhynchos*), and Brewer's blackbird (*Euphagus cyanocephalus*) throughout the year. The site's rural lands are also likely to be used for foraging by open country raptors such as the red-tailed hawk (*Buteo jamaicensis*) and American kestrel (*Falco sparverius*). Trees within which these raptors could nest, while absent from the site's rural lands, are found immediately outside of project boundaries in some of these areas.

Small mammal species likely to occur in the site's rural lands include the deer mouse, California ground squirrel, Botta's pocket gopher, California vole (*Microtus californicus*), and Audubon's cottontail (*Sylvilagus audubonii*). Raccoons, striped skunks, and coyotes (*Canis latrans*) are likely to occur here from time to time. Various bat species may forage on or over the site's rural lands; however, roosting habitat is absent.

Wastewater Treatment Plant

The WWTP work area consists of lands and facilities used for wastewater treatment. It includes two aerated lagoons, each approximately 3 acres in size; three stabilization ponds collectively encompassing approximately 13 acres; two asphalt-bottomed sludge drying beds; a network of access roads around the pond perimeters; and other ruderal upland areas. At the time of LOA's field survey, most of these lands were highly maintained and barren of vegetation. Where present, vegetation consisted of patches of bermudagrass (*Cynodon dactylon*) and other non-native grasses and forbs. A small portion of the work area is outside of the fenced facility and appears infrequently maintained; this area, located immediately to the west of the aerated lagoons, supported dense cover of non-native grasses and forbs including ripgut brome, foxtail barley, and Russian thistle (*Salsola tragus*).

The WWTP's stabilization ponds are perennially inundated and support various wildlife species associated with aquatic environments. At the time of LOA's field survey, southwestern pond turtles (*Actinemys pallida*) were detected in all three stabilization ponds; this is a California Species of Special Concern that is also proposed for federal listing as threatened. Several amphibian species are likely to occur in the stabilization ponds; these include the Sierran treefrog, western toad, and American bullfrog (*Lithobates catesbeianus*). The stabilization ponds support both waterfowl and shorebirds. Examples of the former observed during LOA's survey include the ruddy duck (*Oxyura amicensis*), green-winged teal (*Anas crecca*), and mallard (*Anas platyrhynchos*), while examples of the latter include the great egret (*Ardea alba*), greater yellowlegs (*Tringa melanoleuca*), and black-necked stilt (*Himantopus mexicanus*). The ponds may serve as a source of mud for black phoebes and cliff swallows (*Petrochelidon pyrrhonata*) during nest-building, and black phoebes may also forage in flight over the ponds.

Upland areas of the WWTP may be utilized by basking turtles of the aforementioned species. Killdeer and black-necked stilts could nest on the ground in these areas. California ground squirrels were observed in upland areas of the WWTP at the time of LOA's survey, and other small mammals such as Botta's pocket gophers, deer mice, and California voles may also occur here. Raccoons and striped skunks are likely to use or pass through these areas from time to time.

Desktop Review

Many species of plants and animals within the state of California have low populations, limited distributions, or both. Such species may be considered "rare" and are vulnerable to extirpation as the state's human population grows and the habitats these species occupy are converted to agricultural and urban uses. As described more fully in Section 3.0, state and federal laws have provided California Department of Fish and Wildlife (CDFW) and the U.S. Fish and Wildlife Service (USFWS) with a mechanism for conserving and protecting the diversity of plant and animal species native to the state. A

sizable number of native plants and animals have been formally designated as threatened or endangered under state and federal endangered species legislation. Others have been designated as "candidates" for such listing. Still others have been designated as "species of special concern" by the CDFW. The California Native Plant Society (CNPS) has developed its own set of lists (i.e., California Rare Plant Ranks, or CRPR) of native plants considered rare, threatened, or endangered (CNPS 2025). Collectively, these plants and animals are referred to as "special status species."

The California Natural Diversity Data Base (CNDDB) was queried for special status plant and animal occurrences in the nine USGS 7.5-minute quadrangles containing and surrounding the project site (*Joaquin Rocks, Domengine Ranch, Harris Ranch, Alcalde Hills, Coalinga, Guijarral Hills, Curry Mountain, Kreyenhagen Hills,* and *Avenal*). A number of special status plants and animals were returned in the query and are summarized below in Table 1. Sources of information for this table included *California's Wildlife, Volumes I, II, and III* (Zeiner et. al 1988-1990), *California Natural Diversity Data Base* (CDFW 2025), *The Jepson Manual: Vascular Plants of California, second edition* (Baldwin et al 2012), the *California Native Plant Society's Inventory of Rare and Endangered Vascular Plants of California* (CNPS 2025), *Calflora.org, iNaturalist.org*, and *eBird.org*.

Reconnaissance Survey

A reconnaissance-level field survey of the project site was conducted on March 20 and 21, 2025 by LOA biologist Natalie Neff. The survey consisted of a meandering walk and drive through the project site while identifying its principal land uses and the constituent plants and animals of each land use. The field survey conducted for this study was sufficient to assess the significance of possible biological impacts associated with the development plans for the project site.

LOA conducted an analysis of potential project impacts based on the known and potential biotic resources of the project site. Sources of information used in the preparation of this analysis included: (1) results of the March 2025 reconnaissance-level surveys, (2) the *California Natural Diversity Data Base* (CDFW 2025), (3) the *Online Inventory of Rare and Endangered Vascular Plants of California* (CNPS 2025), and (4) manuals, reports, and references related to plants and animals of the San Joaquin Valley region.

LOA's field investigation did not include an aquatic resources delineation or focused surveys for special status species. The field survey was sufficient to generally describe those features of the project site that could be subject to the jurisdiction of the U.S. Army Corps of Engineers (USACE), California Department of Fish and Wildlife (CDFW), and/or the Regional Water Quality Control Board (RWQCB), and to assess the significance of possible biological impacts associated with development of the project site.

Effects Determinations

Critical Habitat

Critical habitat is a specific geographic area(s) that contains features essential for the conservation of a threatened or endangered species and that may require special management and protection.

Designated critical habitat is absent from the project site and surrounding lands. The nearest units of critical habitat are located some 30 miles from project boundaries in the Inner Coast Range, and are designated for the protection of the vernal pool fairy shrimp (*Branchinecta lynchi*) and California red-legged frog (*Rana draytonii*).

Special-Status Species

As identified in the BE, the Project may affect but is not likely to adversely affect protected species consisting of Monarch Butterfly, Southwestern Pond Turtle, Temblor Legless Lizard, California Glossy Snake, San Joaquin Coachwhip, Swainson's Hawk, Burrowing Owl, San Joaquin Kit Fox, American Badger, and Nesting Migratory Birds and Raptors. The Project is not expected to affect any other special-status species due to the lack of habitat or known occurrence records for those species near the Project site.

Migratory Birds

The BE concludes the Project may affect but is not likely to adversely affect nesting migratory birds.

Regulated Habitats

The BE concludes the Project will have **no effect** on regulated habitats as no impacts to such habitats are expected.

Direct and Indirect Impacts

The Project could adversely affect, either directly or through habitat modifications, several special-status animal species that occurs or may occur on or near the Project site. Construction activities such as excavating, trenching, or using other heavy equipment that disturbs or harms a special-status species or substantially modifies its habitat could constitute a significant impact. Therefore, Mitigation Measures identified below will be included in the conditions of approval to reduce the potential impacts to less-than-significant levels. A brief description of each potentially impacted protected species, followed by the corresponding mitigation is provided below.

Project Impacts to Monarch Butterfly

Potential Impacts. As discussed, the monarch butterfly (*Danaus plexippus*) has some potential to reproduce, forage, and roost within the project site (see Table 2). Reproduction takes place solely on milkweed (*Asclepias* sp.) plants, which could conceivably be found in those portions of the sewer main work area that pass through residential yards or park land (urban land use type) or ruderal/fallow fields (rural land use type). Milkweed, and by extension breeding, is not expected in the highly degraded habitats of the WWTP work area. Foraging may take place in any vegetated portion of the project site; this includes portions of the WWTP work area that do not experience regular vegetation management. Finally, roosting is a possibility in the few trees of the sewer main work area.

If milkweed occurs in portions of the project site that are planned for impact, the project may result in mortality of monarch eggs, larvae, and pupae, as well as loss of monarch reproductive habitat. These are considered potentially significant impacts under CEQA and NEPA.

Project construction is not expected to adversely affect foraging or roosting monarchs. Monarchs are highly mobile while foraging and would presumably have the ability to avoid active construction zones. After construction, any habitats that provide nectar resources for monarchs under existing conditions would be expected to naturally revegetate and return to their pre-project level of suitability for this species. Because the project will not remove any trees, it will not impact any monarchs that happen to be roosting on site at the time of construction and will not result in loss of monarch roosting habitat.

Mitigation. The following measures will be implemented to reduce the magnitude of potential project impacts to the monarch butterfly.

> ***Mitigation Measure BIO – 1A (Milkweed Survey).*** Prior to the start of construction, a qualified biologist will conduct a survey for milkweed plants in any portion of the sewer main work area that passes through residential yards, park land, ruderal/fallow fields, or other potentially suitable habitats. The survey will be conducted at a time of year when milkweed is readily identifiable. The objective of the survey will be to tally and map all milkweed plants that could potentially be impacted by project activities.
>
> ***Mitigation Measure BIO – 1B (Construction Timing).*** If feasible, no milkweed plants will be removed during the period when monarchs may be breeding in the project vicinity, March 15-October 31 (The Xerces Society 2019).
>
> ***Mitigation Measure BIO – 1C (Compensatory Mitigation).*** Any milkweed plants located within areas proposed for impact will be replaced at a 3:1 ratio in accordance with a revegetation plan prepared by a qualified biologist. The planting site(s) must be in similar or higher quality habitat to the habitat that was impacted, in area(s) that will not be treated with pesticides or herbicides.

Implementation of the above measures will reduce impacts to the monarch butterfly to a less than significant level under CEQA and NEPA.

Potential Project Impacts to the Southwestern Pond Turtle

Potential Impacts. As discussed, the southwestern pond turtle (*Actinemys pallida*) is present at the WWTP. At the time of LOA's survey, 36 individuals of this species were observed, evenly distributed among the three stabilization ponds. The turtles were of various growth stages, indicating that this is a breeding population. No turtles were observed in the aerated lagoons, and these features are presumably not suitable for this species due to surface turbulence and reduced water quality; the aerated lagoons represent an earlier stage of water treatment than the stabilization ponds. Pond turtles are likely to regularly bask in upland areas surrounding the three occupied ponds and may even nest within the fenced facility, as has been documented at wastewater treatment facilities elsewhere in California (Davidson and Alvarez 2020; M. Jennings, Rana Resources, pers. comm.). Water temperatures at the WWTP are likely warm enough that pond turtles would be able to remain active through much of the winter; however, during the coldest periods individuals may brumate underwater (M. Jennings, Rana Resources, pers. comm.).

During construction activities at the WWTP, resident pond turtles will be at considerable risk of direct injury or mortality, as well as disturbance leading to indirect mortality. Direct injury or mortality may result from heavy equipment operation in and around the occupied ponds. Subterranean eggs or hatchlings may be crushed, and migrating turtles may be struck and killed. Turtles may also respond to pond dewatering and construction-related noise and vibration by attempting to leave the area, making them vulnerable to predation and vehicle strikes. Construction-related injury and mortality of southwestern pond turtles, both direct and indirect, is a potentially significant impact of this project under CEQA and NEPA.

During operation of the upgraded WWTP, pond turtles would not be at heightened risk of direct injury or mortality because operational activities will be similar to existing. However, indirect mortality is likely to be higher than under baseline conditions due to periodic dry-down of the percolation ponds. Following construction, any given percolation pond will receive treated effluent until percolation rates drop, at which point the pond will be allowed to dry down and will be disked prior to being placed back in service. Pond dry-down will force turtles on to land and potentially out of the WWTP facility altogether, increasing their vulnerability to predation and vehicle strikes. Indirect mortality of southwestern pond turtles during the operations phase is also a potentially significant impact of the project under CEQA and NEPA.

Proposed WWTP upgrades will increase the extent of potential aquatic habitat for the western pond turtle while decreasing its habitat value. Specifically, the project will convert approximately 12.5 acres of suitable, occupied ponds and approximately 6 acres of unsuitable, unoccupied ponds to approximately 18.5 acres of ponds with fluctuating suitability for southwestern pond turtles. On the one hand, the percolation ponds will have higher water quality than existing, with lower levels of biochemical oxygen demand (BOD), total suspended solids (NSS), and nitrogen. Improved water quality in the future percolation ponds may boost invertebrate prey populations (M. Jennings, Rana Resources, pers. comm.) and otherwise benefit pond turtle fitness. On the other hand, unlike the stabilization ponds, the percolation ponds will not have a perennial inundation regime, but will cycle through inundated and dry periods based on percolation rates. At present, it is unknown how many months of the year any given pond will retain water. Habitat impacts are expected to have a net negative effect on southwestern pond turtles and are potentially significant under CEQA and NEPA.

Mitigation. The following measures will be implemented to reduce the magnitude of project-related impacts to the southwestern pond turtle.

> ***Mitigation Measure BIO – 2A (Construction Timing).*** Construction activities at the WWTP will take place entirely between the months of November and March to avoid the typical timeframe for southwestern pond turtle nesting and egg incubation in this locality.
>
> ***Mitigation Measure BIO – 2B (Preconstruction Survey).*** Within 24 hours prior to the start of construction at the WWTP, a qualified biologist will survey the WWTP work area to identify any locations of possible underground nests, as would be indicated by eggshells on the surface from predation. Because hatchlings sometimes overwinter underground in their nests, this survey is required even with the implementation of Mitigation Measure 4.1.2a above.
>
> ***Mitigation Measure BIO – 2C (Environmental Awareness Training).*** Prior to the start of construction at the WWTP, construction personnel will be trained on the identification, behavior, and ecology of the southwestern pond turtle, and the project-specific measures adopted for its protection. Attendees will be given a handout that summarizes the training material and provides a photographic key to differentiating between the southwestern pond turtle and the common non-native red-eared slider. Attendance at all training sessions will be documented on sign-in sheets.
>
> ***Mitigation Measure BIO – 2D (Refuge Ponds).*** Construction activities at the WWTP will be staged so that, at any given time, at least two ponds suitable for the southwestern pond turtles will be inundated to their full operational depth ("refuge ponds"). In the first stage, at least two of the existing stabilization ponds will remain inundated, as these (and not the aerated lagoons) are presently occupied by pond turtles. Construction activities may proceed at the remaining features. As any given feature is converted to a percolation pond and inundated to its full

operational depth, it will become a refuge pond and one of the previous refuge ponds may be released for dewatering and construction.

Mitigation Measure BIO – 2D (Construction Monitoring). One or more qualified biologists will continuously monitor construction activities at the WWTP for the protection of southwestern pond turtles. The biologist(s) will look for pond turtles attempting to leave the ponds or otherwise traveling through upland areas of the WWTP, and will hand-capture and relocate these individuals to the nearest refuge pond. Any red-eared sliders or other introduced turtles that are discovered during this effort will be removed from the WWTP and either permanently rehomed or humanely dispatched. The biologist(s) will monitor all ground-disturbing activities in upland areas, looking for any subterranean nests or hatchlings that may be unearthed. The biologist(s) will have the authority to stop work if any nests or hatchlings are detected, and will appropriately secure the area before construction resumes. The number of biologists on site at any given time will be determined by the scope and extent of construction activities.

Mitigation Measure BIO – 2E (WWTP Operational Practices to Ensure No Net Loss of Aquatic Habitat). During operation of the upgraded WWTP, periodic dry-down and disking of the percolation ponds will be staged so that, at any given time, at least three ponds encompassing a minimum of 12.5 acres will be inundated to their full operational depth.

Mitigation Measure BIO – 2F (Habitat Enhancement). When inundated, each percolation pond will be equipped with at least three turtle basking structures. Such devices may consist of logs or floating boards, anchored with chains and weights, that can be removed during periods of dry-down and reinstalled once the pond is ready to be placed back in service.

Mitigation Measure BIO – 2G (Annual Monitoring). For the first five years post-construction, a qualified biologist will conduct annual monitoring of the WWTP's southwestern pond turtle population. Monitoring surveys will be conducted between May and July, when pond turtles are most active, and will target favorable weather conditions for basking. The biologist will assess aquatic habitat suitability by noting inundation levels, recording the species composition and cover of any emergent vegetation, conducting a dipnet survey for invertebrate food sources, and evaluating other parameters as appropriate. The biologist will record the number of all turtles observed by species and age class. An attempt will be made to capture any red-eared sliders or other introduced turtles that are discovered during annual monitoring; captured individuals will be removed from the WWTP and either permanently rehomed or humanely dispatched. The biologist will document their findings in an annual report, to be submitted to the City of Coalinga and other agencies as necessary. If any corrective actions are needed, they will be identified in the annual report and promptly implemented by the City.

Implementation of the above measures will reduce potential project impacts to the southwestern pond turtle to a less than significant level under CEQA and NEPA.

Potential Project Impacts to the Temblor Legless Lizard, California Glossy Snake, and San Joaquin Coachwhip

Potential Impacts. As discussed, three special status terrestrial reptiles, the Temblor legless lizard (*Anniella alexanderae*), California glossy snake (*Arizona elegans occidentalis*), and San Joaquin coachwhip (*Masticophis flagellum ruddocki*), have some potential to occur along the Warthan and Los Gatos Creek corridors in the immediate project vicinity, and to wander onto the WWTP work area and/or rural portions of the sewer main work area from time to time. If any individuals of these species are present at the time of construction, they could be injured or killed by project activities. Construction-related injury or mortality of these three species is a potentially significant impact under CEQA and NEPA.

The project will not adversely affect the Temblor legless lizard, California glossy snake, or San Joaquin coachwhip through loss of habitat. The site consists of highly modified lands that do not constitute habitat for these special status reptiles but may nevertheless experience occasional use based on these species' potential presence along the adjoining creek corridors. Nearly all project impacts will be temporary, with the sewer mains located belowground and any disturbed surface habitats expected to return to their pre-project level of suitability following project implementation. Considerable habitat of similar or higher quality for these species will remain available in the project vicinity. Project-related loss of habitat for the Temblor legless lizard, California glossy snake, and San Joaquin coachwhip is not considered a significant impact under CEQA and NEPA.

Mitigation. The following measures will be implemented to avoid and minimize construction-related impacts to the Temblor legless lizard, California glossy snake, and San Joaquin coachwhip.

> ***Mitigation Measure BIO – 3A* (*Preconstruction Surveys*).** Within 24 hours prior to the start of construction activities at the WWTP and in rural portions of the sewer main work area, a qualified biologist will conduct preconstruction surveys for the Temblor legless lizard, California glossy snake, and San Joaquin coachwhip. The biologist will make an attempt to hand-capture any individuals of these species that are found and relocate them to suitable alternative habitat away from the work area.
>
> ***Mitigation Measure BIO – 3B (Environmental Awareness Training).*** Prior to the start of construction at the WWTP and in rural portions of the sewer main work area, construction personnel will be trained on the identification, behavior, and ecology of the Temblor legless lizard, California glossy snake, and San Joaquin coachwhip, and the project-specific measures adopted for its protection. Attendees will be given a handout that summarizes the training material. Attendance at all training sessions will be documented on sign-in sheets.
>
> ***Mitigation Measure BIO – 3C* (*Protective Measures During Construction*).** Workers will regularly inspect the work area for reptiles. At a minimum, this will include (1) checking for reptiles under and around any parked vehicles or equipment prior to their operation, (2) scanning

the ground for reptiles while operating vehicles or equipment, and (3) checking any open trenches or other excavations for trapped reptiles at the beginning and end of each work day. Any reptiles found during these inspections will be allowed to leave the area of their own volition, or will be captured and relocated out of harm's way.

Implementation of these measures will reduce project-related impacts to the Temblor legless lizard, California glossy snake, and San Joaquin coachwhip to a less than significant level under CEQA and NEPA.

Potential Project Impacts to the Swainson's Hawk

Potential Impacts. The Swainson's hawk, a California Threatened species, is likely to forage in rural portions of the project site from time to time, and may also nest in mature trees on or near the site, particularly outside of the urban core of Coalinga. No trees will be removed by the project; therefore, there is no appreciable potential for direct injury or mortality of nesting Swainson's hawks or their young. However, construction activities proximate to active nests may disturb the nests to the extent that the nests could fail or have reduced success. Project activities that injure, kill, or reduce the nesting success of Swainson's hawks would violate state and federal laws and be considered a significant impact under CEQA and NEPA.

Swainson's hawks would not be vulnerable to construction-related injury or mortality while foraging because they are highly mobile during this activity and are expected to avoid active work areas. The project is not expected to adversely affect this species through loss of foraging habitat. All impacts to potential Swainson's hawk foraging habitat will be temporary, as the sewer mains will be buried and surface habitats will be allowed to return to pre-project conditions. Loss of habitat for the Swainson's hawk is considered a less than significant impact of the project under CEQA and NEPA.

Mitigation. The following measures will be implemented to avoid and minimize construction-related impacts to Swainson's hawk.

***Mitigation Measure BIO – 4A* (*Construction Timing*).** If feasible, project construction will occur entirely outside of the March -September 15 Swainson's hawk nesting season.

***Mitigation Measure BIO – 4B* (*Protocol Nesting Surveys*).** If construction activities must occur between March 1 and September 15, then a qualified biologist will conduct protocol nesting surveys in accordance with the Swainson's Hawk Technical Advisory Committee (SHTAC) 2000 *Recommended Timing and Methodology for Swainson's Hawk Nesting Surveys in California's Central Valley*. Surveys will be conducted in at least the two SHTAC-defined survey periods immediately preceding construction. The survey periods are Period 1: January-March 20, Period II: March 20-April 5, Period III: April 5-20, Period IV: April 21-June 10, Period V: June 10-July 30.

Mitigation Measure BIO – 4C (Avoidance of Active Nests). Should any active nests be discovered within the survey area, an appropriate disturbance-free buffer will be established by the biologist based on local conditions and agency guidelines. Disturbance free buffers will be identified on the ground with flagging, fencing, or by other easily visible means and will be maintained until a qualified biologist has determined that the young have fledged and are capable of foraging independently.

Implementation of these measures will reduce project-related impacts to the Swainson's hawk to a less than significant level under CEQA and NEPA and facilitate compliance with state and federal laws protecting this species.

Potential Project Impacts to the Burrowing Owl

Potential Impacts. Although LOA is not aware of any recent, nearby sightings of the burrowing owl, rural portions of the sewer main work area could potentially be used by individuals of this species if it occurs in the vicinity. Burrowing owls are particularly vulnerable to construction-related impacts while occupying underground burrows, either for nesting or roosting. In the unlikely event that one or more burrowing owls were to be occupying burrows within the project site at the time of construction, they could be injured or killed by construction activities, or, if nesting, could be disturbed such that they would abandon their eggs or young. Such an event would constitute a violation of the Migratory Bird Treaty Act and California Endangered Species Act, and would represent a significant impact of the project under CEQA and NEPA. Individuals of this species would not be vulnerable to construction-related injury or mortality while foraging because they are highly mobile foragers and would presumably avoid active work areas.

The project will not result in the loss of burrowing owl nesting or foraging habitat. All impacts to such habitats will be temporary, as the sewer mains will be buried and surface habitats will be allowed to return to pre-project conditions. Loss of habitat for the burrowing owl is considered a less than significant impact of the project under CEQA and NEPA.

Mitigation. The following measures will be implemented to avoid and minimize construction-related impacts to burrowing owls.

Mitigation Measure BIO – 5A (Take Avoidance Survey). A take avoidance survey for burrowing owls will be conducted by a qualified biologist within 14 days prior to the start of construction, following methods described in the *Staff Report on Burrowing Owl Mitigation* (CDFG 2012). The survey area will include all potential roosting and nesting habitat on or within 200 meters of the project site.

Mitigation Measure BIO – 5B (Avoidance of Active Burrows). If project activities are undertaken during the breeding season (February 1-August 31) and active nest burrows are identified within

or near project impact areas, a 200-meter disturbance-free buffer will be established around these burrows. The buffers will be enclosed with temporary fencing to prevent construction equipment and workers from entering the setback area. Buffers will remain in place for the duration of the breeding season. During the non-breeding season (September 1-January 31), active burrowing owl burrows will be avoided by a minimum distance of 50 meters.

Mitigation Measure BIO – 5C (CDFW Consultation). If it is not feasible to avoid burrows by the setback distances specified above, the applicant will develop other measures to fully avoid take of burrowing owls in consultation with CDFW. If full take avoidance is not possible, the applicant will obtain a Section 2081 Incidental Take Permit (ITP) for this species. If an ITP is required, it would include minimization and mitigation measures including a passive relocation effort, construction monitoring, replacement burrow creation/enhancement, and/or other forms of compensatory mitigation.

Implementation of these measures will reduce potential project impacts to the burrowing owl to a less than significant level under CEQA and NEPA and facilitate compliance with state and federal laws protecting this species.

Potential Project Impacts to the San Joaquin Kit Fox

Potential Impacts. Coalinga is known to support an urban-adapted population of the SJKF (Cypher et al. 2012). Individuals of this species have some potential to forage and den in both urban and rural portions of the sewer main work area, particularly outside of residential neighborhoods. SJKF are unlikely to occur within the fenced WWTP, but may occur within those portions of the WWTP work area outside of the fenceline. In the event that one or more SJKF individuals were to be occupying the project site at the time of construction, they could be injured or killed by construction activities. Such an event would constitute a violation of federal and state law and would represent a significant impact of the project under CEQA and NEPA.

The project will not result in the loss of denning or foraging habitat for this species. All impacts to such habitats will be temporary, as the sewer mains will be buried and surface habitats will be allowed to return to pre-project conditions. Loss of habitat for the SJKF is considered a less than significant impact of the project under CEQA and NEPA.

Mitigation. The applicant will implement the following measures derived from the USFWS 2011 *Standardized Recommendations for Protection of the San Joaquin Kit Fox Prior to or During Ground Disturbance*.

Mitigation Measure BIO – 6A (Pre-construction Surveys). Between 14 and 30 days prior to the start of any project activity that could potentially affect the SJKF, a qualified biologist will conduct preconstruction surveys for this species following the USFWS 2011 *Standardized Recommendations for Protection of the Endangered San Joaquin Kit Fox Prior to or during Ground Disturbance*

("Standardized Recommendations"). The primary objective will be to identify potential SJKF habitat features and evaluate their use by kit foxes.

Mitigation Measure BIO – 6B (Avoidance). Should one or more active kit fox dens be detected during preconstruction surveys, the USFWS and CDFW will be notified immediately. A disturbance-free buffer will be established around the dens in consultation with the USFWS and CDFW, to be maintained until an agency-approved biologist has determined that the dens have been abandoned.

Mitigation Measure BIO – 6C (Minimization). The applicant will implement all minimization measures presented in the *USFWS Standardized Recommendations*. Such measures include, but are not limited to: restriction of project-related vehicle traffic to established roads, construction areas, and other designated areas; measures to prevent the inadvertent entrapment of kit foxes in holes, trenches, and pipes; restriction of rodenticide and herbicide use; and proper disposal of food items and trash.

Mitigation Measure BIO – 6D (Environmental Awareness Training). A qualified biologist will provide training to all personnel who will be working on site. The training will include a description of the kit fox and its habitat needs; a report of the occurrence of kit fox in the project vicinity; an explanation of the status of the species and its protection under the Endangered Species Act; and a list of the measures being taken to reduce impacts to the species during project construction and implementation. A handout will be provided to all attendees that summarizes the information presented in the training and presents the contact name and number of a designated representative to contact in case SJKF individuals are observed in or near the work area during construction.

Implementation of these measures will reduce potential project impacts to the SJKF to a less than significant level under CEQA and NEPA and facilitate compliance with state and federal laws protecting this species.

Potential Project Impacts to the American Badger

Potential Impacts. Although badgers do not appear to be regularly sighted in the project vicinity, this wide-ranging species has some potential to pass through the area from time to time. If present in the vicinity, then individuals could potentially forage and den in rural portions of the sewer main work area and/or in that portion of the WWTP work area outside of the fenceline. Badgers are particularly vulnerable to construction-related impacts while in their dens. In the unlikely event that one or more badgers were to be occupying dens within the project site at the time of construction, they could be injured or killed by construction activities. Construction mortality of denning badgers is considered a potentially significant impact of the project under CEQA and NEPA. Individuals of this species would not be vulnerable to construction-related injury or mortality while foraging because they would

presumably avoid foraging within active work areas, and because their nocturnal foraging behavior should prevent them from overlapping temporally with construction activities.

The project will not result in the loss of American badger denning or foraging habitat. All impacts to such habitats will be temporary, as the sewer mains will be buried and surface habitats will be allowed to return to pre-project conditions. Loss of habitat for the badger is considered a less than significant impact of the project under CEQA and NEPA.

Mitigation. The following measures will be implemented to avoid and minimize construction-related impacts to American badgers.

> ***Mitigation Measure BIO – 7A (Preconstruction Surveys).*** A preconstruction survey for American badgers will be conducted by a qualified biologist within 7 days prior to the start of construction activities in rural portions of the sewer main work area and at the WWTP. The surveys will target all potential denning habitat on or within 50 feet of these areas.
>
> ***Mitigation Measure BIO – 7B (Avoidance).*** Should an active sleeping den be identified during the preconstruction surveys, the den shall be identified in the field with brightly-colored fencing or flagging, and avoided until a qualified biologist has determined that it has been abandoned. Should an active natal den be identified during the preconstruction surveys, a suitable disturbance-free buffer will be established around the den and maintained until a qualified biologist has determined that the cubs have dispersed or the den has been abandoned.

Implementation of the above measures will reduce potential project impacts to the American badger to a less than significant level under CEQA and NEPA.

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. No wetlands were present in the proposed Project area and as such, there would be ***no impacts*** associated with the proposed improvements.

Mitigation Measures: None are required.

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 with Mitigation. No marine or estuarine fishery resources or migratory routes to and from anadromous fish spawning grounds were present in the survey area. In addition, no EFH, defined by the Magnuson-Stevens Act as those resources necessary for fish spawning, breeding, feeding, or growth to maturity, were present in the survey area.

The project site and adjoining lands have the potential to be used for nesting by a variety of migratory birds and raptors protected by the federal Migratory Bird Treaty Act and related state laws. This includes common species such as the mourning dove, killdeer, and American robin, but may also include several uncommon species. An example of the latter is the special status long-eared owl (*Asio otus*), which could nest immediately adjacent to the WWTP work area along the riparian corridor associated with Los Gatos Creek. If project construction takes place during the nesting season, birds nesting on the site could be injured or killed by construction activities, while birds nesting on or adjacent to the site could be disturbed such that they would abandon their nests. Construction-related mortality of nesting birds and disturbance leading to nest abandonment would violate state and federal laws and be considered a significant impact of the project under CEQA and NEPA.

The special status long-eared owl also has the potential to forage in rural portions of the project site. Individuals of this species would not be vulnerable to construction-related injury or mortality while foraging because they are highly mobile during this activity and because their nocturnal foraging behavior should prevent them from overlapping temporally with construction. The project is not expected to adversely affect this species through loss of foraging habitat. All impacts to such habitats will be temporary, as the sewer mains will be buried and surface habitats will be allowed to return to pre-project conditions. Loss of habitat for the long-eared owl is considered a less than significant impact of the project under CEQA and NEPA.

Mitigation. The following measures will be implemented to avoid and minimize construction-related impacts to nesting migratory birds and raptors including the long-eared owl.

> ***Measure BIO – 8A (Construction Timing).*** If feasible, project construction will occur entirely outside of the February 1-August 31 general avian nesting season.
>
> ***Measure BIO – 8B (Preconstruction Surveys*).** If construction must occur between February 1 and August 31, a qualified biologist will conduct pre-construction surveys for active bird nests within 7 days prior to the start of any work within this period. The survey area will encompass the work area and surrounding lands within 250 feet for nesting migratory birds and 500 feet for raptors.

Measure BIO – 8C (Avoidance of Active Nests). Should any active nests be discovered in or near proposed construction zones, the biologist will identify a suitable construction-free buffer around the nest. The buffer distance will be determined based on species biology, site-specific conditions, and the level of project-related disturbance that is anticipated near the nest(s) in question. Buffers will be identified on the ground with flagging or fencing and will be maintained until the biologist has determined that the young have fledged and are capable of foraging independently.

Implementation of the above measures will reduce project impacts to nesting migratory birds and raptors, including the special status long-eared owl, to a less than significant level under CEQA and NEPA and facilitate compliance with state and federal laws.

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?

No Impact. There are no local policies or ordinances that the Project will conflict with. Additionally, there are no adopted local, regional, or state habitat conservation plans adopted for the area. As such, there is ***no impact.***

Mitigation Measures: None are required.

V. CULTURAL RESOURCES

Would the project:

	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
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 formal cemeteries?	☐	☐	☒	☐

RESPONSES

The Project is subject to CEQA, which holds municipal and state agencies accountable for impacts to the cultural environment. If a project has the potential to cause substantial adverse change in the characteristics of an important cultural resource, known as a "historical resource" under CEQA—either through demolition, destruction, relocation, alteration, or other means—then the project is judged to have a significant impact on the environment (CEQA Guidelines, Section 15064.5[b]). Given that the project will involve ground-disturbing activities and demolition, it has the potential to impact historical resources, if present, within the Project area.

In addition, because the proposed Project will be funded through the State Water Resources Control Board's Clean Water State Revolving Fund, a joint federal-state program, it is federal undertaking per Title 36, Code of Federal Regulations, Section 800.16(y) subject to Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended (Title 54, U.S. Code, Section 306108). As such, the lead federal agency must consider whether a project will have an adverse effect on historic properties (i.e., resources that are eligible for inclusion on the National Register of Historic Places) within the Project Area of Potential Effects (APE).

Human Remains

Section 7050.5 of the California Health and Safety Code states that in the event of discovery or recognition of any human remains in any location other than a dedicated cemetery, there shall be no further excavation or disturbance of the site or any nearby area reasonably suspected to overlie adjacent remains until the coroner of the county in which the remains are discovered has determined whether or not the remains are subject to the coroner's authority. If the human remains are of Native American origin, the coroner must notify the Native American Heritage Commission within 24 hours of this identification. The Native American Heritage Commission will identify a Native American Most Likely Descendant (MLD) to inspect the site and provide recommendations for the proper and dignified treatment of the remains and associated grave artifacts.

Paleontological Resources

Paleontological resources are the fossilized remains of plants and animals and associated deposits. The Society of Vertebrate Paleontology has identified vertebrate fossils, their taphonomic and associated environmental indicators, and fossiliferous deposits as significant nonrenewable paleontological resources. Botanical and invertebrate fossils and assemblages may also be considered significant resources.

CEQA requires that a determination be made as to whether a project would directly or indirectly destroy a unique paleontological resource or site or unique geological feature (CEQA Appendix G(v)(c)). If an impact is significant, CEQA requires feasible measures to minimize the impact (CCR Title 14(3) §15126.4 (a)(1)). California Public Resources Code §5097.5 (see above) also applies to paleontological resources.

Methodology

To meet State and federal requirements, the City retained ASM Affiliates, Inc. to conduct background research, complete a records search, request a search of the Native American Heritage Commission's Sacred Lands File and reach out to appropriate Native American contacts, conduct a cultural resources survey, and prepare a technical report, dated July 2026. The *Class III Inventory / Phase I Survey, Coalinga Sewer Collection System and Wastewater Treatment Plant Improvements Project* (Cultural Study) is included as Appendix D. The results of the Cultural Study are summarized herein and were used to support the determinations made in this CEQA document.

Native American Outreach

As part of the CEQA process, a search of the Native American Heritage Commission (NAHC) Sacred Lands File was completed on May 9, 2024. Based on the NAHC records, the APE is negative for sacred sites or traditional cultural places. Outreach letters were sent on July 23, 2024, to tribal organizations on the NAHC contact list. Follow-up emails were sent on August 30, 2024. On August 12, 2024, Table Mountain Rancheria responded stating the Project was out of their area of interest. No other responses

were received as a result of this outreach. NAHC requests, NAHC results, Tribal outreach letters, and Tribal responses can be found in Confidential Appendix B of Appendix D.

Records Search and Site-Specific Research

To determine whether the Project APE had been previously surveyed for cultural resources, and/or whether any such resources were known to exist within or near to it, staff of the Southern San Joaquin Valley Information Center (SSJVIC) conducted an archival records search on May 29, 2024. The records search was completed to determine: (i) if pre-contact or historic-era cultural resources had previously been recorded within the Project APE; (ii) if the Project APE had been systematically surveyed by archaeologists prior to the initiation of this fieldwork; and/or (iii) whether the area surrounding the proposed Project was known to contain archaeological sites or built environment resources and to thereby be culturally sensitive. Records examined included archaeological site files and maps, the NRHP, Historic Property Data File, California Inventory of Historic Resources, and the California Points of Historic Interest. The records search included the Project APE and a 0.5-mi. buffer.

According to the SSJVIC, six previous studies have been conducted within the Project APE, and 31 previous studies were identified within the 0.5-mi. buffer (Table 4 of Appendix D). Based on SSJVIC data, approximately 30 percent of the Project APE has been previously surveyed. Dates for previous studies in the APE range from 1974 to 2021.

The SSJVIC results identified a single previously recorded cultural resource (P-10-003930) within the APE (Table 5). An additional 17 resources were identified within the 0.5-mi. buffer. The results of the SSJVIC records search are available in Confidential Appendix A of Appendix D.

Pedestrian Survey

The Class III inventory/Phase I survey of the Project APE was conducted from August to September 2024. ASM Associate Archaeologist Robert Azpitarte, BA, conducted the survey with assistance from Assistant Archaeologist Margarita Medina Lemus, BA. Parallel survey transects spaced at maximum intervals of 15 meters (m) apart were employed for pedestrian survey. The Class III inventory/Phase I survey included a review of the Project APE for the presence of built environment features. The field methods employed also included intensive pedestrian examination of the ground surface for evidence of archaeological sites in the form of artifacts, surface features (such as bedrock mortars or historical mining equipment), and archaeological indicators (e.g., organically enriched midden soil or burnt animal bone); the identification and location of any discovered sites, should they be present; tabulation and recording of surface diagnostic artifacts; site sketch mapping; preliminary evaluation of site integrity; and site recording, following the California Office of Historic Preservation (OHP) Instructions for Recording Historic Resources using California Department of Parks and Recreation (DPR) 523 forms. Parallel

survey transects spaced at maximum intervals of 15 m. apart were employed for pedestrian survey of the 174.7 ac. Project APE.

Effects Determinations

a. Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?

Less than Significant Impact with Mitigation. A Class III inventory/Phase I survey was conducted for the Coalinga Sanitary Sewer Collection System and WWTP Improvements Project, Fresno County, California. A records search was conducted at the SSJVIC. This search indicated that the portions of the Project APE had been previously surveyed, and a single previously recorded cultural resource (P-10-003930) was observed within the Project APE; however, there are no extant features related to the resource within the current Project APE. An NAHC SLF search was conducted for the Project APE and the NAHC responded with negative SLF results. Geoarchaeological review of the project APE indicates that the pipeline portion of the APE is potentially likely to contain buried deposits; however, historic aerial and topographic map review indicates the APE has been heavily disturbed by development as far back as the mid-twentieth century.

A Class III inventory/Phase I survey fieldwork of the Project APE was conducted in August and September 2024, with parallel transects spaced at 15-m intervals. A single refuse scatter was observed along the northwestern edges of the existing aerator ponds. This refuse scatter was recommended not eligible for the NRHP/CRHR. No other archaeological resources of any kind were identified within the Project APE.

ASM considered the potential for a historic district associated the Coalinga WWTP with six primary buildings and structures, and additional ponds, lagoons, and sludge beds associated with the operations of Coalinga WWTP identified within the APE. ASM evaluated Coalinga WWTP for eligibility for listing in the NRHP/CRHR as a potential historic district and evaluated all buildings and structures associated with the WWTP within the APE. ASM recommended that a potential Coalinga WWTP historic district within the APE is not eligible for listing in the NRHP/CRHR under any criteria. ASM also recommended that none of the buildings, structures, lagoons, or ponds associated with the WWTP are individually eligible for listing in the NRHP/CRHR under any criteria.

A single previously recorded historic-era archaeological site and an unrecorded historic-era archaeological site and a historic-era built structure were recorded during the Class III inventory/Phase I survey. All 3 have been evaluated for eligibility to the NRHP/CRHR as a result of this study and previous studies and are recommended not eligible for inclusion in the NRHP/CRHR. As such, none of these resources are considered historic properties under NHPA nor historical resources under CEQA. and there will be no adverse effect or significant impact.

No cultural resources identified within the APE were recommended eligible for inclusion in the NRHP/CRHR under any criteria. Therefore, ASM recommends that there are no adverse effects or significant impacts as a result of the Project.

Unidentified cultural or historical resources could be uncovered during proposed Project construction which could result in a potentially significant impact; however, implementation of Mitigation Measure CUL-1 would ensure that significant impacts remain ***less than significant with mitigation incorporation.***

Mitigation Measures:

CUL – 1 In the event that archaeological remains are encountered at any time during development or ground-moving activities within the entire Project area, all work in the vicinity of the find should be halted until a qualified archaeologist can assess the discovery and take appropriate actions as necessary.

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

Less than Significant Impact with Mitigation. The possibility exists that subsurface construction activities may encounter undiscovered archaeological resources. This would be a potentially significant impact. Implementation of Mitigation Measure CUL-1 would require inadvertently discovery practices to be implemented should previously undiscovered archeological resources be located. As such, impacts to undiscovered archeological resources would be ***less than significant with mitigation incorporation.***

Mitigation Measures: None are required.

c. Disturb any human remains, including those interred outside of formal cemeteries?

Less than Significant Impact. Although unlikely given the highly disturbed nature of the site and the records search did not indicate the presence of such resources, subsurface construction activities associated with the proposed Project could potentially disturb previously undiscovered human burial sites. Accordingly, this is a potentially significant impact. The California Health and Safety Code Section 7050.5 states that if human remains are discovered on-site, no further disturbance shall occur until the Fresno County Coroner has made a determination of origin and disposition. If the Coroner determines that the remains are not subject to his or her authority and if the Coroner recognizes the human remains to be those of a Native American, or has reason to believe that they are those of a Native American, he

or she shall contact, by telephone within 24 hours, the NAHC. The NAHC shall identify the person or persons it believes to be the "most likely descendant" (MLD) of the deceased Native American. The MLD may make recommendations to the landowner or the person responsible for the excavation work, for means of treating or disposing of, with appropriate dignity, the human remains and any associated grave goods as provided in Public Resource Code Section 5097.98.

Although considered unlikely subsurface construction activities could cause a potentially significant impact to previously undiscovered human burial sites, however compliance with regulations would reduce this impact to ***less than significant***.

Mitigation Measures: None are required.

VI. ENERGY

Would the project:	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
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?	☐	☐	☒	☐

RESPONSES

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. Improvements proposed by the City consist of the rehabilitation of approximately 30,815 linear feet (LF) of gravity sewer mains using trenchless construction methods, replacement of approximately 19,801 LF of gravity sewer mains via conventional construction methods, and provision of miscellaneous repairs and improvements to the City's WWTP. During construction, the Project would consume energy in two general forms: (1) the fuel energy consumed by construction vehicles and equipment; and (2) bound energy in construction materials, such as asphalt, steel, concrete, pipes, and manufactured or processed materials such as lumber and glass. Title 24 Building Energy Efficiency Standards would provide guidance on construction techniques for the plant house to maximize energy conservation and it is expected that contractors and the City have a strong financial incentive to use recycled materials and products originating from nearby sources in order to reduce materials costs. As such, it is anticipated that materials used in construction and construction vehicle fuel energy would not involve the wasteful, inefficient, or unnecessary consumption of energy.

Operational Project energy consumption would be minimal, as the sewer mains do not require energy once they are installed. Operational energy would also be consumed during the WWTP processing and during each vehicle trip associated with the proposed use for maintenance or otherwise.

As discussed in Impact XVII – Transportation/Traffic, the proposed Project would not generate on-going daily vehicle trips, other than for maintenance. The length of these trips and the individual vehicle fuel efficiencies are not known; therefore, the resulting energy consumption cannot be accurately calculated. Adopted federal vehicle fuel standards have continually improved since their original adoption in 1975 and assists in avoiding the inefficient, wasteful, and unnecessary use of energy by vehicles.

As discussed previously, the proposed Project would be required to implement and be consistent with existing energy design standards at the local and state level, such as Title 24. The Project would also be subject to energy conservation requirements in the California Energy Code and CALGreen for the new structures associates with the WWTP improvements. Adherence to state code requirements would ensure that the Project would not result in wasteful and inefficient use of non-renewable resources due to operation.

Therefore, any impacts are ***less than significant***.

Mitigation Measures: None are required.

VII. GEOLOGY AND SOILS

Would the project:

	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
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 most recently	☐	☐	☒	☐

VII. GEOLOGY AND SOILS

Would the project:

	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
adopted Uniform Building Code 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?	☐	☐	☒	☐

RESPONSES

a-i. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving 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. Coalinga is located in a seismically active area. According to the Fault Rupture Zones Map prepared by the California Department of Conservation in 2018, the Project site is not located within a Fault-Rupture Hazard Area. Moreover, no active faults have been identified within Coalinga. The nearest fault to Coalinga is a portion of the San Andreas Fault, located approximately 15-20 miles east of Coalinga. The Project Area could be subjected to strong ground shaking during an earthquake on a nearby fault. However, the proposed Project does not include the installation of any habitable structures. The Project will be required to adhere to all relevant building codes, including the California Building Code (CBC) requirements. Adherence to local and State regulations would result in a l***ess than significant impact.***

Mitigation Measures: None are required.

a (ii-iv). Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving strong seismic ground shaking, liquefaction or landslides?

Less than Significant Impact. It is anticipated that the proposed Project site would be subject to some ground acceleration and ground shaking associated with seismic activity during its design life. However, the Project is not proposing any habitable structures that would be subject to risk of injury from strong seismic ground shaking or liquefaction. In addition, the site is relatively flat, which precludes the risk of landslides. The Project will be required to adhere to all relevant building codes, including the California Building Code (CBC) requirements. Adherence to local and State regulations would result in a l***ess than significant impact.***

Mitigation Measures: None are required.

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

Less than Significant Impact. The proposed Project site has relatively flat topography and does not include any Project features that would result in substantial soil erosion or loss of topsoil. Most of the Project components will be located below grade. Once construction is completed, the sewer main trenches will be returned to pre-construction conditions and will not result in soil erosion greater than existing conditions. Therefore, the impact is ***less than significant***.

Mitigation Measures: None are 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. As described in Impact VI (aii-aiv), the potential for landslides, liquefaction, settlement or other seismically related hazards is less than significant. As such, the Project will not be constructed on unstable soil and any impacts will be ***less than significant.***

Mitigation Measures: None are required.

d. Be located on expansive soil, as defined in Table 18-1-B of the most recently adopted Uniform Building Code creating substantial risks to life or property?

Less than Significant Impact. As described above, the potential for hazards from landslide and liquefaction in the Project area is less than significant. Therefore, the potential for liquefaction induced lateral spreading is also less than significant. Causes of soil instability include, but are not limited to, withdrawal of groundwater, pumping of oil and gas from underground, liquefaction, and hydro-compaction.[3] The proposed Project does not include the on-site withdrawal of groundwater and the Project site is not located in an area that has been subjected to activities that might cause soil instability. Because the Project site has not been subject to activities that may cause soil instability, the risk of subsidence or collapse is expected to be low. Any impacts would be ***less than significant.***

Mitigation Measures: None are required.

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?

Less Than Significant Impact. The Project itself is a sewer main rehabilitation and replacement and WWTP improvement Project in the Project Area. No septic tanks or alternative waste water disposal systems are included in the proposed Project. The Project has been designed to work with the soil types in the City. Therefore, there would be a ***less than significant impact.***

Mitigation Measures: None are required.

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

Less Than Significant Impact. Paleontological resources are the fossilized remains of plants and animals and associated deposits. The Society of Vertebrate Paleontology has identified vertebrate fossils, their taphonomic and associated environmental indicators, and fossiliferous deposits as significant nonrenewable paleontological resources. Botanical and invertebrate fossils and assemblages may also be considered significant resources.

[3] USGS. California Water Science Center. Land Subsidence: Cause & Effect. https://ca.water.usgs.gov/land_subsidence/california-subsidence-cause-effect.html. Accessed March 2026.

CEQA requires that a determination be made as to whether a project would directly or indirectly destroy a unique paleontological resource or site or unique geological feature (CEQA Appendix G(v)(c)). If an impact is significant, CEQA requires feasible measures to minimize the impact (CCR Title 14(3) §15126.4 (a)(1)). California Public Resources Code §5097.5 (see above) also applies to paleontological resources.

There are no unique geological features or known fossil-bearing sediments in the vicinity of the proposed Project site. However, there remains the possibility for previously unknown, buried paleontological resources or unique geological sites to be uncovered during subsurface construction activities. Implementation of Mitigation Measure CUL-1 (See Section V – Cultural Resources) would require inadvertently discovery practices to be implemented should previously undiscovered paleontological resources be located. As such, impacts to undiscovered paleontological resources would be ***less than significant.***

Mitigation Measures: Implement Mitigation Measure CUL – 1.

VIII. GREENHOUSE GAS EMISSIONS

Would the project:

	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
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?	☐	☐	☒	☐

RESPONSES

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?

Less than Significant Impact. The proposed Project would generate exhaust-related GHG emissions during construction resulting from construction equipment operation, material haul and delivery trucks, and by trips by construction worker vehicles. Construction-related GHG emissions are estimated to begin in Year 2027 and end in 2028. Emissions would cease following completion of the Project. The proposed Project is not a land-use development project that would generate vehicle trips and is not a roadway capacity increasing project that could carry additional VMT. Therefore, the proposed Project would not result in a net increase in operational GHG emissions. As such, the proposed Project would not interfere or obstruct implementation of an applicable GHG emissions reduction plan. The proposed Project would be consistent with all applicable local plans, policies, and regulations for reducing GHG emissions. Any impacts related to GHG emissions would be ***less than significant.***

Mitigation Measures: None are required.

IX. HAZARDS AND HAZARDOUS MATERIALS

Would the project:

	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
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	☐	☐	☒	☐

IX. HAZARDS AND HAZARDOUS MATERIALS

Would the project:

	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
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?	☐	☐	☐	☒

RESPONSES

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. While trenching, grading and construction activities may involve the limited transport, storage, use or disposal of hazardous materials, such as the fueling/servicing of construction equipment onsite, the activities would be short-term or one-time in nature and would be subject to federal, state, and local health and safety regulations.

Long-term operation of the proposed Project would involve transport, storage, use or disposal of hazardous materials. Water treatment chemicals may be utilized at the WWTP treatment site. Small quantities of petroleum products, thinners, and paints would also likely be used on-site. There are several federal, state and local requirements and regulations that are designed to minimize risks from accidental releases of hazardous materials and the proposed Project will be in compliance with all applicable requirements and regulations. Hazardous material storage and use areas at the WWTP will be built and operated in compliance with the minimum requirements of the Uniform Fire Code and the California Fire Code. Additionally, improvements to the WWTP will be constructed in compliance with the California Building Code, which requires design features to resist forces generated by a major earthquake with limited architectural or structural damage and to provide adequate fire protection that precludes accidental releases of hazardous chemicals due to fire. The WWTP improvements are also subject to review and approval by the Regional Water Quality Control Board (RWQCB). Since the

Project is intended to improve the existing deteriorated sewer system, it is assumed to have a positive impact by reducing the number of sewer breaks/leaks or other issues that may result in the release of hazardous materials.

With implementation of the proposed Project, there are no reasonably foreseeable upset and accident conditions that would create a significant hazard to the public due to the release of hazardous materials. Impacts are considered ***less than significant***.

Mitigation Measures: None are required.

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

Less Than Significant Impact. There are several schools within ¼ mile of the proposed pipelines including elementary schools, a middle school, a high school and a community college.. As previously described, long-term operation of the proposed Project would involve little or no hazardous materials (see previous responses). Once operational, the sewer mains are sealed and will not emit hazardous materials. The WWTP is located more than ¼ mile from the school. Since the Project is intended to improve the existing deteriorated sewer system, it is assumed to have a positive impact by reducing the number of sewer breaks/leaks or other issues that may result in the release of hazardous materials. Therefore, there is a ***less than significant impact.***

Mitigation Measures: None are required.

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?

Less Than Significant Impact. The proposed Project would occur throughout the City of Coalinga. There are five sites on a list of hazardous materials sites complied pursuant to Government Code Section 65962.5.[4] These sites consist of two Historical Sites, a School Cleanup Site, a Voluntary Cleanup Site and an Evaluation Site. The proposed Project will not impede on these sites and none

[4] California Department of Toxic Substance Control. EnviroStor. https://www.envirostor.dtsc.ca.gov/public/map/?myaddress=delrey. Accessed July 2026.

of the sites are considered a Federal Superfund or State Response site. As such, there is a ***less than significant impact.***

Mitigation Measures: None are required.

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?

Less Than Significant Impact. There are no airports or airstrips within two miles of the Project. The nearest airport is the Coalinga Municipal Airport located approximately 2 ¼ miles northeast of the Project sites. Therefore, the Project has ***no impact*** on any airport operations.

Mitigation Measures: None are required.

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

Less Than Significant Impact. Sewer main replacement and rehabilitation will be temporary in nature and will not cause any road closures that could interfere with any adopted emergency response or evacuation plan. Construction schedules pertaining to pipelines within roadways will be coordinated with police/fire/emergency services. Adequate emergency access will be maintained at all times. As such, any impacts will be ***less than significant***.

Mitigation Measures: None are required.

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

No Impact. Implementation of the Project would not change the degree of exposure to wildfires because no new housing or businesses or other habitable structures will be constructed. Therefore, there is ***no impact.***

Mitigation Measures: None are required.

X. HYDROLOGY AND WATER QUALITY

Would the project:

	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
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 offsite;	☐	☐	☒	☐
iii. create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; or	☐	☐	☒	☐
iv. impede or redirect flood flows?	☐	☐	☒	☐

X. HYDROLOGY AND WATER QUALITY

Would the project:	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
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?	☐	☐	☐	☒

RESPONSES

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

Less than Significant Impact. Improvements proposed by the City consist of the rehabilitation of approximately 30,815 linear feet (LF) of gravity sewer mains using trenchless construction methods, replacement of approximately 19,801 LF of gravity sewer mains via conventional construction methods, and provision of miscellaneous repairs and improvements to the City's WWTP.

The primary need for a sewer collection system improvement project is due to the significant deterioration of the sewer infrastructure in the current City area. Inspection revealed poor condition of some of the City's older sewer lines. Defects observed included deformation, root intrusion, cracked pipes, collapsed and broken pipes, sags, intruding laterals, defective lateral break-ins, attached deposits, and medium to large joint displacements. There have been no formal Notices of Violation (NOV) from regulatory agencies concerning the City's sewer collection system; however, numerous health and safety threats may arise from sewer system overflows because of sewer line disrepair, which would ultimately result in dangerous conditions on the City's streets and residential properties.

Construction

Excavation, trenching and soil-impacting activities associated with construction of the Project could temporarily increase runoff, erosion, and sedimentation. Construction activities also could result in soil compaction and wind erosion effects that could adversely affect soils and reduce the revegetation potential at construction sites and staging areas.

Three general sources of potential short-term construction-related stormwater pollution associated with the proposed Project are: 1) the handling, storage, and disposal of construction materials containing pollutants; 2) the maintenance and operation of construction equipment; and 3) earth moving activities which, when not controlled, may generate soil erosion and transportation, via storm runoff or mechanical equipment. Generally, routine safety precautions for handling and storing construction materials may effectively mitigate the potential pollution of stormwater by these materials. These same types of common sense, "good housekeeping" procedures can be extended to non-hazardous stormwater pollutants such as sawdust and other solid wastes.

Poorly maintained vehicles and heavy equipment leaking fuel, oil, antifreeze, or other fluids on the construction site are also common sources of stormwater pollution and soil contamination. In addition, grading activities can greatly increase erosion processes. Two general strategies are recommended to prevent construction silt from entering local storm drains. First, erosion control procedures should be implemented for those areas that must be exposed. Secondly, the area should be secured to control offsite migration of pollutants. These best management practices (BMPs) would be required in the Storm Water Pollution Prevention Plan (SWPPP) to be prepared prior to commencement of Project construction activities. When properly designed and implemented, these "good-housekeeping" practices are expected to reduce short-term construction-related impacts to less than significant.

In accordance with the National Pollutant Discharge Elimination System (NPDES) Stormwater Program, the Project will be required to comply with existing regulatory requirements to prepare a Storm Water Pollution Prevention Plan (SWPPP) designed to control erosion and the loss of topsoil to the extent practicable using BMPs that the RWQCB has deemed effective in controlling erosion, sedimentation, runoff during construction activities. The specific controls are subject to the review and approval by the RWQCB and are an existing regulatory requirement. Preparation of a SWPPP is a regulatory requirement of the Project and thus is not listed as a mitigation measure. Compliance with the NPDES and SWPPP would ensure that the proposed Project would have a less than significant impact relative to this topic.

Operation

The proposed Project includes several miscellaneous improvements to the existing City-operated WWTP. The WWTP improvements and implementation will be performed under the regulatory requirements of the County of Fresno, the State Water Resources Control Board, and the Regional Water Quality Control Board. Compliance with such regulations will ensure that water quality and waste discharge standards are met. The wastewater characteristics will be typical of urban development and will not result in any additional water releases that could potentially impact groundwater or water quality. Because the Project provides long-needed upgrades to sewer mains currently experiencing blockages and leaks, the Project will likely have a beneficial impact on water quality because of the

elimination of existing leaking or damaged sewer pipelines that currently exist. Compliance with the regulatory requirements of the County of Fresno, the State Water Resources Control Board, and the Regional Water Quality Control Board would result in a ***less than significant impact***.

Mitigation Measures: None are required.

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. Improvements proposed by the City consist of the rehabilitation of and replacement of gravity sewer mains and improvements to the City's WWTP. The Project will not use additional groundwater beyond what is already being used in the Project Area. Additionally, the proposed Project will not significantly interfere with groundwater recharge as it will not introduce significant new impermeable surfaces. As such, any impacts to groundwater supplies will be ***less than significant***.

Mitigation Measures: None are required.

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 offsite;
ii. substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or offsite;
iii. create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; or
iv. impede or redirect flood flows?

Less than Significant Impact. The proposed upgrades to the sewer collection system will introduce a minimal amount of new non-permeable surfaces. The pipelines and other improvements will be installed within the existing road right-of-way, or other easements and will not alter any existing drainage patterns. All areas where the improvements are made will be restored to pre-construction conditions. There are no waterways that will be impacted in the immediate vicinity of the proposed Project. Any impacts would be ***less than significant.***

Mitigation Measures: None are required.

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?

No Impact. The Project is not within a regulatory floodway or within a base floodplain (100 year) elevation. In addition, the Project does not include any housing or structures that would be subject to flooding either from a watercourse or from dam inundation. There are no bodies of water near the site that would create a potential risk of hazards from seiche, tsunami or mudflow. The Project will not conflict with any water quality control plans or sustainable groundwater management plan. Therefore, there are ***no impacts.***

Mitigation Measures: None are required.

XI. LAND USE AND PLANNING

Would the project:

	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
a. Physically divide an established community?	☐	☐	☐	☒
b. Cause a 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?	☐	☐	☐	☒

RESPONSES

a. Physically divide an established community?

b. Cause a 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?

No Impact. Improvements proposed by the City consist of the rehabilitation and replacement of gravity sewer mains and provision of miscellaneous repairs and improvements to the City's WWTP. The proposed Project pipelines are located largely within the existing streetscape within the City as presented in Figure 2 in Chapter Two – Project Description. The rehabilitation and replacement of the sewer mains would not cause any land use changes in the surrounding vicinity nor would it divide an established community. Once construction is completed, disturbed ground around the pipelines will be restored to pre-construction conditions. The WWTP improvements would be located on-site where the current WWTP has been constructed. This area is not surrounded by any urban uses and thus would not cause an established community to divide. The proposed Project involves improvements to the existing sewer infrastructure system and does not conflict with any land use plans, policies or regulations. ***No impacts*** would occur as a result of Project implementation.

Mitigation Measures: None are required.

XI. MINERAL RESOURCES

Would the project:

	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
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?	☐	☐	☐	☒

RESPONSES

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. Improvements proposed by the City consist of the rehabilitation and replacement of gravity sewer mains and provision of miscellaneous repairs and improvements to the City's WWTP. Construction will primarily take place within the existing streetscape and on the existing WWTP site and not in an area with known mineral resources. Therefore, there is ***no impact***.

Mitigation Measures: None are required.

XII. NOISE

Would the project:

	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
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?	☐	☐	☒	☐

RESPONSES

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?

Less than Significant Impact. The nearest sensitive receptors to the proposed Project would be the residences along the existing pipeline alignment, as presented in Figure 2. Project construction would involve temporary, short-term noise sources including site preparation and installation of the sewer mains. Construction-related short-term, temporary noise levels would be higher than existing ambient noise levels in the Project area, but is temporary and would not occur after construction is completed.

Operations-related noise would be similar to existing conditions. The pipelines themselves do not emit noise, nor do the related improvements. The proposed WWTP improvements would be located on the existing WWTP site, in an area without adjacent residences or businesses. As such, any on-going noise impacts to sensitive receptors would be less than significant.

During the proposed Project construction, noise from construction related activities will contribute to the noise environment in the immediate vicinity. Activities involved in construction will generate maximum noise levels, as indicated in Table 2, ranging from 79 to 91 dBA at a distance of 50 feet, without feasible noise control (e.g., mufflers) and ranging from 75 to 80 dBA at a distance of 50 feet, with feasible noise controls.

Table 2
Typical Construction Noise Levels

Type of Equipment	dBA at 50 ft	
	Without Feasible Noise Control	With Feasible Noise Control
Dozer or Tractor	80	75
Excavator	88	80
Scraper	88	80
Front End Loader	79	75
Backhoe	85	75
Grader	85	75
Truck	91	75

The distinction between short-term construction noise impacts and long-term operational noise impacts is a typical one in both CEQA documents and local noise ordinances, which generally recognize the reality that short-term noise from construction is inevitable and cannot be mitigated beyond a certain level. Thus, local agencies frequently tolerate short-term noise at levels that they would not accept for permanent noise sources. A more severe approach would be impractical and might preclude the kind of construction activities that are to be expected from time to time. Most residents recognize this reality and expect to hear construction activities on occasion.

The City's General Plan states that noise associated with construction shall be exempted, as long as construction activities take place between 7:00 a.m. and 9:00 p.m. on any day except Saturday or Sunday, or between the hours of 8:00 a.m. or after 5:00 p.m. on Saturday or Sunday. Adherence to the City's Noise Ordinance will result in less than significant impacts associated with this topic.

Vibration

Typical outdoor sources of perceptible ground borne vibration are construction equipment, steel-wheeled trains, and traffic on rough roads. Construction vibrations can be transient, random, or continuous. Construction associated with the proposed Project is earthmoving activities associated with the replacement and rehabilitation of the sewer mains.

The approximate threshold of vibration perception is 65 VdB, while 85 VdB is the vibration acceptable only if there are an infrequent number of events per day.[5] Table 3 describes the typical construction equipment vibration levels.

Table 3
Typical Construction Vibration Levels

Equipment	VdB at 25 ft
Small Bulldozer	58
Jackhammer	79

Vibration from construction activities will be temporary and not exceed the Federal Transit Authority threshold for the nearest sensitive receptors. As such, any impacts resulting from an increase in noise levels or from groundborne noise levels is ***less than significant.***

Mitigation Measures: None are required.

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. As there are no airports or airstrips in the vicinity, there is ***no impact***.

Mitigation Measures: None are required.

[5] Transit Noise and Vibration Impact Assessment. Final Report No. FTA-VA-90-1003 prepared for the U.S. Federal Transit Administration by Harris Miller Miller & Hanson Inc., May 2006. Page 7-5. https://www.transit.dot.gov/research-innovation/transit-noise-and-vibration-impact-assessment-manual-report-0123. Accessed March 2026.

XIV. POPULATION AND HOUSING

Would the project:

	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
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?	☐	☐	☒	☐

RESPONSES

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?

Less Than Significant Impact. There are no new homes or businesses associated with the proposed Project, nor would Project implementation displace people or housing. The proposed Project is needed to improve existing sewer infrastructure. There is a ***less than significant impact***.

Mitigation Measures: None are required.

XV. PUBLIC SERVICES

Would the project:

	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
a. 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:				
Fire protection?	☐	☐	☒	☐
Police protection?	☐	☐	☒	☐
Schools?	☐	☐	☒	☐
Parks?	☐	☐	☒	☐
Other public facilities?	☐	☐	☒	☐

RESPONSES

a. 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:

Fire Protection?

No Impact. The proposed Project would improve the existing Project Area sewer system. The proposed Project would not directly or indirectly induce population growth and the City's fire suppression services would continue to provide service to the site. There is ***no impact.***

Police Protection?

No Impact. The proposed Project would improve the existing Project Area sewer system. The proposed Project would not directly or indirectly induce population growth and the City's Police Department would continue to provide service to the site. There is ***no impact.***

Schools, Parks, Other Public Facilities?

No Impact. The proposed Project would not increase the number of residents in the City, as the Project does not include residential units. Because the demand for schools, parks, and other public facilities is driven by population, the proposed Project would not increase demand for those services. As such, the proposed Project would result in ***no impacts.***

Mitigation Measures: None are required.

XVI. RECREATION

Would the project:

	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
a. Would the project 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?	☐	☐	☐	☒

RESPONSES

a. Would the project 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?

No Impact. The proposed Project does not include the construction of residential uses and would not directly or indirectly induce population growth. Therefore, the proposed Project would not cause physical deterioration of existing recreational facilities from increased usage or result in the need for new or expanded recreational facilities. The Project would have ***no impact*** to existing parks.

Mitigation Measures: None are required.

XVII. TRANSPORTATION/ TRAFFIC

Would the project:	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
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?	☐	☐	☒	☐

RESPONSES

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?

Less Than Significant Impact. The proposed Project would not cause a substantial increase in traffic, reduce the existing level of service, create any additional congestion at any intersections, or be inconsistent with CEQA Guidelines Section 15064.3. Once completed, the replaced and rehabilitated sewer mains, as well as the necessary WWTP upgrades, will not generate any substantial additional daily traffic (beyond routine maintenance traffic trips) and as such, level of service standards would not be

exceeded. There are no components of the proposed Project that would increase hazards due to a geometric design feature. As traffic due to construction activities would be temporary in nature, the proposed Project would not cause a substantial increase in traffic or result in inadequate emergency access. Construction schedules pertaining to pipelines within roadways will be coordinated with police/fire/emergency services. Adequate emergency access will be maintained at all times.

Once installed, the proposed Project would not generate significant additional traffic trips per day, other than as needed for periodic maintenance. The Project would not conflict with a program plan, ordinance, or policy addressing the circulation system and as such, impacts would be ***less than significant.***

Mitigation Measures: None are required.

XVIII. TRIBAL CULTURAL RESOURCES

Would the project:

	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
a. Would the project 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 Resource Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe.	☐	☐	☒	☐

RESPONSES

a). Would the project 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 Resource Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe.

Less Than Significant Impact. In accordance with Assembly Bill (AB) 52, potentially affected Tribes were formally notified of this Project and were given the opportunity to request consultation on the Project.

As part of the CEQA process, a search of the Native American Heritage Commission (NAHC) Sacred Lands File was completed on May 9, 2024. Based on the NAHC records, the APE is negative for sacred sites or traditional cultural places. Outreach letters were sent on July 23, 2024, to tribal organizations on the NAHC contact list. Follow-up emails were sent on August 30, 2024. On August 12, 2024, Table Mountain Rancheria responded stating the Project was out of their area of interest. No other responses were received as a result of this outreach. NAHC requests, NAHC results, Tribal outreach letters, and Tribal responses can be found in Confidential Appendix B of Appendix D. Therefore, there is a ***less than significant impact***.

Mitigation Measures: None are required.

XIX. UTILITIES AND SERVICE SYSTEMS

Would the project:

	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
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?	☐	☐	☒	☐

RESPONSES

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. Improvements proposed by the City consist of the rehabilitation and replacement of gravity sewer mains and provision of miscellaneous repairs and improvements to the City's WWTP.

The primary need for a sewer collection system improvement project is due to the significant deterioration of the sewer infrastructure in the current City area. Inspection revealed poor condition of some of the City's older sewer lines. Defects observed included deformation, root intrusion, cracked pipes, collapsed and broken pipes, sags, intruding laterals, defective lateral break-ins, attached deposits, and medium to large joint displacements. There have been no formal Notices of Violation (NOV) from regulatory agencies concerning the City's sewer collection system; however, numerous health and safety threats may arise from sewer system overflows because of sewer line disrepair, which would ultimately result in dangerous conditions on the City's streets and residential properties.

The proposed Project includes several miscellaneous improvements to the existing City-operated WWTP. The WWTP improvements and implementation will be performed under the regulatory requirements of the County of Fresno, the State Water Resources Control Board, and the Regional Water Quality Control Board. Compliance with such regulations will ensure that water quality and waste discharge standards are met. The wastewater characteristics will be typical of urban development and will not result in any additional water releases that could potentially impact groundwater or water quality. Because the Project provides long-needed upgrades to sewer mains currently experiencing blockages and leaks, the Project will likely have a beneficial impact on water quality because of the elimination of existing leaking or damaged sewer pipelines that currently exist. Compliance with the regulatory requirements of the County of Fresno, the State Water Resources Control Board, and the Regional Water Quality Control Board would result in a ***less than significant impact***. There are no other utility expansions that would be needed for the Project.

Mitigation Measures: None are required.

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

No Impact. Improvements proposed by the City consist of the rehabilitation and replacement of gravity sewer mains and provision of miscellaneous repairs and improvements to the City's WWTP. No new water supplies would be required as a result of this Project. There is ***no impact.***

Mitigation Measures: None are required.

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. See Response XIX (a) above. The Project itself consists of improvements to the City's sewer system and WWTP. The City's existing commitments to its users will remain unaffected. Compliance with the regulatory requirements of the County of Fresno, the State Water Resources Control Board, and the Regional Water Quality Control Board would result in a ***less than significant impact***.

Mitigation Measures: None are required.

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. Proposed Project construction and operation will generate minimal amounts of solid waste. The proposed Project will not generate waste on an on-going basis and will comply with all federal, state and local statutes and regulations related to solid waste. Any impacts will be ***less than significant.***

Mitigation Measures: None are required.

XX. WILDFIRE

If located in or near state responsibility areas or lands classified as very high fire hazard severity zones, would the project:	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	Less than Significant Impact	No Impact
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?	☐	☐	☒	☐

RESPONSES

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?

Less Than Significant Impact. The proposed Project is located in areas that have been developed with urban uses/agricultural and there are no areas within or adjacent to the Project Area that have a significant wildfire risk. The Project will include WWTP improvements, underground sewer mains and minor related improvements. There is no increased risk or on-going risk of wildfire beyond existing conditions associated with the Project.

As such, any wildfire risk to the project structures or people would be ***less than significant.***

Mitigation Measures: None are required.

XXI. MANDATORY FINDINGS OF SIGNIFICANCE

Would the project:

	Potentially Significant Impact	Less than Significant With Mitigation Incorporation	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 considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?	☐	☐	☒	☐
c. Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☒	☐	☐

RESPONSES

a. Does the project have the potential to 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, 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 analyses of environmental issues contained in this Initial Study indicate that the proposed Project is not expected to have substantial impact on the environment or on any resources identified in the Initial Study. Mitigation measures have been incorporated in the Project to reduce all potentially significant impacts to ***less than significant***.

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

Less than Significant Impact. CEQA Guidelines Section 15064(i) states that a Lead Agency shall consider whether the cumulative impact of a project is significant and whether the effects of the project are cumulatively considerable. The assessment of the significance of the cumulative effects of a project must, therefore, be conducted in connection with the effects of past projects, other current projects, and probable future projects. Due to the nature of the Project and consistency with environmental policies, incremental contributions to impacts are considered less than cumulatively considerable. The proposed Project would not contribute substantially to adverse cumulative conditions, or create any substantial indirect impacts (i.e., increase in population could lead to an increase need for housing, increase in traffic, air pollutants, etc.). The impact is ***less than significant***.

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

Less than Significant Impact With Mitigation. The analyses of environmental issues contained in this Initial Study indicate that the project is not expected to have substantial impact on human beings, either directly or indirectly. Mitigation measures have been incorporated in the Project to reduce all potentially significant impacts to ***less than significant.***

Chapter 4

MITIGATION MONITORING & REPORTING PROGRAM

MITIGATION MONITORING AND REPORTING PROGRAM

This Mitigation Monitoring and Reporting Program (MMRP) has been formulated based upon the findings of the Initial Study/Mitigated Negative Declaration (IS/MND) for the City of Coalinga – Sanitary Sewer Collection System and WWTP Improvements Project. The MMRP lists mitigation measures recommended in the IS/MND for the proposed Project and identifies monitoring and reporting requirements as well as conditions recommended by responsible agencies who commented on the project.

The first column of the Table identifies the mitigation measure. The second column, entitled "Party Responsible for Implementing Mitigation," names the party responsible for carrying out the required action. The third column, "Implementation Timing," identifies the time the mitigation measure should be initiated. The fourth column, "Party Responsible for Monitoring," names the party ultimately responsible for ensuring that the mitigation measure is implemented. The last column will be used by the City to ensure that individual mitigation measures have been monitored.

Mitigation Measure	Party responsible for Implementing Mitigation	Implementation Timing	Party responsible for Monitoring	Verification (name/date)
Biological Resources				
Protection of Monarch Butterfly *Mitigation Measure BIO – 1A (Milkweed Survey).* Prior to the start of construction, a qualified biologist will conduct a survey for milkweed plants in any portion of the sewer main work area that passes through residential yards, park land, ruderal/fallow fields, or other potentially suitable habitats. The survey will be conducted at a time of year when milkweed is readily identifiable. The objective of the survey will be to tally and map all milkweed plants that could potentially be impacted by project activities. *Mitigation Measure BIO – 1B (Construction Timing).* If feasible, no milkweed plants will be removed during the period when monarchs may be breeding in the project vicinity, March 15-October 31 (The Xerces Society 2019). *Mitigation Measure BIO – 1C (Compensatory Mitigation).* Any milkweed plants located within areas proposed for impact will be replaced at a 3:1 ratio in accordance with a revegetation plan prepared by a qualified biologist. The planting site(s) must be in similar or higher quality habitat to the	City of Coalinga	Prior to and/or during construction	City of Coalinga and construction contractor	

Mitigation Measure	Party responsible for Implementing Mitigation	Implementation Timing	Party responsible for Monitoring	Verification (name/date)
habitat that was impacted, in area(s) that will not be treated with pesticides or herbicides. **Protection of Southwestern Pond Turtle** *Mitigation Measure BIO – 2A (Construction Timing).* Construction activities at the WWTP will take place entirely between the months of November and March to avoid the typical timeframe for southwestern pond turtle nesting and egg incubation in this locality. *Mitigation Measure BIO – 2B (Preconstruction Survey).* Within 24 hours prior to the start of construction at the WWTP, a qualified biologist will survey the WWTP work area to identify any locations of possible underground nests, as would be indicated by eggshells on the surface from predation. Because hatchlings sometimes overwinter underground in their nests, this survey is required even with the implementation of Mitigation Measure 4.1.2a above. *Mitigation Measure BIO – 2C (Environmental Awareness Training).* Prior to the start of construction at the WWTP, construction personnel will be trained on the identification, behavior, and ecology of the southwestern pond turtle, and the project-specific measures adopted for its protection.				

Mitigation Measure	Party responsible for Implementing Mitigation	Implementation Timing	Party responsible for Monitoring	Verification (name/date)
Attendees will be given a handout that summarizes the training material and provides a photographic key to differentiating between the southwestern pond turtle and the common non-native red-eared slider. Attendance at all training sessions will be documented on sign-in sheets. *Mitigation Measure BIO – 2D (Refuge Ponds).* Construction activities at the WWTP will be staged so that, at any given time, at least two ponds suitable for the southwestern pond turtles will be inundated to their full operational depth ("refuge ponds"). In the first stage, at least two of the existing stabilization ponds will remain inundated, as these (and not the aerated lagoons) are presently occupied by pond turtles. Construction activities may proceed at the remaining features. As any given feature is converted to a percolation pond and inundated to its full operational depth, it will become a refuge pond and one of the previous refuge ponds may be released for dewatering and construction. *Mitigation Measure BIO – 2D (Construction Monitoring).* One or more qualified biologists will continuously monitor construction activities at the WWTP for the protection of southwestern pond turtles. The biologist(s) will look for pond turtles				

Mitigation Measure	Party responsible for Implementing Mitigation	Implementation Timing	Party responsible for Monitoring	Verification (name/date)
attempting to leave the ponds or otherwise traveling through upland areas of the WWTP, and will hand-capture and relocate these individuals to the nearest refuge pond. Any red-eared sliders or other introduced turtles that are discovered during this effort will be removed from the WWTP and either permanently rehomed or humanely dispatched. The biologist(s) will monitor all ground-disturbing activities in upland areas, looking for any subterranean nests or hatchlings that may be unearthed. The biologist(s) will have the authority to stop work if any nests or hatchlings are detected, and will appropriately secure the area before construction resumes. The number of biologists on site at any given time will be determined by the scope and extent of construction activities. *Mitigation Measure BIO – 2E (WWTP Operational Practices to Ensure No Net Loss of Aquatic Habitat).* During operation of the upgraded WWTP, periodic dry-down and disking of the percolation ponds will be staged so that, at any given time, at least three ponds encompassing a minimum of 12.5 acres will be inundated to their full operational depth. *Mitigation Measure BIO – 2F (Habitat Enhancement).* When inundated, each percolation pond will be equipped with at least three turtle basking				

Mitigation Measure	Party responsible for Implementing Mitigation	Implementation Timing	Party responsible for Monitoring	Verification (name/date)
structures. Such devices may consist of logs or floating boards, anchored with chains and weights, that can be removed during periods of dry-down and reinstalled once the pond is ready to be placed back in service. *Mitigation Measure BIO – 2G (Annual Monitoring).* For the first five years post-construction, a qualified biologist will conduct annual monitoring of the WWTP's southwestern pond turtle population. Monitoring surveys will be conducted between May and July, when pond turtles are most active, and will target favorable weather conditions for basking. The biologist will assess aquatic habitat suitability by noting inundation levels, recording the species composition and cover of any emergent vegetation, conducting a dipnet survey for invertebrate food sources, and evaluating other parameters as appropriate. The biologist will record the number of all turtles observed by species and age class. An attempt will be made to capture any red-eared sliders or other introduced turtles that are discovered during annual monitoring; captured individuals will be removed from the WWTP and either permanently rehomed or humanely dispatched. The biologist will document their findings in an annual report, to be submitted to the City of Coalinga and other agencies as necessary. If				

Mitigation Measure	Party responsible for Implementing Mitigation	Implementation Timing	Party responsible for Monitoring	Verification (name/date)
any corrective actions are needed, they will be identified in the annual report and promptly implemented by the City. **Protection of Temblor Legless Lizard, California Glossy Snake, and San Joaquin Coachwhip** *Mitigation Measure BIO – 3A* (*Preconstruction Surveys*). Within 24 hours prior to the start of construction activities at the WWTP and in rural portions of the sewer main work area, a qualified biologist will conduct preconstruction surveys for the Temblor legless lizard, California glossy snake, and San Joaquin coachwhip. The biologist will make an attempt to hand-capture any individuals of these species that are found and relocate them to suitable alternative habitat away from the work area. *Mitigation Measure BIO – 3B (Environmental Awareness Training).* Prior to the start of construction at the WWTP and in rural portions of the sewer main work area, construction personnel will be trained on the identification, behavior, and ecology of the Temblor legless lizard, California glossy snake, and San Joaquin coachwhip, and the project-specific measures adopted for its protection. Attendees will be given a handout that summarizes				

Mitigation Measure	Party responsible for Implementing Mitigation	Implementation Timing	Party responsible for Monitoring	Verification (name/date)
the training material. Attendance at all training sessions will be documented on sign-in sheets. *Mitigation Measure BIO – 3C* (*Protective Measures During Construction*). Workers will regularly inspect the work area for reptiles. At a minimum, this will include (1) checking for reptiles under and around any parked vehicles or equipment prior to their operation, (2) scanning the ground for reptiles while operating vehicles or equipment, and (3) checking any open trenches or other excavations for trapped reptiles at the beginning and end of each work day. Any reptiles found during these inspections will be allowed to leave the area of their own volition, or will be captured and relocated out of harm's way. **Protection of Swainson's Hawk** *Mitigation Measure BIO – 4A* (*Construction Timing*). If feasible, project construction will occur entirely outside of the March -September 15 Swainson's hawk nesting season. *Mitigation Measure BIO – 4B* (*Protocol Nesting Surveys*). If construction activities must occur between March 1 and September 15, then a qualified biologist will conduct protocol nesting surveys in accordance with the Swainson's Hawk Technical				

Mitigation Measure	Party responsible for Implementing Mitigation	Implementation Timing	Party responsible for Monitoring	Verification (name/date)
Advisory Committee (SHTAC) 2000 *Recommended Timing and Methodology for Swainson's Hawk Nesting Surveys in California's Central Valley*. Surveys will be conducted in at least the two SHTAC-defined survey periods immediately preceding construction. The survey periods are Period 1: January-March 20, Period II: March 20-April 5, Period III: April 5-20, Period IV: April 21-June 10, Period V: June 10-July 30. *Mitigation Measure BIO – 4C* (*Avoidance of Active Nests*). Should any active nests be discovered within the survey area, an appropriate disturbance-free buffer will be established by the biologist based on local conditions and agency guidelines. Disturbance free buffers will be identified on the ground with flagging, fencing, or by other easily visible means and will be maintained until a qualified biologist has determined that the young have fledged and are capable of foraging independently. **Protection of Burrowing Owl** *Mitigation Measure BIO – 5A (Take Avoidance Survey).* A take avoidance survey for burrowing owls will be conducted by a qualified biologist within 14 days prior to the start of construction, following methods described in the *Staff Report on Burrowing Owl*				

Mitigation Measure	Party responsible for Implementing Mitigation	Implementation Timing	Party responsible for Monitoring	Verification (name/date)
Mitigation (CDFG 2012). The survey area will include all potential roosting and nesting habitat on or within 200 meters of the project site. *Mitigation Measure BIO – 5B (Avoidance of Active Burrows).* If project activities are undertaken during the breeding season (February 1-August 31) and active nest burrows are identified within or near project impact areas, a 200-meter disturbance-free buffer will be established around these burrows. The buffers will be enclosed with temporary fencing to prevent construction equipment and workers from entering the setback area. Buffers will remain in place for the duration of the breeding season. During the non-breeding season (September 1-January 31), active burrowing owl burrows will be avoided by a minimum distance of 50 meters. *Mitigation Measure BIO – 5C (CDFW Consultation)*. If it is not feasible to avoid burrows by the setback distances specified above, the applicant will develop other measures to fully avoid take of burrowing owls in consultation with CDFW. If full take avoidance is not possible, the applicant will obtain a Section 2081 Incidental Take Permit (ITP) for this species. If an ITP is required, it would include minimization and mitigation measures including a passive relocation effort, construction				

Mitigation Measure	Party responsible for Implementing Mitigation	Implementation Timing	Party responsible for Monitoring	Verification (name/date)
monitoring, replacement burrow creation/enhancement, and/or other forms of compensatory mitigation. **Protection of San Joaquin Kit Fox** *Mitigation Measure BIO – 6A (Pre-construction Surveys).* Between 14 and 30 days prior to the start of any project activity that could potentially affect the SJKF, a qualified biologist will conduct preconstruction surveys for this species following the USFWS 2011 *Standardized Recommendations for Protection of the Endangered San Joaquin Kit Fox Prior to or during Ground Disturbance* ("Standardized Recommendations"). The primary objective will be to identify potential SJKF habitat features and evaluate their use by kit foxes. *Mitigation Measure BIO – 6B (Avoidance).* Should one or more active kit fox dens be detected during preconstruction surveys, the USFWS and CDFW will be notified immediately. A disturbance-free buffer will be established around the dens in consultation with the USFWS and CDFW, to be maintained until an agency-approved biologist has determined that the dens have been abandoned.				

Mitigation Measure	Party responsible for Implementing Mitigation	Implementation Timing	Party responsible for Monitoring	Verification (name/date)
Mitigation Measure BIO – 6C (Minimization). The applicant will implement all minimization measures presented in the *USFWS Standardized Recommendations*. Such measures include, but are not limited to: restriction of project-related vehicle traffic to established roads, construction areas, and other designated areas; measures to prevent the inadvertent entrapment of kit foxes in holes, trenches, and pipes; restriction of rodenticide and herbicide use; and proper disposal of food items and trash. *Mitigation Measure BIO – 6D (Environmental Awareness Training)*. A qualified biologist will provide training to all personnel who will be working on site. The training will include a description of the kit fox and its habitat needs; a report of the occurrence of kit fox in the project vicinity; an explanation of the status of the species and its protection under the Endangered Species Act; and a list of the measures being taken to reduce impacts to the species during project construction and implementation. A handout will be provided to all attendees that summarizes the information presented in the training and presents the contact name and number of a designated representative to				

Mitigation Measure	Party responsible for Implementing Mitigation	Implementation Timing	Party responsible for Monitoring	Verification (name/date)
contact in case SJKF individuals are observed in or near the work area during construction. **Protection of American Badger** *Mitigation Measure BIO – 7A (Preconstruction Surveys).* A preconstruction survey for American badgers will be conducted by a qualified biologist within 7 days prior to the start of construction activities in rural portions of the sewer main work area and at the WWTP. The surveys will target all potential denning habitat on or within 50 feet of these areas. *Mitigation Measure BIO – 7B (Avoidance).* Should an active sleeping den be identified during the preconstruction surveys, the den shall be identified in the field with brightly-colored fencing or flagging, and avoided until a qualified biologist has determined that it has been abandoned. Should an active natal den be identified during the preconstruction surveys, a suitable disturbance-free buffer will be established around the den and maintained until a qualified biologist has determined that the cubs have dispersed or the den has been abandoned.				

Mitigation Measure	Party responsible for Implementing Mitigation	Implementation Timing	Party responsible for Monitoring	Verification (name/date)
Protection of Nesting Migratory Birds Including Long-Eared Owl *Measure BIO – 8A (Construction Timing).* If feasible, project construction will occur entirely outside of the February 1-August 31 general avian nesting season. *Measure BIO – 8B (Preconstruction Surveys*). If construction must occur between February 1 and August 31, a qualified biologist will conduct pre-construction surveys for active bird nests within 7 days prior to the start of any work within this period. The survey area will encompass the work area and surrounding lands within 250 feet for nesting migratory birds and 500 feet for raptors. *Measure BIO – 8C (Avoidance of Active Nests*). Should any active nests be discovered in or near proposed construction zones, the biologist will identify a suitable construction-free buffer around the nest. The buffer distance will be determined based on species biology, site-specific conditions, and the level of project-related disturbance that is anticipated near the nest(s) in question. Buffers will be identified on the ground with flagging or fencing and will be maintained until the biologist has				

Mitigation Measure	Party responsible for Implementing Mitigation	Implementation Timing	Party responsible for Monitoring	Verification (name/date)
determined that the young have fledged and are capable of foraging independently.				
Cultural Resources				
Measure CUL – 1 (Protect Undiscovered Cultural Resources) In the event that archaeological remains are encountered at any time during development or ground-moving activities within the entire Project area, all work in the vicinity of the find should be halted until a qualified archaeologist can assess the discovery and take appropriate actions as necessary.	City of Coalinga	Prior to and/or during construction	City of Coalinga and construction contractor	

Chapter 5

PREPARERS

LIST OF PREPARERS

Crawford & Bowen Planning, Inc.

- Travis Crawford, AICP, Principal Environmental Planner
- Emily Bowen, Principal Environmental Planner

Live Oak Associates, Inc. (Biological Firm)

ASM Affiliates, Inc. (Cultural Firm)

AM Consulting Engineers

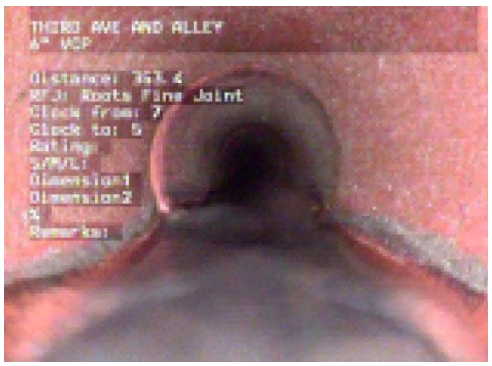
Appendices

Appendix A

Preliminary Engineering Report

CITY OF COALINGA

SANITARY SEWER COLLECTION SYSTEM AND WASTEWATER TREATMENT PLANT IMPROVEMENTS







DRAFT PRELIMINARY ENGINEERING REPORT

December 2023

Prepared by:

Consulting Engineers

AM Consulting Engineers, Inc. – 5150 N Sixth Street, Suite 124 – Fresno, CA 93711 – P: 559.473.1371 – F: 559.513.8449

Table of Contents

SECTION 1 - INTRODUCTION 1
1.1. Purpose of Preliminary Engineering Report 1
1.2. Study Area Characteristics 1
1.2.1. Location 1
1.2.2. Environmental Resources 4
1.2.3. Land Use and Population 4
1.2.4. Soils 4
1.2.5. Climate 4
SECTION 2 - MUNICIPAL WATER SUPPLY 6
2.1. Water Supply Source 6
2.2. Water Facilities 6
SECTION 3 - WASTEWATER FLOWS AND CHARACTERISTICS 8
3.1. Wastewater Flows 8
3.2. Wastewater Flow Characteristics 11
3.3. Salinity 11
3.4. Effluent Quality Requirements 14
3.5. Discharge Violations 14
SECTION 4 - EXISTING FACILITIES AND PROJECT NEED 16
4.1. Overview 16
4.2. Existing Wastewater Treatment Plant 16
4.2.1. Background 16
4.2.2. Existing Treatment 17
4.2.3. Existing Effluent Disposal 19
4.3. Project Need 19
4.3.1. System O&M 19
4.3.2. Current O&M Expenses 19
4.4. Sewer Collection System 21

4.5. Condition of Sewer Collection System 23
4.5.1. CCTV Inspection 23
4.6. Project Need 24
4.6.1. Health and Safety 26
4.6.2. System O&M 26
SECTION 5 - IMPROVEMENTS TO SEWER COLLECTION SYSTEM 28
5.1. Alternatives Considered 28
5.2. Alternative No. I: No Project 28
5.3. Alternative No. II: Convention Construction Method 28
5.3.1. Sewer Main Replacement 29
5.3.2. Probable Construction Costs 34
5.3.3. Annual O&M Costs 34
5.4. Alternative No. III Conventional and Trenchless Construction Methods 36
5.4.1. Pipe Bursting 36
5.4.2. CIPP 36
5.4.3. Sewer Main Replacement and Rehabilitation 37
5.4.4. Probable Construction Costs 42
5.4.5. Annual O&M Costs 43
5.5. Alternative Evaluation 45
5.5.1. Design Criteria/Compliance Issues 45
5.5.2. Annual O&M Costs 45
5.5.3. Life-Cycle Costs 46
5.6. Recommended Alternative 46
SECTION 6 - WASTEWATER TREATMENT PLANT IMPROVEMENTS 47
6.1. Alternatives Considered 47
6.2. Alternative I: No Project 47
6.3. Alternative II: Existing Treatment with Offsite Disposal through Agricultural Irrigation (Non-Human Crops) 47
6.3.1. Overview 47
6.3.2. Potential User Survey 47

6.3.3. Water Balance 48
6.3.4. Storage Requirements 48
6.3.5. Capital Construction Costs 48
6.3.6. Estimated O&M Costs 49
6.4. Alternative III: Upgrading WWTP to Extended Aeration with Biological Nutrient Removal and Onsite Disposal through percolation (Groundwater Recharge) 51
6.4.1. Overview 51
6.4.2. Improvements to WWTP 51
6.4.3. Improvements to Percolation Ponds 52
6.4.4. Capital Construction Costs 53
6.4.5. Estimated O&M Costs 54
6.5. Alternative IV: Upgrading WW Treatment Facility to Tertiary Treatment 55
6.5.1. Overview 55
6.5.2. Improvements to WWTP 55
6.5.3. Alternative IV-A Offsite Disposal through Agricultural Irrigation (Human Crops) 58
6.5.4. Alternative IV-B Offsite Disposal through Landscape Irrigation 61
SECTION 7 - PROPOSED PROJECT 67
7.1. Project Overview 67
7.2. Proposed Improvements to Sewer Collection System 67
7.2.1. Sewer Main Replacement 67
7.2.2. Sewer Main Rehabilitation 67
7.2.3. Potential Construction Problems 68
7.3. Proposed Improvements to Wastewater Treatment Plant 70
7.3.1. Extended Aeration and Biological Nutrient Removal 70
7.3.2. Clarifier 70
7.3.3. Effluent Disposal 70
7.4. Climate Change Considerations 71
7.5. Permitting Requirements 71
7.6. Opinions of Probable Construction Costs 72
7.6.1. Capital Construction Costs 72

7.6.2. Operation and Maintenance 73
7.6.3. Present Worth Analysis 75
7.6.4. Life Cycle Costs 77
7.7. Project Schedule 77
APPENDIX A SOILS REPORT 79
APPENDIX B WASTE DISCHARGE REQUIREMENTS ORDER NO. 94-184 139
APPENDIX C ANNUAL WATER BALANCE 158
APPENDIX D ANNUAL WATER BALANCE 162
APPENDIX E ANNUAL WATER BALANCE 166
APPENDIX F ANNUAL WATER BALANCE 170

LIST OF TABLES

Table 1-1 City of Coalinga Projected Population 4
Table 1-2 City of Coalinga Average Precipitaion 5
Table 3-1 Average and Maximum Daily Flows 8
Table 3-2 Projected Wastewater Flows 11
Table 3-3 Average Influent and Effluent BOD 11
Table 3-4 Specific Conductivity 14
Table 3-5 WWTP Discharge Constituents and Limits 14
Table 4-1 Summary of Sewer Pipelines 21
Table 4-2 NASSCO PACP Ratings 23
Table 4-3 Summary of PACP Defects 24
Table 4-1 Current O&M Expenses 26
Table 5-1 Sewer Mains Recommended to be Replaced 29
Table 5-2 Alternative No. II Probable Construction Costs 34
Table 5-3 Alternative No. III Sewer Mains Recommended to be Rehabilitated/Replaced 37
Table 5-4 Alternative No. III Probable Construction Costs 43
Table 5-5 Average Annual O&M Costs 46
Table 5-6 Life Cycle Cost Estimates 46
Table 6-1 Potential Recycled Water Users 47

Table 6-2 Alternative II – Water Balance Design Data 48
Table 6-3 Alternative II – Water Balance Calculation Summary 48
Table 6-4 Alternative II – Capital Construction Costs 49
Table 6-5 Alternative II – Estimated Annual O&M 49
Table 6-6 Alternative III – Extended Aeration Activated Sludge Parameters 51
Table 6-7 Alternative III – Circular Clarifier Design Parameters 52
Table 6-8 Alternative III – Water Balance Design Data 53
ATable 6-9 Alternative III – Capital Construction Costs 53
Table 6-10 Alternative III – Estimated O&M Costs 54
Table 6-11 Alternative IV A – Water Balance Design Data 58
Table 6-12 Alternative IV A – Water Balance Calculation Summary 58
Table 6-13 Alternative IV A – Capital Construction Costs 59
Table 6-14 Alternative IV A – Estimated O&M Costs 60
Table 6-15 Alternative IV B– Potential Landscapre Irrigation Customers 61
Table 6-16 Alternative IV B– Water Balance Design Data 62
Table 6-17 Alternative IV B– Water Balance Calculation Summary 62
Table 6-18 Alternative IV B– Capital Construction Costs 63
Table 6-19 Alternative IV B– Estimated O&M Costs 61
Table 7-1 Proposed Sewer Main Replacement 67
Table 7-2 Proposed Sewer Main Rehabilitation 68
Table 7-3 Proposed Evaporation/Percolation Pond Characteristics 71
Table 7-4 Capital Construction Costs 72
Table 7-5 Estimated O&M Costs 74
Table 7-6 Estimated Salvage Value 76
Table 7-7 Present Worth Cost Analysis 76
Table 7-8 Proposed Project Life Cycle Costs 77
Table 7-9 Estimated Project Schedule 78

LIST OF FIGURES

Figure 1-1 Regional Location and Vicinity Map 2
Figure 1-2 Service Area Boundary 3
Figure 3-1 Monthly Wastewater Flows 10
Figure 3-2 Influent BOD Frequency Diagram 14
Figure 4-1 Wastewater Treatment Plant Site Layout 20
Figure 4-2 Existing Sanitary Sewer Collection System 22
Figure 4-3 Sewer Collection System Condition Assessment 25
Figure 5-1 Alternative No. II – Sewer Mains to be Replaced 35
Figure 5-2 Alternative No. III – Sewer Mains to be Replaced/Rehabilitated 44
Figure 6-1 Wastewater Treatment Plant Improvements – Potential Recycled Water Users 48
Figure 6-2 Wastewater Treatment Plant Improvements – Porposed Alternative II Layout 49
Figure 6-3 Wastewater Treatment Plant Improvements – Proposed Alternative III Layout 53
Figure 6-4 Wastewater Treatment Plant Improvements – Recycled Water User Survey 57
Figure 6-5 Wastewater Treatment Plant Improvements – Proposed Alternative IV A Layout 60
Figure 6-5 Wastewater Treatment Plant Improvements – Alternative IV B Layout 66
Figure 7-1 Proposed Sewer Collection System Improvements 69
Figure 7-2 Proposed Wastewater Treatment Plant Improvements – Alternative III 69

ABBREVIATIONS

ac-ft	Acre-Feet
ACS	American Community Survey
AFL	Aerated Facultative Lagoons
BOD	Biochemical Oxygen Demand
CDC	California Department of Corrections
CIMIS	California Irrigation Management Information System
City	City of Coalinga
CVP	Central Valley Project
CWSRF	Clean Water State Revolving Fund
CCTV	Closed-Circuit Television
CIPP	Cured-In-Place
EC	Electric Conductivity
ET_o	Evapotranspiration
ft	Feet
gpcd	Gallons per Capita Day
in	Inch
LF	Linear Feet
MHI	Median Household Income
µmhos/cm	Micromhos per Centimeter
MG	Million Gallons
MGD	Million Gallons per Day
mg/L	Milligrams per Liter
MLSS	Mixed Liquor Suspended Solids
NASSCO	National Association of Sewer Service Companies
VIS	Video Inspection Specialists, Inc.
NRCS	Natural Resources Conservation Service
NOV	Notices of Violation
O&M	Operation and Maintenance
PACP	Pipeline Assessment Conditions Program
PER	Preliminary Engineering Report

Prison	Coalinga State Prison
PV	Photovoltaic
RAS	Recirculated Activated Sludge
RWQCB	Regional Water Quality Control Board
ROW	Right-of-Way
RAS	Recirculating Activated Sludge
SDAC	Severely Disadvantaged Community
SSO	Sewer System Overflow
SOI	Sphere of Influence
SWRCB	State Water Resource Control Board
SP	Stabilization Ponds
SSO	Sewer System Overflows
TSS	Total Suspended Solids
USBR	U.S. Bureau of Reclamation
VSS	Volatile Suspended Solids
VFD	Variable Frequency Drive
WAS	Wasted Activated Sludge
WDR	Waste Discharge Requirements
WWTP	Wastewater Treatment Plant
WRCC	Western Regional Climate Center

SECTION 1 - INTRODUCTION

1.1. Purpose

The purpose of this Preliminary Engineering Report (PER) is to provide a comprehensive evaluation of the City of Coalinga's (City) existing sewer collection system and wastewater treatment plant (WWTP) and recommend the most viable and sustainable sewer service alternative that will result in the least cost to City customers. This PER will assess the condition of the collection system's existing pipelines and manholes, correct existing deficiencies, and prioritize the replacement of sewer lines based on their estimated remaining useful life. This PER will also provide recommendations that will correct system deficiencies at the existing WWTP to improve treatment operations.

The preparation of this PER is being funded by the State Water Resources Control Board (SWRCB) through the Clean Water State Revolving Fund (CWSRF). The contents of this Report are intended to meet the requirements of the SWRCB and can be utilized to submit a CWSRF construction funding application for the implementation of the proposed project. This PER will include an overview of the City of Coalinga, description of the City's existing water sources, evaluation of the existing sewer collection system and WWTP, and necessary improvement needed to provide adequate sewer service to residents within the City's service area.

1.2. Study Area Characteristics

1.2.1. Location

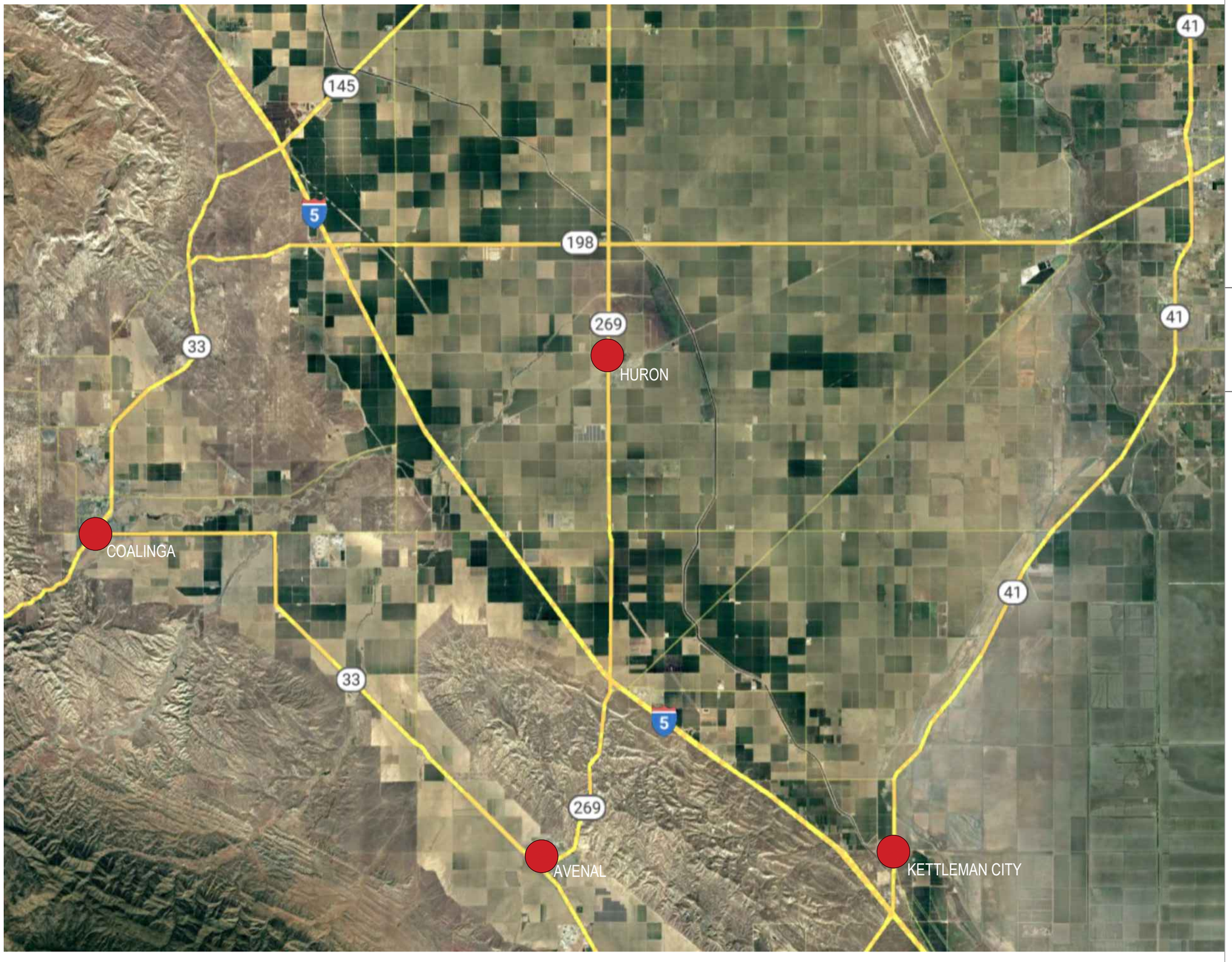
The City of Coalinga is located near the eastern foothills of the Diablo Range and to the west of the Central San Joaquin Valley in western Fresno County. Figure 1-1 displays the City's regional location and vicinity, including its relation to some of the surrounding communities in the area. The City is generally bounded by Lucile Avenue to the south, West Gale Avenue to the north, Monterey Street to the west and Springbrook Street to the East. The City of Fresno is located approximately 60 miles to the northeast, the city of Avenal is located approximately 18 miles to the southeast, and the city of Huron is located approximately 19 miles to the northeast. The primary access routes to Coalinga include California State Route 33 and California State Route 198 from the north and south. Interstate 5 is approximately 13 miles to the east.

The City's boundary encompasses approximately 6 square miles, of which 2.1 square miles are urbanized. The Sphere of Influence (SOI) encompasses 3.6 square miles. Figure 1-2 displays the City's current service area and SOI. The City has primary authority over land use and other governmental actions within this area.

The City owns and operates a citywide sewer collection system and a WWTP under Waste Discharge Requirements (WDR) No. 94-184. The current WDRs limit the volume of average monthly discharge to 1.34 million gallons per day. The sewer collection system currently serves 3,369 residences and 318 businesses. The WWTP site is located approximately one mile east of the City. The WWTP consists of screening, primary clarification, and secondary treatment (aerated facultative lagoons followed by stabilization lagoons). Undisinfected secondary effluent is pumped year-round to irrigate fodder crops such as alfalfa, Sudan grass, oat hay and pasture. The City Maintenanceains sewer assets in accordance with industry standard practices by performing preventive Maintenance on mechanical equipment and pipelines.

CITY OF COALINGA

SANITARY SEWER COLLECTION SYSTEM
PRELIMINARY ENGINEERING REPORT



LEGEND

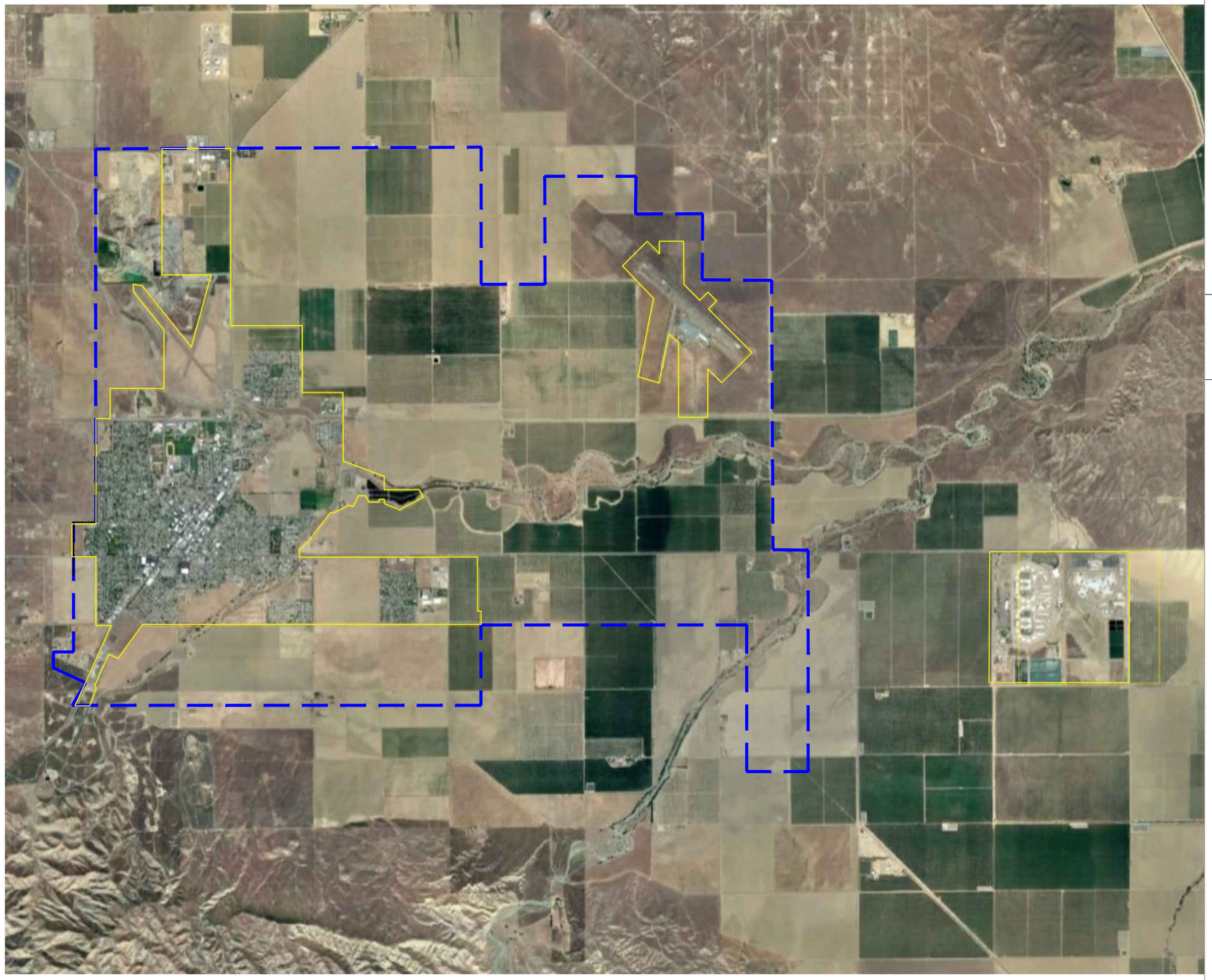
ROADS

NORTH
SCALE: 1" = 10 MI

FIGURE 1-1
REGIONAL LOCATION AND VICINITY MAP

CITY OF COALINGA

SANITARY SEWER COLLECTION SYSTEM
PRELIMINARY ENGINEERING REPORT



LEGEND

CITY LIMITS (SERVICE AREA BOUNDARY)

SPHERE OF INFLUENCE

NORTH
SCALE: 1" = 4000'

FIGURE 1-2 SERVICE BOUNDARY

1.2.2. Environmental Resources

The proposed sewer collection system improvements evaluated in this Report will primarily consist of the replacement and/or rehabilitation of public sewer mains in the City's existing public right-of-way (ROW). Little or no construction will occur on land which is not currently developed within those ROW. It is not anticipated that impacts to floodplains, farmland, historic resources, or endangered species will be part of the project.

1.2.3. Land Use and Population

Land use within the City's service area consists mainly of residential properties, commercial businesses, and the Pleasant Valley State Prison. According to the 2017-2021 U.S. Census American Community Survey (ACS), the City's median household income (MHI) is $65,180. The current residential sewer rate is $23.29 per month ($279.48 per year), which is approximately 0.43 percent of the MHI.

According to the 2020 U.S. Census, the population of the City was 17,590, which was up from 13,380 at the 2010 Census and up from 11,668 at the 2000 Census. According to the U.S. Census Population Estimates Program, population within the City has decreased to approximately 17,560 in 2021. This represents an average growth rate of approximately 2.30 percent from 1990 to 2022.

Population projection for the City through 2045 is presented in Table 1-1 below. A long-term growth of 2.30 percent has been used in those projections. The City provides sewer service to 3,148 connections and receives an average daily flow of approximately 0.9 million gallons per day (MGD). The City of Coalinga is responsible for providing current as well as projected sewer service needs to customers within its service area.

Table 1-1 City of Coalinga Projected Population

	2022	2024	2030	2035	2040	2045
Service Area Population	17,024	17,818	20,428	22,893	25,655	28,750

Notes:
(1) Projected estimates are based on population growth from 1990 to 2022. An annual growth rate of 2.30 percent is used.

1.2.4. Soils

The City of Coalinga has a relatively flat topography. According to the Custom Soil Resources Report for Fresno County, California, published by the Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), the most prevalent soils series in the City of Coalinga service area are Excelsior sandy loam, Westhaven loam and Posochanet clay loam. A copy of this soils report is attached in Appendix A.

1.2.5. Climate

The Western Regional Climate Center (WRCC) has maintained climate records for the past 100 years for areas within Fresno County. Average annual temperature and precipitation data is provided in Table 1-2.

Similar to the Western Regional Climate Center, the California Irrigation Management Information System (CIMIS) tracks and Maintenanceains records of evapotranspiration (ETo) for select cities only. Table 1-2 provides ETo statistics were obtained from the City of Coalinga

The City is characterized as having a semiarid climate, which occurs on the periphery of deserts in low latitude. The Köppen Climate Classification subtype for this climate is "BSk" (Tropical and Subtropical Steppe Climate). Summers are typically hot and dry, while winters are cool with an average precipitation of about 7.7 inches per year. Most of the annual precipitation occurs during the period from November and March. Table 1-2 below shows the average monthly precipitation, maximum and minimum average temperatures, and evapotranspiration within the City.

Table 1-2 City of Coalinga Average Perception

Month	Average Precipitation (in)	Average Temperature (°F)		Evapotranspiration, Et_o (in)
		Maximum	Minimum	
January	1.60	57.8	35.8	1.98
February	1.51	63.6	39.2	2.93
March	1.21	69.2	41.8	4.49
April	0.55	76.0	45.9	6.43
May	0.25	84.9	52.5	8.37
June	0.04	92.7	59.2	9.66
July	0.01	99.4	65.3	10.01
August	0.02	97.8	63.2	8.99
September	0.19	92.7	58.6	6.94
October	0.31	81.8	49.7	4.88
November	0.72	67.6	40.6	2.64
December	1.20	58.2	35.7	1.72
Total/Average	**7.61**	**78.5**	**49.0**	**69.04**

SECTION 2 - MUNICIPAL WATER SUPPLY

2.1. Water Supply Source

The City of Coalinga imports its water through the federal Central Valley Project (CVP) supervised by the U.S. Bureau of Reclamation (USBR). Due to the poor groundwater quality in the area, the City does not pump groundwater to supplement the water supply due to its poor quality and high concentrations of sulfates, total dissolved solids (TDS), and sodium. On October 28, 1968, the City entered a 40-year contract with the US Bureau of Reclamation for up to 10,000 acre-feet (ac-ft) of CVP water on an annual basis. This contract expired on December 31, 2008. On January 22, 2021, a long-term contract was signed between the City and the USBR (Contract No. 14-06-200-4173A-IR1-P) that established new rates and extended the City's right to pump up to 10,000 AF of water per year.

Raw water for the City flows from the Sacramento-San Joaquin Delta to the south into either the Delta-Mendota Canal or the CVP California Aqueduct, which discharges in the O'Neil Forebay. From the O'Neil Forebay, water continues to flow south into the California Aqueduct to the point of origination of the Coalinga Canal, approximately 15 miles northeast of the City where Highway 145 crosses over the California Aqueduct. After leaving the California Aqueduct, water is carried in the Coalinga Canal approximately 12 miles south to the City of Coalinga WTP intake. A raw water pump station then lifts the water from the Coalinga Canal to the City's conventional surface WTP.

2.2. Water Facilities

Surface water from the Coalinga Canal is treated at the City's Water Treatment Plant, which is located approximately 7 miles outside of city limits. The City's surface WTP originally came online in April 1972 with an average daily flow capacity of 8 million gallons per day (MGD) and maximum daily flow capacity of 12 MGD. In anticipation of the increased demands resulting from the construction of the Pleasant Valley State Prison, the capacity of the WTP was increased to receive an average daily flow of 12 MGD and a maximum daily flow of 16 MGD. The Plant provides conventional surface water treatment, with processes that include chemical pretreatment, chlorine disinfection, corrosion control, filtration, flocculation, and sedimentation. As a secondary disinfection, chlorination is used to maintain chlorine residual in the distribution system while reducing further production of disinfection byproducts. Treated water is pumped by a filtered-water pump station into a 27-inch diameter pipeline in Palmer Avenue.

Treated water is pumped by a filtered-water pump station into a 27-inch diameter pipeline on Palmer Avenue. Approximately two miles west of the WTP, the flow tees at Calaveras Avenue. Water flowing west continues for another mile and a half to the Palmer Avenue Reservoir. Water going to the Pleasant Valley State Prison travels south in the 12-inch Calaveras Avenue pipeline to the Calaveras Avenue Reservoir. After flowing through the Calaveras Reservoir, it continues south along Calaveras Avenue another 3.5 miles to Jayne Avenue and then east to the prison. Water can potentially travel from the Calaveras Reservoir westerly into the City; however, this seldom occurs due to the hydraulic conditions. Water leaving the Palmer Reservoir flows through approximately eight miles of 24 and 27-inch transmission mains to the Derrick Avenue Reservoir. Water travels primarily from the Derrick Avenue Reservoir through 18, 24, and 30-inch transmission mains into the City's water distribution system. The distribution system consists of a network of water mains ranging in size from 4 to 14 inches in diameter. The system can supply peak hour needs without excessive losses and can deliver fire flows to main lines.

The City's existing storage reservoirs all consist of steel tanks resting on reinforced concrete ring wall foundations. The following is a description of each of the City's treated water storage reservoirs:

- Palmer Avenue Reservoir – This reservoir is located on the south side of Palmer Avenue and has a capacity of 2.8 MG. This reservoir receives pumped treated water from the WTP.
- Calaveras Avenue Reservoir – This reservoir is located on the east side of Calaveras Avenue and has a capacity of 5.0 MG. Water flows from the WTP to the Calaveras Reservoir and then to the Pleasant Valley State Prison.
- Derrick Avenue Reservoir – This reservoir is located west of the City, on the east side of Derrick Avenue. This reservoir has a capacity of 7.6 MG. Water from the Palmer Reservoir flows to the Derrick Reservoir and then into the City.
- Oil King Reservoir – This reservoir is located west of Highway 33/198, approximately three miles north of Palmer Avenue. The reservoir has a capacity of 0.5 MG and exclusively serves the City's oil company customers.
- Northwest Reservoir – This reservoir is located east of Derrick Avenue, approximately three miles north of Gale Avenue. This reservoir has a capacity of 0.2 MG. Like the Oil King Reservoir, this reservoir is also used exclusively for the City's oil company customers.

Since the Oil King and Northwest reservoirs' sole function is to provide water to oil companies, they are excluded from the evaluation of the City's available storage. The existing combined storage capacity of the Palmer, Derrick and Calaveras reservoirs is 15.4 million gallons (MG).

SECTION 3 - WASTEWATER FLOWS AND CHARACTERISTICS

3.1. Wastewater Flows

The City of Coalinga (City) owns and operates a WWTP under Regional Water Quality Control Board (RWQCB) Waste Discharge Requirements (WDR) Order No. 94-184. The current WDRs limit the volume of the average monthly discharge to 1.34 million gallons per day (MGD). The WWTP consists of screening, primary clarification, and secondary treatment (aerated facultative lagoons followed by stabilization lagoons). Undisinfected secondary effluent is pumped year-round to irrigate fodder crops such as alfalfa, Sudan grass, oat hay and pasture.

Based on Records from January 1, 2018, through December 31, 2022, the City's WWTP received an average daily flow of approximately 0.857 MGD. The maximum daily flow for the same period is approximately 1.014 MGD. Table 3-1 displays the average daily flow and maximum daily flows from January 1, 2018, through December 31, 2022.

Table 3-1 Average and Maximum Daily Wastewater Flows

	2018	2019	2020	2021	2022	Average
Average Daily Flow (MGD)	0.824	0.838	0.864	0.877	0.880	0.857
Maximum Daily Flow (MGD)	0.925	0.908	0.957	1.014	1.005	0.962

Figure 3-1 displays the monthly average daily flow and maximum daily flow for each month between 2018 and 2022. The maximum daily flow peaks at an average of 1.003 MGD in June, while the average daily flow peaks at an average of 0.895 in February.

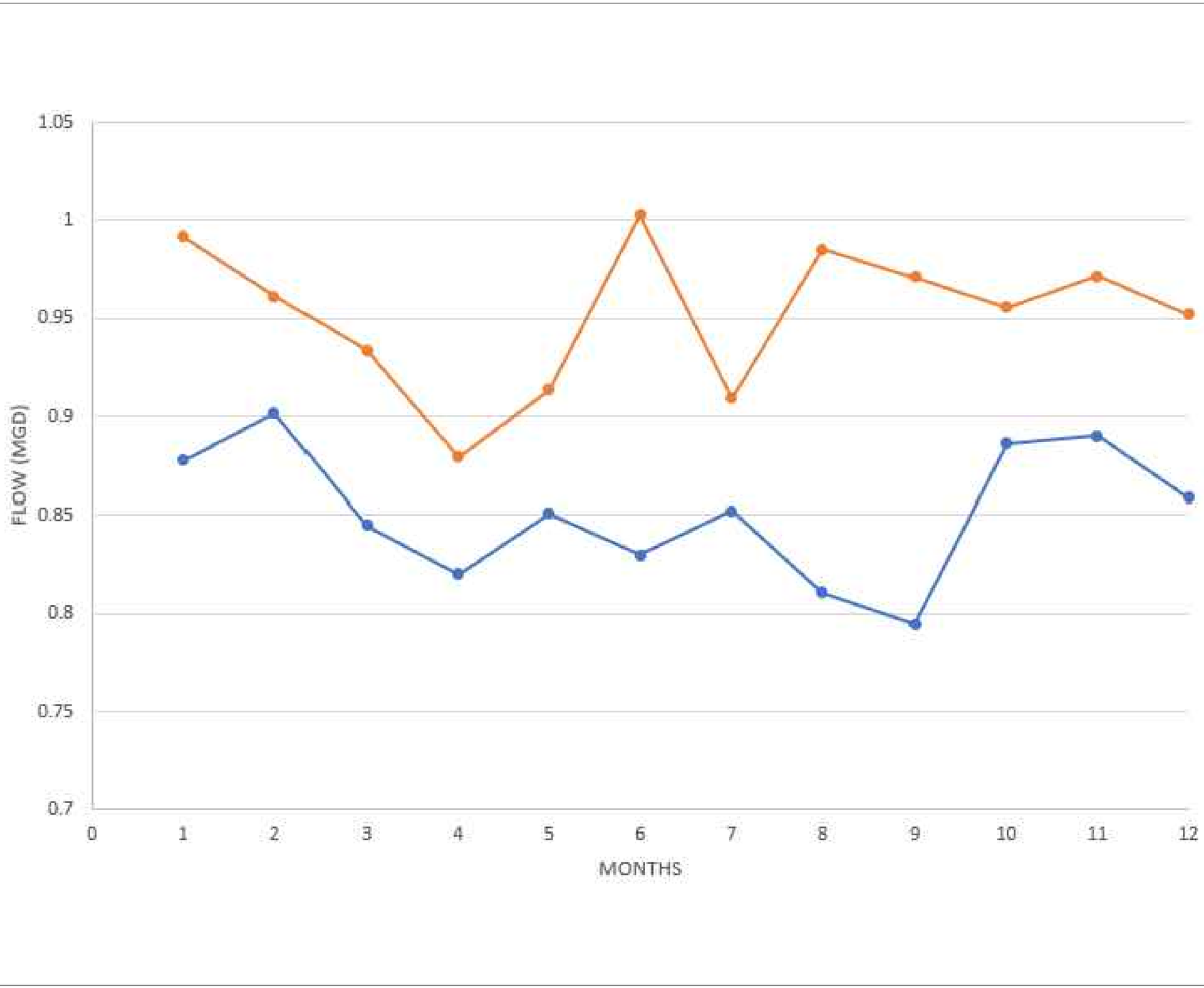
Using population data and influent wastewater presented in Table 3-1, the average wastewater generation per capita is approximately 51.690 gallons per capita day (gpcd). The maximum per capita wastewater generation for the same period is approximately 59.003 gpcd. Table 3-2 provides projected values for the influent wastewater flows through 2045. As previously stated in Section 1 of this Report, population within the City has increased approximately 2.30 percent per year. As shown in Table 3-2, the WWTP's current design flow of 1.34 MGD does not appear to provide adequate capacity through 2045.

Table 3-2 Projected Wastewater Flows

	2024	2030	2035	2040	2045
Service Area Population	17,818	20,428	22,893	25,655	28,750
Estimated Average Daily Flows (MGD)	0.921	1.056	1.183	1.326	1.486
Estimated Average Maximum Flows (MGD)	1.051	1.205	1.351	1.514	1.696
Average Per Capita Consumption (gpcd)	51.690	51.690	51.689	51.690	51.690
Max Per Capita Consumption (gpcd)	59.004	59.003	59.003	59.003	59.003

	2024	2030	2035	2040	2045
Service Area Population	17,818	20,428	22,893	25,655	28,750
Estimated Average Daily Flows (MGD)	0.921	1.056	1.183	1.326	1.486
Estimated Average Maximum Flows (MGD)	1.051	1.205	1.351	1.514	1.696
Average Per Capita Consumption (gpcd)	51.690	51.690	51.689	51.690	51.690
Max Per Capita Consumption (gpcd)	59.004	59.003	59.003	59.003	59.003

The City owns and operates a citywide sewer collection system and a wastewater treatment plant (WWTP), which provides sewer service to approximately 3,687 connections, of which 3,369 are residential dwellings. The sewer collection system includes approximately 14 miles of sewer mains ranging in 6-inch to 24-inch in diameter. All of the homes currently receive water and wastewater services from the City of Coalinga.



CITY OF COALINGA

SANITARY SEWER COLLECTION SYSTEM
PRELIMINARY ENGINEERING REPORT

LEGEND

MAXIMUM DAILY FLOW (MGD)

AVERAGE DAILY FLOW (MGD)

DRAWING NOT TO SCALE

FIGURE 3-1
MONTHLY WASTEWATER FLOWS

3.2. Wastewater Flow Characteristics

As stated above, influent wastewater flow to the City of Coalinga WWTP is comprised of primarily residential wastewater. The WWTP discharges undisinfected secondary effluent to adjacent land. According to WDR Order No. 94-184, the WWTP is not required to monitor TSS. Table 3-3 summarizes the results of WWTP influent and effluent monitoring of BOD from the period of January 2018 through December 2022.

Table 3-3 Average Influent and Effluent BOD

Year	Influent	Effluent
	BOD (mg/L)	BOD (mg/L)
2018	196	42
2019	273	55
2020	264	41
2021	213	25
2022	225	31
90th Percentile	**303**	**-**

The City's WWTP is currently regulated by the Central Valley Regional Water Quality Control Board (RWQCB). Discharge from the WWTP is required to meet all limits set forth in WDR Order No. 94-184. According to WDR Order No. 94-184, the monthly average effluent BOD shall not exceed 40 milligrams per liter (mg/l) and the daily maximum shall not exceed 80 mg/l.

For design purposes, the 90th percentile is typically used in place of average values for BOD. The 90th percentile of past influent data represents the value that is exceeded 10 percent of the time. Figure 3-2 displays the frequency diagrams for BOD from January 2018 through December 2022.

3.3. Salinity

Treated wastewater contains higher concentrations of total dissolved solids (salinity) than that of the sources water. The increase in salinity is a result of domestic and commercial use of the water. The City currently monitors salinity by measuring the electrical conductivity of the WWTP effluent. The City's source water, raw water from the Coalinga Canal, is currently monitored on an annual basis by the SWRCB. Table 3-4 shows the average EC levels in the City's wastewater effluent during the period of January 2018 through December 2022. EC levels in the City's source water are not available prior to 2023.

Table 3-4 Specific Conductivity

Month-Year	Specific Conductivity (µmhos/cm)	
	Source Water [(1)]	Effluent
Jan-18	NA	840
Feb-18	NA	NA
Mar-18	NA	NA
Apr-18	NA	NA
May-18	NA	1,000
Jun-18	NA	930
Jul-18	NA	1,000
Aug-18	NA	1,000
Sep-18	NA	1,030
Oct-18	NA	989
Nov-18	NA	1,090
Dec-18	NA	1,060
Jan-19	NA	1,060
Feb-19	NA	1,050
Mar-19	NA	1,150
Apr-19	NA	1,080
May-19	NA	984
Jun-19	NA	1,010
Jul-19	NA	953
Aug-19	NA	866
Sep-19	NA	899
Oct-19	NA	899
Nov-19	NA	889
Dec-19	NA	929
Jan-20	NA	923
Feb-20	NA	NA
Mar-20	NA	1,000
Apr-20	NA	1,000
May-20	NA	1,000
Jun-20	NA	1,100
Jul-20	NA	1100
Aug-20	NA	1,100
Sep-20	NA	920
Oct-20	NA	960
Nov-20	NA	1,100
Dec-20	NA	1,100

Month-Year	Specific Conductivity (µmhos/cm)	
	Source Water [1]	Effluent
Jan-21	NA	1,400
Feb-21	NA	1,100
Mar-21	NA	NA
Apr-21	NA	1,300
May-21	NA	1,300
Jun-21	NA	1,300
Jul-21	NA	1,100
Aug-21	NA	1,100
Sep-21	NA	1,200
Oct-21	NA	1,100
Nov-21	NA	1,300
Dec-21	NA	1,200
Jan-22	NA	1,200
Feb-22	NA	1,200
Mar-22	NA	1,500
Apr-22	NA	1,300
May-22	NA	1,300
Jun-22	NA	1,200
Jul-22	NA	1,200
Aug-22	NA	1,100
Sep-22	NA	1,200
Oct-22	NA	NA
Nov-22	NA	1,200
Dec-22	NA	NA

Notes:
(1) Source water EC is not available prior to 2023.
(2) Based on EC sample results from October 2018.
(3) Based on EC sample results from October 2019.
(4) Based on EC sample results from October 2020.
(5) Based on EC sample results from October 2021.
(6) Based on EC sample results from October 2022.

3.4. Effluent Quality Requirements

As previously stated, the City's WWTP is regulated by the RWQCB and treated effluent discharges from the plant are required to meet all limits set forth WDR Order No. 94-184. A copy of this Order is provided in Appendix B. WDR Order No. 94-184 requires the City to monitor biological oxygen demand (BOD_5) weekly and settleable solids (SS) daily. Total suspended solids (TSS) were measured prior to issuance of the current WDRs. The City does not monitor TSS. Table 3-5 displays the current limits set by the Order.

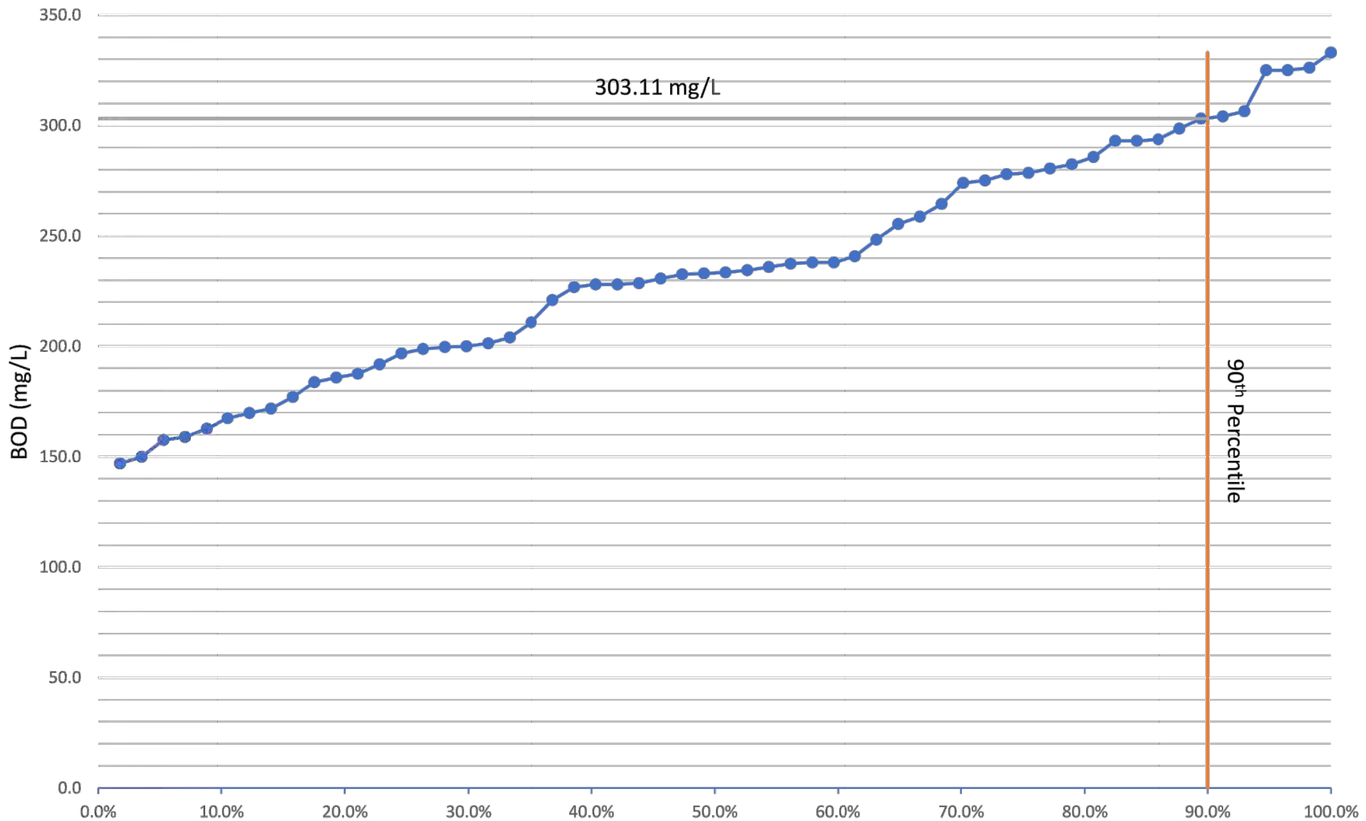
Table 3-5 WWTP Discharge Constituents and Limits

Constituent	Units	Monthly Average	Daily Maximum
BOD	mg/l	40	80
Settleable Solids	mg/l	0.2	0.5

The current WDR does not place a limit on total nitrogen, and it is not measured at the plant. Treated effluent is discharged to approximately 325 acres of agricultural land located on several parcels adjacent to the WWTP site to grow non-human consumption crops. The parcels are leased by User. One of the goals of this PER is to determine improvements to the WWTP to be able to match the facility's wastewater treatment and disposal capacities. However, nitrogen reduction will also be considered in the upgrade of the WWTP in preparation for a likely future requirement to reduce nitrogen.

3.5. Discharge Violations

Currently, the WWTP is meeting all limits outlined in the WDR Order No. 94-184 and no discharge violations have been issued by the RWQCB.



CITY OF COALINGA

SANITARY SEWER COLLECTION SYSTEM
PRELIMINARY ENGINEERING REPORT

LEGEND

90th Percentile BOD Value

FIGURE 3-2
INFLUENT BOD
FREQUENCY DIAGRAM

SECTION 4 - EXISTING FACILITIES AND PROJECT NEED

4.1. Overview

The City owns and operates a wastewater collection and treatment system that provides sewer service to the City's urbanized areas. The sewer collection system consists of over 42 miles of sewer pipelines with sizes ranging from 6 to 24-inches in diameter and a Wastewater treatment plant that currently serves 3,369 residences and 318 businesses.

4.2. Existing Wastewater Treatment Plant

The City owns and operates the WWTP under the current Waste Discharge Requirements (WDRs) Order No. 94-184. The WWTP is located at the confluence of Los Gatos Creek and Warthan Creek, approximately one mile east of the City. More specifically, the WWTP is located on Assessor's Parcel Nos. 070-070-023, 071-020-026.

The WWTP treats and discharges the municipal wastewater generated by residences and businesses within the City. The treatment process at the City's WWTP consists of screening, primary clarification, and secondary treatment (aerated facultative lagoons followed by stabilization lagoons). Treated effluent quality is undisinfected secondary effluent as described in Section 30301.900 of Title 22 of the California Code of Regulations (CCR).

4.2.1. Background

The City's WWTP has undergone two major modifications and additions over the last 40 years. According to WDR Order No. 76-180, the WWTP originally consisted of a primary clarifier followed by three oxidation ponds in series. The final disposal consisted of irrigating land controlled by the City and West Hills Community College for agricultural reclamation. At that time, the WWTP's treatment capacity was 0.6 MGD.

In 1980 the City submitted a Report of Waste Discharge for the expansion of the existing treatment capacity from 0.6 MGD to 0.93 MGD. The modifications consisted of influent screening followed by two aerated facultative lagoons and three stabilization ponds. Final effluent disposal was consistent with previous practices on City-owned land and West Hills College grounds. These modifications and additions were implemented in 1982. WDR Order No. 80-064 was adopted on May 26, 1980.

In 1991, the City submitted a Report of Waste Discharge in support of a change in operation and an increase in quantity of discharge from its municipal WWTP. The treatment capacity was increased from 0.93 MGD to the current 1.34 MGD. The City completed the rehabilitation of the primary clarifier and aerobic digester, which were removed from service during the previous plant modification. Effluent is pumped from one of the stabilization ponds to 30 acres of farmland owned by the Discharger (leased and operated by West Hills Community College District) and 102 acres of farmland owned by West Hills Community College (User) for crop irrigation and percolation disposal. The User grows alfalfa, hay, cotton, pasture, and sugar beets (for research only) with reclaimed wastewater. The Discharger owns an additional 96.7 acres of land in the immediate area, which could be used for reclamation if needed.

The Wastewater Treatment Plant relied on land owned by the City and nearby West Hills Community College Farm (College) for the disposal of its treated wastewater effluent until 2003. In 2003, the College announced its plans to relocate their facility and develop the land where effluent was being disposed of. Without the College, the City did not have an effluent disposal method and began investigating alternative disposal methods.

The City found HCM Farms, a landowner adjacent to the WWTP site who was interested in accepting recycled water. HCM Farms owned and operated about 448 acres of agricultural land and was interested in using the City's treated effluent to irrigate agricultural crops, primarily cotton. In 2010, HCM Farms was sold to Mouren Farms. Mouren Farms continued using recycled water from the City's WWTP until March 31, 2014. In 2014, The City found Jeff Brooks, another farmer who was interested in using the City's recycled water temporarily until the City secures a long-term disposal method. Mr. Brooks leases 325 acres around the WWTP including the West-Hills college reclamation areas permitted under the current WDRs. The City also owns approximately 470 acres on the southwest corner of Jayne Avenue and Alpine Avenue. The City purchased that land in 2006 with the intent of relocating its WWTP and disposal areas. The economic downturn has delayed the completion of that project. The use of recycled water by User is considered to be only temporary until the construction of infrastructure needed to convey the reclaimed water to the City-owned land is complete. Currently, treated effluent is pumped from one of the stabilization ponds to adjacent land, where it either evaporates or percolates into the soil and is used to recharge the groundwater table. By way of this process, most of the treated domestic wastewater is recycled as groundwater recharge.

4.2.2. Existing Treatment

The existing WWTP was constructed in 1982 and has a permitted capacity of 1.34 MGD. The City's WWTP produces undisinfected secondary effluent suitable for irrigation of non-human consumption crops. The treatment process consists of screening, primary clarification, and secondary treatment (aerated facultative lagoons followed by stabilization lagoons). Treated effluent quality is undisinfected secondary effluent as described in Section 30301.900 of Title 22 of the California Code of Regulations (CCR). The treatment process is comprised of the following unit processes:

4.2.2.1. Screening

Wastewater flows by gravity throughout the City's sewer collection system and enters the WWTP at the headworks. At this point, the wastewater undergoes preliminary treatment, which consists of trash screening for removal of rags, sticks, and other large objects that could damage downstream equipment processes. Wastewater then flows through a Parshall flume equipped with an ultrasonic level transducer that continuously monitors the level and records the corresponding plant flow data.

4.2.2.2. Primary Treatment

Pretreated effluent from the headworks flows through a 24-inch gravity line into a clarifier center feed well. The purpose of the feed well baffle is to disperse the incoming wastewater without disturbing the settled sludge in the bottom of the clarifier. As wastewater flows through the clarifier, heavy solids settle to the bottom and are removed as primary sludge. The clarified effluent is collected by a peripheral overflow launder protected by a submerged baffle that retains floatable from entering the effluent channel. Floating material is removed by a surface skimmer that pushes the material into a

scum beach. From there, the scum is pumped to the digester. Settled solids, primarily inorganic, and some large organic particles constitute the primary settled sludge. This sludge is scraped and pushed into the center sludge hopper by rotating rake arms. Scum is scraped by a rotating skimmer and deposited into a scum box. Eight spray nozzles are mounted along the clarifier walkway to aid in scum removal. Two 6-inch lines carry sludge from the sludge hopper and scum from the scum box to the primary pump station. From the primary pump station, the sludge is pumped to an aerobic digester by two separate plunger pumps. Both pumps are actuated either manually or automatically from a local control panel at the pump station. The piping is arranged in a way that both pumps are capable of pumping sludge.

4.2.2.3. Aerated Facultative Lagoons

Aerated facultative lagoons (AFLs) are the main treatment process responsible for the reduction of the soluble BOD. These lagoons, in conjunction with the downstream stabilization ponds, achieve high removal of organic materials, solids that are not removed in primary treatment, and pathogen bacteria.

The AFLs are equipped with surface aerators to supply the required oxygen for treatment and provide mixing of the surface zone. Eight aerators are installed, four in each lagoon. The aerators are driven by constant-speed electric motors. The aerators are controlled where they can be started and stopped to maintain a minimum dissolved oxygen concentration of 1 mg/L in the top layer of the lagoons.

The AFLs are designed to operate in parallel to better distribute the wastewater. The first aerator in each lagoon is a 20 HP unit while the remaining three are 10 HP. This design provides increased aeration in the zones of high oxygen demand at the beginning of the AFLs and inhibits uneven deposition or mounding of sludge.

4.2.2.4. Stabilization Ponds

Wastewater effluent from the AFLs flows into an effluent control box and then through three stabilization ponds (SPs) operated in series. The main purpose of these stabilization ponds is to provide secondary treatment or further removal of the remaining BOD and TSS not removed in primary treatment and aerated facultative lagoons. The stabilization ponds also act as seasonal storage facilities for the treated wastewater prior to effluent disposal. The water surface elevation in the first two stabilization ponds is controlled by a downstream weir at the end of the second pond. The water level at the third stabilization pond is controlled by the effluent pumping rate used at a given time to meet irrigation needs.

4.2.2.5. Aerobic Digester

Sludge collected at the primary clarifiers is regularly pumped into the aerobic digester. The aerobic digester provides an anoxic environment where the organic matter contained in the sludge is decomposed and transformed into stable material that can be air dried without causing objectionable odors. The aerobic digestion process decomposes the organic matter in water and C02, reducing the strength or volatile suspended solids (VSS) in the sludge collected by the primary clarifier. Aeration in the aerobic digester is provided by two positive displacement blowers that feed coarse bubble diffusers located near the bottom of the digester. The aerators are located at the side to impart turnover and mixing in the digester.

4.2.2.6. Sludge Drying Beds

Digested sludge leaving the aerobic digesters is fed to one of two asphalt-bottom sludge drying beds. These beds provide enough air-sludge surface contact to enhance the evaporation of the water contained in the sludge. The sludge is first allowed to settle at the beds, after which the supernatant is decanted by telescopic valves and returned to the headworks. The remaining sludge is allowed to dry before it is scraped and stockpiled on-site. The sludge is then tested for regulated heavy metals before it is transported off-site by truck to a sludge composting facility for final disposal.

4.2.3. Existing Effluent Disposal

Currently, the City's wastewater effluent is transported to adjacent land and used for irrigation of non-food crops such as cotton, alfalfa, and feed grains. Technically, all of Coalinga's wastewater can be said to be recycled since it is used to irrigate crops and a portion of the irrigation water percolates beyond the crop root zone ultimately to become groundwater. However, since groundwater is not a source of drinking water supply, it cannot be considered as offsetting potable water demand.

4.3. Project Need

The primary need for the City’s wastewater treatment facility improvement is due to the lack of effluent disposal alternatives. Currently, treated effluent is pumped from one of the stabilization ponds to adjacent land owned by the City and leased by Mr. Brooks. This effluent disposal method is a temporary solution to the City's effluent disposal needs.

4.3.1. System O&M

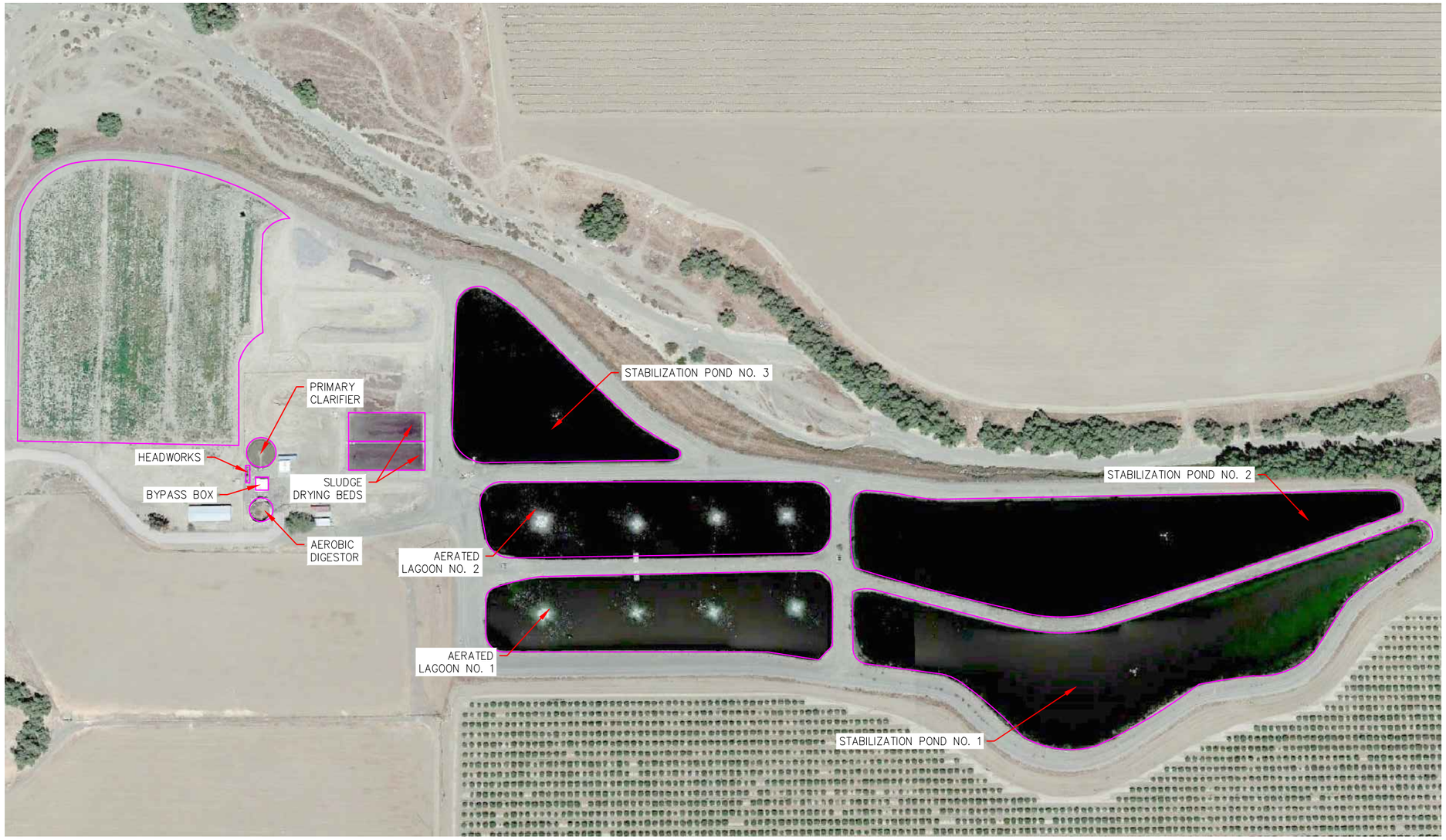
The City’s limited resources make it difficult to address the deficiencies in the wastewater treatment facility. This planning study has provided a comprehensive evaluation of the wastewater treatment facility. The City would like to correct the identified deficiencies in the wastewater treatment facility and is applying to the Clean Water State Revolving Fund to fund the recommended improvements.

4.3.2. Current O&M Expenses

Currently, operation and Maintenance (O&M) costs for the wastewater treatment facility include the cost labor, equipment, supplies, consulting fees, Maintenance, construction costs, equipment, and operational transfers. Table 4-4 displays the City’s actual O&M cost for the 2022-2023 fiscal year.

CITY OF COALINGA

SANITARY SEWER COLLECTION SYSTEM
PRELIMINARY ENGINEERING REPORT



LEGEND

NORTH
SCALE: 1"=250'

FIGURE 4-1
WWTP SITE LAYOUT

4.4. Sewer Collection System

The City owns and operates a citywide sewer collection system which provides sewer service to approximately 3,687 connections, of which 3,369 are residential dwellings. The sewer collection system includes approximately 14 miles of sewer mains ranging in 6-inch to 24-inch in diameter. All the homes currently receive water and wastewater services from the City of Coalinga. The overall condition of the sewer collection system is unknown. The older areas are believed to be in poor condition and in need of substantial repairs. The City's Maintenance staff regularly respond to problems with the collection system and spend a great deal of their time locating and/or repairing the system in response to emergency calls from the City's residents. Table 4-1 provides a summary of the existing sewer pipelines within the City's collection system and a map of the system is shown in Figure 4-2.

Table 4-1 Summary of Sewer Pipelines

Diameter (in)	Length (ft)
6	±72,732
8	±23,462
10	±4,031
12	±1,105
15	±1,364
18	±5,987
24	±2,499
Total	**±111,180**



CITY OF COALINGA

CCTV INSPECTION PROJECT

LEGEND

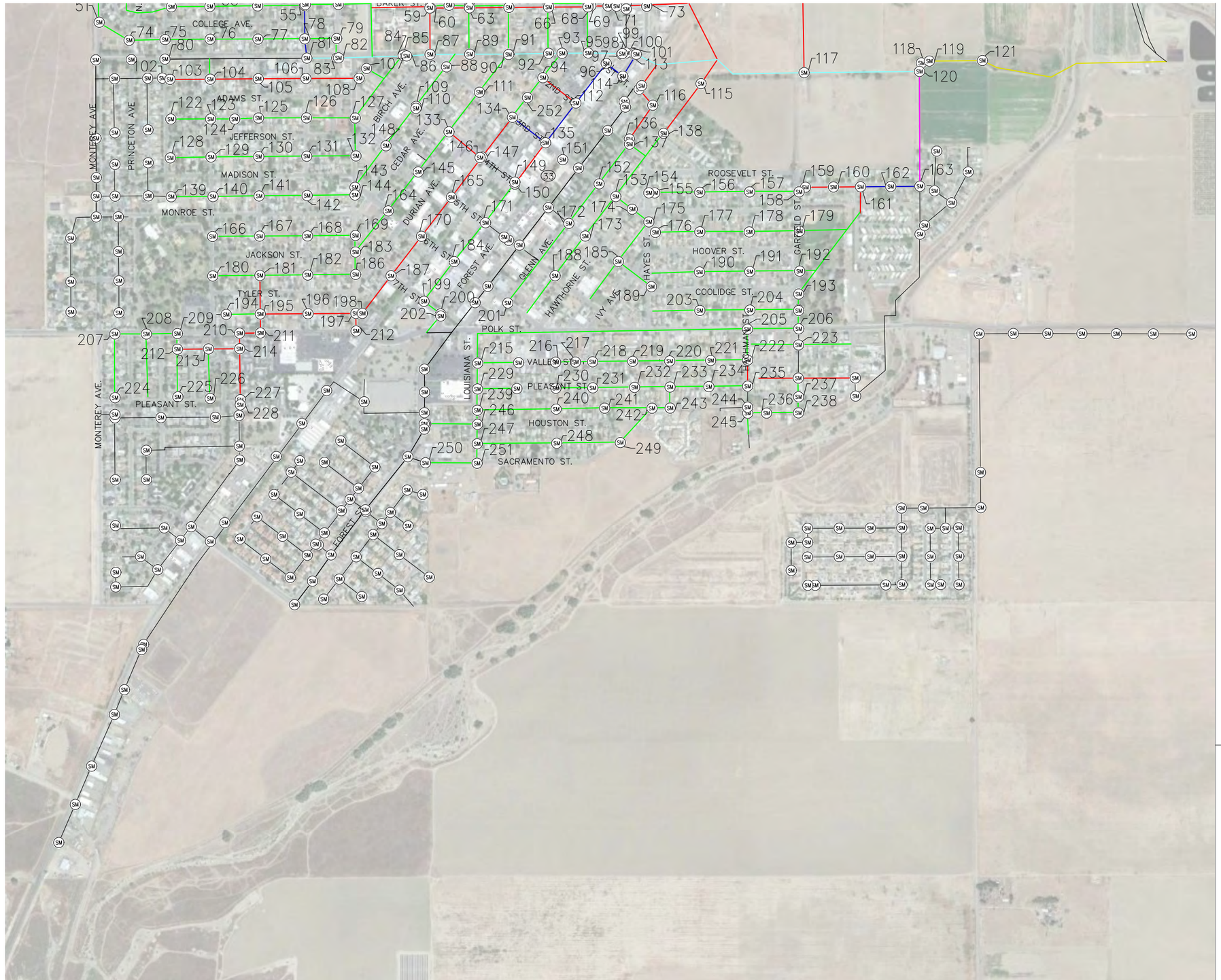
6 IN LINE	
8" LINE	
10" LINE	
12" LINE	
15" LINE	
18" LINE	
24" LINE	
MAINS NOT INCLUDED IN SURVEY	
MANHOLES INCLUDED IN SURVEY	SM
MANHOLES NOT INCLUDED IN SURVEY	SM

NORTH

SCALE IN FEET

0 1,000 FT

FIGURE 4-2 SEWER MAINS TO BE INSPECTED VIA CCTV SURVEY



CITY OF COALINGA

CCTV INSPECTION PROJECT

LEGEND

6 IN LINE	
8" LINE	
10" LINE	
12" LINE	
15" LINE	
18" LINE	
24" LINE	
MAINS NOT INCLUDED IN SURVEY	
MANHOLES INCLUDED IN SURVEY	SM
MANHOLES NOT INCLUDED IN SURVEY	SM

NORTH

SCALE IN FEET

0 1,000 FT

FIGURE 4-2 SEWER MAINS TO BE INSPECTED VIA CCTV SURVEY

4.5. Condition of Sewer Collection System

The City's sewer collection system is aged and some of the older portions of the system experience frequent blockages, overflows and require cleaning or removal of roots. The physical condition of some of these sewer lines is believed to be very poor, likely beyond their life expectancy, and needs to be replaced. Beyond the required Maintenance and repair activities, there has not been any major replacement or rehabilitation of the City's sewer collection system to date.

A condition survey of the sewer collection system was conducted to document the system's existing condition, identify deficiencies, and estimate the useful life of the sewer mains. The current physical condition of the system's components was assessed through site visits, discussion with City staff, and a comprehensive closed-circuit television (CCTV) inspection. As part of this PER, the City conducted a comprehensive CCTV inspection on the older portions of the sewer collection system. The results of the CCTV inspection are described below.

4.5.1. CCTV Inspection

Video Inspection Services (VIS) was retained by the City to perform hydro-flushing and a CCTV inspection assessment on approximately 111,180 LF of gravity sanitary sewer mains. The condition of the sewer mains was rated using the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Conditions Program (PACP) standardized rating. NASSCO PACP provides a standardized system for the consistent assessment of sanitary sewer conditions. PACP provides the capability to benchmark sewer conditions to track deterioration over time.

Table 4-2 NASSCO PACP Ratings

Rating	Importance	Likelihood of Failure
5 – Immediate Attention	Defects require immediate action	Pipe has failed or will likely fail within the next 5 years
4 – Poor	Severe defects	Pipe will probably fail in 5 to 10 years
3 – Fair	Moderate defect that will continue to deteriorate	Pipe may fail in 10 to 20 years
2 – Good	Defects that have not begun to deteriorate	Pipe unlikely to fail for at least 20 years
1 - Excellent	Minor or no defects	Failure unlikely in the foreseeable future

The PACP process identifies major deterioration factors and assigns a rating that is related to the likelihood of failure or collapse. Deterioration factors include surrounding soil condition, position of groundwater table, frequency of sewer surcharging, above ground traffic loading, methods and materials used in construction, third party damages and defects such as roots, grease, and debris causing more frequent cleaning. It is important to note that the condition of the sewer involves many deterioration factors, both internal and external. A CCTV inspection can only determine the internal defects that affect the sewer condition. PACP defects are assigned a grade of 1 to 5 in order of increasing severity. Table 4-3 shows the criteria of NASSCP PACP ratings.

Table 4-4 provides a summary of the ratings observed in the 104,618 LF of CCTV video evaluated.

Table 4-3 Summary of PACP Defects

Rating	Diameter (in)	Total Length Surveyed (ft)
5	6, 8 & 10	5,182
4	6, 8, 10, 15 & 18	21,497
3	6, 8, 10, 15 & 18	26,351
2	6, 8, 10, 15, 18 & 24	10,067
1	6, 8, 10, 15, 18 & 24	41,522
	Total Length Surveyed	**104,618**

Figure 4-4 displays the map of the sewer collection system with the overall ratings of the pipes that were included in the CCTV inspection. Ratings are based on the structural integrity of the pipes and the operation and Maintenance issues such as changes in pipe alignment.

The CCTV inspection revealed the poor conditions of some of the City's older lines. Defects found in the sewer lines include deformation, root intrusion, cracked pipe, collapsed and broken pipe, sags, intruding laterals, defective lateral break-ins, attached deposits (grease and concrete), and medium to large joint displacements.

4.6. Project Need

The primary need for a sewer collection system improvement project is due to the significant deterioration of the sewer infrastructure. The City's Maintenance staff regularly response to problems with the collection system as back-ups and overflows/spills and spend a great deal of their time locating and/or repairing the system in response to emergency calls from the City's residents. According to the results of the CCTV inspection, approximately 50 percent of the sewer lines inspected require either replacement or rehabilitation.



CITY OF COALINGA

CCTV INSPECTION PROJECT

LEGEND

- NASSCO PACP RATING 1
- NASSCO PACP RATING 2
- NASSCO PACP RATING 3
- NASSCO PACP RATING 4
- NASSCO PACP RATING 5

NORTH

SCALE IN FEET

0 1,500 FT

FIGURE 4-3
SEWER COLLECTION SYSTEM CONDITION ASSESSMENT

4.6.1. Health and Safety

The major concerns related to health and safety are associated with the age and operating condition of the City's collection system. As stated above, the current state of the system is the cause of blockages and sewer system overflows (SSOs).

There have been no formal Notices of Violation (NOV) from regulatory agencies concerning the City's sewer collection system. The recent CCTV inspection provided the best evidence of the poor condition of some segments of the sewer collection system which are responsible for most of the SSOs in the City.

There are numerous public health and safety threats arising from SSOs onto the City's streets and residential properties. There are also significant health and safety risks for staff that are responsible for the cleanup and repair of the sewer lines.

4.6.2. System O&M

The City's limited resources make it difficult to address the deficiencies in the sewer collection system. This planning study has provided a comprehensive evaluation of the sewer collection system. The City would like to correct the identified deficiencies in the sewer collection system and is applying to the Clean Water State Revolving Fund to fund the recommended improvements.

4.6.2.1. Current O&M Expenses

Currently, operation and Maintenance (O&M) costs for the sewer collection system include the cost labor, equipment, supplies, consulting fees, Maintenance, construction costs, equipment, and operational transfers. Table 4-5 displays the City's actual O&M cost for the 2022-2023 fiscal year.

Table 4-4 Current O&M Expenses

Description	Costs
Salaries Regular	$ 124,053.00
Salaries Overtime	$ 3,900.00
Salaries Cash Outs	$ 2,377.00
Retirement CALPERS	$ 11,674.00
Medical/Life Insurance	$ 28,761.00
Social Security FICA	$ 7,753.00
Medicare Insurance	$ 1,799.00
Disability Income Insurance	$ 1,551.00
Deferred Comp - 457 Retirement	$ 5,250.00
Workers Comp. Insurance	$ 14,886.00
Uniform Allowance	$ 236.00
Retirement CalPERS UL	$ 1,997.00
Unemployment Insurance	$ 1,241.00
Personnel Cost	$ 205,478.00

Description	Costs
Office Supplies	$ 200.00
Postage & Freight Out	$ 50.00
Printing & Binding	$ 50.00
Uniforms	$ 2,500.00
Uniforms-Safety Equipment	$ 3,000.00
Street Materials	$ 4,500.00
Utility Parts & Supplies	$ 4,500.00
Gasoline & Diesel	$ 12,000.00
Miscellaneous Supplies	$ 2,000.00
Water, Gas, Sanitation & Sewer	$ 2,000.00
Electric	$ 10,000.00
Telephone	$ 5,000.00
Office Equip, Repairs & Maintenance	$ 500.00
Major Equip Repairs & Maintenance	$ 15,000.00
Buildings Repairs & Maintenance	$ 5,000.00
Vehicle Parts, Repairs & Maintenance	$ 20,000.00
Training, Travel, & Conference	$ 5,000.00
Subs., Dues, & Publications	$ 3,000.00
City Attorney Fees	$ 1,000.00
Computer Program & Consulting	$ 8,000.00
Medical - General	$ 100.00
Professional Services	$ 10,000.00
Geographic Information Systems	$ 1,000.00
Grant Writing/Application	$ 7,000.00
Physical w/Drug & Alcohol Test	$ 150.00
Fingerprinting	$ 15.00
Liability & Property Insurance	$ 16,000.00
Taxes, Licenses, & Fees	$ 1,200.00
Major Machinery & Equipment	$ 30,000.00
New Los Gatos Lift Station	$ 200,000.00
O&M Cost	$ 368,765.00
Wastewater Collection Total	$ 574,243.00

4.6.3. Growth

As described in Section 1.2.4, the City's population according to the 2000 U.S. Census was 11,668. According to the U.S. Census Population Estimates Program, population within the City has increased to approximately 17,024 in 2022. Therefore, the observed average annual growth rate from 1990 through 2022 is approximately 2.30 percent.

SECTION 5 - IMPROVEMENTS TO SEWER COLLECTION SYSTEM

5.1. Alternatives Considered

Three alternatives were considered for the improvement of the City of Coalinga's sewer collection system, including a no project alternative. Additionally, two construction alternatives are considered herein for the repair or replacement of damaged sewer mains. The first construction alternative consists of using only conventional construction methods, such as digging the damaged sewer main and replacing it with a new pipe. The second alternative consists of using both convention and trenchless construction methods. The trenchless construction method will consist of pipe bursting or cured-in-place (CIPP) where feasible. In summary, the three alternatives are as follows:

- Alternative No. I: No Project
- Alternative No. II: Convention Construction Method
- Alternative No. III: Conventional and Trenchless Construction Methods

The following sections contain a description of each alternative, including design parameters, purposed layouts, and an opinion of probable construction costs and operation and Maintenance (O&M) costs. The anticipated useful life of rehabilitated sewer pipe and replaced sewer pipe is the same and in excess of 50 years.

5.2. Alternative No. I: No Project

Under the "No Project" Alternative, the City's sewer collection systems would continue to operate under current conditions. This Alternative was dismissed due to not addressing concerns with the current condition of the sewer collection. As described in Section 4.4, the CCTV inspection of the sewer collection system revealed the severe condition of several pipe segments within the collection system. These pipe segments will require replacement in the future as they will continue to deteriorate.

5.3. Alternative No. II: Convention Construction Method

Alternative No. II involves replacing deteriorated sewer pipes with new pipes located along the same alignment as the existing. Under this Alternative, bypass pumping equipment and piping will be utilized on a temporary basis to convey wastewater around the construction zone while the existing pipe is excavated and removed. The new sanitary sewer will be installed in the existing pipe trench. Acquisition of new easements is not anticipated.

Conventional construction requires detailed geotechnical investigations and topographical surveys to locate existing utilities that may be impacted by the excavation of the sewer line. Conventional construction uses heavy equipment to dig the trenches and requires surface restoration of the excavated trench.

Conventional Construction is the recommended construction method under the following circumstances:

- where a portion of the existing pipe is collapsed; 0
- where there are multiple offset joints greater than 1-inch or if sealing rings protrude more than 1 inch;
- where the pipe is structurally deformed, and the profile of the pipe is lost;

- where heavy roots through pipe joints cannot be removed by interior cutting;
- where heavy roots have compromised the structural integrity of the pipe;
- where sags are greater than 60 percent of the pipe diameter.

5.3.1. Sewer Main Replacement

The segments of the City's sewer collection system recommended for replacement have been selected based on sorted NASSCO ratings. It is recommended that sewer mains with a NASSCO overall condition rating of 3 and above be replaced unless the NASSCO rating is the result of designate alignment changes to the sewer main. Additionally, sewer mains where sags are present are also recommended to be replaced. Table 5-1 shows a summary of the sewer lines that are recommended to be replaced under this Alternative.

Table 5-1 Sewer Mains Recommended to be Replaced

From MH	To MH	Reason(s)	Method	Length (ft)
AP 1 B	001	Survey abandoned due to obstruction	Replacement	530
AP 19 B	019	Broken Pipe, Hole Void Visible	Replacement	214
CO	245	Broken pipe, Hole Void Visible	Replacement	333
005	005 B	Survey abandoned due to Root Joint Fine and cannot pass, Material pipe change RCP to VCP	Replacement	411
5th	4th	Multiple Pipe Fractures, Broken Pipe, Hole Void Visible, Multiple Cracks, Tap Break-in Intruding	Replacement	401
007	008	Broken Pipe Soil Visible	Replacement	235
012	014	Multiple Cracks and Tap Break-in Intruding	Replacement	427
012	013	Broken Pipe, Multiple Fractures, Tap Intruding	Replacement	223
013	014	Multiple Fractures, Multiple Cracks, Tap Intruding	Replacement	201
014	015	Multiple Cracks	Replacement	300
015	021 B	Pipe Fractures, Hole Void Visible, Tap Intruding	Replacement	331
018	024	Sags 25%, Broken Pipe, Multiple Cracks, Joint Offset Medium, Material Pipe change VCP to PVC	Replacement	330
022	033	Broken Pipe, Multiple Fractures	Replacement	324
024	025	Multiple Cracks, Multiple Fractures, Sags 25% 25% 30%	Replacement	299
020	021	Multiple Cracks	Replacement	478
021	021 B	Multiple Cracks	Replacement	317
021 B	022	Multiple Cracks	Replacement	165
029	052	Joint Offset Medium - Large	Replacement	73
033	044 B	Multiple Fractures, Material Pipe Change PVC to VCP	Replacement	309
037	050	Survey abandoned due to debri and surface damage aggregate visible	Replacement	19
038	039	Hole Void Visible	Replacement	229
039	040	Broken Pipe	Replacement	499
040	040 B	Joint Offset Medium	Replacement	425
41 B	117 B	Broken Soil Visible, JOM	Replacement	196
044 B	055	Multiple Cracks, Multiple Fractures, Sag 45%, Material Pipe Change	Replacement	311

Table 5-1 Sewer Mains Recommended to be Replaced

From MH	To MH	Reason(s)	Method	Length (ft)
050	049	Survey abandoned due to deposits settled gravel, bend in pipe, Material change CP to Clay	Replacement	46
055	078	Multiple Cracks, Multiple Fractures, Joint Offset Medium, Root Joint Fine	Replacement	320
059	058	Broken pipe hole void visible	Replacement	6
059	087	Multiple Fractures, Broken Pipe, Hole Void Visible, Multiple Cracks	Replacement	448
064	091	Multiple Fractures, Hole Void Visible, Joint Offset Medium	Replacement	442
069	095	Multiple Fractures, Broken pipe soil visible, Tap Intruding	Replacement	166
73 C	113 C	Broken Soil Visible	Replacement	549
066	092	Multiple Fractures, Hole Void Visible, Sag 30%	Replacement	72
081	082	Multiple Fractures, Multiple Cracks	Replacement	305
082	082 B	Multiple Fractures, Multiple Cracks, Joint Offset Medium, Sags 50%	Replacement	639
084	090	Multiple Fractures, Multiple Cracks	Replacement	502
088	088 B	Survey abandoned due to Joint Offset Medium - Large	Replacement	41
089	063	Survey abandoned due to tap break in intruding	Replacement	90
091	093	Multiple Fractures	Replacement	505
093	098	Multiple Fractures, Multiple Cracks	Replacement	588
094	112	Survey abandoned, Broken Pipe	Replacement	338
095	068	Multiple Fractures, Broken Pipe, Hole Void Visible, Joint Offset Medium, Tap Intruding	Replacement	259
096	114	Multiple Cracks, Deposits Settled Gravel	Replacement	200
100	100 B	Multiple Fractures, Multiple Cracks Longitudinal, Gravel Deposits	Replacement	435
106	108	Multiple Cracks, Hole Void Visible	Replacement	303
106	108	Multiple Cracks, Hole Void Visible, Grease Deposits Attached	Replacement	322
106	108	Multiple Cracks, Multiple Fractures, Hole Void Visible, Sag 20%	Replacement	337
106	108	Joint Offset Medium - Large, Broken pipe, Hole Void Visible	Replacement	16
107	85	Multiple Cracks	Replacement	199
108	107	Multiple Cracks	Replacement	116
109	088	Multiple Fractures, Multiple Cracks, Tap Intruding, Material Pipe change PVC to VCP	Replacement	256
113	113 C	Multiple Fractures, Broken Pipe, Hole Void Visible	Replacement	446
113 C	113 B	Multiple Pipe Fractures, Broken Pipe and Material Pipe Change VCP to PVC	Replacement	154
114	114 B	Multiple Fractures, Sag 30%, Gravel deposits settled	Replacement	159
115 B	115 C	Multiple Fractures, Multiple Cracks, Sags 30%	Replacement	161
115 C	117 B	Multiple Fractures	Replacement	184
117	120	Pipe Fracture	Replacement	1,109
117 B	117	Multiple Fractures, Multiple Cracks, JOM, Material Pipe Change PVC to VCP	Replacement	1,240
127 B	85	Broken Pipe, Hole Void Visible	Replacement	439

Table 5-1 Sewer Mains Recommended to be Replaced

From MH	To MH	Reason(s)	Method	Length (ft)
132	127	Obstruction in pipe, Broken Pipe Soil Visible, Roots Joint Fine	Replacement	359
133	146	Broken pipe soil visible	Replacement	398
133	111	Multiple Fractures, Hole Void Visible, Joint Offset Medium	Replacement	364
134	135	Pipe Collapse, Broken Pipe, Multiple Fractures, Multiple Cracks, Grease Deposits attached	Replacement	401
135	112	Multiple Fractures, Joint Offset Medium, Sag 20%	Replacement	479
138 B	138 C	Multiple Cracks, Pipe Material Change	Replacement	176
138 D	138	Multiple Fractures, Hole Void Visible, Multiple Cracks, Joint Offset Medium, Sag 20% 20% 40%, Survey abandoned due to debris	Replacement	365
138	115 B	Multiple Cracks, Multiple Fractures, Sag 20%	Replacement	116
138 C	138 D	Hole Void Visible	Replacement	96
141	142	Pipe deformed (Cut in pipe)	Replacement	463
143	148	Multiple Cracks, Multiple Fractures, Hole Void Visible	Replacement	495
144	143	Multiple Cracks, Multiple Fractures	Replacement	83
145	133	Survey abandoned due to Joint Offset Medium, Debri under water, Broken Pipe, Hole Void Visible, Multiple Cracks	Replacement	105
147	134	Joint Offset Medium, Grease Deposits Attached	Replacement	481
148	110	Multiple Fractures, Broken Pipe, Multiple Cracks	Replacement	446
149	135	Broken Pipe, Multiple Fractures, Hole Void Visible, Sag 30%, 40%	Replacement	480
152	137	Pipe Fractures	Replacement	480
153	138 B	Broken Pipe, Hole Void Visible, Multiple Cracks	Replacement	235
155	154	Hole Void Visible, Pipe Surface Damage	Replacement	57
155	156	Survey abandoned due to holes getting larger, deposits settled and debris	Replacement	175
156	157	Broken Pipe Soil Visible, Survey abandoned due to surface damage aggregate visible	Replacement	239
157	158	Survey abandoned due to surface damage aggregate visible	Replacement	195
163	163 B	Joint Separated Medium, Surface Spalling Damage	Replacement	265
164	145	Multiple Fractures, Hole Void Visible, Multiple Cracks, Joint Offset Medium	Replacement	475
165	147	Joint Offset Medium, Grease Deposits Attached	Replacement	491
166	167	Broken pipe, Hole Void Visible	Replacement	454
171	149	Multiple Fractures, Multiple Cracks, Broken Pipe, Severe Grease Deposits Attached	Replacement	482
172	152	Pipe Fractures , Hole Void Visible	Replacement	479
173	153	Broken Pipe, Hole Void Visible, Multiple Cracks	Replacement	479
174	153	Multiple Cracks	Replacement	199
175	174	Hole Void Visible	Replacement	199
176	177	Pipe Fractures, Holes Void Visible, Survey abandoned due to Joint Offset Medium	Replacement	354
177	178	Pipe Fractures, Deposits settled survey abandoned	Replacement	162

Table 5-1 Sewer Mains Recommended to be Replaced

From MH	To MH	Reason(s)	Method	Length (ft)
178	179	Survey abandoned due to Joint Offset Medium, Pipe Fractures	Replacement	301
179	179 B	Survey abandoned due to debri under water	Replacement	147
183	164	Survey abandoned due to obstruction in pipe	Replacement	274
184	171	Pipe Fractures, Broken Pipe, Hole Void Visible, Joint Offset Medium, Tap Intruding	Replacement	481
185 C	185 B	Survey abandoned cannot continue	Replacement	307
185	175	Multiple Cracks, Broken Pipe Soil Visible	Replacement	479
185 B	185	Hole Void Visible, Multiple Cracks	Replacement	478
186	183	Multiple Cracks	Replacement	228
188 C	188 B	Multiple Cracks	Replacement	189
188	173	Hole in Pipe, Multiple Cracks, Survey abandoned due to obstruction in Pipe	Replacement	389
188 B	188	Broken Pipe, Hole Void Visible, Multiple Cracks	Replacement	478
189 B	189	Survey abandoned due to obstruction	Replacement	264
189	185	Multiple Cracks	Replacement	398
194	195	Survey abandoned due to pipe in line	Replacement	240
195	196	Survey abandoned due to Joint Offset Medium - Large	Replacement	461
199	184	Survey abandoned due to grease deposits attached, Broken Pipe, Multiple Cracks	Replacement	111
200	199	Pipe Fractures	Replacement	198
201	201 C	Pipe Fractures, Hole Void Visible, Joint Offset Medium	Replacement	484
201 B	201	Broken Pipe, Pipe Fractures, Hole Void Visible	Replacement	236
201 C	172	Survey abandoned due to deposits settled and debris	Replacement	108
202 B	202	Survey abandoned due to Joint Offset Medium	Replacement	163
203	204	Joint Offset Medium	Replacement	480
204 B	193	Multiple Fractures, Multiple Cracks	Replacement	150
204 C	204 B	Broken Pipe with crack and fracture	Replacement	7
205	206	Multiple Longitudinal Cracks, JOM - Large	Replacement	215
206	204 C	Multiple Fractures, Multiple Cracks, Pipe surface damage	Replacement	175
206	206 B	Multiple Longitudinal Cracks	Replacement	176
209	212	Broken Pipe	Replacement	150
210	211	Multiple Cracks, Roots Joint Fine	Replacement	200
213	214	Multiple Cracks	Replacement	300
224	207	Multiple Cracks, Broken Pipe with Pipe Fracture	Replacement	613
225	212	Multiple Cracks, Roots Joint Medium	Replacement	459
226	213	Multiple Cracks, Joint Offset Medium	Replacement	469
227	214	Multiple Cracks	Replacement	489
229	215	Multiple Fractures, Joint Offset Medium, Material Change VCP to PVC	Replacement	253

Table 5-1 Sewer Mains Recommended to be Replaced

From MH	To MH	Reason(s)	Method	Length (ft)
229 B	229	Broken Pipe Soil Visible, Multiple Cracks	Replacement	377
230	229 B	Broken Pipe Soil Visible, Multiple Cracks, Joint Offset Medium	Replacement	373
230	231	Broken Pipe Soil Visible	Replacement	355
231	232	Broken Pipe Soil Visible	Replacement	401
232	233	Soil Visible and Multiple Cracks	Replacement	339
233	234	Broken Pipe	Replacement	63
234	235	Hole Void Visible	Replacement	373
235	222	Pipe Fractures, Joint Offset Medium - Large, Material change VCP to PVC	Replacement	250
237	237 B	Joint Offset Medium	Replacement	177
239	229	Survey abandoned due to camera under water, Multiple fractures	Replacement	124
240	239	Multiple Cracks, Hole Void Visible	Replacement	756
240	241	Survey abandoned due to obstruction under water level, Pipe material change VCP to PVC	Replacement	146
241	242	Pipe Fracture, Joint Offset Medium	Replacement	157
242	243	Multiple Fractures Joint Offset Medium - Roots	Replacement	175
243	233	Pipe Fracture	Replacement	200
246 B	246	Broken Pipe Soil Visible, Multiple Cracks, Joint Offset Medium	Replacement	471
246 B	246	Survey abandoned due Infiltration Stain Joint, Multiple Holes Soil Visible, Multiple Fractures	Replacement	263
247	246	Pipe Fractures, Multiple Cracks, Hole Void Visible	Replacement	371
248	249	Pipe Fractures, Joint Offset Medium	Replacement	25
248	247	Sag, Multiple cracks, Multiple Fracture	Replacement	765
248	249	Survey abandoned due to line collapsing	Replacement	25
250	251	Broken Pipe Soil Visible, Multiple Cracks	Replacement	496
251	247	Pipe Fractures	Replacement	185
252	134	Broken pipe, hole void visible, Sag 10%	Replacement	239
252	094	Joint Offset Medium. Material Pipe change PVC to VCP	Replacement	242
252	134	Obstruction in pipe	Replacement	232
255	256	Broken Pipe, Soil Visible, Joint Offset Medium, Multiple Fractures	Replacement	329
256	257	Broken Pipe, Multiple Fractures, Joint Offset Medium, Hole Void Visible, Tap Intruding	Replacement	153
257	258	Broken Pipe, Multiple Fractures, Hole Void Visible, Multiple Cracks, Joint Offset Medium, Survey abandoned due to large offset	Replacement	180
258	259	Tap Break-in Intruding, Multiple Longitudinal Cracks, Joint Separated Medium	Replacement	243
259	260	Hole Void Visible, Tap Break-in Intruding	Replacement	7
259	260	Hole Void Visible, Multiple Cracks, Fracture Longitudinal, Tap Break-in Intruding	Replacement	271
260	261	Broken Pipe, Hole Void Visible, Multiple Cracks	Replacement	218

Table 5-1 Sewer Mains Recommended to be Replaced

From MH	To MH	Reason(s)	Method	Length (ft)
261	262	Broken Pipe Soil Visible, Multiple Cracks, JOM	Replacement	750
262	205	Deposits Grease attached, Multiple Cracks	Replacement	277
		Total Length to Be Replaced		**50,616**

Under this Alternative, approximately 50,616 LF of sewer mains will be replaced with new sewer pipes before failure occurs. Figure 5-1 displays the pipe segments that are recommended for replacement.

5.3.2. Probable Construction Costs

Table 5-2 provides an opinion of probable construction costs for the replacement of the deteriorated and/or sagging sewer mains.

Table 5-2 Alternative No. II Probable Construction Costs

Description	Quantity	Units	Unit Cost ($/Unit)	Total
Mobilization	1	LS	$240,000	$240,000
Traffic Control Plan	1	LS	$90,000	$90,000
New 6" PVC Pipe	29,751	LF	$215	$6,397,000
New 8" PVC Pipe	11,524	LF	$215	$2,478,000
New 10" PVC Pipe	3,809	LF	$240	$915,000
New 15" PVC Pipe	2,558	LF	$265	$678,000
New 18" PVC Pipe	2,975	LF	$265	$789,000
Excavation	31,130	CY	$9	$281,000
Backfill	43,582	TON	$6	$262,000
Surface Restoration	7,780	SY	$30	$234,000
Remove and Replace Sewer Lateral	40	EA	$4,800	$192,000
Bypass Pumping	140	Day	$1,200	$168,000
			Subtotal Construction Costs	**$12,724,000**
Contingency (15%)				$1,908,600
Engineering, Environmental, Construction Administration (12%)				$1,526,880
			Total Capital Construction Costs	**$16,159,480**
NOTE: All capital construction costs are rounded up to the nearest thousand.				

5.3.3. Annual O&M Costs

The annual operation and Maintenance (O&M) costs for Alternative No. II will consist of conventional Maintenance costs to operate the sewer collection system. Since this alternative only includes the replacement of existing sewer mains and laterals, no additional O&M costs are anticipated after construction concludes. The City's existing O&M costs for the sewer collection system are provided in Table 4-5 of this PER.

CITY OF COALINGA

CCTV INSPECTION PROJECT



LEGEND

NO REPLACEMENT

REPLACEMENT

NOT SURVEYED

NORTH

SCALE IN FEET

0 1,500 FT

ALTERNATIVE II - SEWER MAINS TO BE REPLACED

AM Consulting Engineers • 5150 N. Sixth Street Suite 124 • Fresno, California 93710 • (559) 473-1371

5.4. Alternative No. III Conventional and Trenchless Construction Methods

Under this Alternative, both conventional and trenchless construction methods will be used to either replace or rehabilitate deteriorated sewer mains. Where applicable, Alternative No. III will utilize trenchless sewer rehabilitation techniques in lieu of conventional replacement methods. Trenchless sewer rehabilitation techniques offer a method of correcting pipe deficiencies that requires less restoration and causes less disturbance and environmental degradation than the conventional construction method. The most common trenchless sewer rehabilitation methods are Pipe Bursting and Cured-In-Place Pipe (CIPP).

5.4.1. Pipe Bursting

Pipe bursting is a method by which the existing pipe is forced outward and opened by a bursting tool. In pipe bursting the existing pipe is used as a guide for inserting the expansion head (part of the bursting tool). The expansion head, typically pulled by a cable rod and winch, increases the area available for the new pipe by pushing the existing pipe radially outward until it cracks. The bursting device pulls the new pipeline behind itself.

During the pipe bursting process, the rehabilitated pipe segment must be taken out of service by rerouting flows around it. After the pipe bursting is completed, laterals are re-connected, typically by conventional excavation methods.

Pipe Bursting is the recommended rehabilitation method under the following circumstances:

- when capacity of the existing line needs to be increased;
- when the number of lateral connections is limited;
- when the number of crossing utilities is limited and the clearance between utilities is greater than 3 ft;
- when the depth of the sewer lines is less than 12 ft;
- when sags in the line do not exceed 20 percent of the pipe diameter;
- when pipes are not encased in concrete.

5.4.2. CIPP

Cured-in-place pipe (CIPP) is a rehabilitation method that uses a flexible fabric liner coated with a thermosetting resin to form a new pipe inside the existing pipe. The liner is inserted into the existing pipeline and cured to form a new liner. The liner is typically inserted into the existing pipe through an existing manhole. The fabric tube holds the resin in place until the tube is inserted in the pipe and ready to be cured. Commonly manufactured resins include unsaturated polyester, vinyl ester, and epoxy, each having distinct chemical resistance to domestic wastewater.

The CIPP method can be applied to rehabilitate pipelines with defects such as cracks, small offset joints, and structurally deficient segments. The thermosetting resin material bonds with the existing pipe materials to form a tighter seal than most other trenchless techniques. The liner is typically applied using gravity and either water or air pressure to force the tube through the pipe and invert it or turn the tube inside out. This process presses the resin- coated tube against the walls of the existing pipe. Heat is used to cure the resin to form a strong bond between the tube and the existing pipe.

As the liner expands to fit the new pipe, dimples occur in the line where the laterals exist. Dimples in the line can be found by TV inspection or robotic equipment. Laterals are typically reinstated with robotic cutting devices, or, for large-diameter pipes, by manually cutting the liner.

CIPP is the recommended rehabilitation method under the following circumstances:

- where offset pipe joints are generally 1 inch or less;
- where longitudinal or circumferential cracking in the pipe has caused minimal structural deformation;
- where light to medium roots exist through the pipe joints and can be removed by interior cutting;
- where sags in the pipe are less than 60 percent of the pipe diameter;
- where debris can be removed from the pipe;
- where holes in the pipe don't have visible voids (i.e., no soil visible outside the hole); larger holes allow CIPP liners to deform and weaken near the edges of the hole.

5.4.3. Sewer Main Replacement and Rehabilitation

Alternative No. III consists of an "in-kind" rehabilitation and replacement of the City's gravity sewer mains. Where feasible, segments of the sewer collection system will be rehabilitated using trenchless construction methods. In order to ensure the structural integrity of the sewer system, conventional "open trench" construction methods will be used to replace the sewer mains that display pipe deformations, broken pipes, or sags greater than 60 percent of the pipe diameter. Table 5-3 displays the sewer mains that are recommended to be rehabilitated or replaced under this alternative. The proposed improvements are shown in Figure 5-2.

Table 5-3 Alternative No. III Sewer Mains Recommended to be Rehabilitated/Replaced

From MH	To MH	Reason(s)	Method	Length (ft)
AP 1 B	001	Survey abandoned due to obstruction	Trenchless	530
005	005 B	Survey abandoned due to Root Joint Fine and cannot pass	Trenchless	276
005	005 B	Material pipe change RCP to VCP, Lining damage, Roots Joint Fine	Trenchless	135
013	214	Multiple Cracks	Trenchless	300
014	015	Multiple Cracks	Trenchless	300
018	024	Sags 25%, Broken Pipe, Multiple Cracks, JOM, Material Pipe change VCP to PVC	Trenchless	330
020	021	Multiple Cracks	Trenchless	478
021	021 B	Multiple Cracks	Trenchless	317
021 B	022	Multiple Cracks	Trenchless	165
022	033	Broken Pipe, Multiple Fractures	Trenchless	324
024	025	Multiple Cracks, Multiple Fractures, Sags 25% 25% 30%	Trenchless	299
039	040	Broken Pipe	Trenchless	499
040	040 B	JOM	Trenchless	425
41 B	117 B	Broken Soil Visible, JOM	Trenchless	196

Table 5-3 Alternative No. III Sewer Mains Recommended to be Rehabilitated/Replaced

From MH	To MH	Reason(s)	Method	Length (ft)
044 B	055	Multiple Cracks, Multiple Fractures, Sag 45%, Material Pipe Change	Trenchless	311
055	078	Multiple Cracks, Multiple Fractures, JOM, Root Joint Fine	Trenchless	320
066	092	Multiple Fractures, Hole Void Visible, Sag 30%	Trenchless	72
081	082	Multiple Fractures, Multiple Cracks	Trenchless	305
082	082 B	Multiple Fractures, Multiple Cracks, JOM, Sags 50%	Trenchless	639
084	090	Multiple Fractures, Multiple Cracks	Trenchless	502
091	093	Multiple Fractures	Trenchless	505
093	098	Multiple Fractures, Multiple Cracks	Trenchless	588
094	112	Survey abandoned, Broken Pipe	Trenchless	338
096	114	Multiple Cracks, Deposits Settled Gravel	Trenchless	200
100	100 B	Multiple Fractures, Multiple Cracks Longitudinal, Gravel Deposits	Trenchless	436
106	108	Multiple Cracks, Multiple Fractures, Hole Void Visible, Sag 20%	Trenchless	337
107	85	Multiple Cracks	Trenchless	199
108	107	Multiple Cracks	Trenchless	116
109	088	Multiple Fractures, Hole Void Visible, Survey abandoned	Trenchless	121
113	113 C	Multiple Fractures, Broken Pipe, Hole Void Visible	Trenchless	445
113 C	113 B	Multiple Pipe Fractures, Broken Pipe and Material Pipe Change VCP to PVC	Trenchless	154
114	114 B	Multiple Fractures, Sag 30%, Gravel deposits settled	Trenchless	159
115 B	115 C	Multiple Fractures, Multiple Cracks, Sags 30%	Trenchless	161
115 C	117 B	Multiple Fractures	Trenchless	184
117	120	Pipe Fracture	Trenchless	1,109
117 B	117	Multiple Fractures and Cracks Longitudinal, JOM, Material Pipe Change PVC to VCP	Trenchless	1,241
133	111	Multiple Fractures, Hole Void Visible, JOM	Trenchless	364
138	115 B	Multiple Cracks, Multiple Fractures, Sag 20%	Trenchless	116
138 B	138	Multiple Fractures, Hole Void Visible, Multiple Cracks, JOM, Sag 20% 20% 40%, Survey abandoned due to debris	Trenchless	365
144	143	Multiple Cracks, Multiple Fractures	Trenchless	83
147	134	JOM, Grease Deposits Attached	Trenchless	481
152	137	Pipe Fractures	Trenchless	480
153	138 B	Broken Pipe, Hole Void Visible, Multiple Cracks	Trenchless	235
155	156	Survey abandoned due to deposits settled and debris	Trenchless	60
156	157	Survey abandoned due to surface damage aggregate visible	Trenchless	67
163	163 B	Joint Separated Medium, Surface Spalling Damage	Trenchless	265

Table 5-3 Alternative No. III Sewer Mains Recommended to be Rehabilitated/Replaced

From MH	To MH	Reason(s)	Method	Length (ft)
165	147	JOM, Grease Deposits Attached	Trenchless	491
171	149	Multiple Fractures, Multiple Cracks, Broken Pipe, Severe Grease Deposits Attached	Trenchless	482
174	153	Multiple Cracks	Trenchless	199
175	174	Hole Void Visible	Trenchless	199
176	177	Survey abandoned due to JOM	Trenchless	4
179	179 B	Survey abandoned due to debri under water	Trenchless	147
185	175	Multiple Cracks, Broken Pipe Soil Visible	Trenchless	479
185 B	185	Hole Void Visible, Multiple Cracks	Trenchless	478
186	183	Multiple Cracks	Trenchless	228
188 B	188	Broken Pipe, Hole Void Visible, Multiple Cracks	Trenchless	478
188 C	188 B	Multiple Cracks	Trenchless	189
189	185	Multiple Cracks	Trenchless	398
199	184	Survey abandoned due to grease deposits attached, Broken Pipe, Multiple Cracks	Trenchless	111
194	195	Survey abandoned due to pipe in line, Multiple Cracks	Trenchless	330
195	196	Survey abandoned due to JOM - Large	Trenchless	461
200	199	Pipe Fractures	Trenchless	198
201 C	172	Survey abandoned due to deposits settled and debris	Trenchless	108
202 B	202	Survey abandoned due to JOM	Trenchless	163
203	204	JOM	Trenchless	480
204 B	193	Multiple Fractures, Multiple Cracks	Trenchless	150
204 C	204 B	Broken Pipe with crack and fracture	Trenchless	7
205	206	Multiple Longitudinal Cracks, JOM - Large	Trenchless	215
206	204 C	Multiple Fractures, Multiple Cracks, Pipe surface damage	Trenchless	175
206	206 B	Multiple Longitudinal Cracks	Trenchless	176
209	212	Broken Pipe	Trenchless	150
210	211	Multiple Cracks, Roots Joint Fine	Trenchless	200
224	207	Multiple Cracks, Broken Pipe with Pipe Fracture	Trenchless	613
225	212	Multiple Cracks, Roots Joint Medium	Trenchless	459
226	213	Multiple Cracks, JOM	Trenchless	469
227	214	Multiple Cracks	Trenchless	489
229	215	Multiple Fractures, JOM, Material Change VCP to PVC	Trenchless	253
229 B	229	Broken Pipe Soil Visible, Multiple Cracks	Trenchless	377
230	229 B	Broken Pipe Soil Visible, Multiple Cracks, JOM	Trenchless	373
234	235	Hole Void Visible	Trenchless	373
237	237 B	JOM	Trenchless	177

Table 5-3 Alternative No. III Sewer Mains Recommended to be Rehabilitated/Replaced

From MH	To MH	Reason(s)	Method	Length (ft)
240	239	Multiple Cracks, Hole Void Visible	Trenchless	756
240	241	Survey abandoned due to obstruction under water level, Pipe material change VCP to PVC	Trenchless	146
241	242	Pipe Fracture, JOM	Trenchless	157
243	233	Pipe Fracture	Trenchless	200
247	246	Pipe Fractures	Trenchless	185
247	246	Multiple Cracks, Hole Void Visible	Trenchless	186
248	247	Sag, Multiple cracks and Fracture	Trenchless	765
248	249	Pipe Fractures, JOM	Trenchless	25
251	247	Pipe Fractures	Trenchless	185
252	134	Obstruction in pipe, Broken pipe, hole void visible, Sag 10%	Trenchless	471
252	094	JOM. Material Pipe change PVC to VCP	Trenchless	242
257	258	Broken Pipe, Multiple Fractures, Hole Void Visible, Multiple Cracks, JOM, Survey abandoned due to large offset	Trenchless	180
259	259	JOM	Trenchless	263
260	261	Broken Pipe, Hole Void Visible, Multiple Cracks	Trenchless	218
261	262	Broken Pipe Soil Visible, Multiple Cracks, JOM	Trenchless	750
262	205	Deposits Grease attached, Multiple Cracks	Trenchless	277
			Total Length to Be Rehabilitated	**30,816**
AP 19 B	019	Broken Pipe, Hole Void Visible	Conventional	214
CO	245	Broken pipe, Hole Void Visible	Conventional	333
5th	4th	Multiple Pipe Fractures, Broken Pipe, Hole Void Visible, Multiple Cracks, Tap Break-in Intruding	Conventional	401
007	008	Broken Pipe Soil Visible	Conventional	235
012	013	Broken Pipe, Multiple Fractures, Tap Intruding	Conventional	223
012	014	Multiple Cracks and Tap Break-in Intruding	Conventional	427
013	014	Multiple Fractures, Multiple Cracks, Tap Intruding	Conventional	201
015	021 B	Pipe Fractures, Hole Void Visible, Tap Intruding	Conventional	331
029	052	JOM - Large	Conventional	73
033	044 B	Multiple Fractures, Material Pipe Change PVC to VCP	Conventional	309
037	050	Survey abandoned due to debri and surface damage aggregate visible	Conventional	19
038	039	Hole Void Visible	Conventional	229
050	049	Survey abandoned due to deposits settled gravel, bend in pipe, Material change CP to Clay	Conventional	46
059	058	Broken pipe hole void visible	Conventional	6
059	087	Multiple Fractures, Broken Pipe, Hole Void Visible,	Conventional	448

Table 5-3 Alternative No. III Sewer Mains Recommended to be Rehabilitated/Replaced

From MH	To MH	Reason(s)	Method	Length (ft)
		Multiple Cracks		
064	091	Multiple Fractures, Hole Void Visible, JOM	Conventional	442
066	095	Multiple Fractures, Broken pipe soil visible, Tap Intruding	Conventional	166
73 C	113 C	Broken Soil Visible	Conventional	549
088	088 B	Broken pipe soil visible, JOM - Large, Survey abandoned	Conventional	41
089	063	Survey abandoned due to tap break in intruding	Conventional	90
095	068	Multiple Fractures, Broken Pipe, Hole Void Visible, JOM, Tap Intruding	Conventional	259
106	108	Multiple Cracks, Hole Void Visible, JOM - Large, Broken pipe	Conventional	319
106	108	Multiple Cracks, Hole Void Visible, Grease Deposits Attached	Conventional	322
109	088	Multiple Fractures, Multiple Cracks, Tap Intruding, Material Pipe change PVC to VCP	Conventional	135
127 B	85	Broken Pipe, Hole Void Visible	Conventional	439
132	127	Obstruction in pipe, Broken Pipe Soil Visible, Roots Joint Fine	Conventional	359
133	146	Broken pipe soil visible	Conventional	398
134	135	Pipe Collapse, Broken Pipe, Multiple Fractures, Multiple Cracks, Grease Deposits attached	Conventional	401
135	112	Multiple Fractures, JOM, Sag 20%	Conventional	479
138 C	138 D	Hole Void Visible	Conventional	96
138 B	138 C	Multiple Cracks, Pipe Material Change	Conventional	176
141	142	Pipe deformed (Cut in pipe)	Conventional	463
143	148	Multiple Cracks, Multiple Fractures, Hole Void Visible	Conventional	495
145	133	Survey abandoned due to JOM, Debri under water, Broken Pipe, Hole Void Visible, Multiple Cracks	Conventional	105
148	110	Multiple Fractures, Broken Pipe, Multiple Cracks	Conventional	446
149	135	Broken Pipe, Multiple Fractures, Hole Void Visible, Sag 30%, 40%	Conventional	480
155	156	Survey abandoned due to holes getting larger	Conventional	115
155	154	Hole Void Visible, Pipe Surface Damage	Conventional	57
156	157	Broken Pipe Soil Visible	Conventional	172
157	158	Survey abandoned due to surface damage aggregate visible	Conventional	195
164	145	Multiple Fractures, Hole Void Visible, Multiple Cracks, JOM	Conventional	475
166	167	Broken pipe, Hole Void Visible	Conventional	454
172	152	Pipe Fractures , Hole Void Visible	Conventional	479
173	153	Broken Pipe, Hole Void Visible, Multiple Cracks	Conventional	479
176	177	Pipe Fractures, Holes Void Visible	Conventional	350

Table 5-3 Alternative No. III Sewer Mains Recommended to be Rehabilitated/Replaced

From MH	To MH	Reason(s)	Method	Length (ft)
177	178	Pipe Fractures, Deposits settled survey abandoned	Conventional	162
178	179	Survey abandoned due to JOM, Pipe Fractures	Conventional	301
183	164	Survey abandoned due to obstruction in pipe	Conventional	274
184	171	Pipe Fractures, Broken Pipe, Hole Void Visible, JOM, Tap Intruding	Conventional	481
185 C	185 B	Survey abandoned cannot continue	Conventional	307
188	173	Hole in Pipe, Multiple Cracks, Survey abandoned due to obstruction in Pipe	Conventional	389
189 B	189	Survey abandoned due to obstruction	Conventional	264
201	201 C	Pipe Fractures, Hole Void Visible, JOM	Conventional	484
201 B	201	Broken Pipe, Pipe Fractures, Hole Void Visible	Conventional	236
201 C	172	Survey abandoned	Conventional	8
230	231	Broken Pipe Soil Visible	Conventional	355
231	232	Broken Pipe Soil Visible	Conventional	401
232	233	Soil Visible and Multiple Cracks	Conventional	339
233	234	Broken Pipe	Conventional	63
235	222	Pipe Fractures, JOM - Large, Material change VCP to PVC	Conventional	250
239	229	Survey abandoned due to camera under water, Multiple fractures	Conventional	124
242	243	Multiple Fractures, JOM - Roots	Conventional	175
246 B	246	Survey abandoned due Infiltration Stain Joint, Multiple Holes Soil Visible, Multiple Fractures	Conventional	263
246 B	246	Broken Pipe Soil Visible, Multiple Cracks, JOM	Conventional	472
248	249	Survey abandoned due to line collapsing	Conventional	25
250	251	Broken Pipe Soil Visible, Multiple Cracks	Conventional	496
255	256	Broken Pipe, Soil Visible, JOM, Multiple Fractures	Conventional	329
256	257	Broken Pipe, Multiple Fractures, JOM, Hole Void Visible, Tap Intruding	Conventional	153
258	259	Tap Break-in Intruding, Multiple Longitudinal Cracks, Joint Separated Medium	Conventional	243
259	260	Hole Void Visible, Multiple Cracks, Fracture Longitudinal, Tap Break-in Intruding	Conventional	271
259	260	Hole Void Visible, Tap Break-in Intruding	Conventional	7
			Total Length to Be Replaced	**19,801**

5.4.4. Probable Construction Costs

Table 5-4 provides an opinion of probable construction costs for the rehabilitation of approximately 30,816 LF of gravity sewer mains and the replacement of approximately 19,801 gravity sewer mains.

Table 5-4 Alternative No. III Probable Construction Costs

Description	Quantity	Units	Unit Cost ($/Unit)	Total
Mobilization	1	LS	$240,000	$240,000
Traffic Control Plan	1	LS	$90,000	$90,000
Rehabilitation 6" PVC Pipe	15,914	LF	$95	$1,511,783
Rehabilitation 8" PVC Pipe	7,297	LF	$105	$766,227
Rehabilitation 10" PVC Pipe	2,071	LF	$110	$227,832
Rehabilitation 15" PVC Pipe	2,558	LF	$120	$306,948
Rehabilitation 18" PVC Pipe	2,975	LF	$120	$356,964
New 6" PVC Pipe	13,838	LF	$215	$2,975,063
New 8" PVC Pipe	4,226	LF	$215	$908,676
New 10" PVC Pipe	1,738	LF	$240	$417,072
Excavation	9,933	CY	$9	$89,400
Backfill	13,907	TON	$6	$83,440
Surface Restoration	2,481	SY	$30	$74,426
Remove and Replace Sewer Lateral	40	EA	$4,800	$192,000
Bypass Pumping	70	Day	$1,200	$84,000
Subtotal Construction Costs				**$8,323,830**
Contingency (15%)				$1,248,574
Engineering, Environmental, Construction Administration (15%)				$998,860
Total Capital Construction Costs				**$10,571,264**
NOTE: All capital construction costs are rounded up to the nearest thousand.				

5.4.5. Annual O&M Costs

Similar to Alternative No. II, Alternative No. III includes only the rehabilitation or replacement of existing deteriorated gravity sewer mains and laterals and will consist of conventional Maintenance costs to operate the sewer collection system. Table 4-4 displays the annual O&M costs associated with the sewer collection system.

CITY OF COALINGA

CCTV INSPECTION PROJECT



LEGEND

- NO REPLACEMENT
- REPLACEMENT
- REHABILITATION
- NOT SURVEYED

NORTH

SCALE IN FEET

0 1,000 FT

ALTERNATIVE II - SEWER MAINS TO BE REPLACED AND REHABILITATED

AM Consulting Engineers • 5150 N. Sixth Street Suite 124 • Fresno, California 93710 • (559) 473-1371

5.5. Alternative Evaluation

As previously stated, the purpose of this PER is to provide a comprehensive evaluation of the City's existing sewer collection system and to recommend the replacement or rehabilitation of deteriorated gravity sewer mains through the City in order to prevent blockages, SSO's, and pipe failure. The anticipated useful life of rehabilitated sewer pipe and replaced sewer pipe is the same and in excess of 50 years. The three alternatives considered are as follows:

- Alternative I: No Project
- Alternative II: Convention Construction Method
- Alternative III: Conventional and Trenchless Construction Methods

Alternative I was eliminated from consideration as it does not address the long-term needs of the City. The sewer mains considered in this Section would still require replacement in the future as they begin to fail. It was deemed more practical to address these structural and performance issues prior to failure of the system. The following paragraphs provide an evaluation of the remaining two alternatives.

5.5.1. Design Criteria/Compliance Issues

Alternatives Nos. II and III would require the replacement or rehabilitation of the City's existing gravity sewer mains. There are no anticipated design issues, as both alternatives implement standard, common replacement, or rehabilitation methods. These alternatives may include excavation near trees and shrubs; however, Alternative No. III seeks to minimize the amount of excavation by using trenchless construction methods.

Replacing or rehabilitating the City's existing sewer collection system will address the State's planning priorities included in California Governmental Code Section 65041.1. Alternative Nos. II and III will both promote infill development by rehabilitating and improving existing infrastructure. The rehabilitated sewer collection system will protect environmental resources by reducing the likelihood of sewer collection system leaks and overflows. The improved system will also minimize costs to City residents by lowering repair and replacement costs.

5.5.2. Annual O&M Costs

For each alternative, the annual O&M cost associated with the improved sewer collection system would be similar to the existing O&M expenses. Table 5-5 displays the City's operating expenses for the sewer collection system and personnel for the past five fiscal years. According to the table, the City's average annual O&M costs for the sewer collection system are approximately $745,458.

Table 5-5 Average Annual O&M Costs

Fiscal Year	O & M Costs
2018/19	$590,760
2019/20	$515,807
2020/21	$814,221
2021/22	$1,232,257
2022/23	$574,243
Average	**$745,458**

Notes:
Source: City of Coalinga Adopted Budget for
FY 2018/19, 2019/20, 2020/21, 2021/22 , 2022/23

5.5.3. Life-Cycle Costs

The alternatives described above were evaluated to determine the most feasible, cost-effective alternative. A life cycle of 25 years was used to determine lifetime O&M costs. A summary of costs for Alternative Nos. II and III are shown below in Table 5-6.

Table 5-6 Life Cycle Cost Estimates

Alternative	Capital Cost	Lifetime O&M	Total Life-Time Cost
II – Conventional Construction Methods	$16,159,480	$18,636,440	$34,795,920
III – Trenchless & Conventional Construction Methods	$10,571,264	$18,636,440	$29,207,704

The table shows that Alternative III has the lowest life-time cost. As previously stated, it is anticipated that O&M will be the same regardless of if the sewer mains are replaced or rehabilitated, therefore both Alternatives have the same lifetime O&M.

5.6. Recommended Alternative

Based on each alternative's life-time cost, design criteria/compliance issues, and feasibility, it is recommended that the City proceed with Alternative No. III. As demonstrated above, Alternative III has the lowest capital cost and lifetime cost of the two feasible alternatives. This alternative also minimizes the amount of excavation required.

SECTION 6 - WASTEWATER TREATMENT PLANT IMPROVEMENTS

6.1. Alternatives Considered

This section describes the alternatives considered for the improvement of the existing Coalinga WWTP. The alternatives included in this section are intended for reuse or recycle treated effluent produced from the Coalinga WWTP to offset some of the non-potable water demands within the City's service area or to provide an incidental recharge of the groundwater basin. In summary, the four alternatives are as follows:

- Alternative I: No Project
- Alternative II: Existing Treatment with Offsite Disposal through Agricultural Irrigation (Non-Human Crops)
- Alternative III: Upgrade Treatment to an Extended Aeration with Biological Nutrient Removal and Onsite Disposal through percolation (Groundwater Recharge)
- Alternative IV: Upgrade Treatment to Tertiary
    - IV-A. Offsite Disposal through Agricultural Irrigation (Human crops)
    - IV-B. Offsite Disposal through Landscape Irrigation

The following sections briefly describe each alternative, including design parameters, proposed layouts, probable construction costs, and operation and Maintenance (O&M) costs.

6.2. Alternative I: No Project

Under the "No Project" alternative, Coalinga's WWTP would continue to operate under current conditions. This Alternative was dismissed due to not addressing concerns with the facility's limited disposal alternatives.

6.3. Alternative II: Existing Treatment with Offsite Disposal through Agricultural Irrigation (Non-Human Crops)

6.3.1. Overview

Alternative II would consist of disposing undisinfected secondary effluent to adjacent land through agricultural irrigation at agronomic rates.

6.3.2. Potential User Survey

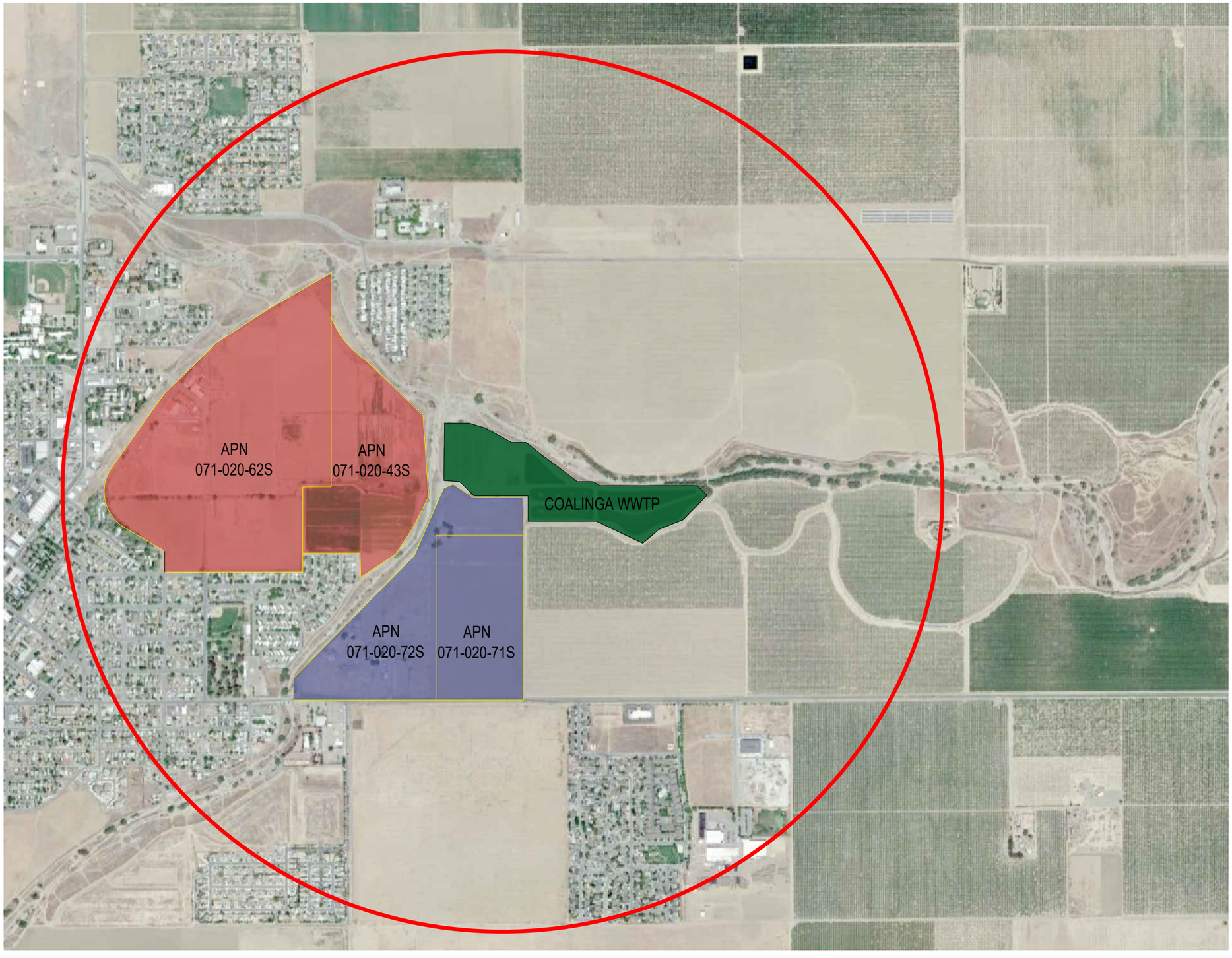
For Alternative II, the city identified all parcels and property owners within a 2-mile radius of the WWTP as shown in Figure 6-1. Table 6-1 lists the owner of record and the acreage of each Assessor's Parcel Number (APN) within the recycled water user survey area.

Table 6-1 Potential Recycled Water Users

APN	Total Area (Acres)	Owner of Record
071-020-43S & 071-020-62S	225.95	Jeff S Brooks
071-020-71S & 071-020-72S	101.43	Michael T Canaday

CITY OF COALINGA

SANITARY SEWER COLLECTION SYSTEM
PRELIMINARY ENGINEERING REPORT



LEGEND

- 2 MILE RADIUS
- POTENTIAL USER
- WWTP

NORTH
SCALE: 1" = 1200'

FIGURE 6-1
RECYCLED WATER USER SURVEY

6.3.3. Water Balance

Water balance calculations are typically used to determine the area required to adequately dispose of the daily flow of recycled water and the volume of storage required. Table 6-2 summarizes the design data used in the water balance calculations for Alternative II. A copy of the water balance for this alternative is included in Appendix C.

Table 6-2 Alternative II – Water Balance Design Data

Parameter	Value
Average Design Flow, MGD	1.340
Irrigation Efficiency, %	70%
Treatment Pond Area, Acres	18.34
Effluent Reclamation Area, Acres	219
Percolation Rate, inch/day	0

The WWTP currently receives an average daily flow of approximately 0.857 MGD. The water balance calculations have been prepared for the facility's existing flow and the design flow of 1.34 MGD. Table 6-3 summarizes the water balance calculations for Alternative II.

Table 6-3 Alternative II – Water Balance Calculation Summary

	Current Flow 0.857 MGD	Design Flow 1.34 MGD
Reclamation Aera Required, Acres	325	219
Total Storage Volume Required, Acres-Feet	184.8	472

At current flows, the City can irrigate approximately 325 acres of land using approximately 2182 acre-feet of treated effluent on an annual basis. When the facility reaches its design flow conditions of 1.34 MGD, the City can irrigate 219 acres using approximately 1469 acre-feet of treated effluent on an annual basis.

6.3.4. Storage Requirements

When using recycled water for agricultural irrigation, a certain amount of effluent storage will be required to supply recycled water during the summer months. According to the water balance calculations provided in Appendix C, the maximum irrigation demand will occur during the month of July, during which approximately 242.5 acre-feet of recycled water will be used. For Alternative II, the City will need approximately 472 acres-feet of additional storage. Figure 6-2 displays the proposed site layout for this Alternative, including approximately 46 acres of additional storage.

6.3.5. Capital Construction Costs

Table 6-4 displays the total construction costs associated with constructing storage ponds and a delivery system to convey treated effluent for the use of agricultural irrigation.

Table 6-4 Alternative II – Capital Construction Costs

Description	Quantity	Units	Unit Cost ($/Unit)	Total
Mobilization	1	LS	$400,000	$400,000
Headworks	1	LS	$600,000	$600,000
Wastewater Facility Piping	1	LS	$2,000,000	$2,000,000
Storage Pond Excavation	959,160	CY	$2.5	$2,397,000
HDPE Storage Pond Liners	1,992,800	SF	$1.2	$2,391,000
Recycled Water Pump Station	1	LS	$1,200,000	$1,200,000
Recycled Water Piping	2,000	LF	$190	$285,000
Permitting	1	LS	$25,000	$25,000
Electrical & Instrumentation	1	LS	$800,000	$800,000
			Subtotal Construction Costs	**$9,993,000**
Contingency (15%)				$1,499,000
Engineering, Environmental, Construction Administration (12%)				$1,199,000
			TOTAL	**$12,691,000**
NOTE: All capital construction costs are rounded up to the nearest thousandth.				

The total project cost for Alternative II would be approximately $12.6 million. The City would apply for construction funding to the SWRCB CWSRF to fund this improvements project.

6.3.6. Estimated O&M Costs

The O&M cost provided in Table 6-5 is based on the City's current O&M costs for the WWTP.

Table 6-5 Alternative II – Estimated Annual O&M

Description	Costs
Salaries Regular	$229,773
Salaries Part Time	$19,124
Salaries Overtime	$16,000
Salaries Cash Outs	$4,670
Retirement CALPERS	$21,584
Medical/Life Insurance	$55,073
Social Security FICA	$15,556
Medicare Insurance	$3,609
Disability Income Insurance	$3,111
Deferred Comp - 457 Retirement	$8,422
Workers Comp. Insurance	$29,868
Safety Boot Allowance	$588
Retirement CalPERS UL	$2,640
Unemployment Insurance	$2,298
Personnel Cost	$412,316

Description	Costs
Office Supplies	$500
Postage & Freight Out	$250
Printing & Binding	$250
Small Tolls &Equipment	1000
Uniforms	$2,000
Utility Parts & Supplies	$10,000
Vehicle Parts & Supplies	$1,000
Gasoline & Diesel	$3,500
Water, Gas, Sanitation & Sewer	$18,000
Electric	$150,000
Telephone	$2,000
Equipment Rental	2000
Office Equip, Repairs & Maintenance	$3,000
Major Equip Repairs & Maintenance	$40,000
Buildings Repairs & Maintenance	$5,000
Grounds, Chemicals & Maintenance	5000
Vehicle Parts, Repairs & Maintenance	$2,000
Safety Equipment	$2,000
Training, Travel, & Conference	2000
Subs., Dues, & Publications	$2,000
Certifications, Renewals & Test	3500
City Attorney Fees	$2,000
Computer Program & Consulting	$4,500
Medical - General	$700
Laboratory	$5,000
Professional Services	$25,000
Sludge Removal Contract	$50,000
Grant Writing/Application	$10,000
Physical w/Drug & Alcohol Test	$300
Fingerprinting	$50
Liability & Property Insurance	$25,000
Taxes, Licenses, & Fees	$25,000
2021A Water/WW Rev Bonds Principal	$70,000
2021A Water/WW Rev Bonds Interest	$66,689
Sewer Plant Automation and Security Upgrades	$200,000
O&M Cost	$739,239
Wastewater Plant Total	$1,151,555

6.4. Alternative III: Upgrading WWTP to Extended Aeration with Biological Nutrient Removal and Onsite Disposal through percolation (Groundwater Recharge)

6.4.1. Overview

Alternative III would consist of upgrading the WWTP to an extended aeration system with biological nutrient removal and disposing treated effluent on the City's WWTP site through percolation ponds.

6.4.2. Improvements to WWTP

To recharge the groundwater, the effluent quality from the Coalinga WWTP will need to be upgraded to undisinfected secondary effluent with nitrogen removal.

6.4.2.1. Extended Aeration system

Under this alternative, the existing WWTP will be upgraded to an extended aeration system. The activated sludge system comprises of a basin for the wastewater to be aerated and suspended; a secondary clarifier; and a recirculation system for returning settled sludge to the basin. Extended aeration systems typically operate with a hydraulic retention time (HRT) that ranges from 18 to 36 hours. Extended aeration provides almost complete oxidation of organic material and nitrification. Extended aeration also Maintenanceains a high sludge age of 20-30 days. Biological nitrogen removal can occur within the aerated lagoon if adequate conditions are created. In extended aeration, wastewater will enter the aerated lagoon and mix with biological culture known as mixed liquor (ML). Mixed liquor from the aerated lagoon then flows into a secondary clarifier, where activated sludge settles to the bottom and clear treated effluent flows over a surface mount weir. The settled mixed liquor solids recirculate to the aerated lagoon, a process known as recirculating activated sludge (RAS). Periodically, some of the RAS solids are wasted and sent to dewatering, a process known as wasted activated sludge (WAS).

Table 6-6 Alternative III – Extended Aeration Activated Sludge Parameters

Item	Parameters	Design Value
Aeration Basin	Retention Time, hours	24
	Aeration Tank Volume, MG	1.34
	MCRT, days	24
	Wastewater Temperature, ^{o}C	15
Aerobic Digester	Volume, % of Aeration Tank	29
	Maximum Solids Conc., mg/l	12,000
	Digester Temperature, ^{o}C	15
Sludge Holding Tank	Volume, % of Aeration Tank	0
	Maximum Solids Conc., mg/l	25,000
Aeration Pond Blower	Motor, HP	125

For this alternative, two clarifiers will be utilized. A center-feed configuration is commonly used for influent entering the tank. Mixed liquor is carried to the center of the tank and enters a circular feed well designed to distribute the flow radially from the top of the basin. An influent baffle redirects the flow towards the bottom of the clarifier. A peripheral weir is used to collect effluent and a surface

skimmer is used to collect floating scum. Table 6-7 displays the preliminary design parameters used to size the clarifiers. As previously stated, two identical clarifiers will be constructed; one will be constructed to handle the facility's build-out flow of 1.34 MGD and one will be constructed for redundancy.

Table 6-7 Alternative III – Clarifier Design Parameters

Parameters	Design Value
Number of Tanks	2
Tank Water Depth, ft	14
Weir Length, ft	366
Weir Overflow Rate, gpd/linear ft	3661
Surface Overflow Rate, gpd/sf	349

The bottom scrapper of the clarifier will collect settled sludge into a return pipe to be withdrawn. Recirculated activated sludge or wasted activated sludge (RAS/WAS) will either be returned to inlet of the aeration basin (RAS) or wasted for dewatering (WAS). A sludge recirculation system will pump settled sludge from the bottom of the clarifiers to the head of aerated lagoon. The optimal recirculation ratio will be modified after the plant has been placed in operation. For extended aeration activated sludge systems, recirculation ratios typically range from 50 to 150 percent of the influent flow. One sludge pump will remove RAS/WAS from the secondary clarifier, with an additional pump for redundancy.

6.4.3. Improvements to Percolation Ponds

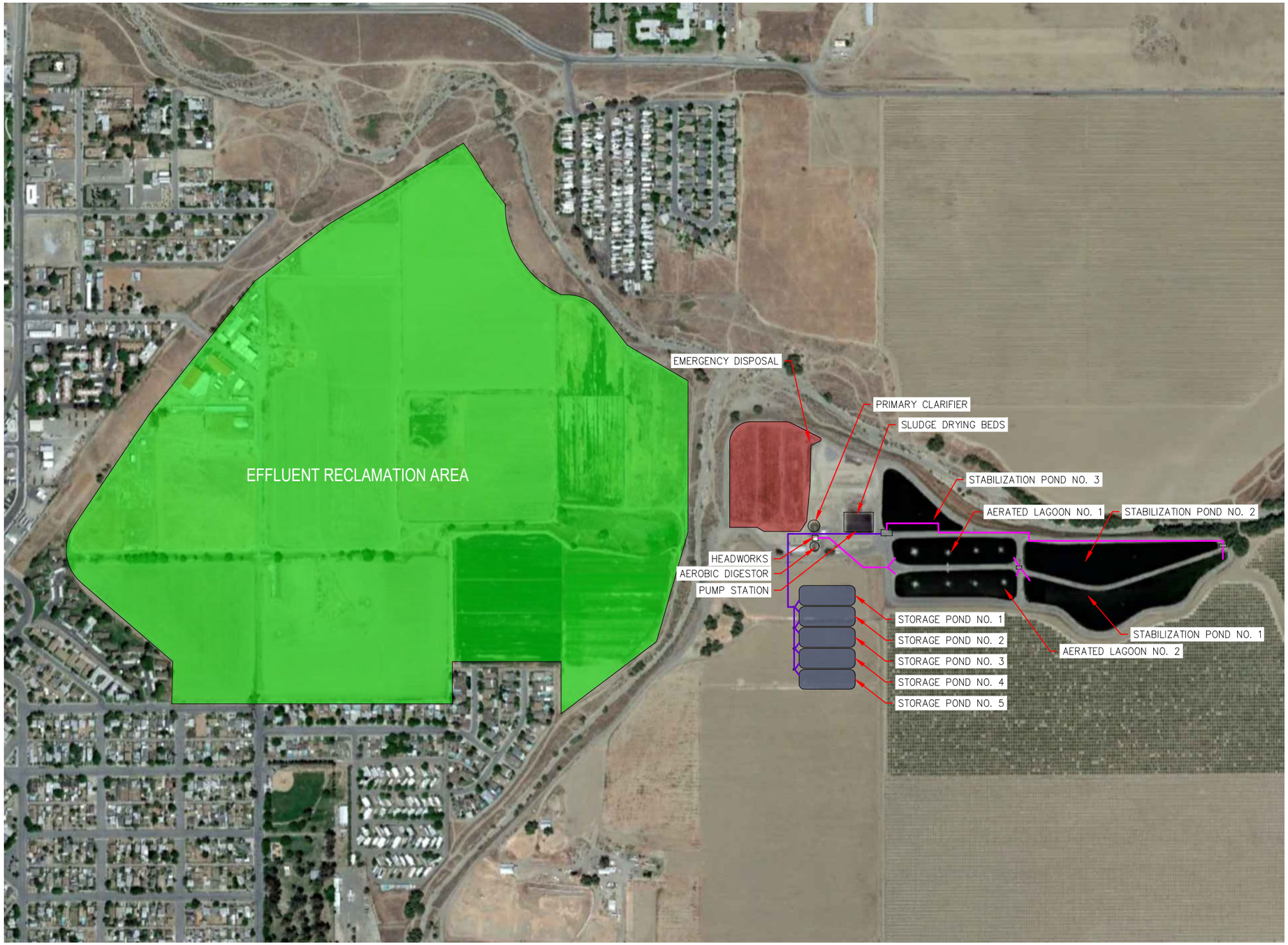
Under this alternative, the City needs to decommission the existing aerated lagoons and stabilization ponds to construct percolation ponds. Water balance calculations were used to determine the area required to adequately dispose of the City's treated effluent and volume required for the percolation ponds. The results of the water balance calculations are analyzed in detail in the following sections.

6.4.3.1. Water Balance

The City's WWTP currently receives an average daily flow of approximately 0.857; however, the facility's disposal capacity is limited to 1.34 MGD. A soil survey was done to determine an appropriate percolation rate. The soil in this area consists mainly of silty sand, which has a typical coefficient of permeability greater than 0.85 inch per day (in/day). For this alternative, a percolation rate of 2.8 in/day is used to evaluate the amount of percolation in the new ponds. Figure 6-3 displays the proposed site layout for Alternative III. As shown in the figure, five percolation ponds with a total surface area of approximately 18.34 acres will be constructed. Table 6-8 summarizes the design data used in the water balance calculations.

CITY OF COALINGA

SANITARY SEWER COLLECTION SYSTEM
PRELIMINARY ENGINEERING REPORT



LEGEND

WASTEWATER PIPELINE

RECYCLED WATER PIPELINE

NORTH
SCALE: 1" = 650'

FIGURE 6-2
ALTERNATIVE II WWTF SITE LAYOUT

Table 6-8 Alternative III – Water Balance Design Data

Parameter	Value
Average Design Flow, MGD	1.34
Irrigation Efficiency, %	90%
Percolation Pond Area, Acres	18.34
Percolation Pond Volume, Acre-feet	98.5
Percolation Rate, inch/day	2.8

According to the water balance calculations, a total percolation area of 18.34 acres would allow the City to discharge 1.34 MGD. A copy of the water balance calculations is provided in Appendix D.

6.4.4. Capital Construction Costs

Table 6-9 provides the total construction costs associated with constructing an extended aeration system and treated effluent disposal through percolation ponds.

Table 6-9 Alternative III – Capital Construction Costs

Description	Quantity	Units	Unit Cost ($/Unit)	Total
Mobilization	1	LS	$400,000	$400,000
Headworks	1	LS	$600,000	$600,000
Extended Aeration Basin	1	LS	$3,500,000	$3,500,000
WWTP Equipment Package	1	LS	$4,500,000	$4,500,000
Blower Building	1	LS	$800,000	$800,000
Sludge Dewatering System	1	LS	$650,000	$650,000
Dry Sludge Storage	1	LS	$200,000	$200,000
Wastewater Facility Piping	1	LS	$500,000	$500,000
Evaporation/Percolation Pond Excavation	390,000	CY	$2.50	$975,000
Recycled Water Pump Station	1	LS	$1,000,000	$1,000,000
Permitting	1	LS	$25,000	$25,000
Electrical & Instrumentation	1	LS	$2,000,000	$2,000,000
Subtotal Construction Costs				**$15,150,000**
Contingency (15%)				$2,272,500
Engineering, Environmental, Construction Administration (12%)				$1,818,000
TOTAL				**$19,240,500**
NOTE: All capital construction costs are rounded up to the nearest thousandth.				

The total project cost for Alternative III would be approximately $19.2 million. The City would apply for construction funding to the SWRCB CWSRF to fund this improvements project.

6.4.5. Estimated O&M Costs

In addition to the City's existing operation and administration costs, O&M costs associated with the upgraded WWTP include costs for a Grade 3 Operator, electric, laboratory, and sludge disposal. The O&M cost provided in Table 6-5 is based on the City's current O&M costs for the WWTP.

Table 6-10 Alternative III – Estimated O&M Costs

Description	Costs
Salaries Regular	$229,773
Salaries Part Time	$19,124
Salaries Overtime	$16,000
Salaries Cash Outs	$4,670
Retirement CALPERS	$21,584
Medical/Life Insurance	$55,073
Social Security FICA	$15,556
Medicare Insurance	$3,609
Disability Income Insurance	$3,111
Deferred Comp - 457 Retirement	$8,422
Workers Comp. Insurance	$29,868
Safety Boot Allowance	$588
Retirement CalPERS UL	$2,640
Unemployment Insurance	$2,298
Personnel Cost	$412,316
Description	**Costs**
Office Supplies	$500
Postage & Freight Out	$250
Printing & Binding	$250
Small Tolls &Equipment	$1,000
Uniforms	$2,000
Utility Parts & Supplies	$10,000
Vehicle Parts & Supplies	$1,000
Gasoline & Diesel	$3,500
Water, Gas, Sanitation & Sewer	$18,000
Electric	$150,000
Telephone	$2,000
Equipment Rental	$2,000
Office Equip, Repairs & Maintenance	$3,000
Major Equip Repairs & Maintenance	$40,000
Buildings Repairs & Maintenance	$5,000
Grounds, Chemicals & Maintenance	$5,000
Vehicle Parts, Repairs & Maintenance	$2,000

Description	Costs
Safety Equipment	$2,000
Training, Travel, & Conference	$2,000
Subs., Dues, & Publications	$2,000
Certifications, Renewals & Test	$3500
City Attorney Fees	$2,000
Computer Program & Consulting	$4,500
Medical - General	$700
Laboratory	$5,000
Chlorine	$22,500
Polymer	$10,000
Professional Services	$25,000
Sludge Removal Contract	$50,000
Grant Writing/Application	$10,000
Physical w/Drug & Alcohol Test	$300
Fingerprinting	$50
Liability & Property Insurance	$25,000
Taxes, Licenses, & Fees	$25,000
2021A Wtr/WW Rev Bonds Prin	$70,000
2021A Wtr/WW Rev Bonds Int	$66,689
Sewer Plant Automation and Security Upgrades	$200,000
O&M Cost	$739,239
Wastewater Plant Total	$1,151,555

6.5. Alternative IV: Upgrading WW Treatment Facility to Tertiary Treatment

6.5.1. Overview

Alternative IV would consist of upgrading the effluent quality produced by Coalinga's WWTP to disinfected tertiary. Under this alternative we will evaluate the following offsite disposal alternatives:

- Alternative IV A: Offsite Disposal through Agricultural Irrigation (Human Crops)
- Alternative IV B: Offsite Disposal through Landscape Irrigation

6.5.2. Improvements to WWTP

6.5.2.1. Tertiary Treatment

Under this alternative, the existing WWTP will be upgraded to an extended aeration system followed by filtration and disinfection.

After wastewater has passed the aeration process and solids separation process (clarification), wastewater must be filtered and then disinfected. To use recycled wastewater for the irrigation of food crops, the treated effluent produced from the WWTP must meet the effluent quality requirements in Title 22, without any major interruption in the treatment performance. According to Title 22, the

average daily effluent turbidity limit for disinfected tertiary recycled water is 2 NTU, and the allowable total coliform must not exceed 2.2 MPN/100 mL.

As shown in Figure 6-5, after the secondary treatment process, wastewater will be filtered in accordance with Title 22 standards. For this Alternative, filtration may be achieved by either media filtration or membrane filtration. Media filtration consists of passing the clarified effluent through a bed of filter media such as sand. The clarified wastewater must then be coagulated and flocculated with a suitable chemical coagulant before entering the filters. Membrane filtration consists of submerging hollow membrane fibers or membrane plates, and through suction, force the liquid through the membrane pores. These pores are smaller than most microorganisms suspended in the mixed liquor. This process of filtration does not require the use of a chemical coagulant.

Tertiary treatment will require at least a Grade III certified treatment operator at the WWTF. The local availability and cost of Grade III operators can be significant for small wastewater utilities. In addition, chemical usage will include chlorine and possibly coagulants, which will also increase operation costs. Finally, in-plant and effluent monitoring requirements are typically much more extensive in tertiary facilities than in secondary facilities to ensure that public health is adequately protected. The capital construction costs associated with constructing disinfected tertiary treatment facility are provided in Table 6-14.

6.5.2.2. Storage Requirements

When using disinfected tertiary recycled water for agricultural irrigation, a certain amount of effluent storage will be required to supply recycled water during the summer months. Since crops are typically watered on a weekly basis during the summer, the amount of storage required for each reclamation area is assumed to be one fourth of the maximum irrigation demand. According to the water balance calculations, the maximum irrigation demand will occur during the month of July, during which approximately 106.3 acre-feet of recycled water will be used. For Alternative III, it has been assumed that the amount of storage required will be one fourth of the maximum irrigation demand. Therefore, approximately 26.6 acre-feet of storage will be required.

For this Alternative, evaporation/percolation Pond No. 4 will need to be excavated from a depth of 4.7 feet to 5.1 feet. At this depth, Pond No. 4 will be able to store approximately 26.9 acre-feet of recycled water. Pond No. 4 will also be lined with a High-Density Polyethylene (HDPE) liner. Table 6-14 displays the capital construction costs associated with excavating and lining Pond No. 4.

6.5.3. Alternative IV-A Offsite Disposal through Agricultural Irrigation (Human Crops)

This alternative would consist of disposing disinfected tertiary effluent to adjacent land through agricultural irrigation at agronomic rates.

6.5.3.1. Potential User Survey

For alternative IV-A, the City identified all parcels and property owners within a 2-mile radius southeast of the WWTP as shown in Figure 6-4. Figure 6-5 shows the parcels within the recycled water user survey area.

6.5.3.2. Water Balance

Water balance calculations were used to determine the area required to adequately dispose of the daily flow of recycled water and the volume of storage required. Table 6-11 and Table 6-12 summarize the design data used in the water balance calculations and the water balance calculation summary for alternative IV A. A copy of the water balance for this alternative is included in Appendix E.

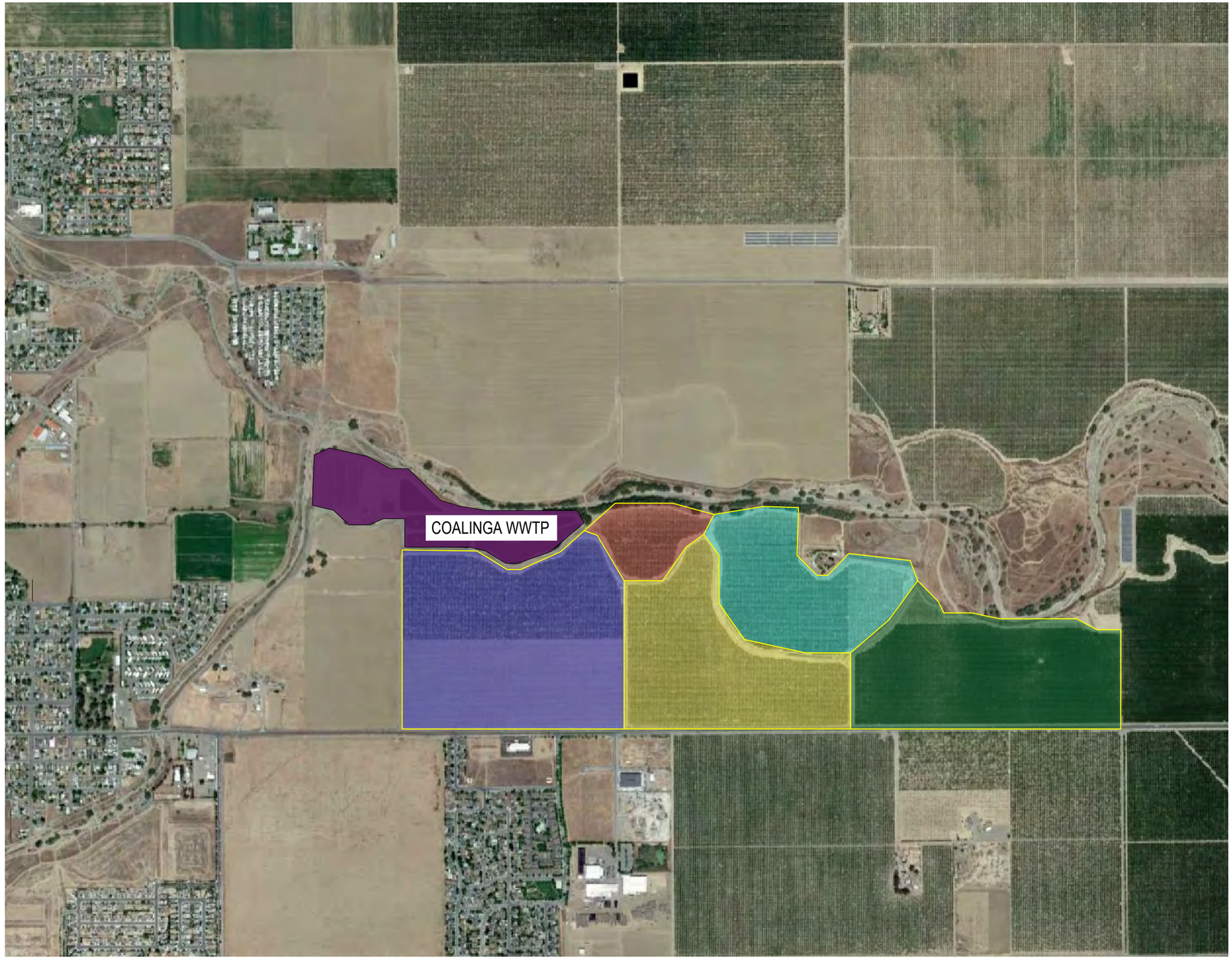
Table 6-11 Alternative IV-A - Water Balance Design Data

Parameter	Value
Average Design Flow, MGD	1.340
Irrigation Efficiency, %	90%
Storage Pond Area, Acres	18.34
Effluent Reclamation Area, Acres	288
Percolation Rate, in/day	0

Table 6-12 Alternative IV-A - Water Balance Calculation Summary

	Current Flow 0.857 MGD	Design Flow 1.34 MGD
Reclamation Area, Acres	325	288
Total Storage Volume Required, Acre-Feet	306.1	574.5
Additional Storage Required, Acre-Feet	306.1	476

According to the water balance calculations provided in Appendix E, the maximum irrigation demand will occur during the month of July, during which approximately 275.3 acre-feet of recycled water will be used for irrigation. In this alternative, the City will require an additional 574.5 acre-feet for storage. When upgrading to tertiary treatment, the City will use the existing aerated lagoons and stabilization ponds as storage ponds. Figure 6-5 displays the proposed site layout for this alternative, including approximately 46 acres of additional storage.



CITY OF COALINGA

SANITARY SEWER COLLECTION SYSTEM
PRELIMINARY ENGINEERING REPORT

LEGEND

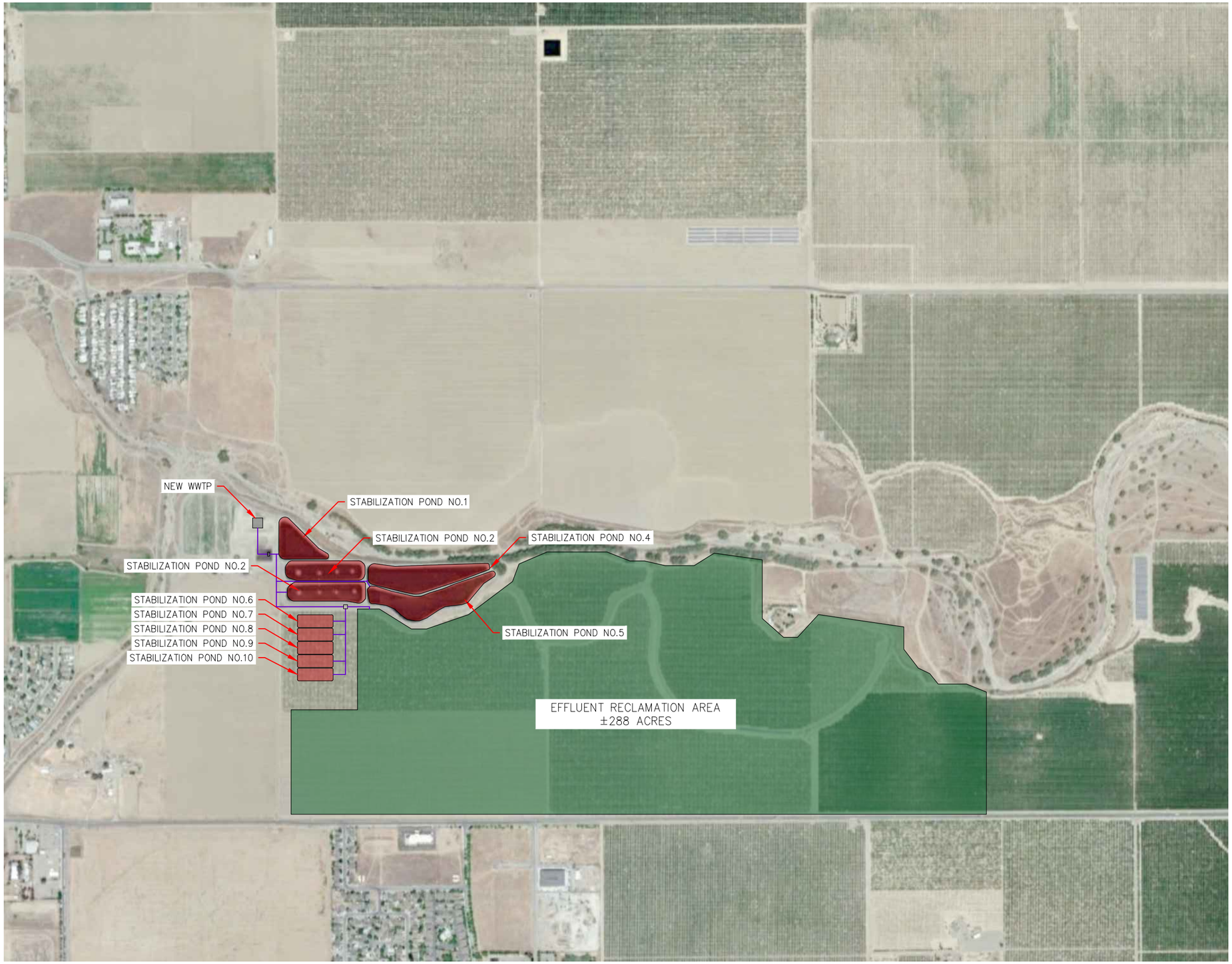
POTENTIAL USER

NORTH
SCALE: 1"=1200'

FIGURE 6-4
RECYCLED WATER USER SURVEY

CITY OF COALINGA

SANITARY SEWER COLLECTION SYSTEM
PRELIMINARY ENGINEERING REPORT



LEGEND

RECYCLED WATER PIPELINE

NORTH
SCALE: 1"=1000'

FIGURE 6-5
ALTERNATIVE IV A
PROPOSED WWTP SITE LAYOUT

6.5.3.3. Capital Construction Costs

Table 6-14 displays the total construction costs associated with constructing a tertiary treatment facility and recycled water delivery system to convey recycled water for the use of agricultural irrigation.

Table 6-13 Alternative IV-A – Capital Construction Costs

Description	Quantity	Units	Unit Cost ($/Unit)	Total
Mobilization	1	LS	$400,000	$400,000
Headworks	1	LS	$600,000	$600,000
Extended Aeration System Basin	1	LS	$3,500,000	$3,500,000
WWTP Equipment Package & Installation	1	LS	$4,500,000	$4,500,000
Filtration + UV Disinfection	1	LS	$1,100,000	$1,100,000
Blower Building	1	LS	$800,000	$800,000
Sludge Dewatering System	1	LS	$650,000	$650,000
Dry Sludge Storage	1	LS	$200,000	$200,000
Wastewater Facility Piping	1	LS	$500,000	$500,000
Recycled Pump Station	1	LS	$1,000,000	$1,000,000
Storage Pond Excavation	1,203,782	LS	$2.50	$3,009,000
HDPE Storage Pond Liners	1,095,665	LS	$1.10	$1,205,000
Recycled Water Piping	2,000	LF	$190	$380,000
Permitting	1	LS	$25,000	$25,000
Electrical & Instrumentation	1	LS	$2,000,000	$2,000,000
			Subtotal Construction Costs	**$19,774,000**
Contingency (15%)				$2,967,000
Engineering, Environmental, Construction Administration (12%)				$2,373,000
			TOTAL	**$25,114,000**
NOTE: All capital construction costs are rounded up to the nearest thousandth.				

The total project cost for Alternative IV A would be approximately $25.1 million. Like the previous alternatives, the City would apply for construction funding to the SWRCB CWSRF to fund this improvements project.

6.5.3.4. Estimated O&M Costs

In addition to the City's existing O&M costs, Alternative IV A will also include costs for a Grade 3 Operator, electric, laboratory, sludge disposal, and chemicals for disinfection. The O&M cost provided in Table 6-15 is based on the City's current O&M costs for the WWTP.

Table 6-14 Alternative IV A – Estimated O&M Costs

Description	Costs
Salaries Regular	$229,773
Salaries Part Time	$19,124
Salaries Overtime	$16,000
Salaries Cash Outs	$4,670
Retirement CALPERS	$21,584
Medical/Life Insurance	$55,073
Social Security FICA	$15,556
Medicare Insurance	$3,609
Disability Income Insurance	$3,111
Deferred Comp - 457 Retirement	$8,422
Workers Comp. Insurance	$29,868
Safety Boot Allowance	$588
Retirement CalPERS UL	$2,640
Unemployment Insurance	$2,298
Personnel Cost	$412,316
Description	**Costs**
Office Supplies	$500
Postage & Freight Out	$250
Printing & Binding	$250
Small Tolls &Equipment	$1,000
Uniforms	$2,000
Utility Parts & Supplies	$10,000
Vehicle Parts & Supplies	$1,000
Gasoline & Diesel	$3,500
Water, Gas, Sanitation & Sewer	$18,000
Electric	$150,000
Telephone	$2,000
Equipment Rental	$2,000
Office Equip, Repairs & Maintenance	$3,000
Major Equip Repairs & Maintenance	$40,000
Buildings Repairs & Maintenance	$5,000
Grounds, Chemicals & Maintenance	$5,000
Vehicle Parts, Repairs & Maintenance	$2,000
Safety Equipment	$2,000
Training, Travel, & Conference	$2,000
Subs., Dues, & Publications	$2,000
Certifications, Renewals & Test	$3500

Description	Costs
City Attorney Fees	$2,000
Computer Program & Consulting	$4,500
Medical - General	$700
Laboratory	$5,000
Chlorine	$22,500
Polymer	$10,000
Professional Services	$25,000
Sludge Removal Contract	$50,000
Grant Writing/Application	$10,000
Physical w/Drug & Alcohol Test	$300
Fingerprinting	$50
Liability & Property Insurance	$25,000
Taxes, Licenses, & Fees	$25,000
2021A Wtr/WW Rev Bonds Prin	$70,000
2021A Wtr/WW Rev Bonds Int	$66,689
Sewer Plant Automation and Security Upgrades	$200,000
O&M Cost	$739,239
Wastewater Plant Total	$1,151,555

6.5.4. Alternative IV-B Offsite Disposal through Landscape Irrigation

This alternative would consist of disposing disinfected tertiary effluent to irrigate public parks, school grounds and other landscape areas within the City's service area.

6.5.4.1. Potential Customers

In order to identify potential customers for this alternative, the City provided the annual water usage data of each potential recycled water customer where available. Figures 6-6 and 6-7 display the irrigable areas available at each site. Table 6-16 displays each customer's total water demand and the estimated irrigable area available at each site.

Table 6-15 Potential Landscape Irrigation Customers

Site No	Location	Demand (MGD)
1	CHUSD	0.09
2	West Hills	0.09
3	Keck Park	0.03
4	Olsen Park	0.03
5	Chevron 25D	0.04
6	Sandalwood Park	0.01
7	Latchkey Pioneers	0.02

Site No	Location	Demand (MGD)
8	West Hills Farm of the Future	0.00
9	Wastewater Plant	0.02
10	Sports Complex	0.02
11	Centenniel Park	0.03
12	Next Green Wave	0.01
13	Triple J Ready Mix	0.00
14	Washington/Monterey Medians	0.00
15	Juniper Ridge Medians	0.01
16	Posa Chanet Medians	0.01
17	Lyons Park	0.00
18	Fountain	0.01
	Total	**0.42**

6.5.4.2. Water balance

Under Alternative IV B, the water balance calculations are used to determine the amount of recycled water that will be disposed on the irrigation sites and the volume of storage required. Table 6-17 and Table 6-18 summarize the design data used in the water balance calculations and the water balance calculation summary for alternative IV A. A copy of the water balance calculation for this Alternative is provided in Appendix F.

Table 6-16 Water Balance Design Data

Parameter	Value
Average Design Flow, MGD	1.340
Irrigation Efficiency, %	90%
Storage Pond Area, Acres	18.34
Effluent Reclamation Area, Acres	273
Percolation Rate, inch/day	0

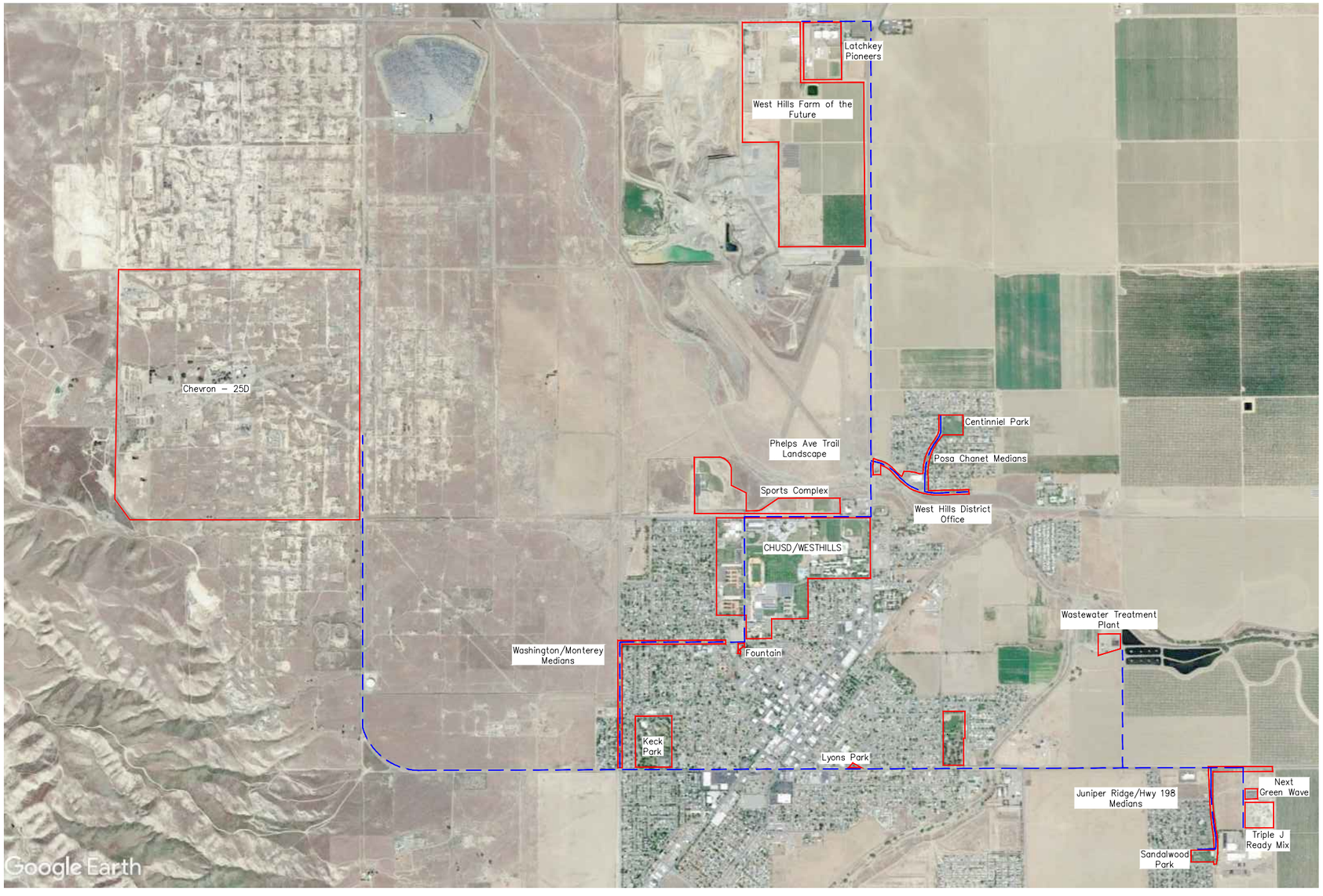
Table 6-17 Water Balance Calculation Summary

	Current Flow 0.857 MGD	Design Flow 1.34 MGD
Reclamation Area, Acres	325	273
Total Storage Volume Required, Acre-Feet	306.1	480.2
Additional Storage Required, Acre-Feet	306.1	476

According to the water balance calculations, the maximum irrigation demand will occur during the month of July, during which approximately 235.1 acre-feet of recycled water will be used. For this alternative, the City will require an additional 480.2 acre-feet for storage. When upgrading to tertiary treatment, the City will use the existing aerated lagoons and stabilization ponds as storage ponds. Figure 6-6 displays the proposed site layout for this Alternative, including approximately 46 acres of additional storage.

CITY OF COALINGA

SANITARY SEWER COLLECTION SYSTEM
PRELIMINARY ENGINEERING REPORT



LEGEND

WATER RECYCLING LIMIT

WATER LINE ROUTE

NORTH

SCALE IN FEET

0 2500

FIGURE 6-7
POTENTIAL LANDSCAPE IRRIGATION CUSTOMERS

6.5.4.3. Recycled Water Delivery System

To supply recycled water to town, approximately 57,167 linear feet (LF) of purple pipeline will be constructed. Figure 6-7 displays the recycled water conveyance system for this Alternative. The existing irrigation systems at each facility will need to be disconnected from the City's potable water supply and connected to the new recycled water pipeline.

6.5.4.4. Capital Construction Costs

Table 6-19 displays the total construction costs associated with constructing a tertiary treatment facility and recycled water delivery system to convey recycled water for the use of agricultural irrigation.

Table 6-18 Alternative IV B – Capital Construction Costs

Description	Quantity	Units	Unit Cost ($/Unit)	Total
Mobilization	1	LS	$400,000	$400,000
Headworks	1	LS	$600,000	$600,000
Extended Aeration System	1	LS	$3,500,000	$3,500,000
WWTP Equipment Package & Installation	1	LS	$4,500,000	$4,500,000
Filtration + UV Disinfection	1	LS	$1,100,000	$1,100,000
Blower Building	1	LS	$800,000	$800,000
Sludge Dewatering System	1	LS	$650,000	$650,000
Dry Sludge Storage	1	LS	$200,000	$200,000
Wastewater Facility Piping	1	LF	$500,000	$500,000
Storage Pond Excavation	1,203,782	LS	$2.50	$3,009,000
HDPE Storage Pond Liners	1,095,665	LS	$1.10	$1,205,000
Recycled Water Pump Station	1	LS	$1,000,000	$1,000,000
Recycled Water Piping	60,000	LF	$190	$11,400,000
Electrical & Instrumentation	1	LS	$2,000,000	$2,000,000
Permitting	1	LS	$25,000	$25,000
Subtotal Construction Costs				**$30,889,000**
Contingency (15%)				$4,634,000
Engineering, Environmental, Construction Administration (12%)				$3,706,000
TOTAL				**$39,229,000**
NOTE: All capital construction costs are rounded up to the nearest thousandth.				

The total project cost for Alternative IV B would be approximately $39.2 million. Like the previous alternatives, the City would apply for construction funding to the SWRCB CWSRF to fund this improvements project.

6.5.4.5. Estimated O&M Costs

In addition to the City's existing O&M costs, Alternative IV will also include costs for a Grade 3 Operator, electric, laboratory, sludge disposal, chemicals for disinfection. The O&M cost provided in Table 6-20 is based on the City's current O&M costs for the WWTP.

Table 6-19 Alternative IV B – Estimated O&M Costs

Description	Costs
Salaries Regular	$229,773
Salaries Part Time	$19,124
Salaries Overtime	$16,000
Salaries Cash Outs	$4,670
Retirement CALPERS	$21,584
Medical/Life Insurance	$55,073
Social Security FICA	$15,556
Medicare Insurance	$3,609
Disability Income Insurance	$3,111
Deferred Comp - 457 Retirement	$8,422
Workers Comp. Insurance	$29,868
Safety Boot Allowance	$588
Retirement CalPERS UL	$2,640
Unemployment Insurance	$2,298
Personnel Cost	$412,316
Description	**Costs**
Office Supplies	$500
Postage & Freight Out	$250
Printing & Binding	$250
Small Tolls &Equipment	$1,000
Uniforms	$2,000
Utility Parts & Supplies	$10,000
Vehicle Parts & Supplies	$1,000
Gasoline & Diesel	$3,500
Water, Gas, Sanitation & Sewer	$18,000
Electric	$150,000
Telephone	$2,000
Equipment Rental	$2,000
Office Equip, Repairs & Maintenance	$3,000
Major Equip Repairs & Maintenance	$40,000
Buildings Repairs & Maintenance	$5,000
Grounds, Chemicals & Maintenance	$5,000
Vehicle Parts, Repairs & Maintenance	$2,000

Description	Costs
Safety Equipment	$2,000
Training, Travel, & Conference	$2,000
Subs., Dues, & Publications	$2,000
Certifications, Renewals & Test	$3500
City Attorney Fees	$2,000
Computer Program & Consulting	$4,500
Medical - General	$700
Laboratory	$5,000
Chlorine	$22,500
Polymer	$10,000
Professional Services	$25,000
Sludge Removal Contract	$50,000
Grant Writing/Application	$10,000
Physical w/Drug & Alcohol Test	$300
Fingerprinting	$50
Liability & Property Insurance	$25,000
Taxes, Licenses, & Fees	$25,000
2021A Wtr/WW Rev Bonds Prin	$70,000
2021A Wtr/WW Rev Bonds Int	$66,689
Sewer Plant Automation and Security Upgrades	$200,000
O&M Cost	$739,239
Wastewater Plant Total	$1,151,555

This alternative would consist of disposing of treated wastewater offsite through evaporation/percolation ponds. As previously stated, AMCE prepared a Recycled Water User Survey to all private landowners included in Table 6-11. Unlike Alternative III, if the property owners decide to use treated wastewater from the WWTF to recharge the groundwater aquifer basin and satisfy the goals of the Sustainable Groundwater Management Act (SGMA).

The SGMA was passed by the California legislature in 2014, as an effort to achieve sustainable use and management of groundwater by 2040. The Act requires local and regional governments and water agencies of high and medium priority groundwater basis to halt overdraft and bring groundwater basins into balanced levels of pumping and recharge. The role of farmers is critical in achieving water sustainability because agriculture is the largest human use of water in the state. Instead of using treated effluent for irrigation purposes, local farmers are now considering using treated wastewater for groundwater recharge to offset the amount of groundwater pumped.

Under this Alternative, the existing WWTF will be upgraded to a tertiary treatment system to improve the effluent quality for agriculture and irrigation purposes. The extended aeration activated sludge

system will provide almost compete of organic material and nitrification. Treated wastewater will then be discharged to an evaporation/percolation pond or will be used to recharge the groundwater aquifers.

SECTION 7 - PROPOSED PROJECT

7.1. Project Overview

As previously stated, the purpose of this PER is to recommend the most viable and sustainable alternative that will correct deficiencies in the sewer collection system and improve the operation of existing WWTP. This Section provides a detailed description of the proposed project, which consists of rehabilitating approximately 30,815 LF of gravity sewer mains using trenchless construction methods, replacing approximately 19,801 LF of gravity sewer mains using convention construction methods, upgrading the existing WWTF to an extended aeration activated sludge facility, and constructing percolation ponds to increase the facility's disposal capacity. The following sections describe the proposed improvements and upgrades to the existing sewer collection system and WWTF.

7.2. Proposed Improvements to Sewer Collection System

Based on the condition assessment conducted, the recommended improvements for the City's sewer collection system are summarized in the following paragraphs. Figure 7-1 displays the proposed improvements to the sewer collection system.

7.2.1. Sewer Main Replacement

As previously discussed in Section 4.4 of this PER, CCTV inspection conducted on 104,618 LF of the City's sewer collection system revealed sever defects in portions of the collection system. Defects found in the sewer mains included root intrusion, fractured and broken pipe, cracked pipe, sags greater than 60 percent, defective and intruding laterals, joint displacements, and attached deposits (grease and concrete). The segments of the sewer collection system recommended for replacement have been selected based on sorted NASSCO ratings and the condition of the existing sewer mains. For this proposed project, it is recommended that approximately 41,073 LF of gravity sewer mains be replaced with new sewer pipes before failure occurs. Table 7-1 provides a summary of the sewer mains that will be replaced using the conventional construction method of dig and replace.

Table 7-1 Proposed Sewer Main Replacement

Parameter	Total Length (ft)
6" PVC Pipe	13,838
8" PVC Pipe	4,226
10" PVC Pipe	1,738
Total	**19,802**

7.2.2. Sewer Main Rehabilitation

Trenchless sewer rehabilitation is recommended where applicable to reduce surface disturbance over traditional dig and replace methods, reduce the number of traffic and pedestrian detours, spare tree removal, decrease construction noise, and reduce air pollution from construction equipment. Table 7-2 provides a summary of the sewer mains that will be rehabilitated using the trenchless construction method known as cured-in-place (CIPP).

Table 7-2 Proposed Sewer Main Rehabilitation

Parameter	Total Length (ft)
6" PVC Pipe	15,914
8" PVC Pipe	7,297
10" PVC Pipe	2,071
15" PVC Pipe	2,558
18" PVC Pipe	2,975
Total	**30,815**

7.2.3. Potential Construction Problems

Sewer collection system historically have construction problems related to many factors. As previously stated, approximately 50,616 LF of sewer mains will either be replaced using the conventional construction method of dig and replace or rehabilitated using the trenchless construction method of CIPP. The following is a list of potential problems associated with replacing/rehabilitating sewer mains within the City's sewer collection system:

- Handling of raw sewage by construction crews while replacing sewer mains.
- Disruption to the local streets and temporary detours.
- Reconstruction of trench paving to match roadway standards.
- Access to private properties and businesses during construction.
- Timely backfilling of trenches, sewer line testing, and repaving of streets.
- Connection of existing laterals at depths that could vary 6-feet or more.
- Coordination for disruption of sewer services with both private and public users.

CITY OF COALINGA

CCTV INSPECTION PROJECT



LEGEND

- NO REPLACEMENT
- REPLACEMENT
- REHABILITATION
- NOT SURVEYED

NORTH

SCALE IN FEET

0 1,000 FT

ALTERNATIVE II - SEWER MAINS TO BE REPLACED AND REHABILITATED

AM Consulting Engineers • 5150 N. Sixth Street Suite 124 • Fresno, California 93710 • (559) 473-1371

7.3. Proposed Improvements to Wastewater Treatment Plant

This Section provides a more detailed description of the proposed improvements to Coalinga's WWTP. Figures 7-3 and 7-4 display the proposed WWTP site layout and illustrate the various treatment improvements. The existing aerated lagoons and stabilization ponds will be decommissioned for the construction of percolation ponds. In this proposed project, an extended aeration system with biological nutrient removal with filtration and disinfection will be constructed.

For this proposed project, Aero Mod extended aeration system was selected. The moving aeration chains are equipped with diffuser and provide efficient mixing of the basin contents as well as high oxygen transfer at low energy usage. Aeration will be provided by aeration blowers, which will be operated by VFDs. Mixed liquor will flow across the aerated tank reactor and will enter a distribution box that will split flow between two clarifiers. One clarifier will be required to handle the plant's design flow of 1.34 MGD, while the other will be provided for redundancy. Mixed liquor will settle in the clarifier and clear liquid will overflow into a peripheral weir channel and into the RAS/WAS pump station. Settled sludge will be recirculated back to the aeration basin or wasted to a sludge drying bed. Treated effluent will be conveyed to the facility's new percolation ponds that will be constructed. Figure 7-3 displays the proposed improvements to the WWTF.

7.3.1. Extended Aeration and Biological Nutrient Removal

The proposed aeration tank will be constructed in the existing WWTP facility. Aero-Mod SEQUOX for biological nutrient removal offers the benefits of sequencing aeration and continuous clarification. Flow enters through an anoxic tank, where the raw sewage is combined with returned activated sludge (RAS) from the clarifiers. The combination of cyclical aeration in the four (4) basins creates excellent aerobic conditions for BOD and ammonia removal when aerating. When the air is off, the nitrate laden MLSS settles and becomes oxygen deprived, creating anoxic conditions for the nitrates to become the oxygen source and allow for denitrification to occur.

The plug flow process repeats this cyclical on/off aeration several times as the liquid mass progresses through the SEQUOX process and on to the clarifier. The effluent quality is achieved with TN levels as low as 3 mg/L. The process is energy efficient and has a small footprint and it does not require recycling pumps or mixers. Table 7-3 contains the required dimensions for the aerated treatment system.

7.3.2. Clarifier

The SEQUOX process often incorporates the ClarAtor clarifier where the biomass is settled and returned to the Selector Tank. The clarified effluent is withdrawn and discharged. This technology is low Maintenance featuring stainless steel and fiberglass components with no moving parts below the water, its unique flow regulation system provides in-basin surge storage. For this proposed project, a center-fee configuration will be used for influent entering the secondary clarifier. Mixed liquor will be carried to the center of the clarifier, which will radially distribute flow from the top of the basin. a peripheral weir will collect effluent and surface skimmer will collect floating scum.

7.3.3. Effluent Disposal

The purpose of upgrading the existing WWTP to an extended aeration activated system with biological nutrient removal facility is to lower the nitrogen concentration of the effluent before it is discharged to percolate the underground aquifer. Nitrogen is a nutrient normally present in domestic wastewater at a concentration that can degrade groundwater quality. Currently, the existing WWTP is not protective of



CITY OF COALINGA

SANITARY SEWER COLLECTION SYSTEM
PRELIMINARY ENGINEERING REPORT

LEGEND

RECYCLED WATER PIPELINE

NORTH
SCALE: 1"=300'

FIGURE 7-3
PROPOSED WWTP SITE LAYOUT

the current beneficial use of the groundwater and is not consistent with RWQCB's policy of beneficial reuse. By upgrading the WWTP to include secondary/tertiary treatment and discharging the higher effluent quality to percolation ponds on site, the City will provide an incidental recharge of the groundwater aquifer, which will ultimately help demonstrate groundwater sustainability. By removing nitrogen, treated effluent will be allowed to percolate and be protective of the groundwater's beneficial uses. As previously described in Section 6.4.3 of this PER, the City would need to decommission the existing aerated lagoons and stabilization ponds to construct five percolation ponds to increase the facility's disposal capacity. According to the water balance calculations provided in Appendix D, a total percolation area of 18.34 acres would allow the City to dispose 1.34 MGD. Table 7-3 display the surface areas and estimated volumes of each percolation pond.

Table 7-3 Proposed Evaporation/Percolation Pond Characteristics

Pond No	Top Surface Area (ac)	Depth (ft)	Volume (ac-ft)	Volume (gal)
Pond 1	3	6	18	5,866,200
Pond 2	3	6	18	5,866,200
Pond 3	2.45	5	12.25	3,992,275
Pond 4	4.83	5	24.15	7,870,485
Pond 5	5.06	5	25.30	8,245,270
Total	**18.34**		**97.7**	**31,840,430**

7.4. Climate Change Considerations

The impacts of climate change on the selected alternative as well as adaptation and mitigation measures have been considered for this PER. The WWTF will be most vulnerable to the effects of drought and water supply depletion and will be minorly affected by increasing water and air temperatures, flooding, and increased storm severity. The extended aeration activated sludge system is well suited to operating over a wide range of influent conditions. Decreased influent flows and higher biological load concentrations have little impact on the important operational factors of influent BOD per volume and sludge retention time. To prevent flooding of the evaporation/percolation ponds, the levees will be constructed well above the base flood elevation. Proper site drainage and erosion control will reduce the damage from severe storms.

Mitigation measures are measures taken to slow or stop changes to the environment caused by GHG emissions. Since filtration and disinfection are not included, the proposed WWTF will require less power and will produce less GHG emissions from power generation than a disinfected treaty treatment facility. Additionally, the use of variable frequency drives (VFDs) on blowers and pumps will further reduce power demands, as will decreasing aeration during periods of low oxygen demand. The use of efficient aeration/mixing equipment will also decrease the amount of GHG emissions produced during operation of the facility.

7.5. Permitting Requirements

Permitting requirements to construct the upgraded WWTF include the following:

- Preparation of the necessary environmental documentation in accordance with CEQA-Plus. It is assumed a mitigated negative declaration will suffice for the work being proposed.

- Preparation of a Report on Waste Discharge to the Regional Water Quality Control Board describing the proposed changes to treatment and disposal.
- Preparation of a Title 22 Report to the SWRCB-DDW describing the new effluent disposal areas and the safety measures that will be implemented to protect public health.

7.6. Opinions of Probable Construction Costs

This section describes the probable cost for construction, operating, and Maintaining the City's improved sewer collection system and WWTP. No key issues or items likely to significantly impact the project budget or schedule are foreseen at this time.

7.6.1. Capital Construction Costs

The capital construction costs for the proposed improvements to the sewer collection system and WWTP are included in this section. The cost estimates included in this Section are only preliminary and final estimates will be prepared at the completion of each design stage. Table 7-4 displays the estimated construction costs for the proposed improvements, including contingency, engineering and construction administration fees.

Table 7-4 Summary of Capital Construction Costs

Description	Quantity	Units	Unit Cost ($/Unit)	Total
General Construction Costs				
Mobilization	1	LS	$240,000	$240,000
Traffic Control Plan	1	LS	$90,000	$90,000
Subtotal General Construction Costs				**$330,000**
Sewer Main Replacement				
6" PVC Pipe	13,838	LF	$215	$2,975,100
8" PVC Pipe	4,226	LF	$215	$908,700
10" PVC Pipe	1,738	LF	$240	$417,100
Excavation	9,933	CY	$9	$89,500
Backfill	13,907	TON	$6	$83,500
Surface Restoration	2,481	SY	$30	$74,500
Remove and Replace Sewer Lateral	40	EA	$4,800	$192,000
Bypass Pumping	70	Day	$1,200	$84,000
Subtotal Sewer Main Replacement Costs				**$4,824,400**
Sewer Main Rehabilitation				
6" CIPP Liner	15,914	LF	$95	$1,511,800
8" CIPP Liner	7,297	LF	$105	$766,300
10" CIPP Liner	2,071	LF	$110	$227,900
15" CIPP Liner	2,558	LF	$120	$306,000
18" CIPP Liner	2,975	LF	$120	$356,000
Subtotal Sewer Main Replacement Costs				**$3,170,000**
WWTP Improvements				

Table 7-4 Summary of Capital Construction Costs

Description	Quantity	Units	Unit Cost ($/Unit)	Total
Mobilization	1	LS	$400,000	$400,000
Headworks	1	LS	$600,000	$600,000
Extended Aeration Basin	1	LS	$3,500,000	$3,500,000
WWTP Equipment Package & Installation	1	LS	$4,500,000	$4,500,000
Blower Building	1	LS	$800,000	$800,000
Sludge Dewatering System	1	LS	$500,000	$650,000
Dry Sludge Storage	1	LS	$200,000	$200,000
Wastewater Facility Piping	1	LS	$500,000	$500,000
Evaporation/Percolation Pond Excavation	390,000	CY	$2.50	$975,000
Recycled Water Pump Station	1	LS	$1,000,000	$1,000,000
Electrical & Instrumentation	1	LS	$2,000,000	$2,000,000
Permitting	1	LS	$25,000	$25,000
Subtotal WWTP Improvements Costs				**$15,150,000**
Subtotal Construction Costs				**$23,474,400**
Contingency (15%)				$3,521,160
Engineering, Environmental, Construction Administration (12%)				$2,816,928
Total Capital Construction Costs				**$29,812,00**
NOTE: All capital construction costs are rounded up to the nearest thousand.				

The total capital construction costs for the proposed Project would be approximately $29.8 million. The City would apply for grant funding through the SWRCB CWSRF to fund the proposed improvements to the sewer collection system and WWTP. The City should be eligible to receive funding from CWSRF Grant for both planning and construction costs. Table 7-4 displays the proposed planning and construction for the proposed Project.

7.6.2. Operation and Maintenance

Annual O&M costs provided in Table 6-5 are based on the City's current O&M costs associated with the sewer collection system and WWTP. These costs include labor, tools, operating supplies, replacement parts, engineering fees, sludge disposal, and various administration costs. The City is currently in the process of constructing a solar photovoltaic (PV) system within the boundary of the WWTP. Since the solar PV system will be used to power the WWTP, a cost of $0 has been assumed for the plant's electricity costs. According to Table 7-5, the estimated annual O&M costs for the sewer collection system and WWTP.

Table 7-5 Estimated Annual O&M Costs

Description	Amount
Sewer Collection System	
Full Time Employees	$245,000
Full Time Employees/Overtime	$35,000
PERS Contribution	$63,250
FICA Contribution	$21,500
Medical Benefits	$61,125
Uniforms	$3,000
Other Operating Supplies	$12,000
Equipment Parts	$10,000
Building Repair Supplies	$1,500
Street Maintenance Materials	$5,800
Tools	$1,200
Other Maintenance Supplies	$4,000
Auditing Services	$3,000
Engineering Services	$4,000
Professional Services	$15,000
Conference/Training	$1,000
Machinery Repair & Maintenance	$1,500
Other Repairs & Maintenance	$1,000
Regulatory Agencies	$300
Construction	$20,000
Equipment Transfers	$83,283
Operational Transfers	$80,618
Subtotal Sewer Collection System Costs	**$673,076**
Wastewater Treatment/Distribution	
Full Time Employees	$276,000
Full Time Employees/Overtime	$48,000
PERS Contribution	$72,000
FICA Contribution	$25,000
Medical Benefits	$79,000
Uniforms	$3,500
Office Supplies	$500
Computer Supplies	$250
Cleaning Supplies	$1,000
Lubricants	$500
Chemicals	$250
Shop Materials	$250

Table 7-5 Estimated Annual O&M Costs

Description	Amount
Equipment Parts	$12,500
Sludge Removal	$10,000
Building Repair Supplies	$750
Street Maintenance Materials	$3,000
Tools	$2,000
Other Maintenance Supplies	$15,000
Auditing Services	$5,000
Engineering Services	$1,000
Computer Lease/Enhance	$1,000
Professional Services	$13,000
Emergency Generator Services	$3,500
Telephone	$3,000
Billing/Postage	$100
Conference/Training	$3,000
Electricity	$0
Machinery Repair & Maintenance	$8,000
Other Repairs & Maintenance	$8,000
Books/Subscriptions	$250
Memberships	$500
Water Contract/Utilities	$12,000
Regulatory Agencies	$10,000
Testing Services	$9,000
General Services/Liability	$10,000
Machinery/Equipment	$30,000
Equipment Transfers	$83,282
Operational Transfers	$80,618
Public Safety Allocation	$30,000
Subtotal Wastewater Treatment/Distribution	**$860,750**
Estimated Annual O&M Costs	**$1,533,826**

7.6.3. Present Worth Analysis

To determine the present worth of the proposed Project, the salvage value for each construction item was first determined. Table 6-6 displays the estimated cost for each construction item and each item corresponding useful life. The salvage value for each item was calculated using the SWRCB's Economic Analysis Model. The salvage value for the proposed project was estimated to be approximately $ 14.54 Million.

Table 7-6 Estimated Salvage Value

Item	Cost	Useful Life	Salvage Value
Site Work[1]	$2,587,000	100	$2,069,000
Surface Restoration	$74,500	30	$24,000
Pipelines[2]	$7,970,900	80	$5,978,000
Lateral Connections	$192,000	80	$144,000
Equipment	$12,650,000	40	$6,325,000
Subtotal Construction Costs	**$23,474,400**	-	**$14,540,000**
Contingency[3]	$3,521,160	-	-
Engineering, Environmental, Construction Administration[3]	$2,816,928	-	-
TOTAL	**$29,812,488**	-	**$14,540,000**

Notes:
(1) Site Work includes mobilization, traffic control and flagging, excavation and backfill of pipelines, and bypass pumping.
(2) Pipelines includes replacing and rehabilitating sewer mains.
(3) No salvage value is given for permitting, contingency, engineering, environmental and construction administration.

Table 6-7 displays the present worth cost analysis that was used to determine the present worth of the proposed project. Using the SWRCB Economic Analysis Model, the proposed Project's present worth was estimated to be approximately $ 23.88 Million. All costs are in 2019 dollars.

Table 7-7 Present Worth Cost Analysis

Year	Design & Construction Cost	O&M Costs		Salvage Value	Present Worth Factor at 6%	Present Worth of Costs				
						Design & Construction Cost	O&M Costs		Salvage Value	Total
		Fixed	Variable				Fixed	Variable		
2023	29,812,488				1	$29,812,488	$0	$0		$29,812,488
2024		$1,372,726	$161,100		0.943		$1,294,481	$151,917		$1,446,398
2025		$1,372,726	$161,100		0.89		$1,221,726	$143,379		$1,365,105
2026		$1,372,726	$161,100		0.84		$1,153,090	$135,324		$1,288,414
2027		$1,372,726	$161,100		0.792		$1,087,199	$127,591		$1,214,790
2028		$1,372,726	$161,100		0.747		$1,025,426	$120,342		$1,145,768
2029		$1,372,726	$161,100		0.705		$967,772	$113,576		$1,081,347
2030		$1,372,726	$161,100		0.665		$912,863	$107,132		$1,019,994
2031		$1,372,726	$161,100		0.627		$860,699	$101,010		$961,709
2032		$1,372,726	$161,100		0.592		$812,654	$95,371		$908,025
2033		$1,372,726	$161,100		0.558		$765,981	$89,894		$855,875
2034		$1,372,726	$161,100		0.527		$723,427	$84,900		$808,326
2035		$1,372,726	$161,100		0.497		$682,245	$80,067		$762,312
2036		$1,372,726	$161,100		0.469		$643,808	$75,556		$719,364

Table 7-7 Present Worth Cost Analysis

Year	Design & Construction Cost	O&M Costs		Salvage Value	Present Worth Factor at 6%	Present Worth of Costs				
						Design & Construction Cost	O&M Costs		Salvage Value	Total
		Fixed	Variable				Fixed	Variable		
2037		$1,372,726	$161,100		0.442		$606,745	$71,206		$677,951
2038		$1,372,726	$161,100		0.417		$572,427	$67,179		$639,605
2039		$1,372,726	$161,100		0.394		$540,854	$63,473		$604,327
2040		$1,372,726	$161,100		0.371		$509,281	$59,768		$569,049
2041		$1,372,726	$161,100		0.35		$480,454	$56,385		$536,839
2042		$1,372,726	$161,100		0.331		$454,372	$53,324		$507,696
2043		$1,372,726	$161,100	15,147,000	0.312		$428,291	$50,263	$4,725,864	($4,247,310)
Total	**29,812,488**					**29,812,488**	**15,743,794**	**1,847,656**	**4,725,864**	**42,678,074**

7.6.4. Life Cycle Costs

Life-cycle cost refers to the sum of the capital construction costs and recurring O&M cost over the full life span of the proposed project. Table 6-8 displays the life cycle cost analysis for the proposed project. The analysis covers a 20, 30 and 40-year life-cycle and assumes a 1.2 percent discount rate for the 20-year lifecycle and a 1.5 percent discount rate for the 30 and 40-year life-cycle.

Table 7-8 Proposed Project Life-Cycle Costs

	Total Amount
Capital Construction	$29,811,400
O&M Cost	$1,533,826
O&M Cost (20-yrs)	$23,911,062
O&M Cost (30-yrs)	$32,103,427
O&M Cost (40-yrs)	$38,503,289
20-yr Life Cycle	$25,444,888
30-yr Life Cycle	$33,637,253
40-yr Life Cycle	$40,037,115

7.7. Project Schedule

Approval of the CWSRF construction application is expected in 9 months to a year after submission to the SWRCB. After Approval, the project engineer can begin the project design. Once the plans and specifications and construction documents have been prepared, bidding can begin, followed by construction. Construction time is expected to be one year. A project schedule is provided in Table 6-9 below.

Table 7-9 Estimated Project Schedule

Task	Estimated Date
Environmental Documents	February 28, 2024
Sewer Rate Study	June 30, 2024
CWSRF Application Preparation	
General Package	July 31, 2023
Technical Package	August 31, 2023
Environmental Package	February 28, 2024
Financial Package	April 30, 2024
CWSRF Application Submission	April 30, 2024
CWSRF Application Review	July 31, 2024
Funding Agreement Approved	August 31, 2024
Project Design	March 31, 2025
Preparation of Construction Documents	October 31, 2025
Bidding	December 30, 2025
Construction Begins	January 5, 2026
Construction Ends	May 31, 2026

APPENDIX A

SOILS REPORT

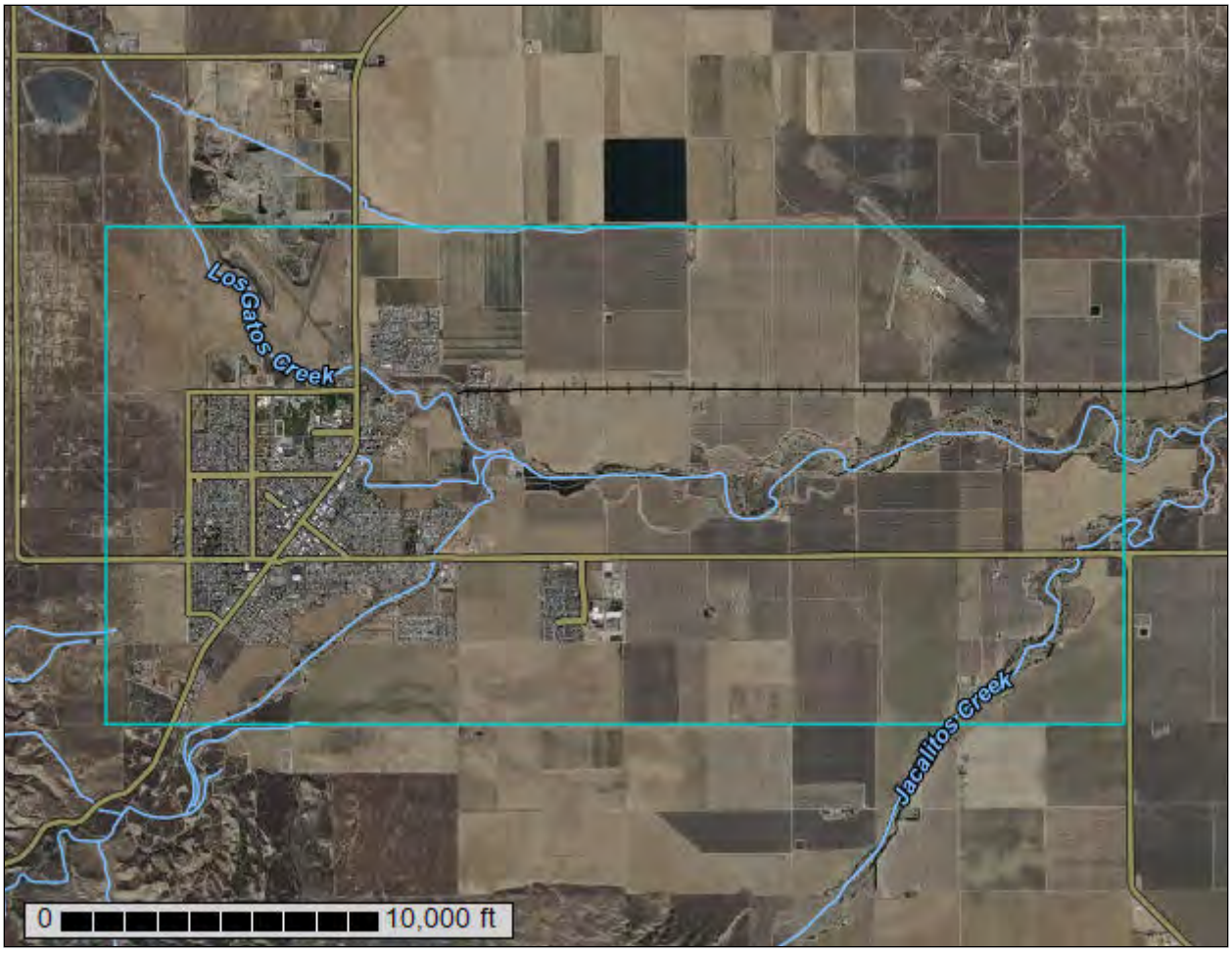
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Fresno County, California, Western Part



May 23, 2023

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Preface.....2
How Soil Surveys Are Made.....5
Soil Map.....8
Soil Map.....9
Legend.....10
Map Unit Legend.....11
Map Unit Descriptions.....11
Fresno County, California, Western Part.....14
412—Yribarren clay loam, 0 to 2 percent slopes.....14
435—Lethent clay loam, 0 to 1 percent slopes.....15
445—Excelsior sandy loam, 0 to 2 percent slopes, MLRA 17.....17
447—Excelsior sandy loam, sandy substratum, 0 to 2 percent slopes.....19
448—Excelsior loamy sand, sandy substratum, 0 to 1 percent slopes, eroded.....21
451—Milham sandy loam, 0 to 2 percent slopes MLRA 17.....22
452—Milham sandy loam, 2 to 5 percent slopes.....24
474—Westhaven loam, 0 to 2 percent slopes.....25
476—Posochanet clay loam, saline-sodic, 0 to 2 percent slopes.....27
477—Westhaven clay loam, 0 to 2 percent slopes.....29
478—Cerini sandy loam, 0 to 2 percent slopes, MLRA 17.....30
479—Cerini clay loam, 0 to 2 percent slopes.....32
480—Calflax clay loam, saline-sodic, 0 to 2 percent slopes, MLRA 17.....34
847—Carranza gravelly sandy loam, 2 to 8 percent slopes.....36
950—Pits, gravel.....38
960—Excelsior, sandy substratum-westhaven association, flooded, 0 to 2 percent slopes.....39
981—Sewage disposal pond.....41
References.....43

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

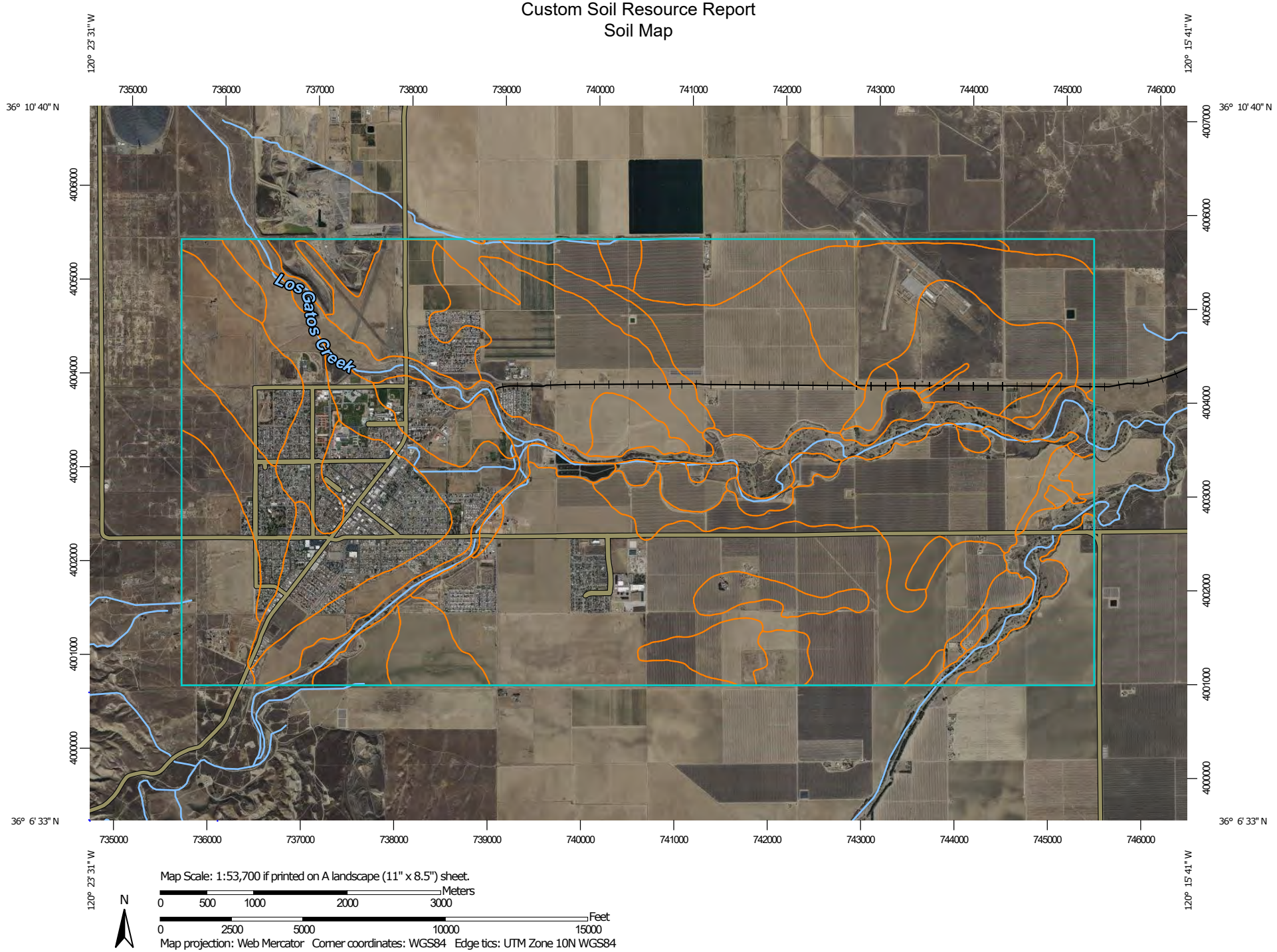
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Fresno County, California, Western Part
Survey Area Data: Version 17, Sep 1, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 16, 2022—Mar 21, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
412	Yribarren clay loam, 0 to 2 percent slopes	371.6	3.2%
435	Lethent clay loam, 0 to 1 percent slopes	34.9	0.3%
445	Excelsior sandy loam, 0 to 2 percent slopes, MLRA 17	3,381.4	29.3%
447	Excelsior sandy loam, sandy substratum, 0 to 2 percent slopes	1,183.3	10.3%
448	Excelsior loamy sand, sandy substratum, 0 to 1 percent slopes, eroded	41.4	0.4%
451	Milham sandy loam, 0 to 2 percent slopes MLRA 17	286.6	2.5%
452	Milham sandy loam, 2 to 5 percent slopes	498.0	4.3%
474	Westhaven loam, 0 to 2 percent slopes	1,353.9	11.8%
476	Posochanet clay loam, saline-sodic, 0 to 2 percent slopes	1,157.5	10.0%
477	Westhaven clay loam, 0 to 2 percent slopes	720.5	6.3%
478	Cerini sandy loam, 0 to 2 percent slopes, MLRA 17	547.6	4.8%
479	Cerini clay loam, 0 to 2 percent slopes	696.4	6.0%
480	Calflax clay loam, saline-sodic, 0 to 2 percent slopes, MLRA 17	128.5	1.1%
847	Carranza gravelly sandy loam, 2 to 8 percent slopes	79.7	0.7%
950	Pits, gravel	117.7	1.0%
960	Excelsior, sandy substratum-westhaven association, flooded, 0 to 2 percent slopes	877.2	7.6%
981	Sewage disposal pond	44.6	0.4%
Totals for Area of Interest		**11,522.9**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps.

The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Fresno County, California, Western Part

412—Yribarren clay loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: hnzf
Elevation: 540 to 800 feet
Mean annual precipitation: 6 to 7 inches
Mean annual air temperature: 63 to 64 degrees F
Frost-free period: 240 to 250 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Yribarren, clay loam, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Yribarren, Clay Loam

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from calcareous sedimentary rock

Typical profile

Ap - 0 to 9 inches: clay loam
A - 9 to 16 inches: silty clay loam
Btk - 16 to 31 inches: silty clay
2Bky - 31 to 51 inches: silt loam
3Bk - 51 to 60 inches: clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Very rareNone
Frequency of ponding: None
Calcium carbonate, maximum content: 4 percent
Gypsum, maximum content: 4 percent
Maximum salinity: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 15.0
Available water supply, 0 to 60 inches: High (about 9.4 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Ecological site: R017XY906CA - Non-Alkali San Joaquin Valley Desert

Hydric soil rating: No

Minor Components

Panoche, loam
Percent of map unit: 4 percent
Landform: Alluvial fans
Hydric soil rating: No

Excelsior, sandy loam
Percent of map unit: 3 percent
Landform: Alluvial fans
Hydric soil rating: No

Milham, sandy loam
Percent of map unit: 3 percent
Landform: Fan remnants
Hydric soil rating: No

Westhaven, loam
Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: No

Ciervo, clay
Percent of map unit: 2 percent
Landform: Fan skirts
Hydric soil rating: No

Carranza, gravelly sandy loam
Percent of map unit: 1 percent
Landform: Fan remnants
Hydric soil rating: No

435—Lethent clay loam, 0 to 1 percent slopes

Map Unit Setting
National map unit symbol: hnzm
Elevation: 240 to 1,000 feet
Mean annual precipitation: 7 to 8 inches
Mean annual air temperature: 62 to 64 degrees F
Frost-free period: 220 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Lethent, clay loam, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lethent, Clay Loam

Setting

Landform: Fan remnants
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from calcareous sedimentary rock

Typical profile

Ap1 - 0 to 7 inches: clay loam
Ap2 - 7 to 16 inches: clay loam
Ap3 - 16 to 25 inches: clay loam
Btkn1 - 25 to 33 inches: clay loam
Btkn2 - 33 to 62 inches: clay loam
C - 62 to 72 inches: clay loam

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: 20 to 39 inches to natric
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Very rareNone
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Slightly saline to strongly saline (4.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 40.0
Available water supply, 0 to 60 inches: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Ecological site: R017XY906CA - Non-Alkali San Joaquin Valley Desert
Hydric soil rating: No

Minor Components

Gepford, clay

Percent of map unit: 2 percent
Landform: Flood plains on basin floors
Ecological site: R017XY907CA - Aridic Alkali Desert
Hydric soil rating: Yes

Posochanet, clay loam, saline-sodic

Percent of map unit: 2 percent
Landform: Fan skirts
Ecological site: R017XY907CA - Aridic Alkali Desert
Hydric soil rating: No

Ciervo, clay, saline-sodic

Percent of map unit: 2 percent

Landform: Fan skirts
Ecological site: R017XY907CA - Aridic Alkali Desert
Hydric soil rating: No

Cerini, clay loam
Percent of map unit: 2 percent
Landform: Alluvial fans
Ecological site: R017XY907CA - Aridic Alkali Desert
Hydric soil rating: No

Calflax, clay loam, saline-sodic
Percent of map unit: 1 percent
Landform: Fan skirts
Ecological site: R017XY907CA - Aridic Alkali Desert
Hydric soil rating: No

Calflax, clay loam, saline-sodic, wet
Percent of map unit: 1 percent
Landform: Fan skirts
Ecological site: R017XY907CA - Aridic Alkali Desert
Hydric soil rating: No

445—Excelsior sandy loam, 0 to 2 percent slopes, MLRA 17

Map Unit Setting
National map unit symbol: 2ss8v
Elevation: 200 to 1,000 feet
Mean annual precipitation: 5 to 8 inches
Mean annual air temperature: 62 to 65 degrees F
Frost-free period: 240 to 300 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Excelsior and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Excelsior

Setting
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous coarse-loamy alluvium derived from sedimentary rock

Typical profile
Ap - 0 to 7 inches: sandy loam
A - 7 to 23 inches: sandy loam
C - 23 to 72 inches: sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Very rareNone
Frequency of ponding: None
Calcium carbonate, maximum content: 3 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water supply, 0 to 60 inches: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 7c
Hydrologic Soil Group: A
Ecological site: R017XY904CA - Subirrigated Deep Alluvial Fans
Hydric soil rating: No

Minor Components

Cerini

Percent of map unit: 6 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Excelsior

Percent of map unit: 4 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Kimberlina

Percent of map unit: 3 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Bakersfield

Percent of map unit: 1 percent
Landform: Flood plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Westhaven

Percent of map unit: 1 percent
Landform: Flood plains, alluvial fans
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

447—Excelsior sandy loam, sandy substratum, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: hnzw
Elevation: 180 to 900 feet
Mean annual precipitation: 6 to 8 inches
Mean annual air temperature: 62 to 64 degrees F
Frost-free period: 240 to 280 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Excelsior, sandy loam, sandy substratum, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Excelsior, Sandy Loam, Sandy Substratum

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from calcareous sedimentary rock

Typical profile

Ap - 0 to 7 inches: sandy loam
A - 7 to 23 inches: sandy loam
C1 - 23 to 53 inches: stratified loamy sand to silt loam
C2 - 53 to 72 inches: loamy sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: RareNone
Frequency of ponding: None
Calcium carbonate, maximum content: 3 percent

Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water supply, 0 to 60 inches: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Ecological site: R017XY906CA - Non-Alkali San Joaquin Valley Desert
Hydric soil rating: No

Minor Components

Excelsior, sandy loam

Percent of map unit: 4 percent
Landform: Alluvial fans
Ecological site: R017XY904CA - Subirrigated Deep Alluvial Fans
Hydric soil rating: No

Kimberlina, sandy loam

Percent of map unit: 4 percent
Landform: Alluvial fans
Ecological site: R017XY904CA - Subirrigated Deep Alluvial Fans
Hydric soil rating: No

Polvadero, sandy loam

Percent of map unit: 2 percent
Landform: Fan remnants
Ecological site: R017XY904CA - Subirrigated Deep Alluvial Fans
Hydric soil rating: No

Wasco, sandy loam

Percent of map unit: 2 percent
Landform: Alluvial fans
Ecological site: R017XY904CA - Subirrigated Deep Alluvial Fans
Hydric soil rating: No

Excelsior, sandy loam, saline-sodic

Percent of map unit: 2 percent
Landform: Alluvial fans
Ecological site: R017XY904CA - Subirrigated Deep Alluvial Fans
Hydric soil rating: No

Westhaven, loam

Percent of map unit: 1 percent
Landform: Alluvial fans
Ecological site: R017XY904CA - Subirrigated Deep Alluvial Fans
Hydric soil rating: No

448—Excelsior loamy sand, sandy substratum, 0 to 1 percent slopes, eroded

Map Unit Setting

National map unit symbol: hnzx
Elevation: 470 to 670 feet
Mean annual precipitation: 7 to 8 inches
Mean annual air temperature: 62 to 64 degrees F
Frost-free period: 240 to 270 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Excelsior, loamy sand, sandy substratum, eroded, and similar soils: 88 percent
Minor components: 12 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Excelsior, Loamy Sand, Sandy Substratum, Eroded

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from calcareous sedimentary rock

Typical profile

Ap - 0 to 8 inches: loamy sand
C1 - 8 to 38 inches: stratified sandy loam to silt loam
C2 - 38 to 60 inches: loamy sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Very rareNone
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water supply, 0 to 60 inches: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 7e

Hydrologic Soil Group: B
Ecological site: R017XY906CA - Non-Alkali San Joaquin Valley Desert
Hydric soil rating: No

Minor Components

Westhaven, loam
Percent of map unit: 3 percent
Landform: Alluvial fans
Ecological site: R017XY904CA - Subirrigated Deep Alluvial Fans
Hydric soil rating: No

Kimberlina, sandy loam
Percent of map unit: 2 percent
Landform: Alluvial fans
Ecological site: R017XY904CA - Subirrigated Deep Alluvial Fans
Hydric soil rating: No

Guijarral, sandy loam
Percent of map unit: 2 percent
Landform: Fan remnants
Ecological site: R017XY904CA - Subirrigated Deep Alluvial Fans
Hydric soil rating: No

Polvadero, sandy loam
Percent of map unit: 2 percent
Landform: Fan remnants
Ecological site: R017XY904CA - Subirrigated Deep Alluvial Fans
Hydric soil rating: No

Wasco, sandy loam
Percent of map unit: 2 percent
Landform: Alluvial fans
Ecological site: R017XY904CA - Subirrigated Deep Alluvial Fans
Hydric soil rating: No

Excelsior, loamy sand
Percent of map unit: 1 percent
Landform: Alluvial fans
Ecological site: R017XY904CA - Subirrigated Deep Alluvial Fans
Hydric soil rating: No

451—Milham sandy loam, 0 to 2 percent slopes MLRA 17

Map Unit Setting
National map unit symbol: 2ss91
Elevation: 200 to 1,200 feet
Mean annual precipitation: 5 to 8 inches
Mean annual air temperature: 63 to 65 degrees F
Frost-free period: 250 to 300 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Milham and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Milham

Setting

Landform: Terraces, fan remnants, plains, alluvial fans
Landform position (three-dimensional): Tread, rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from igneous and sedimentary rock

Typical profile

Ap - 0 to 4 inches: sandy loam
Bk - 4 to 10 inches: sandy loam
Btk1 - 10 to 22 inches: loam
Btk2 - 22 to 49 inches: clay loam
2Ck - 49 to 60 inches: sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline to moderately saline (0.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 25.0
Available water supply, 0 to 60 inches: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 7c
Hydrologic Soil Group: C
Ecological site: R017XG043CA - Loamy 6-8" P.Z.
Hydric soil rating: No

Minor Components

Kimberlina

Percent of map unit: 5 percent
Landform: Alluvial fans
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Garces

Percent of map unit: 5 percent

Landform: Rims on basin floors
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Panoche

Percent of map unit: 5 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

452—Milham sandy loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: hnzz
Elevation: 440 to 1,100 feet
Mean annual precipitation: 6 to 8 inches
Mean annual air temperature: 63 to 65 degrees F
Frost-free period: 250 to 300 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Milham, sandy loam, and similar soils: 89 percent
Minor components: 11 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Milham, Sandy Loam

Setting

Landform: Fan remnants
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from calcareous sedimentary rock

Typical profile

A - 0 to 6 inches: sandy loam
Bt - 6 to 16 inches: sandy clay loam
Btk - 16 to 31 inches: sandy clay loam
Bk - 31 to 60 inches: sandy loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium

Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 8 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 12.0
Available water supply, 0 to 60 inches: Moderate (about 7.5 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Ecological site: R017XG043CA - Loamy 6-8" P.Z.
Hydric soil rating: No

Minor Components

Polvadero, sandy loam

Percent of map unit: 3 percent
Landform: Fan remnants
Hydric soil rating: No

Excelsior, sandy loam

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: No

Wasco, sandy loam

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: No

Kimberlina, sandy loam

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: No

Milham, sandy loam, undulating

Percent of map unit: 2 percent
Landform: Fan remnants
Hydric soil rating: No

474—Westhaven loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: hp09
Elevation: 270 to 690 feet
Mean annual precipitation: 6 to 8 inches
Mean annual air temperature: 62 to 65 degrees F

Frost-free period: 240 to 290 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Westhaven, loam, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Westhaven, Loam

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from calcareous sedimentary rock

Typical profile

Ap - 0 to 7 inches: loam
Bw - 7 to 17 inches: loam
Bk1 - 17 to 42 inches: stratified loam to silty clay loam
Bk2 - 42 to 65 inches: stratified loamy sand to silty clay loam
C - 65 to 72 inches: stratified loam to silty clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Very rareNone
Frequency of ponding: None
Calcium carbonate, maximum content: 4 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 12.0
Available water supply, 0 to 60 inches: High (about 9.8 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 7c
Hydrologic Soil Group: C
Ecological site: R017XY906CA - Non-Alkali San Joaquin Valley Desert
Hydric soil rating: No

Minor Components

Cerini, clay loam

Percent of map unit: 4 percent
Landform: Alluvial fans
Hydric soil rating: No

Wasco, sandy loam

Percent of map unit: 3 percent

Landform: Alluvial fans
Hydric soil rating: No

Excelsior, sandy loam
Percent of map unit: 3 percent
Landform: Alluvial fans
Hydric soil rating: No

Kimberlina, sandy loam
Percent of map unit: 3 percent
Landform: Alluvial fans
Hydric soil rating: No

Panoche, loam
Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: No

476—Posochanet clay loam, saline-sodic, 0 to 2 percent slopes

Map Unit Setting
National map unit symbol: hp0c
Elevation: 260 to 690 feet
Mean annual precipitation: 6 to 8 inches
Mean annual air temperature: 62 to 65 degrees F
Frost-free period: 230 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Posochanet, clay loam, saline-sodic, and similar soils: 88 percent
Minor components: 12 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Posochanet, Clay Loam, Saline-sodic

Setting
Landform: Fan skirts
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from calcareous sedimentary rock

Typical profile
Ap1 - 0 to 7 inches: clay loam
Ap2 - 7 to 15 inches: clay loam
Bw - 15 to 24 inches: stratified loam to silty clay loam
Bknz - 24 to 60 inches: stratified loam to silty clay loam

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches

Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Very rareNone
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Slightly saline to moderately saline (4.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 30.0
Available water supply, 0 to 60 inches: Moderate (about 8.5 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Ecological site: R017XY906CA - Non-Alkali San Joaquin Valley Desert
Hydric soil rating: No

Minor Components

Tranquillity, clay, saline-sodic

Percent of map unit: 3 percent
Landform: Fan skirts
Hydric soil rating: No

Ciervo, clay, saline-sodic

Percent of map unit: 3 percent
Landform: Fan skirts
Hydric soil rating: No

Lethent, clay loam

Percent of map unit: 3 percent
Landform: Fan remnants
Hydric soil rating: No

Cerini, clay loam

Percent of map unit: 1 percent
Landform: Alluvial fans
Hydric soil rating: No

Calflax, clay loam, saline-sodic

Percent of map unit: 1 percent
Landform: Fan skirts
Hydric soil rating: No

Posochanet, clay loam, saline-sodic, wet

Percent of map unit: 1 percent
Landform: Fan skirts
Hydric soil rating: No

477—Westhaven clay loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: hp0d
Elevation: 250 to 640 feet
Mean annual precipitation: 6 to 8 inches
Mean annual air temperature: 62 to 65 degrees F
Frost-free period: 240 to 290 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Westhaven, clay loam, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Westhaven, Clay Loam

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from calcareous sedimentary rock

Typical profile

Ap - 0 to 12 inches: clay loam
Bw - 12 to 21 inches: silty clay loam
Bk - 21 to 61 inches: stratified loam to silty clay loam
C - 61 to 72 inches: stratified loamy sand to silty clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Very rareNone
Frequency of ponding: None
Calcium carbonate, maximum content: 4 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 12.0
Available water supply, 0 to 60 inches: High (about 10.5 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 7c

Hydrologic Soil Group: C
Ecological site: R017XY906CA - Non-Alkali San Joaquin Valley Desert
Hydric soil rating: No

Minor Components

Cerini, clay loam
Percent of map unit: 5 percent
Landform: Alluvial fans
Hydric soil rating: No

Ciervo, clay
Percent of map unit: 2 percent
Landform: Fan skirts
Hydric soil rating: No

Westhaven, loam
Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: No

Calflax, clay loam, saline-sodic
Percent of map unit: 2 percent
Landform: Fan skirts
Hydric soil rating: No

Lethent, clay loam
Percent of map unit: 2 percent
Landform: Fan remnants
Hydric soil rating: No

Posochanet, clay loam, saline-sodic
Percent of map unit: 2 percent
Landform: Fan skirts
Hydric soil rating: No

478—Cerini sandy loam, 0 to 2 percent slopes, MLRA 17

Map Unit Setting
National map unit symbol: 2vnd5
Elevation: 210 to 930 feet
Mean annual precipitation: 6 to 11 inches
Mean annual air temperature: 62 to 66 degrees F
Frost-free period: 240 to 300 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition
Cerini and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cerini

Setting

Landform: Alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from calcareous sedimentary rock

Typical profile

Ap - 0 to 5 inches: sandy loam
Bw - 5 to 25 inches: clay loam
Bk1 - 25 to 35 inches: stratified sandy loam to clay loam
Bk2 - 35 to 79 inches: stratified sandy loam to clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: NoneVery rare
Frequency of ponding: None
Calcium carbonate, maximum content: 4 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 8.0
Available water supply, 0 to 60 inches: High (about 9.4 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 7c
Hydrologic Soil Group: C
Ecological site: R017XY904CA - Subirrigated Deep Alluvial Fans
Hydric soil rating: No

Minor Components

Excelsior, sandy loam

Percent of map unit: 3 percent
Landform: Alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Westhaven, loam

Percent of map unit: 3 percent
Landform: Alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Kimberlina, sandy loam

Percent of map unit: 2 percent
Landform: Alluvial fans
Down-slope shape: Linear

Across-slope shape: Linear
Hydric soil rating: No

Ciervo, clay

Percent of map unit: 1 percent
Landform: Alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Granoso

Percent of map unit: 1 percent
Landform: Alluvial fans
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

479—Cerini clay loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: hp0g
Elevation: 160 to 800 feet
Mean annual precipitation: 6 to 8 inches
Mean annual air temperature: 62 to 64 degrees F
Frost-free period: 230 to 290 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Cerini, clay loam, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cerini, Clay Loam

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from calcareous sedimentary rock

Typical profile

Ap - 0 to 5 inches: clay loam
Bw - 5 to 25 inches: clay loam
Bk1 - 25 to 35 inches: stratified sandy loam to clay loam
Bk2 - 35 to 62 inches: stratified sandy loam to clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches

Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Very rareNone
Frequency of ponding: None
Calcium carbonate, maximum content: 4 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 8.0
Available water supply, 0 to 60 inches: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 7c
Hydrologic Soil Group: C
Ecological site: R017XY906CA - Non-Alkali San Joaquin Valley Desert
Hydric soil rating: No

Minor Components

Ciervo, clay

Percent of map unit: 4 percent
Landform: Fan skirts
Hydric soil rating: No

Panoche, clay loam

Percent of map unit: 3 percent
Landform: Alluvial fans
Hydric soil rating: No

Cerini, sandy loam

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: No

Excelsior, sandy loam

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: No

Westhaven, loam

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: No

Kimberlina, sandy loam

Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: No

480—Calflax clay loam, saline-sodic, 0 to 2 percent slopes, MLRA 17

Map Unit Setting

National map unit symbol: 2vncm
Elevation: 160 to 730 feet
Mean annual precipitation: 6 to 11 inches
Mean annual air temperature: 61 to 66 degrees F
Frost-free period: 230 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Calflax, clay loam, saline-sodic, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Calflax, Clay Loam, Saline-sodic

Setting

Landform: Fan skirts
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from calcareous sedimentary rock

Typical profile

Ap - 0 to 8 inches: clay loam
Bw - 8 to 26 inches: clay loam
Bny - 26 to 33 inches: loam
Bnyz1 - 33 to 47 inches: silt loam
Bnyz2 - 47 to 65 inches: loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Very rareNone
Frequency of ponding: None
Calcium carbonate, maximum content: 3 percent
Gypsum, maximum content: 5 percent
Maximum salinity: Very slightly saline to strongly saline (2.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 30.0
Available water supply, 0 to 60 inches: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 7s

Hydrologic Soil Group: C
Ecological site: R017XY907CA - Aridic Alkali Desert
Hydric soil rating: No

Minor Components

Calflax, clay loam, saline-sodic, wet
Percent of map unit: 3 percent
Landform: Fan skirts
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Posochanet, clay, saline-sodic
Percent of map unit: 2 percent
Landform: Fan skirts
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Garces, silt loam
Percent of map unit: 1 percent
Landform: Rims on basin floors
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Westhaven
Percent of map unit: 1 percent
Landform: Flood plains, alluvial fans
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Unnamed hydric
Percent of map unit: 1 percent
Landform: Fan skirts
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Twisselman, clay, saline-alkali
Percent of map unit: 1 percent
Landform: Alluvial fans
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Panoche
Percent of map unit: 1 percent
Landform: Alluvial fans
Landform position (three-dimensional): Talf

Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Cerini, clay loam

Percent of map unit: 1 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Lethent

Percent of map unit: 1 percent
Landform: Rims
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Kimberlina, sandy loam

Percent of map unit: 1 percent
Landform: Alluvial fans
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Ciervo, clay, saline-sodic

Percent of map unit: 1 percent
Landform: Fan skirts
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Avenal

Percent of map unit: 1 percent
Landform: Alluvial fans
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

847—Carranza gravelly sandy loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: hp3h
Elevation: 540 to 1,360 feet
Mean annual precipitation: 8 to 10 inches

Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 250 to 270 days
Farmland classification: Not prime farmland

Map Unit Composition

Carranza, gravelly sandy loam, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Carranza, Gravelly Sandy Loam

Setting

Landform: Fan remnants
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sandstone and shale

Typical profile

A - 0 to 7 inches: gravelly sandy loam
ABt - 7 to 14 inches: gravelly sandy loam
Bt1 - 14 to 20 inches: gravelly sandy clay loam
Bt2 - 20 to 25 inches: very gravelly sandy clay loam
Bt3 - 25 to 60 inches: gravelly sandy clay loam

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 1 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 6.0
Available water supply, 0 to 60 inches: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R017XE061CA - Loamy Fan Remnant 8-10" P.Z.
Hydric soil rating: No

Minor Components

Bapos, clay loam

Percent of map unit: 5 percent
Landform: Fan remnants
Hydric soil rating: No

Milham, sandy loam

Percent of map unit: 5 percent

Landform: Fan remnants
Hydric soil rating: No

Pedcat, fine sandy loam, eroded
Percent of map unit: 5 percent
Landform: Fan remnants
Hydric soil rating: Yes

950—Pits, gravel

Map Unit Setting
National map unit symbol: hp2k
Elevation: 420 to 960 feet
Farmland classification: Not prime farmland

Map Unit Composition
Pits, gravel: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pits, Gravel

Setting
Landform: Fan remnants, flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium from mixed rock

Properties and qualities
Slope: 0 to 5 percent
Frequency of flooding: RareNone

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Minor Components

Excelsior, sandy loam
Percent of map unit: 4 percent
Landform: Alluvial fans, flood plains
Microfeatures of landform position: Bars and channels
Hydric soil rating: No

Cerini, sandy loam
Percent of map unit: 4 percent
Landform: Alluvial fans
Hydric soil rating: No

Los banos, clay loam
Percent of map unit: 3 percent
Landform: Fan remnants
Hydric soil rating: No

Panoche, loam
Percent of map unit: 2 percent
Landform: Alluvial fans
Hydric soil rating: No

Guijarral, sandy loam
Percent of map unit: 2 percent
Landform: Fan remnants
Hydric soil rating: No

960—Excelsior, sandy substratum-westhaven association, flooded, 0 to 2 percent slopes

Map Unit Setting
National map unit symbol: hp2l
Elevation: 310 to 850 feet
Mean annual precipitation: 7 to 8 inches
Mean annual air temperature: 62 to 64 degrees F
Frost-free period: 240 to 280 days
Farmland classification: Not prime farmland

Map Unit Composition
Excelsior, sandy loam, sandy substratum, and similar soils: 50 percent
Westhaven, loam, and similar soils: 30 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Excelsior, Sandy Loam, Sandy Substratum

Setting
Landform: Alluvial fans, flood plains
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Tread
Microfeatures of landform position: Bars and channels
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from calcareous sedimentary rock

Typical profile
A1 - 0 to 7 inches: sandy loam
A2 - 7 to 23 inches: sandy loam
C1 - 23 to 53 inches: stratified loamy sand to silt loam
C2 - 53 to 72 inches: loamy sand

Properties and qualities
Slope: 0 to 2 percent

Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: Occasional
Calcium carbonate, maximum content: 3 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 10.0
Available water supply, 0 to 60 inches: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: B
Ecological site: R017XY903CA - Stream Channels and Floodplains
Hydric soil rating: No

Description of Westhaven, Loam

Setting

Landform: Alluvial fans, flood plains
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Tread
Microfeatures of landform position: Bars and channels
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from calcareous sedimentary rock

Typical profile

Ap - 0 to 7 inches: loam
Bw - 7 to 17 inches: loam
Bk1 - 17 to 42 inches: stratified loam to silty clay loam
Bk2 - 42 to 65 inches: stratified loamy sand to silty clay loam
C - 65 to 72 inches: stratified loam to silty clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: Occasional
Calcium carbonate, maximum content: 4 percent
Gypsum, maximum content: 1 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 12.0
Available water supply, 0 to 60 inches: High (about 9.8 inches)

Interpretive groups

Land capability classification (irrigated): 2w

Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: C
Ecological site: R017XY903CA - Stream Channels and Floodplains
Hydric soil rating: No

Minor Components

Ciervo, clay
Percent of map unit: 10 percent
Landform: Fan skirts
Ecological site: R017XY903CA - Stream Channels and Floodplains
Hydric soil rating: No

Excelsior, sandy loam
Percent of map unit: 5 percent
Landform: Alluvial fans, flood plains
Microfeatures of landform position: Bars and channels
Ecological site: R017XY903CA - Stream Channels and Floodplains
Hydric soil rating: No

Cerini, clay loam
Percent of map unit: 3 percent
Landform: Alluvial fans
Ecological site: R017XY903CA - Stream Channels and Floodplains
Hydric soil rating: No

Anela, very gravelly sandy loam
Percent of map unit: 2 percent
Landform: Flood plains
Ecological site: R017XY903CA - Stream Channels and Floodplains
Hydric soil rating: No

981—Sewage disposal pond

Map Unit Setting
National map unit symbol: hp2n
Elevation: 140 to 650 feet
Farmland classification: Not prime farmland

Map Unit Composition
Sewage disposal pond: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sewage Disposal Pond

Properties and qualities
Slope: 0 percent
Frequency of flooding: Very rareNone

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

APPENDIX B

WASTE DISCHARGE REQUIREMENTS ORDER NO. 94-184

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

ORDER NO. 94-184

WASTE DISCHARGE REQUIREMENTS FOR CITY OF COALINGA WASTEWATER TREATMENT FACILITY FRESNO COUNTY

The California Regional Water Quality Control Board, Central Valley Region, (hereafter Board) finds that:

1. The City of Coalinga (hereafter Discharger) submitted a Report of Waste Discharge, dated 2 July 1991, and a site evaluation report, dated 25 June 1991, in support of a change in operation and an increase in quantity of discharge from its municipal wastewater treatment facility (WWTF). The property (Assessor's Parcel Nos. 070-07-023, 071-02-026, and 071-02-043) is owned by the Discharger. The WWTF is at the confluence of Los Gatos Creek and Warthan Creek. The ponds and lagoons are immediately adjacent to Los Gatos Creek, separated by an embankment which extends three feet above the highest pond water level.

2. Waste Discharge Requirements Order No. 80-064, adopted by the Board on 30 May 1980, prescribes requirements for a monthly average dry weather flow discharge of 0.93 million gallons per day (mgd) from the WWTF, for use on irrigated lands.

3. Order No. 80-64 is neither adequate (due to increase in flow and a change in operation) nor consistent with current plans and policies of the Board.

4. The Discharger completed rehabilitation of the primary clarifier and digester, which were removed from service during the previous plant modification, on 25 November 1991. The facility includes a bar screen; a primary clarifier; an aerobic sludge digester; sludge drying beds; two aerated facultative lagoons, each with a surface area of 3 acres; and three stabilization ponds, having a total surface area of 11 acres. Effluent is pumped from one of the stabilization ponds to 30 acres of farm land owned by the Discharger (leased and operated by West Hills Community College District) and 102 acres of farm land owned by West Hills Community College District (User) for crop irrigation and percolation disposal. The User grows alfalfa, hay, cotton, pasture, and sugar beets (for research only) with reclaimed wastewater. The Discharger owns an additional 96.7 acres of land in the immediate area, which could be used for reclamation if needed.

5. Reuse of reclaimed wastewater by User is regulated under separate Order.

6. At current flows, the Discharger applies approximately 6.8 feet/year of treated wastewater to the acreage available for wastewater reclamation. If applied to the total acreage available for reclamation, the application rate would be on the order of 3.9 feet/yearly without considering necessary setbacks from roads, wells and adjacent property. The typical irrigation application rates for Alfalfa and Cotton are 4.7 feet/year and 3.7 feet/year, respectively.

7. The WWTF has a design average daily dry weather flow capacity of 1.34 mgd. It presently serves a population of approximately 9,240, which generates an average daily wastewater flow of 0.80 mgd and maximum peak daily flow of 1.20 mgd.

8. The wastestream consists entirely of domestic wastes. There are no significant industrial dischargers.

9. The WWTF is in Section 33, T20S, R15E , MDB&M, with surface water drainage to Warthan Creek and Los Gatos Creek, as shown in Attachment A, which is attached hereto and part of this Order by reference. The site lies within the Kettleman Hydrologic Area (No. 558.50), as depicted on interagency hydrologic maps prepared by the Department of Water Resources in August 1986.

10. Federal Regulations for storm water discharges were promulgated by the USEPA on 16 November 1990 (40 CFR Parts 122, 123, and 124). The regulations require specific categories of facilities, which discharge storm water associated with industrial activity (storm water), to obtain NPDES permits and to implement Best Available Technology Economically Achievable (BAT) and Best Conventional Pollutant Control Technology (BCT) to reduce or eliminate industrial storm water pollution.

    The State Water Resources Control Board adopted Order No. 91-13-DWQ, NPDES General Permit No. CAS000001, amended 17 September 1992, specifying waste discharge requirements for discharges of storm water associated with industrial activities (hereafter General Permit). The Discharger is required to file a Notice of Intent (NOI) to comply with the General Permit because it is specified in the General Permit that all WWTFs with design flows greater than 1.0 mgd must be covered by the General Permit. The Discharger has not submitted an NOI.

11. The Board adopted a Water Quality Control Plan for the Tulare Lake Basin (5D, hereafter Basin Plan), which contains water quality objectives for all waters of the Basin. These requirements implement the Basin Plan.

12. California Department of Health Services has established statewide reclamation criteria in Title 22, California Code of Regulations (CCR), Section 60301, et seq. (hereafter Title 22) for use of reclaimed water and has developed guidelines for specific uses.

13. Coalinga is a surface water contractor with the United States Bureau of Reclamation for water from the Central Valley project via the Coalinga Canal, which is operated by Westlands Water District (electrical conductivity is about 400 μmhos/cm, total dissolved solids is about 220 mg/l).

14. Ground water is encountered at a depth of 300 feet below ground surface and is of poor quality, with electrical conductivities averaging approximately 2500 μmhos/cm.

15. The beneficial uses of underlying ground water are municipal, agricultural, and industrial supply.

16. Average annual precipitation is 6 to 8 inches.

17. The beneficial uses of Los Gatos Creek and Warthan Creek are agricultural and industrial supply.

18. Soil permeabilities in the vicinity of the WWTF range from 0.06 to 2.0 inches/hour.

19. Coalinga is in an area of active seismic activity because of proximity to the San Andreas, Post-Poso Creek, and White Wolf faults. In 1983 Coalinga was jolted by an earthquake having a magnitude of 6.7 on the Richter Scale. According to the California Division of Mines and Geology, there is a 50 percent likelihood of an earthquake of greater than 8 on the Richter Scale occurring by the year 2000 in the State of California.

20. The Discharger stockpiles its dried sludge on-site. Order No. 80-64 does not require the Discharger to submit a sludge management plan, and the Discharger has not submitted a sludge management plan.

21. The action to revise waste discharge requirements for the rehabilitation of the existing permitted WWTF is exempt from the provisions of the California Environmental Quality Act (CEQA), in accordance with Title 14, California Code of Regulations (CCR), Section 15301.

22. The Board has notified the Discharger and interested agencies and persons of its intent to prescribe waste discharge requirements for this discharge and has provided them with an opportunity for a public hearing and an opportunity to submit their written views and recommendations.

23. The Board, in a public meeting, heard and considered all comments pertaining to the discharge.

IT IS HEREBY ORDERED that Order No. 80-064 is rescinded and the City of Coalinga, its agents, successors, and assigns, in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted thereunder, shall comply with the following:

A. Discharge Prohibitions:

1. Discharge of wastes to surface waters or surface water drainage courses is prohibited.

2. Bypass or overflow of untreated or partially treated waste is prohibited.

3. Discharge of waste classified as 'hazardous' or 'designated', as defined in Sections 2521(a) and 2522(a) of Title 23, California Code of Regulations, Section 2510, et seq, (hereafter Chapter 15) is prohibited.

B. Discharge Specifications:

1. The monthly average dry weather discharge shall not exceed 1.34 mgd.

2. Objectionable odors originating at this facility shall not be perceivable beyond the limits of the wastewater treatment and disposal areas.

3. As a means of discerning compliance with Discharge Specification No. B.2, the dissolved oxygen content in the upper zone (1 foot) of wastewater in ponds and lagoons shall not be less than 1.0 mg/l.

4. The treatment facilities shall be designed, constructed, operated, and maintained to prevent inundation or washout due to floods with a 100-year return frequency.

5. Effluent shall not exceed the following limits:

Constituent	Units	Monthly Average	Daily Maximum
BOD_5[1]	mg/l	40	80
Settleable Solids	ml/l	0.2	0.5

[1] Five-day, 20° Celsius biochemical oxygen demand.

6. Ponds shall not have a pH less than 6.5 or greater than 9.5.

7. Ponds shall be managed to prevent breeding of mosquitos. In particular:

   a. An erosion control program should assure that small coves and irregularities are not created around the perimeter of the water surface.

   b. Weeds shall be minimized through control of water depth, harvesting, or herbicides.

   c. Dead algae, vegetation, and debris shall not accumulate on the water surface.

8. Public contact with wastewater shall be precluded through such means as fences, signs, and other acceptable alternatives.

9. Ponds shall have sufficient capacity to accommodate allowable wastewater flow and design seasonal precipitation and ancillary inflow and infiltration during the nonirrigation season. Design seasonal precipitation shall be based on total annual precipitation using a return period of 100 years, distributed monthly in accordance with historical rainfall patterns. Freeboard shall never be less than two feet (measured vertically).

10. On or about 1 October of each year, available pond storage capacity shall at least equal the volume necessary to comply with Discharge Specification B.9.

C. Reclamation Specifications:

1. There should be no irrigation with, or impoundment of reclaimed water within a minimum of 150 feet of any drinking water well. Drainage should be controlled to prevent reclaimed water from coming within 150 feet of a drinking water well.

2. Reclaimed water used for irrigation shall be managed to minimize erosion.

3. The Discharger may not irrigate effluent during periods of precipitation and for at least 24 hours after cessation of precipitation.

4. The following setback distances (feet) shall be provided at the reclamation area:

Setback Distance (feet)	To
25	Property Line
30	Public Roads
50	On-site irrigation wells
150	Domestic wells
50	Drainage courses

5. The perimeter of the reclamation area shall be graded to prevent ponding along public roads or other public areas.

6. Application of reclaimed water to the reclamation area shall be at reasonable rates considering the crops, soil, climate, and irrigation management system.

7. There shall be no standing water in the reclamation area 24 hours after wastewater is applied.

8. Reclaimed water must be controlled to comply with the following:

   a. Mist should not be created;

   b. Reclaimed water should not be sprayed;

   c. Runoff is confined to the reclaimed water use area;

d. Runoff does not contact or enter a dwelling, food handling facility, passing vehicle, or a place where the public may be present;

e. Runoff does not contact a yard at a residence, or an area with frequent human contact;

f. Runoff does not contact or enter a place where access and exposure to a wetted surface could be similar to that at a park, playground, or school yard.

D. Sludge Disposal:

1. Collected screenings, sludges, and other solids removed from liquid wastes shall be disposed of in a manner that is consistent with Chapter 15 and approved by the Executive Officer.

2. Any proposed change in sludge use or disposal practice shall be reported to the Executive Officer **at least 90 days in advance** of the change.

3. Use and disposal of sewage sludge shall comply with existing federal and state laws and regulations, and with 40 CFR Part 503 technical standards when promulgated.

   If an applicable management practice or numerical limitation for pollutants in sewage sludge is promulgated under 40 CFR Part 503 of the CWA after issuance of this permit which is more stringent than the sludge pollutant limit or management practice specified in this permit or in existing federal or state laws or regulations, the Discharger shall comply with the limitations by not later than the compliance deadline specified in the applicable regulations as required by 40 CFR Part 503.

E. Ground Water Limitations:

The discharge, in combination with other sources, shall not cause underlying ground water to:

1. Contain waste constituents in concentrations statistically greater than receiving water limits, where specified below, or background water quality where not specified. (For purposes of comparison, background water quality shall be

determined when background monitoring provides sufficient data. Quality determined in this manner establishes "water quality protection standards.")

2. Contain chemicals, heavy metals, or trace elements in concentrations that adversely affect beneficial uses or exceed maximum contaminant levels specified in the California Code of Regulations, Title 22, Division 4, Chapter 15.

3. Exceed a most probable number of total coliform organisms of 2.2/100 ml over any seven-day period.

4. Exceed concentrations of radionuclides specified in the California Code of Regulations, Title 22, Division 4, Chapter 15.

5. Contain taste or odor-producing substances in concentrations that cause nuisance or adversely affect beneficial uses.

6. Contain concentrations of chemical constituents in amounts that adversely affect agricultural use.

F. Provisions:

1. The Discharger shall comply with Monitoring and Reporting Program No. 94-184, which is part of this Order, and any revisions thereto as ordered by the Executive Officer.

2. The Discharger shall comply with the "Standard Provisions and Reporting Requirements for Waste Discharge Requirements," dated 1 March 1991, which are attached hereto and by reference a part of this Order. This attachment and its individual paragraphs are commonly referenced as "Standard Provision(s)."

3. In the event of any change in control or ownership of land or waste discharge facilities described herein, the Discharger shall notify the succeeding owner or operator of the existence of this Order by letter, a copy of which shall be immediately forwarded to this office.

   To assume operation under this Order, the succeeding owner or operator must apply in writing to the Executive Officer requesting transfer of the Order. The request must contain the requesting entity's full legal name, the State of incorporation if a corporation, the name and address and telephone number of the persons responsible for contact with the Board, and a statement. The

statement shall comply with the signatory paragraph of Standard Provision B.3 and state that the new owner or operator assumes full responsibility for compliance with this Order. Failure to submit the request shall be considered a discharge without requirements, a violation of the California Water Code. Transfer shall be approved or disapproved by the Executive Officer.

4. At least **90 days** prior to termination or expiration of any lease, contract, or agreement involving disposal or reclamation areas or off-site reuse of effluent, used to justify the capacity authorized herein and assure compliance with this Order, the Discharger shall notify the Board in writing of the situation and of what measures have been taken or are being taken to assure full compliance with this Order.

5. The Discharger shall use the best practicable cost-effective control technique currently available to comply with salinity limits specified in this order.

6. **By 1 January 1995**, the Discharger shall submit a water balance for the reclamation area which includes a topographic map showing the net acreage available for wastewater reclamation; considers crop water needs (feet of water/year); harvesting and planting "down" times, when wastewater is not applied; losses due to percolation and evaporation in the ponds; and compliance with Reclamation Specifications in this Order. The water balance shall be submitted as a technical report prepared by a California registered civil engineer or a California registered agricultural engineer.

7. **By 1 January 1995**, the Discharger shall submit a technical report prepared by a California registered engineer which verifies whether the WWTF complies with Discharge Specification B.4.

8. **By 1 January 1995**, the Discharger shall submit a technical report, which discusses compliance with Reclamation Specifications and includes a time schedule for compliance with said Reclamation Specification where necessary.

9. **By 1 August 1994**, the Discharger shall submit a copy of the agreement between the Discharger and West Hills Community College District for delivery of reclaimed water and an accurate map defining the boundaries of city owned land and the reclamation property belonging to West Hills Community College District farm. The map shall identify where West Hills Community College District is reclaiming effluent or may reclaim effluent and the land the city itself has available for reclamation if the need arises.

10. **By 1 August 1994**, the Discharger shall submit a completed NOI to comply with the General Permit.

11. The Discharger shall submit to the Board on or before each report due date the specified document or, if an action is specified, a written report detailing evidence of compliance with the date and task. If noncompliance is being reported, the reasons for such noncompliance shall be stated, plus an estimate of the date when the Discharger will be in compliance. The Discharger shall notify the Board by letter when it returns to compliance with the time schedule.

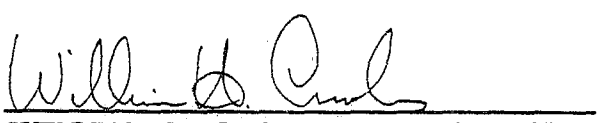
12. The Discharger must comply with all conditions of this Order, including timely submittal of technical and monitoring reports as directed by the Executive Officer. Violations may result in enforcement action, including Regional Board or court orders requiring corrective action or imposing civil monetary liability, or in revision or rescission of this Order.

13. A copy of this Order shall be kept at the discharge facility for reference by operating personnel. Key operating personnel shall be familiar with its contents.

14. If reclaimed water is used for construction purposes, it shall comply with the most current edition of "Guidelines for Use of Reclaimed Water for Construction Purposes". Other uses of reclaimed water not specifically authorized herein shall be subject to the approval of the Executive Officer and shall comply with 22 CCR, Division 4.

15. The Board will review this Order periodically and will revise requirements when necessary.

I, WILLIAM H. CROOKS, Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Central Valley Region, on 24 June 1994.



WILLIAM H. CROOKS, Executive Officer

MS:cjs: 6/24/94

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

MONITORING AND REPORTING PROGRAM NO. 94-184

FOR
CITY OF COALINGA
WASTEWATER TREATMENT FACILITY
FRESNO COUNTY

Specific sample station locations shall be established with concurrence of the Board's staff, and the Discharger shall submit a description of the stations to Board and attach a copy to it's copy of this Program.

INFLUENT MONITORING

Influent samples shall be collected at the inlet of the headworks and approximately the same time as effluent samples. Influent monitoring shall include at least the following:

Constituents	Units	Type of Sample	Sampling Frequency
Flow	mgd	continuous	Daily
Settleable Solids	ml/l	grab	Daily
BOD_5[1]	mg/l	8-hr composite[2]	Weekly

[1] Five-day, 20° Celsius biochemical oxygen demand.
[2] Samples to be collected in proportion to flow.

EFFLUENT MONITORING

Except for flow, which may be measured either at the headworks or treatment unit, effluent samples shall be collected just prior to discharge to the disposal facility. Effluent samples should be representative of the volume and nature of the discharge. Samples collected from the outlet structure of ponds will be considered adequately. Time of collection of a grab sample shall be recorded. Effluent monitoring shall include at least the following:

Constituents	Units	Type of Sample	Sampling Frequency[1]
Dissolved Oxygen[2]	mg/l	Grab	Daily
pH	pH Units	Grab	Daily
Settleable Solids	ml/l	Grab	Daily
BOD_5[3]	mg/l	8-hr composite	Weekly

Constituents	Units	Type of Sample	Sampling Frequency[1]
Specific Conductivity	μmhos/cm	Grab	Monthly
Nitrates as N	mg/l	Grab	Quarterly

[1] If results of monitoring a pollutant appear to violate effluent limitations, but monitoring frequency is not sufficient to validate violation (e.g., the monthly average for BOD), or indicate a violation and potential upset of the treatment process (e.g., less than minimum D.O.), the frequency of sampling shall be increased to confirm the magnitude and duration of violation, if any, and aid in identification and resolution of the problem.

[2] Samples shall be collected at a depth of one foot from each pond, opposite the inlet, and analyzed for dissolved oxygen. Samples shall be collected between 0800 and 0900 hours.

[3] Five-day, 20° Celsius biochemical oxygen demand.

SLUDGE MONITORING

When sludge is removed from ponds and treatment units, but prior to disposal, a composite sample shall be analyzed, on a dry weight basis, for Total Solids (%), Nitrogen (total, NH_4-N, and NO_3-N), Total Phosphorous, Total Potassium, Total PCBs, and totals of specific metals (Pb, Zn, Cu, Ni, Cd, and Ag). Analytical results shall be submitted to the Executive Officer. Analysis of soluble concentrations of these specific metals shall also be included as needed. If final disposal is proposed to go to land, a technical report analyzing application rates and procedures relative to Department of Health Services' *Manual of Good Practices for Landspreading of Sewage Sludge* and EPA's *Process Design Manual for Land Application of Municipal Sludges* and Title 23, California Code of Regulations, Section 2511(f), shall be completed and submitted to the Executive Officer for approval. The report shall be prepared by a California registered civil engineer experienced in wastewater treatment and disposal.

Sampling records shall be retained for a minimum of five years. A log shall be kept of sludge quantities generated and of handling and disposal activities. The frequency of entries is discretionary; however, the log should be complete enough to serve as a basis for part of the annual report.

POND MONITORING

The freeboard shall be monitored on the evaporation/percolation ponds in use to the nearest tenth foot. Pond water monitoring shall include the following:

Constituent	Unit	Type of Sample	Frequency
Freeboard	feet	Observation	Weekly

Permanent markers shall be placed in the pond with calibration indicating the water level at design capacity and available operational freeboard.

In addition, the Discharger shall inspect the condition of the ponds once per week and write visual observation in a bound log book. Notations shall include observations of whether weeds are developing in the water or along the bank, and their location; whether dead algae, vegetation, scum, or debris are accumulating on the pond surface and their location; whether burrowing animals or insects are present; and the color of the pond (e.g., dark sparkling green, dull green, yellow, grey, tan, brown, etc.). A copy of the entries made in the log during each month shall be submitted along with the monitoring report the following month. Where the O&M manual indicates remedial action is necessary, the Discharger shall briefly explain in the transmittal what action has been taken or is scheduled to be taken.

WATER SUPPLY MONITORING

A sampling station shall be established where a representative sample of the water supply can be obtained or the information requested below may be obtained from the supplier. Water supply monitoring shall include at least the following:

Constituents	Units	Sampling Frequency
Standard Minerals[1]	mg/l	Quarterly
Electrical Conductivity @ 25°C	μmhos/cm	Quarterly
Total Dissolved Solids	mg/l	Quarterly

[1] Standard Mineral analyses shall include bicarbonate, calcium, carbonate, chloride, fluoride, iron, manganese, magnesium, nitrate, potassium, sodium, sulfate, total phosphorus, total cations, and total anions.

ANNUAL LAND MANAGEMENT REPORTS

The Discharger shall submit a summary report on its land management operation (West Hills College shall submit its own) after the conclusion of each season. The report shall discuss net acreage irrigated and total water application over the season; the total wastewater applied in acre-feet; the total wastewater, and nutrient loading from wastewater, sludges, and chemical fertilizers; and the amount of nutrients removed through harvest of the crop. In short, the report shall present a mass balance relative to pollutants of concern and hydraulic loading. The report is due by 30 January of the following year.

REPORTING

Monthly monitoring reports shall be submitted to the Board by the **20th day of the following month.**

In reporting the monitoring data, the Discharger shall arrange the data in tabular form so that the date, the constituents, and the concentrations are readily discernible. The data shall be summarized in such a manner that illustrates clearly whether the Discharger complies with waste discharge requirements, including calculation of all averages, etc.

If the Discharger monitors any pollutant at the locations designated herein more frequently than is required by this Order, the results of such monitoring shall be included in the discharge monitoring report.

The Discharger may also be requested to submit an annual report to the Board with tabular and graphical summaries of the monitoring data obtained during the previous year. Any such request shall be made in writing. The report shall discuss the corrective actions taken and planned to bring the discharge into full compliance with the waste discharge requirements.

By **31 January of each year**, the Discharger shall submit a written report to the Executive Officer containing the following:

a. The names, titles, certificate grade (if any) and general responsibilities of persons operating and maintaining the wastewater treatment plant.

b. The names and telephone numbers of persons to contact regarding the plant for emergency and routine situations.

c. A certified statement of when the flow meter and other monitoring instruments and devices were last calibrated, including identification of who did the calibration (Standard Provision C.4).

d. A statement whether the current operation and maintenance manual, and contingency plan, reflect the wastewater treatment plant as currently constructed and operated, and the dates when these documents were last reviewed for adequacy.

e. The total quantity of sludge disposed of during the previous year and ultimate disposal site(s).

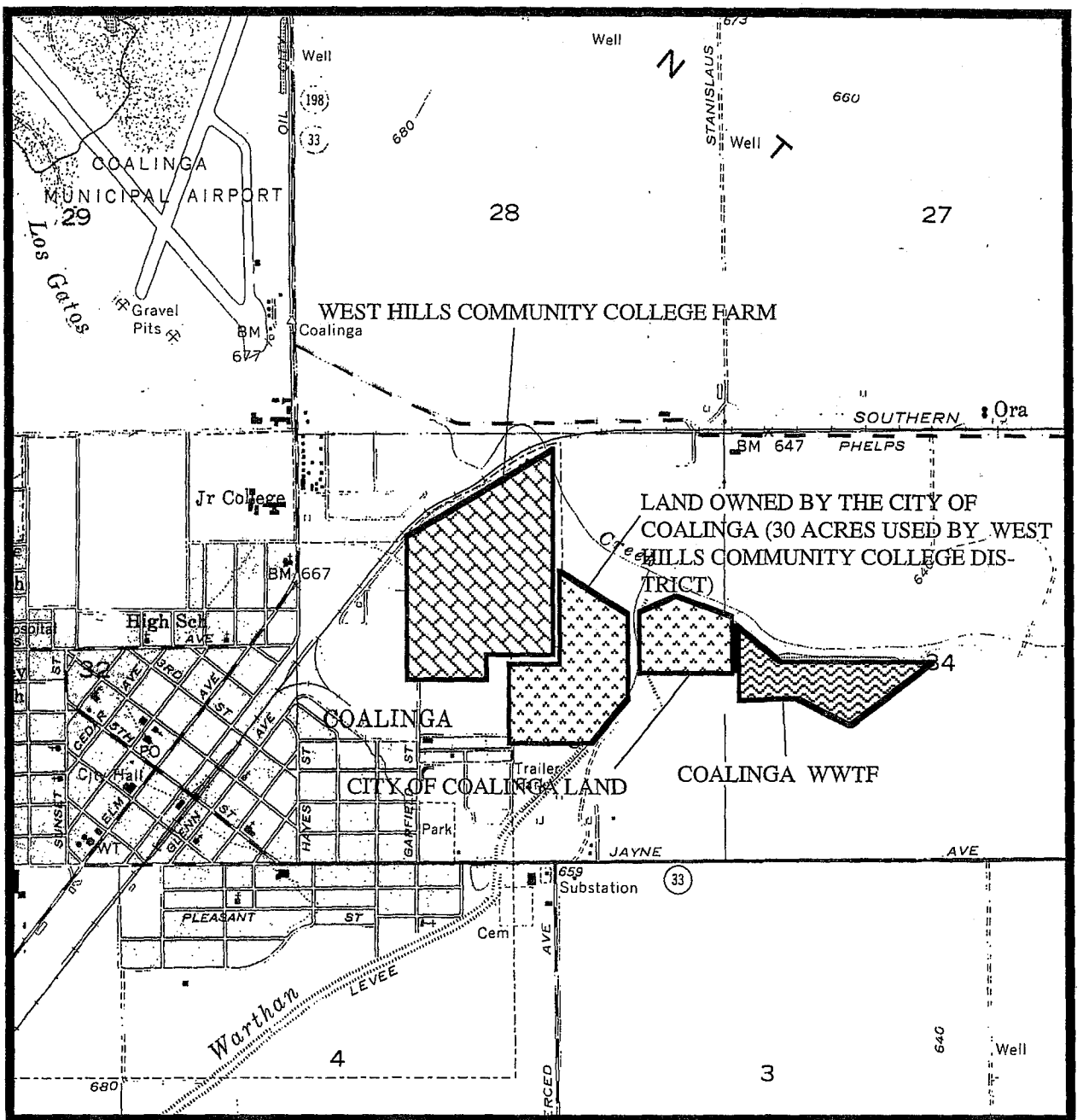
All reports submitted in response to this Order shall comply with the signatory requirements in Standard Provision B.3.

The Discharger shall implement the above monitoring program on the first day of the month following adoption of this Order.

Ordered by: _____
WILLIAM H. CROOKS, Executive Officer

24 June 1994
(Date)

MS:cjs: 6/24/94



N

Scale: 1"=2000'

ATTACHMENT A

City of Coalinga WWTF

FRESNO COUNTY

Portions of Sec. 33 and 34, T20S, R15E, MDB&M
Coalinga, CA. 7.5' USGS Quad
Photorevised 1979

INFORMATION SHEET

CITY OF COALINGA
WASTEWATER TREATMENT FACILITY
FRESNO COUNTY

The City of Coalinga (hereafter Discharger), an incorporated city with an approximate population of 9,240, operates a wastewater treatment facility (WWTF) with surface water drainage to Warthan Creek and Los Gatos Creek in the Pleasant Valley. The City is on the western side of the San Joaquin Valley, along Highway 33 and 198, approximately 12 miles west of interstate 5. The WWTF is regulated by Waste Discharge Requirements Order No. 80-064 for a monthly average dry weather flow of .93 million gallons per day (mgd) of primarily domestic wastewater.

The Discharger completed a project on 25 November 1991 which involved rehabilitation of the primary clarifier and digester, which were removed from service during the previous plant modification. No new construction was involved. The WWTF consists of headworks; a primary clarifier; an aerobic sludge digester; sludge drying beds; two aerated facultative lagoons, each with a surface area of 3 acres; and three stabilization ponds, having a total surface area on 11 acres. Effluent is pumped from one of the stabilization ponds to 30 acres of farmland owned by the Discharger and 102 acres of farmland owned by West Hills Community College District for crop irrigation and percolation disposal. The User grows alfalfa, hay, cotton, pasture, and sugar beets (for research only) with reclaimed wastewater on its land.

The State Water Resources Control Board adopted Order No. 91-13-DWQ, NPDES General Permit No. CAS000001, amended 17 September 1992, specifying waste discharge activities (hereafter General Permit). The Discharger must to file a Notice of Intent (NOI) to comply with the General Permit because all WWTFs with design flows greater than 1.0 mgd must be covered by the General Permit. The Discharger has not submitted a NOI.

Panoche clay loam, and Panoche sandy loam are the predominant soil types in Coalinga. Soil analysis indicates naturally occurring asbestos in the Coalinga area.

The City is in an area of seismic activity in the vicinity of the San Andreas, Post-Poso Creek, and White Wolf faults. In 1983, the City was jolted by an earthquake having a magnitude of 6.7 on the Richter Scale. According to the California Division of Mines and Geology, there is a 50 percent likelihood of an earthquake of greater than 8 on the Richter Scale occurring by the year 2000.

Ground water is encountered at a depth of 300 to 400 feet below ground surface. The ground water quality is poor; specific conductances ranges from 2500 μmhos/cm to 3000 μmhos/cm. The beneficial use of underlying ground water is agricultural supply.

The action to revise waste discharge requirements for the rehabilitation of the existing permitted WWTF is exempt from the provisions of the California Environmental Quality Act (CEQA) in accordance with Title 14, California Code of Regulations (CCR), Section 15301.

APPENDIX C

ANNUAL WATER BALANCE

CITY OF COALINGA
Water Balance Assuming Evaporation and Agricultural Irrigation
0.857 MGD

DESIGN DATA	
Parameter	**Value**
Average Design Flow, MGD	0.857
Irrigation Efficiency, %	70%
Pond #2 Area, Acres	18.34
Effluent Reclamation Area, Acres	325
Percolation Rate, inch/day	0

Month	Sewage Flow (MGD)	Sewage Flow (acre-feet)	Evaporation Ponds (acre-feet)	Precipitation Ponds (acre-feet)	Irrigation Disposal Areas (acre-feet)[2]	Percolation (Acre-ft)[3]	Balance (Acre-feet) Monthly	Balance (Acre-feet) Cumulative[5]
October	0.857	81.5	7.3	1.1	167.9	0.0	-92.5	0.0
November	0.857	78.9	4.0	1.9	79.0	0.0	-2.2	0.0
December	0.857	81.5	2.6	3.2	26.6	0.0	55.5	55.5
January	0.857	81.5	2.6	5.3	0.0	0.0	84.2	139.8
February	0.857	73.6	4.2	5.2	29.6	0.0	45.0	184.8
March	0.857	81.5	6.8	4.6	100.1	0.0	-20.7	164.1
April	0.857	78.9	9.6	1.4	214.9	0.0	-144.2	19.9
May	0.857	81.5	13.0	0.7	299.9	0.0	-230.6	0.0
June	0.857	78.9	14.6	0.2	336.6	0.0	-272.2	0.0
July	0.857	81.5	15.6	0.0	359.8	0.0	-293.9	0.0
August	0.857	81.5	14.1	0.1	323.8	0.0	-256.3	0.0
September	0.857	78.9	10.6	1.0	243.8	0.0	-174.5	0.0
		960.0	105.1	24.8	2182.0	0.0		

[1] Irrigation requirements based on ET values for the San Joaquin Valley.

[2] Water contribution by rainfall over the pond surface areas.

[3] Percolation assumes a rate of 0.00 inch per day.

[4] Monthly excess (deficit) of water. Equal to the sum of sewage flow and precipitation less water loss through evaporation and percolation.

[5] Cummulative Balance is proposed to be either stored on the top 48" of soil (root zone) or percolated beyond the root zone. Water storage capacity of exisitng Hanford Loam soils is 0.11 in/in (See USDA Soil Survey Report).

Note: Reference precipitation and evapotranspiration data are included in this Attachment.

CITY OF COALINGA
Water Balance Assuming Evaporation and Agricultural Irrigation
1.34 MGD

DESIGN DATA	
Parameter	**Value**
Average Design Flow, MGD	1.340
Irrigation Efficiency, %	70%
Treatment Pond Area, Acres	18.34
Effluent Reclamation Area, Acres	219
Percolation Rate, inch/day	0

			Evaporation	Precipitation	Irrigation	Pond		
	Sewage Flow		Ponds	Ponds	Disposal Areas	Percolation	Balance (Acre-feet)	
Month	**(MGD)**	**(acre-feet)**	**(acre-feet)**	**(acre-feet)**	**(acre-feet)[2]**	**(Acre-ft)[3]**	**Monthly**	**Cumulative[5]**
October	1.34	127.5	7.3	1.1	111.8	0.0	9.5	9.5
November	1.34	123.4	4.0	1.9	53.2	0.0	68.0	77.5
December	1.34	127.5	2.6	3.2	17.9	0.0	110.2	187.7
January	1.34	127.5	2.6	5.3	0.0	0.0	130.2	317.9
February	1.34	115.1	4.2	5.2	19.9	0.0	96.2	414.1
March	1.34	127.5	6.8	4.6	67.5	0.0	57.9	472.0
April	1.34	123.4	9.6	1.4	144.8	0.0	-29.6	442.3
May	1.34	127.5	13.0	0.7	202.1	0.0	-86.9	355.4
June	1.34	123.4	14.6	0.2	226.8	0.0	-117.9	237.5
July	1.34	127.5	15.6	0.0	242.5	0.0	-130.6	107.0
August	1.34	127.5	14.1	0.1	218.2	0.0	-104.7	2.3
September	1.34	123.4	10.6	1.0	164.3	0.0	-50.5	0.0
		1,501.0	105.1	24.8	1469.0	0.0		

[1] Irrigation requirements based on ET values for the San Joaquin Valley.

[2] Water contribution by rainfall over the pond surface areas

[3] Percolation assumes a rate of 0.00 inch per day.

[4] Monthly excess (deficit) of water. Equal to the sum of sewage flow and precipitation less water loss through evaporation and percolation.

[5] Cummulative Balance is proposed to be either stored on the top 24" of soil (root zone) or percolated beyond the root zone. Water storage capacity of exisitng Exclusive sandy loam soils is 0.10 in/in (See USDA Soil Survey Report).

Note: Reference precipitation and evapotranspiration data are included in the Appendix.

CITY OF COALINGA

Precipitation and Evaporation Reference Data

Month	Days	Crop Coefficients (kc)[1]			Ref Evap (inches)	Precipitation (inches)		Eff. Precipitation (inches)[5]
		Ponds	Alfalfa	Cotton	ETo[2]	Normal[3]	100-yr[4]	
October	31	1.1	1.00	0.80	4.34	0.38	0.74	0.05
November	30	1.1	1.00	0.80	2.40	0.64	1.25	0.36
December	31	1.1	1.00	0.80	1.55	1.07	2.09	0.86
January	31	1.1	1.00	0.80	1.55	1.78	3.48	1.80
February	28	1.1	1.00	0.80	2.52	1.75	3.42	1.76
March	31	1.1	1.00	0.59	4.03	1.55	3.03	1.44
April	30	1.1	1.00	0.71	5.70	0.46	0.90	0.15
May	31	1.1	1.00	0.83	7.75	0.24	0.47	0.00
June	30	1.1	1.00	0.90	8.70	0.06	0.12	0.00
July	31	1.1	1.00	0.96	9.30	0.01	0.02	0.00
August	31	1.1	1.00	0.96	8.37	0.04	0.08	0.00
September	30	1.1	1.00	0.91	6.30	0.32	0.63	0.00
Total					**62.51**	**8.30**	**16.24**	

[1] Irrigation with Reclaimed Municipal Wastewater. A guidance manual. PettyGrove and Asano, 1986.

[2] California Irrigation Management Information System (ET_0 Map)

[3] National Climate Data Center. Normal Precipitation (1971-2000).

[4] Rainfall-Depth Duration Frequency for California. California Dept. of Water Resources, Division of Planning, February 1981.

[5] Effective Precipitation: FAO Irrigation Water Management, Training Manual No. 3.

APPENDIX D

ANNUAL WATER BALANCE

CITY OF COALINGA
Water Balance Assuming Evaporation and Agricultural Irrigation
0.857 MGD

DESIGN DATA	
Parameter	**Value**
Average Design Flow, MGD	0.857
Irrigation Efficiency, %	70%
Treatment pond Area, Acres	18.34
Effluent Reclamation Area, Acres	325
Percolation Rate, inch/day	0

Month	Sewage Flow (MGD)	Sewage Flow (acre-feet)	Evaporation Ponds (acre-feet)	Precipitation Ponds (acre-feet)	Irrigation Disposal Areas (acre-feet)[2]	Percolation (Acre-ft)[3]	Balance (Acre-feet) Monthly	Balance (Acre-feet) Cumulative[5]
October	0.857	81.5	7.3	1.1	167.9	0.0	-92.5	0.0
November	0.857	78.9	4.0	1.9	79.0	0.0	-2.2	0.0
December	0.857	81.5	2.6	3.2	26.6	0.0	55.5	55.5
January	0.857	81.5	2.6	5.3	0.0	0.0	84.2	139.8
February	0.857	73.6	4.2	5.2	29.6	0.0	45.0	184.8
March	0.857	81.5	6.8	4.6	100.1	0.0	-20.7	164.1
April	0.857	78.9	9.6	1.4	214.9	0.0	-144.2	19.9
May	0.857	81.5	13.0	0.7	299.9	0.0	-230.6	0.0
June	0.857	78.9	14.6	0.2	336.6	0.0	-272.2	0.0
July	0.857	81.5	15.6	0.0	359.8	0.0	-293.9	0.0
August	0.857	81.5	14.1	0.1	323.8	0.0	-256.3	0.0
September	0.857	78.9	10.6	1.0	243.8	0.0	-174.5	0.0
		960.0	105.1	24.8	2182.0	0.0		

[1] Irrigation requirements based on ET values for the San Joaquin Valley.

[2] Water contribution by rainfall over the pond surface areas.

[3] Percolation assumes a rate of 0.00 inch per day.

[4] Monthly excess (deficit) of water. Equal to the sum of sewage flow and precipitation less water loss through evaporation and percolation.

[5] Cummulative Balance is proposed to be either stored on the top 48" of soil (root zone) or percolated beyond the root zone. Water storage capacity of exisitng Hanford Loam soils is 0.11 in/in (See USDA Soil Survey Report).

Note: Reference precipitation and evapotranspiration data are included in this Attachment.

CITY OF COALINGA
Water Balance Assuming Evaporation and Agricultural Irrigation
1.34 MGD

DESIGN DATA	
Parameter	**Value**
Average Design Flow, MGD	1.340
Irrigation Efficiency, %	90%
Effluent Pond Area, Acres	18.34
Percolation Rate, inch/day	2.8

Month	Sewage Flow (MGD)	Sewage Flow (acre-feet)	Evaporation Ponds (acre-feet)	Precipitation Ponds (acre-feet)	Irrigation Disposal Areas (acre-feet)[2]	Pond Percolation (Acre-ft)[3]	Balance (Acre-feet) Monthly	Balance (Acre-feet) Cumulative[5]
October	1.34	127.5	7.3	1.1	0.0	132.7	-11.3	0.0
November	1.34	123.4	4.0	1.9	0.0	128.4	-7.1	0.0
December	1.34	127.5	2.6	3.2	0.0	132.7	-4.6	0.0
January	1.34	127.5	2.6	5.3	0.0	132.7	-2.5	0.0
February	1.34	115.1	4.2	5.2	0.0	119.8	-3.7	0.0
March	1.34	127.5	6.8	4.6	0.0	132.7	-7.3	0.0
April	1.34	123.4	9.6	1.4	0.0	128.4	-13.2	0.0
May	1.34	127.5	13.0	0.7	0.0	132.7	-17.5	0.0
June	1.34	123.4	14.6	0.2	0.0	128.4	-19.5	0.0
July	1.34	127.5	15.6	0.0	0.0	132.7	-20.8	0.0
August	1.34	127.5	14.1	0.1	0.0	132.7	-19.1	0.0
September	1.34	123.4	10.6	1.0	0.0	128.4	-14.6	0.0
		1,501.0	105.1	24.8	0.0	1562.0	-141.2	

[1] Irrigation requirements based on ET values for the San Joaquin Valley.

[2] Water contribution by rainfall over the pond surface areas

[3] Percolation assumes a rate of 2.8 inch per day.

[4] Monthly excess (deficit) of water. Equal to the sum of sewage flow and precipitation less water loss through evaporation and percolation.

[5] Cummulative Balance is proposed to be either stored on the top 24" of soil (root zone) or percolated beyond the root zone. Water storage capacity of exisitng Exclusive sandy loam soils is 0.10 in/in (See USDA Soil Survey Report).

Note: Reference precipitation and evapotranspiration data are included in the Appendix.

CITY OF COALINGA

Precipitation and Evaporation Reference Data

Month	Days	Crop Coefficients (kc)[1]		Ref Evap (inches)	Precipitation (inches)		Eff. Precipitation (inches)[5]		
		Ponds	Grass	ETo[2]	Normal[3]	100-yr[4]			
October	31	1.1	1.00	4.34	0.38	0.74	0.05	(0.17)	0.00
November	30	1.1	1.00	2.40	0.64	1.25	0.36	(0.01)	0.00
December	31	1.1	1.00	1.55	1.07	2.09	0.86	0.25	0.25
January	31	1.1	1.00	1.55	1.78	3.48	1.80	0.67	0.67
February	28	1.1	1.00	2.52	1.75	3.42	1.76	0.66	0.66
March	31	1.1	1.00	4.03	1.55	3.03	1.44	0.54	0.54
April	30	1.1	1.00	5.70	0.46	0.90	0.15	(0.12)	0.00
May	31	1.1	1.00	7.75	0.24	0.47	0.00	(0.25)	0.00
June	30	1.1	1.00	8.70	0.06	0.12	0.00	(0.36)	0.00
July	31	1.1	1.00	9.30	0.01	0.02	0.00	(0.39)	0.00
August	31	1.1	1.00	8.37	0.04	0.08	0.00	(0.37)	0.00
September	30	1.1	1.00	6.30	0.32	0.63	0.00	(0.20)	0.00
Total				**62.51**	**8.30**	**16.24**			

[1] Irrigation with Reclaimed Municipal Wastewater. A guidance manual. PettyGrove and Asano, 1986.

[2] California Irrigation Management Information System (ET_0 Map)

[3] National Climate Data Center. Normal Precipitation (1971-2000).

[4] Rainfall-Depth Duration Frequency for California. California Dept. of Water Resources, Division of Planning, February 1981.

[5] Effective Precipitation: FAO Irrigation Water Management, Training Manual No. 3.

APPENDIX E

ANNUAL WATER BALANCE

CITY OF COALINGA
Water Balance Assuming Evaporation and Agricultural Irrigation
0.857 MGD

DESIGN DATA	
Parameter	**Value**
Average Design Flow, MGD	0.857
Irrigation Efficiency, %	70%
Pond #2 Area, Acres	18.34
Effluent Reclamation Area, Acres	325
Percolation Rate, inch/day	0

Month	Sewage Flow (MGD)	Sewage Flow (acre-feet)	Evaporation Ponds (acre-feet)	Precipitation Ponds (acre-feet)	Irrigation Disposal Areas (acre-feet)[2]	Percolation (Acre-ft)[3]	Balance (Acre-feet) Monthly	Balance (Acre-feet) Cumulative[5]
October	0.857	81.5	7.3	1.1	154.5	0.0	-79.1	0.0
November	0.857	78.9	4.0	1.9	50.2	0.0	26.5	26.5
December	0.857	81.5	2.6	3.2	0.0	0.0	82.1	108.7
January	0.857	81.5	2.6	5.3	0.0	0.0	84.2	192.9
February	0.857	73.6	4.2	5.2	0.0	0.0	74.6	267.6
March	0.857	81.5	6.8	4.6	40.9	0.0	38.5	306.1
April	0.857	78.9	9.6	1.4	170.8	0.0	-100.1	206.0
May	0.857	81.5	13.0	0.7	281.9	0.0	-212.6	0.0
June	0.857	78.9	14.6	0.2	353.4	0.0	-289.0	0.0
July	0.857	81.5	15.6	0.0	399.4	0.0	-333.5	0.0
August	0.857	81.5	14.1	0.1	359.5	0.0	-291.9	0.0
September	0.857	78.9	10.6	1.0	258.4	0.0	-189.1	0.0
		960.0	105.1	24.8	2068.9	0.0		

[1] Irrigation requirements based on ET values for the San Joaquin Valley.

[2] Water contribution by rainfall over the pond surface areas.

[3] Percolation assumes a rate of 0.00 inch per day.

[4] Monthly excess (deficit) of water. Equal to the sum of sewage flow and precipitation less water loss through evaporation and percolation.

[5] Cummulative Balance is proposed to be either stored on the top 48" of soil (root zone) or percolated beyond the root zone. Water storage capacity of exisitng Hanford Loam soils is 0.11 in/in (See USDA Soil Survey Report).

Note: Reference precipitation and evapotranspiration data are included in this Attachment.

CITY OF COALINGA
Water Balance Assuming Evaporation and Agricultural Irrigation
1.34 MGD

DESIGN DATA	
Parameter	**Value**
Average Design Flow, MGD	1.340
Irrigation Efficiency, %	90%
Storage Pond Area, Acres	18.34
Effluent Reclamation Area, Acres	288
Percolation Rate, inch/day	0

Month	Sewage Flow (MGD)	Sewage Flow (acre-feet)	Evaporation Ponds (acre-feet)	Precipitation Ponds (acre-feet)	Irrigation Disposal Areas (acre-feet)[2]	Pond Percolation (Acre-ft)[3]	Balance (Acre-feet) Monthly	Balance (Acre-feet) Cumulative[5]
October	1.34	127.5	7.3	1.1	105.1	0.0	16.2	16.2
November	1.34	123.4	4.0	1.9	34.6	0.0	86.6	102.9
December	1.34	127.5	2.6	3.2	0.0	0.0	128.1	230.9
January	1.34	127.5	2.6	5.3	0.0	0.0	130.2	361.1
February	1.34	115.1	4.2	5.2	0.0	0.0	116.1	477.3
March	1.34	127.5	6.8	4.6	28.2	0.0	97.2	574.5
April	1.34	123.4	9.6	1.4	117.7	0.0	-2.5	571.9
May	1.34	127.5	13.0	0.7	194.3	0.0	-79.1	492.8
June	1.34	123.4	14.6	0.2	243.6	0.0	-134.7	358.1
July	1.34	127.5	15.6	0.0	275.3	0.0	-163.4	194.7
August	1.34	127.5	14.1	0.1	247.8	0.0	-134.2	60.5
September	1.34	123.4	10.6	1.0	178.1	0.0	-64.3	0.0
		1,501.0	105.1	24.8	1424.6	0.0		

[1] Irrigation requirements based on ET values for the San Joaquin Valley.

[2] Water contribution by rainfall over the pond surface areas

[3] Percolation assumes a rate of 0.00 inch per day.

[4] Monthly excess (deficit) of water. Equal to the sum of sewage flow and precipitation less water loss through evaporation and percolation.

[5] Cummulative Balance is proposed to be either stored on the top 24" of soil (root zone) or percolated beyond the root zone. Water storage capacity of exisitng Exclusive sandy loam soils is 0.10 in/in (See USDA Soil Survey Report).

Note: Reference precipitation and evapotranspiration data are included in the Appendix.

CITY OF COALINGA

Precipitation and Evaporation Reference Data

Month	Days	Crop Coefficients (kc)[1]		Ref Evap (inches)	Precipitation (inches)		Eff. Precipitation (inches)[5]
		Ponds	Almond	ETo[2]	Normal[3]	100-yr[4]	
October	31	1.1	0.92	4.34	0.38	0.74	0.05
November	30	1.1	0.69	2.40	0.64	1.25	0.36
December	31	1.1	0.43	1.55	1.07	2.09	0.86
January	31	1.1	0.40	1.55	1.78	3.48	1.80
February	28	1.1	0.41	2.52	1.75	3.42	1.76
March	31	1.1	0.62	4.03	1.55	3.03	1.44
April	30	1.1	0.80	5.70	0.46	0.90	0.15
May	31	1.1	0.94	7.75	0.24	0.47	0.00
June	30	1.1	1.05	8.70	0.06	0.12	0.00
July	31	1.1	1.11	9.30	0.01	0.02	0.00
August	31	1.1	1.11	8.37	0.04	0.08	0.00
September	30	1.1	1.06	6.30	0.32	0.63	0.00
Total				**62.51**	**8.30**	**16.24**	

[1] Irrigation with Reclaimed Municipal Wastewater. A guidance manual. PettyGrove and Asano, 1986.

[2] California Irrigation Management Information System (ET_0 Map)

[3] National Climate Data Center. Normal Precipitation (1971-2000).

[4] Rainfall-Depth Duration Frequency for California. California Dept. of Water Resources, Division of Planning, February 1981.

[5] Effective Precipitation: FAO Irrigation Water Management, Training Manual No. 3.

APPENDIX F

ANNUAL WATER BALANCE

CITY OF COALINGA
Water Balance Assuming Evaporation and Agricultural Irrigation
0.857 MGD

DESIGN DATA	
Parameter	**Value**
Average Design Flow, MGD	0.857
Irrigation Efficiency, %	70%
Pond #2 Area, Acres	18.34
Effluent Reclamation Area, Acres	273
Percolation Rate, inch/day	0

Month	Sewage Flow (MGD)	Sewage Flow (acre-feet)	Evaporation Ponds (acre-feet)	Precipitation Ponds (acre-feet)	Irrigation Disposal Areas (acre-feet)[2]	Percolation (Acre-ft)[3]	Balance (Acre-feet) Monthly	Balance (Acre-feet) Cumulative[5]
October	0.857	81.5	7.3	1.1	141.1	0.0	-65.7	0.0
November	0.857	78.9	4.0	1.9	66.4	0.0	10.4	10.4
December	0.857	81.5	2.6	3.2	22.3	0.0	59.8	70.2
January	0.857	81.5	2.6	5.3	0.0	0.0	84.2	154.4
February	0.857	73.6	4.2	5.2	24.9	0.0	49.8	204.2
March	0.857	81.5	6.8	4.6	84.1	0.0	-4.7	199.5
April	0.857	78.9	9.6	1.4	180.5	0.0	-109.8	89.7
May	0.857	81.5	13.0	0.7	251.9	0.0	-182.7	0.0
June	0.857	78.9	14.6	0.2	282.8	0.0	-218.3	0.0
July	0.857	81.5	15.6	0.0	302.3	0.0	-236.3	0.0
August	0.857	81.5	14.1	0.1	272.0	0.0	-204.4	0.0
September	0.857	78.9	10.6	1.0	204.8	0.0	-135.5	0.0
		960.0	105.1	24.8	1832.9	0.0	-953.2	

[1] Irrigation requirements based on ET values for the San Joaquin Valley.

[2] Water contribution by rainfall over the pond surface areas.

[3] Percolation assumes a rate of 0.00 inch per day.

[4] Monthly excess (deficit) of water. Equal to the sum of sewage flow and precipitation less water loss through evaporation and percolation.

[5] Cummulative Balance is proposed to be either stored on the top 48" of soil (root zone) or percolated beyond the root zone. Water storage capacity of exisitng Hanford Loam soils is 0.11 in/in (See USDA Soil Survey Report).

Note: Reference precipitation and evapotranspiration data are included in this Attachment.

CITY OF COALINGA
Water Balance Assuming Evaporation and Agricultural Irrigation
1.34 MGD

DESIGN DATA	
Parameter	**Value**
Average Design Flow, MGD	1.340
Irrigation Efficiency, %	90%
Storage Pond Area, Acres	18.34
Effluent Reclamation Area, Acres	273
Percolation Rate, inch/day	0

	Sewage Flow		Evaporation Ponds	Precipitation Ponds	Irrigation Disposal Areas	Pond Percolation	Balance (Acre-feet)	
Month	**(MGD)**	**(acre-feet)**	**(acre-feet)**	**(acre-feet)**	**(acre-feet)[2]**	**(Acre-ft)[3]**	**Monthly**	**Cumulative[5]**
October	1.34	127.5	7.3	1.1	108.4	0.0	12.9	12.9
November	1.34	123.4	4.0	1.9	51.6	0.0	69.6	82.6
December	1.34	127.5	2.6	3.2	17.4	0.0	110.7	193.3
January	1.34	127.5	2.6	5.3	0.0	0.0	130.2	323.5
February	1.34	115.1	4.2	5.2	19.3	0.0	96.8	420.3
March	1.34	127.5	6.8	4.6	65.4	0.0	59.9	480.2
April	1.34	123.4	9.6	1.4	140.4	0.0	-25.2	455.0
May	1.34	127.5	13.0	0.7	195.9	0.0	-80.7	374.2
June	1.34	123.4	14.6	0.2	219.9	0.0	-111.0	263.2
July	1.34	127.5	15.6	0.0	235.1	0.0	-123.2	140.0
August	1.34	127.5	14.1	0.1	211.6	0.0	-98.0	42.0
September	1.34	123.4	10.6	1.0	159.3	0.0	-45.5	0.0
		1,501.0	105.1	24.8	1424.3	0.0	-3.5	

[1] Irrigation requirements based on ET values for the San Joaquin Valley.

[2] Water contribution by rainfall over the pond surface areas

[3] Percolation assumes a rate of 0.00 inch per day.

[4] Monthly excess (deficit) of water. Equal to the sum of sewage flow and precipitation less water loss through evaporation and percolation.

[5] Cummulative Balance is proposed to be either stored on the top 24" of soil (root zone) or percolated beyond the root zone. Water storage capacity of exisitng Exclusive sandy loam soils is 0.10 in/in (See USDA Soil Survey Report).

Note: Reference precipitation and evapotranspiration data are included in the Appendix.

CITY OF COALINGA

Precipitation and Evaporation Reference Data

Month	Days	Crop Coefficients (kc)[1]		Ref Evap (inches)	Precipitation (inches)			Eff. Precipitation (inches)[5]
		Ponds	Grass	ETo[2]	Normal[3]		100-yr[4]	
October	31	1.1	1.00	4.34	0.38	0.05	0.74	0.05
November	30	1.1	1.00	2.40	0.64	0.36	1.25	0.36
December	31	1.1	1.00	1.55	1.07	0.86	2.09	0.86
January	31	1.1	1.00	1.55	1.78	1.80	3.48	1.80
February	28	1.1	1.00	2.52	1.75	1.76	3.42	1.76
March	31	1.1	1.00	4.03	1.55	1.44	3.03	1.44
April	30	1.1	1.00	5.70	0.46	0.15	0.90	0.15
May	31	1.1	1.00	7.75	0.24	(0.11)	0.47	0.00
June	30	1.1	1.00	8.70	0.06	(0.32)	0.12	0.00
July	31	1.1	1.00	9.30	0.01	(0.38)	0.02	0.00
August	31	1.1	1.00	8.37	0.04	(0.35)	0.08	0.00
September	30	1.1	1.00	6.30	0.32	(0.02)	0.63	0.00
Total				**62.51**	**8.30**		**16.24**	

[1] Irrigation with Reclaimed Municipal Wastewater. A guidance manual. PettyGrove and Asano, 1986.

[2] California Irrigation Management Information System (ET_0 Map)

[3] National Climate Data Center. Normal Precipitation (1971-2000).

[4] Rainfall-Depth Duration Frequency for California. California Dept. of Water Resources, Division of Planning, February 1981.

[5] Effective Precipitation: FAO Irrigation Water Management, Training Manual No. 3.

Appendix B

Air Emission Output Files

Coalinga Sewer Pipeline Replacement Detailed Report

Table of Contents

1. Basic Project Information
   1.1. Basic Project Information
   1.2. Land Use Types
   1.3. User-Selected Emission Reduction Measures by Emissions Sector
2. Emissions Summary
   2.1. Construction Emissions Compared Against Thresholds
   2.2. Construction Emissions by Year
      2.2.1. Total Construction Emissions by Year, Unmitigated
      2.2.2. Onsite Construction Emissions by Year, Unmitigated
      2.2.3. Offsite Construction Emissions by Year, Unmitigated
3. Construction Emissions Details
   3.1. Linear, Grubbing & Land Clearing (2027)
      3.1.1. Onsite - Unmitigated
      3.1.2. Offsite - Unmitigated
   3.2. Linear, Grading & Excavation (2027)
      3.2.1. Onsite - Unmitigated
      3.2.2. Offsite - Unmitigated
   3.3. Linear, Drainage, Utilities, & Sub-Grade (2027)

3.3.1. Onsite - Unmitigated
3.3.2. Offsite - Unmitigated
3.4. Linear, Paving (2027)
3.4.1. Onsite - Unmitigated
3.4.2. Offsite - Unmitigated
4. Operations Emissions Details
4.10. Soil Carbon Accumulation By Vegetation Type
4.10.1. Soil Carbon Accumulation By Vegetation Type - Unmitigated
4.10.2. Above and Belowground Carbon Accumulation by Land Use Type - Unmitigated
4.10.3. Avoided and Sequestered Emissions by Species - Unmitigated
5. Activity Data
5.1. Construction Schedule
5.2. Off-Road Equipment
5.2.1. Unmitigated
5.3. Construction Vehicles
5.3.1. Unmitigated
5.4. Vehicles
5.4.1. Construction Vehicle Control Strategies
5.5. Architectural Coatings
5.6. Dust Mitigation
5.6.1. Construction Earthmoving Activities
5.6.2. Construction Earthmoving Control Strategies

5.7. Construction Paving
5.8. Construction Electricity Consumption and Emissions Factors
5.18. Vegetation
5.18.1. Land Use Change
5.18.1.1. Unmitigated
5.18.1. Biomass Cover Type
5.18.1.1. Unmitigated
5.18.2. Sequestration
5.18.2.1. Unmitigated
6. Climate Risk Detailed Report
6.1. Climate Risk Summary
6.2. Initial Climate Risk Scores
6.3. Adjusted Climate Risk Scores
6.4. Climate Risk Reduction Measures
7. Health and Equity Details
7.1. CalEnviroScreen 4.0 Scores
7.2. Healthy Places Index Scores
7.3. Overall Health & Equity Scores
7.4. Health & Equity Measures
7.5. Evaluation Scorecard
7.6. Health & Equity Custom Measures
8. User Changes to Default Data

8.1. Justifications

1. Basic Project Information

1.1. Basic Project Information

Data Field	Value
Project Name	Coalinga Sewer Pipeline Replacement
Construction Start Date	1/1/2027
Lead Agency	—
Land Use Scale	Project/site
Analysis Level for Defaults	County
Windspeed (m/s)	3.50000
Precipitation (days)	16.8000
Location	36.14350657546261, -120.3644755280045
County	Fresno
City	Coalinga
Air District	San Joaquin Valley APCD
Air Basin	San Joaquin Valley
TAZ	2531
EDFZ	5
Electric Utility	Pacific Gas & Electric Company
Gas Utility	City of Coalinga
App Version	2022.1.1.45

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
Road Widening	10.00000	Mile	12.0000	0.00000	—	—	—	—

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.	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	4.32532	3.68031	28.0878	39.2304	0.07068	1.18206	0.47938	1.66145	1.08751	0.11251	1.20002	—	8,168.44	8,168.44	0.32440	0.08457	1.65564	8,203.40
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	4.28860	3.62873	28.1284	38.7076	0.07068	1.18206	0.47938	1.66145	1.08751	0.11251	1.20002	—	8,111.53	8,111.53	0.33019	0.08650	0.04296	8,145.61
Average Daily (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	1.18945	1.01367	7.74016	10.9758	0.01931	0.31478	0.17372	0.48850	0.28960	0.04072	0.33032	—	2,241.22	2,241.22	0.08973	0.02543	0.26057	2,251.30

Un/Mit.	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Annual (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unmit.	0.21707	0.18500	1.41258	2.00308	0.00352	0.05745	0.03170	0.08915	0.05285	0.00743	0.06028	—	371.059	371.059	0.01486	0.00421	0.04314	372.728

2.2. Construction Emissions by Year

2.2.1. Total Construction Emissions by Year, Unmitigated

Includes both onsite and offsite emissions.

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

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	4.32532	3.68031	28.0878	39.2304	0.07068	1.18206	0.47938	1.66145	1.08751	0.11251	1.20002	—	8,168.44	8,168.44	0.32440	0.08457	1.65564	8,203.40
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	4.28860	3.62873	28.1284	38.7076	0.07068	1.18206	0.47938	1.66145	1.08751	0.11251	1.20002	—	8,111.53	8,111.53	0.33019	0.08650	0.04296	8,145.61
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	1.18945	1.01367	7.74016	10.9758	0.01931	0.31478	0.17372	0.48850	0.28960	0.04072	0.33032	—	2,241.22	2,241.22	0.08973	0.02543	0.26057	2,251.30
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	0.21707	0.18500	1.41258	2.00308	0.00352	0.05745	0.03170	0.08915	0.05285	0.00743	0.06028	—	371.059	371.059	0.01486	0.00421	0.04314	372.728

2.2.2. Onsite 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	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	3.98784	3.35089	27.9061	36.4512	0.07059	1.18188	0.00000	1.18188	1.08733	0.00000	1.08733	—	7,644.02	7,644.02	0.31008	0.06202	0.00000	7,670.26
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	3.98784	3.35089	27.9061	36.4512	0.07059	1.18188	0.00000	1.18188	1.08733	0.00000	1.08733	—	7,644.02	7,644.02	0.31008	0.06202	0.00000	7,670.26
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	1.07765	0.90477	7.66995	10.1369	0.01929	0.31475	0.00000	0.31475	0.28957	0.00000	0.28957	—	2,065.60	2,065.60	0.08379	0.01676	0.00000	2,072.69
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	0.19667	0.16512	1.39977	1.84998	0.00352	0.05744	0.00000	0.05744	0.05285	0.00000	0.05285	—	341.983	341.983	0.01387	0.00277	0.00000	343.157

2.2.3. Offsite 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	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	0.33748	0.32941	0.18167	2.77921	0.00009	0.00018	0.47938	0.47956	0.00018	0.11251	0.11268	—	524.412	524.412	0.01433	0.02255	1.65564	533.147
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	0.30077	0.27784	0.22230	2.25643	0.00009	0.00018	0.47938	0.47956	0.00018	0.11251	0.11268	—	467.509	467.509	0.02011	0.02448	0.04296	475.351

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	0.11180	0.10890	0.07021	0.83893	0.00002	0.00003	0.17372	0.17375	0.00003	0.04072	0.04075	—	175.619	175.619	0.00594	0.00867	0.26057	178.611
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2027	0.02040	0.01987	0.01281	0.15310	< 0.00005	0.00001	0.03170	0.03171	0.00001	0.00743	0.00744	—	29.0757	29.0757	0.00098	0.00143	0.04314	29.5710

3. Construction Emissions Details

3.1. Linear, Grubbing & Land Clearing (2027)

3.1.1. Onsite - 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	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.50946	0.42808	3.80861	4.46942	0.00584	0.18470	—	0.18470	0.16993	—	0.16993	—	632.486	632.486	0.02566	0.00513	—	634.656
Onsite truck	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.02094	0.01759	0.15652	0.18367	0.00024	0.00759	—	0.00759	0.00698	—	0.00698	—	25.9926	25.9926	0.00105	0.00021	—	26.0818
Onsite truck	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.00382	0.00321	0.02856	0.03352	0.00004	0.00139	—	0.00139	0.00127	—	0.00127	—	4.30336	4.30336	0.00017	0.00003	—	4.31813
Onsite truck	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.1.2. Offsite - 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	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.19699	0.18216	0.13222	1.47669	0.00000	0.00000	0.31282	0.31282	0.00000	0.07332	0.07332	—	296.818	296.818	0.01268	0.01483	0.02778	301.583
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Worker	0.00820	0.00799	0.00488	0.06151	0.00000	0.00000	0.01272	0.01272	0.00000	0.00298	0.00298	—	12.6327	12.6327	0.00042	0.00061	0.01899	12.8437
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00150	0.00146	0.00089	0.01123	0.00000	0.00000	0.00232	0.00232	0.00000	0.00054	0.00054	—	2.09149	2.09149	0.00007	0.00010	0.00314	2.12643
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.2. Linear, Grading & Excavation (2027)

3.2.1. Onsite - 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	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	3.98784	3.35089	27.9061	36.4512	0.07059	1.18188	—	1.18188	1.08733	—	1.08733	—	7,644.02	7,644.02	0.31008	0.06202	—	7,670.26
Onsite truck	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	3.98784	3.35089	27.9061	36.4512	0.07059	1.18188	—	1.18188	1.08733	—	1.08733	—	7,644.02	7,644.02	0.31008	0.06202	—	7,670.26
Onsite truck	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.74294	0.62428	5.19895	6.79091	0.01315	0.22019	—	0.22019	0.20257	—	0.20257	—	1,424.09	1,424.09	0.05777	0.01155	—	1,428.98
Onsite truck	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.13559	0.11393	0.94881	1.23934	0.00240	0.04018	—	0.04018	0.03697	—	0.03697	—	235.775	235.775	0.00956	0.00191	—	236.584
Onsite truck	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.2.2. Offsite - 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	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.33643	0.32871	0.16185	2.77030	0.00000	0.00000	0.47603	0.47603	0.00000	0.11158	0.11158	—	508.609	508.609	0.01350	0.02064	1.62916	516.726
Vendor	0.00106	0.00071	0.01982	0.00891	0.00009	0.00018	0.00336	0.00353	0.00018	0.00093	0.00110	—	12.6314	12.6314	0.00031	0.00185	0.02648	13.2175
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.29977	0.27720	0.20120	2.24714	0.00000	0.00000	0.47603	0.47603	0.00000	0.11158	0.11158	—	451.680	451.680	0.01929	0.02257	0.04227	458.930
Vendor	0.00099	0.00064	0.02110	0.00928	0.00009	0.00018	0.00336	0.00353	0.00018	0.00093	0.00110	—	12.6569	12.6569	0.00031	0.00185	0.00069	13.2171
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.05657	0.05513	0.03364	0.42432	0.00000	0.00000	0.08773	0.08773	0.00000	0.02055	0.02055	—	87.1473	87.1473	0.00288	0.00420	0.13098	88.6032
Vendor	0.00019	0.00012	0.00384	0.00169	0.00002	0.00003	0.00062	0.00065	0.00003	0.00017	0.00020	—	2.35524	2.35524	0.00006	0.00035	0.00213	2.46162
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01032	0.01006	0.00614	0.07744	0.00000	0.00000	0.01601	0.01601	0.00000	0.00375	0.00375	—	14.4282	14.4282	0.00048	0.00070	0.02169	14.6693
Vendor	0.00003	0.00002	0.00070	0.00031	< 0.000005	0.00001	0.00011	0.00012	0.00001	0.00003	0.00004	—	0.38994	0.38994	0.00001	0.00006	0.00035	0.40755
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.3. Linear, Drainage, Utilities, & Sub-Grade (2027)

3.3.1. Onsite - 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	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	2.06595	1.72988	15.0381	19.6689	0.03954	0.56552	—	0.56552	0.52028	—	0.52028	—	4,088.78	4,088.78	0.16586	0.03317	—	4,102.81
Onsite truck	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.25471	0.21327	1.85402	2.42493	0.00488	0.06972	—	0.06972	0.06414	—	0.06414	—	504.096	504.096	0.02045	0.00409	—	505.826
Onsite truck	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.04648	0.03892	0.33836	0.44255	0.00089	0.01272	—	0.01272	0.01171	—	0.01171	—	83.4588	83.4588	0.00339	0.00068	—	83.7453
Onsite truck	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.3.2. Offsite - 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	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.28836	0.28175	0.13873	2.37454	0.00000	0.00000	0.40803	0.40803	0.00000	0.09564	0.09564	—	435.950	435.950	0.01157	0.01769	1.39643	442.908

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.03209	0.03127	0.01908	0.24069	0.00000	0.00000	0.04976	0.04976	0.00000	0.01166	0.01166	—	49.4323	49.4323	0.00163	0.00239	0.07430	50.2581
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00586	0.00571	0.00348	0.04393	0.00000	0.00000	0.00908	0.00908	0.00000	0.00213	0.00213	—	8.18408	8.18408	0.00027	0.00039	0.01230	8.32081
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.4. Linear, Paving (2027)

3.4.1. Onsite - 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	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Off-Road Equipment	0.93732	0.78761	7.30737	11.7016	0.01633	0.27376	—	0.27376	0.25186	—	0.25186	—	1,768.15	1,768.15	0.07172	0.01434	—	1,774.22
Onsite truck	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.05906	0.04963	0.46046	0.73736	0.00103	0.01725	—	0.01725	0.01587	—	0.01587	—	111.418	111.418	0.00452	0.00090	—	111.800
Onsite truck	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01078	0.00906	0.08403	0.13457	0.00019	0.00315	—	0.00315	0.00290	—	0.00290	—	18.4465	18.4465	0.00075	0.00015	—	18.5098
Onsite truck	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

3.4.2. Offsite - 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	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.25953	0.25358	0.12485	2.13709	0.00000	0.00000	0.36722	0.36722	0.00000	0.08608	0.08608	—	392.355	392.355	0.01042	0.01592	1.25678	398.618

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01476	0.01438	0.00878	0.11072	0.00000	0.00000	0.02289	0.02289	0.00000	0.00536	0.00536	—	22.7389	22.7389	0.00075	0.00110	0.03418	23.1187
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.00269	0.00263	0.00160	0.02021	0.00000	0.00000	0.00418	0.00418	0.00000	0.00098	0.00098	—	3.76468	3.76468	0.00012	0.00018	0.00566	3.82757
Vendor	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Hauling	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	—	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

4. Operations Emissions Details

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	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
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	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
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	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Avoided	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sequestered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Removed	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Subtotal	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Species	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
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
Linear, Grubbing & Land Clearing	Linear, Grubbing & Land Clearing	1/1/2027	1/22/2027	5.00000	15.0000	—
Linear, Grading & Excavation	Linear, Grading & Excavation	1/23/2027	4/28/2027	5.00000	68.0000	—
Linear, Drainage, Utilities, & Sub-Grade	Linear, Drainage, Utilities, & Sub-Grade	4/29/2027	7/1/2027	5.00000	45.0000	—
Linear, Paving	Linear, Paving	7/2/2027	8/3/2027	5.00000	23.0000	—

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
Linear, Grubbing & Land Clearing	Crawler Tractors	Diesel	Average	1.000000	8.00000	87.0000	0.43000
Linear, Grubbing & Land Clearing	Excavators	Diesel	Average	2.00000	8.00000	36.0000	0.38000
Linear, Grubbing & Land Clearing	Signal Boards	Electric	Average	20.0000	8.00000	6.00000	0.82000
Linear, Grading & Excavation	Crawler Tractors	Diesel	Average	1.000000	8.00000	87.0000	0.43000
Linear, Grading & Excavation	Excavators	Diesel	Average	3.00000	8.00000	36.0000	0.38000
Linear, Grading & Excavation	Graders	Diesel	Average	2.00000	8.00000	148.000	0.41000
Linear, Grading & Excavation	Rollers	Diesel	Average	2.00000	8.00000	36.0000	0.38000
Linear, Grading & Excavation	Rubber Tired Loaders	Diesel	Average	1.000000	8.00000	150.000	0.36000
Linear, Grading & Excavation	Scrapers	Diesel	Average	2.00000	8.00000	423.000	0.48000
Linear, Grading & Excavation	Signal Boards	Electric	Average	20.0000	8.00000	6.00000	0.82000
Linear, Grading & Excavation	Tractors/Loaders/ Backhoes	Diesel	Average	4.00000	8.00000	84.0000	0.37000
Linear, Drainage, Utilities, & Sub-Grade	Air Compressors	Diesel	Average	1.000000	8.00000	37.0000	0.48000

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Linear, Drainage, Utilities, & Sub-Grade	Generator Sets	Diesel	Average	1.000000	8.00000	14.0000	0.74000
Linear, Drainage, Utilities, & Sub-Grade	Graders	Diesel	Average	1.000000	8.00000	148.000	0.41000
Linear, Drainage, Utilities, & Sub-Grade	Plate Compactors	Diesel	Average	1.000000	8.00000	8.00000	0.43000
Linear, Drainage, Utilities, & Sub-Grade	Pumps	Diesel	Average	1.000000	8.00000	11.0000	0.74000
Linear, Drainage, Utilities, & Sub-Grade	Rough Terrain Forklifts	Diesel	Average	1.000000	8.00000	96.0000	0.40000
Linear, Drainage, Utilities, & Sub-Grade	Scrapers	Diesel	Average	1.000000	8.00000	423.000	0.48000
Linear, Drainage, Utilities, & Sub-Grade	Signal Boards	Electric	Average	20.0000	8.00000	6.00000	0.82000
Linear, Drainage, Utilities, & Sub-Grade	Tractors/Loaders/ Backhoes	Diesel	Average	3.00000	8.00000	84.0000	0.37000
Linear, Paving	Pavers	Diesel	Average	1.000000	8.00000	81.0000	0.42000
Linear, Paving	Paving Equipment	Diesel	Average	1.000000	8.00000	89.0000	0.36000
Linear, Paving	Rollers	Diesel	Average	2.00000	8.00000	36.0000	0.38000
Linear, Paving	Signal Boards	Electric	Average	20.0000	8.00000	6.00000	0.82000
Linear, Paving	Tractors/Loaders/ Backhoes	Diesel	Average	3.00000	8.00000	84.0000	0.37000

5.3. Construction Vehicles

5.3.1. Unmitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Linear, Grubbing & Land Clearing	Worker	57.5000	7.70000	LDA,LDT1,LDT2
Linear, Grubbing & Land Clearing	Vendor	0.00000	4.00000	HHDT,MHDT
Linear, Grubbing & Land Clearing	Hauling	0.00000	20.0000	HHDT
Linear, Grubbing & Land Clearing	Onsite truck	—	—	HHDT
Linear, Grading & Excavation	Worker	87.5000	7.70000	LDA,LDT1,LDT2
Linear, Grading & Excavation	Vendor	1.000000	4.00000	HHDT,MHDT
Linear, Grading & Excavation	Hauling	0.00000	20.0000	HHDT
Linear, Grading & Excavation	Onsite truck	—	—	HHDT
Linear, Drainage, Utilities, & Sub-Grade	Worker	75.0000	7.70000	LDA,LDT1,LDT2
Linear, Drainage, Utilities, & Sub-Grade	Vendor	0.00000	4.00000	HHDT,MHDT
Linear, Drainage, Utilities, & Sub-Grade	Hauling	0.00000	20.0000	HHDT
Linear, Drainage, Utilities, & Sub-Grade	Onsite truck	—	—	HHDT
Linear, Paving	Worker	67.5000	7.70000	LDA,LDT1,LDT2
Linear, Paving	Vendor	0.00000	4.00000	HHDT,MHDT
Linear, Paving	Hauling	0.00000	20.0000	HHDT
Linear, Paving	Onsite truck	—	—	HHDT

5.4. Vehicles

5.4.1. Construction Vehicle Control Strategies

Non-applicable. No control strategies activated by user.

5.5. Architectural Coatings

5.6. Dust Mitigation

5.6.1. Construction Earthmoving Activities

5.6.2. Construction Earthmoving Control Strategies

Non-applicable. No control strategies activated by user.

5.7. Construction Paving

5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

Year	kWh per Year	CO2	CH4	N2O
2027	2,348.06	203.983	0.03300	0.00400

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	25.1400	annual days of extreme heat
Extreme Precipitation	1.65000	annual days with precipitation above 20 mm
Sea Level Rise	—	meters of inundation depth
Wildfire	0.00000	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 (Radke et al., 2017, CEC-500-2017-008), and consider inundation location and depth for the San Francisco Bay, the Sacramento-San Joaquin River Delta and California coast resulting different increments of sea level rise coupled with extreme storm events. Users may select from four scenarios to view the range in potential inundation depth for the grid cell. The four scenarios are: No rise, 0.5 meter, 1.0 meter, 1.41 meters

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	2	0	0	N/A
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	N/A	N/A	N/A	N/A
Wildfire	N/A	N/A	N/A	N/A
Flooding	0	0	0	N/A
Drought	0	0	0	N/A
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	0	0	0	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	2	1	1	3
Extreme Precipitation	N/A	N/A	N/A	N/A
Sea Level Rise	N/A	N/A	N/A	N/A
Wildfire	N/A	N/A	N/A	N/A
Flooding	1	1	1	2
Drought	1	1	1	2
Snowpack Reduction	N/A	N/A	N/A	N/A
Air Quality Degradation	1	1	1	2

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	—

Indicator	Result for Project Census Tract
AQ-Ozone	65.6876
AQ-PM	44.9782
AQ-DPM	48.2390
Drinking Water	66.2420
Lead Risk Housing	50.3718
Pesticides	60.5862
Toxic Releases	31.6079
Traffic	2.93750
Effect Indicators	—
CleanUp Sites	91.0414
Groundwater	40.7604
Haz Waste Facilities/Generators	43.2958
Impaired Water Bodies	23.8765
Solid Waste	52.8981
Sensitive Population	—
Asthma	72.1211
Cardio-vascular	91.6002
Low Birth Weights	49.9102
Socioeconomic Factor Indicators	—
Education	69.1977
Housing	52.0913

Indicator	Result for Project Census Tract
Linguistic	36.9739
Poverty	57.4372
Unemployment	51.2624

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	43.55190556
Employed	29.10304119
Median HI	46.75991274
Education	—
Bachelor's or higher	30.70704478
High school enrollment	5.569100475
Preschool enrollment	20.53124599
Transportation	—
Auto Access	30.77120493
Active commuting	37.16155524
Social	—
2-parent households	17.16925446
Voting	26.22866675

Indicator	Result for Project Census Tract
Neighborhood	—
Alcohol availability	56.37110227
Park access	32.00307969
Retail density	30.32208392
Supermarket access	64.76324907
Tree canopy	12.96034903
Housing	—
Homeownership	44.15501091
Housing habitability	71.60272039
Low-inc homeowner severe housing cost burden	69.34428333
Low-inc renter severe housing cost burden	69.76774028
Uncrowded housing	56.30694213
Health Outcomes	—
Insured adults	67.2783267
Arthritis	0.0
Asthma ER Admissions	31.4
High Blood Pressure	0.0
Cancer (excluding skin)	0.0
Asthma	0.0
Coronary Heart Disease	0.0
Chronic Obstructive Pulmonary Disease	0.0

Indicator	Result for Project Census Tract
Diagnosed Diabetes	0.0
Life Expectancy at Birth	16.3
Cognitively Disabled	52.2
Physically Disabled	10.4
Heart Attack ER Admissions	0.4
Mental Health Not Good	0.0
Chronic Kidney Disease	0.0
Obesity	0.0
Pedestrian Injuries	57.7
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	0.0
SLR Inundation Area	0.0
Children	40.5
Elderly	67.6
English Speaking	65.8

Indicator	Result for Project Census Tract
Foreign-born	19.9
Outdoor Workers	7.3
Climate Change Adaptive Capacity	—
Impervious Surface Cover	46.7
Traffic Density	1.0
Traffic Access	0.0
Other Indices	—
Hardship	59.6
Other Decision Support	—
2016 Voting	46.1

7.3. Overall Health & Equity Scores

Metric	Result for Project Census Tract
CalEnviroScreen 4.0 Score for Project Location (a)	72.0000
Healthy Places Index Score for Project Location (b)	28.0000
Project Located in a Designated Disadvantaged Community (Senate Bill 535)	No
Project Located in a Low-Income Community (Assembly Bill 1550)	No
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

8.1. Justifications

Screen	Justification
Construction: Dust From Material Movement	no soil will be imported or exported

Appendix C

Biological Resource Evaluation

SANITARY SEWER COLLECTION SYSTEM AND WASTEWATER TREATMENT PLANT IMPROVEMENTS BIOLOGICAL EVALUATION CITY OF COALINGA, CALIFORNIA

Prepared by

LIVE OAK ASSOCIATES, INC.

Natalie Neff, Staff Ecologist
Rebekah Jensen, Senior Project Manager and Ecologist
Austin Pearson, Vice President

Prepared for

Travis Crawford
Crawford and Bowen Planning, Inc.
113 N. Church Street
Visalia, CA 93291

May 1, 2025 PN 2887-01

OAKHURST
P.O. Box 2697 | 39930 Sierra Way #B
Oakhurst, CA 93644
P: (559) 642-4880 | F: (559) 642-4883

SAN JOSE
6840 Via Del Oro, Suite 220
San Jose, CA 95119
(408) 224-8300

SOUTH LAKE TAHOE
P.O. Box 7314
South Lake Tahoe, CA 96158
(408) 281-5885

WWW.LOAINC.COM

TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 PROJECT DESCRIPTION 1

1.2 REPORT OBJECTIVES 4

1.3 STUDY METHODOLOGY 5

2.0 EXISTING CONDITIONS 6

2.1 REGIONAL SETTING 6

2.2 PROJECT SITE 6

2.3 BIOTIC HABITATS / LAND USES 8

2.3.1 Urban 8

2.3.2 Rural 10

2.3.3 Wastewater Treatment Facility 11

2.4 SPECIAL STATUS PLANTS AND ANIMALS 12

2.5 JURISDICTIONAL WATERS 23

2.6 DESIGNATED CRITICAL HABITAT 23

2.7 SENSITIVE NATURAL COMMUNITIES 24

2.8 WILDLIFE MOVEMENT CORRIDORS 24

3.0 RELEVANT GOALS, POLICIES, AND LAWS 25

3.1 CALIFORNIA ENVIRONMENTAL QUALITY ACT 25

3.2 NATIONAL ENVIORNMENTAL POLICY ACT 26

3.3 GENERAL PLAN POLICIES OF THE CITY OF COALINGA 27

3.4 THREATENED AND ENDANGERED SPECIES 27

3.5 MIGRATORY BIRDS 28

3.6 BIRDS OF PREY 28

3.7 NESTING BIRDS 29

3.8 HABITAT CONSERVATION PLANS AND NATURAL COMMUNITY CONSERVATION PLANS 29

3.9 WETLANDS AND OTHER JURISDICTIONAL WATERS 29

4.0 IMPACTS AND MITIGATIONS 32

4.1 POTENTIALLY SIGNIFICANT PROJECT IMPACTS 32

4.1.1 Project Impacts to Monarch Butterfly 32

4.1.2 Potential Project Impacts to the Southwestern Pond Turtle 33

4.1.3 Potential Project Impacts to the Temblor Legless Lizard, California Glossy Snake, and San Joaquin Coachwhip 36

4.1.4 Potential Project Impacts to the Swainson's Hawk 38
4.1.5 Potential Project Impacts to the Burrowing Owl 39
4.1.6 Potential Project Impacts to the San Joaquin Kit Fox 40
4.1.7 Potential Project Impacts to the American Badger 42
4.1.8 Potential Project Impacts to Nesting Migratory Birds and Raptors including the Long-eared Owl 43
4.2 LESS THAN SIGNIFICANT PROJECT IMPACTS 44
4.2.1 Project Impacts to Special Status Plant Species 44
4.2.2 Project Impacts to Special Status Animal Species that Would Use the Site for Non-sensitive Activities Only 44
4.2.3 Project Impacts to Roosting Bats including Townsend's Big-eared Bat and Western Mastiff Bat 45
4.2.4 Project Impacts to Special Status Animal Species Absent from, or Unlikely to Occur within, the Project Site 46
4.2.5 Project Impacts to Riparian Habitat and Sensitive Natural Communities 46
4.2.6 Potential Project Impacts to Waters of the State and U.S. 47
4.2.7 Project Impacts to Wildlife Movement Corridors 47
4.2.8 Project Impacts to Designated Critical Habitat 47
4.2.9 Local Policies or Habitat Conservation Plans 48
4.3 SECTION 7 DETERMINATIONS FOR FEDERALLY LISTED SPECIES 48
5.0 LITERATURE REFERENCED 50
APPENDIX A: VASCULAR PLANTS OF THE PROJECT SITE 52
APPENDIX B: TERRESTRIAL VERTEBRATE SPECIES THAT POTENTIALLY OCCUR ON THE PROJECT SITE 56
APPENDIX C: SELECTED SITE PHOTOGRAPHS 62
APPENDIX D: USFWS INFORMATION FOR PLANNING AND CONSULTATION OFFICIAL SPECIES LIST 69

1.0 INTRODUCTION

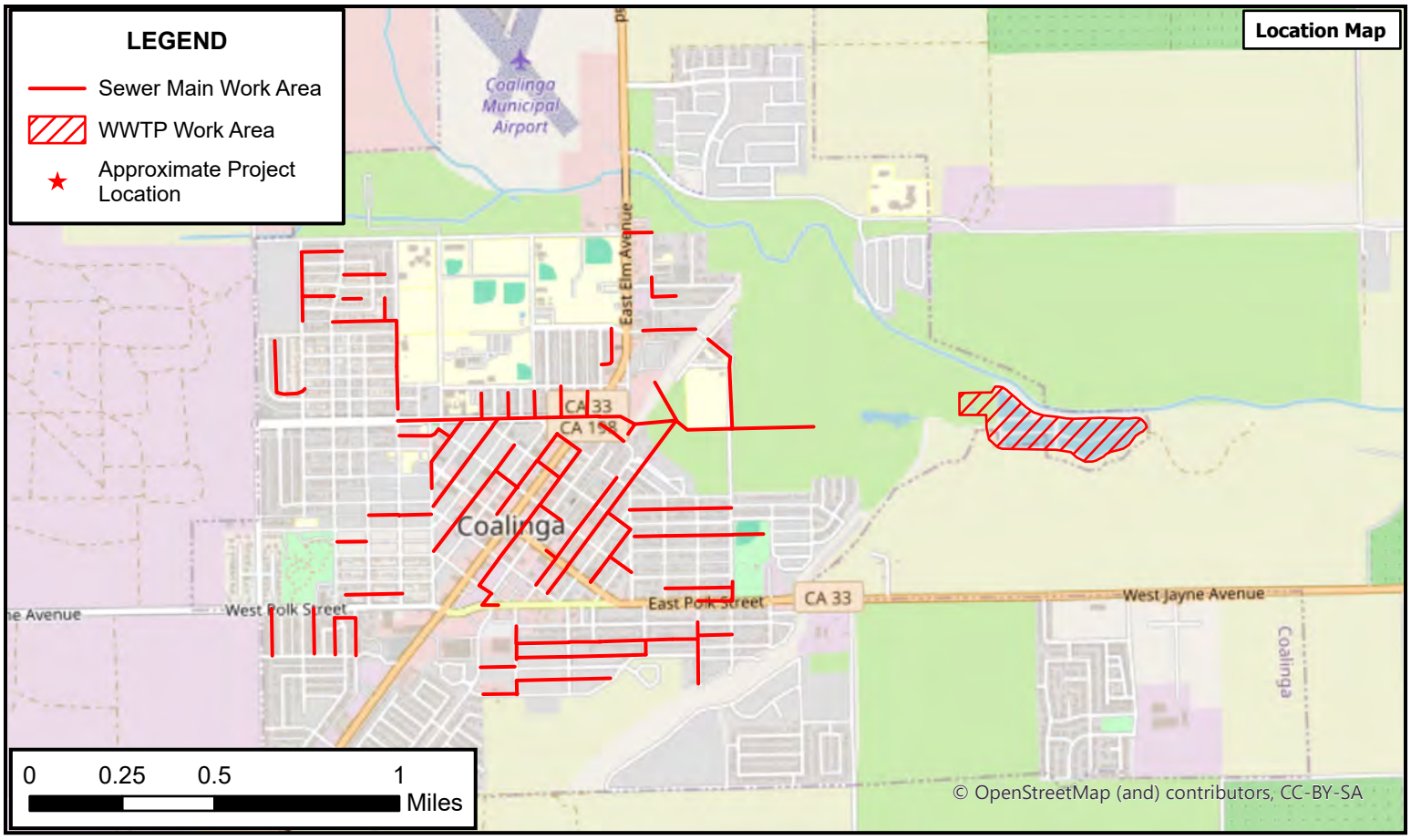
This technical report, prepared by Live Oak Associates, Inc. (LOA) to facilitate compliance with the California Environmental Quality Act (CEQA), National Environmental Policy Act (NEPA), and Section 7 of the federal Endangered Species Act, describes the biotic resources of lands that may be affected by the City of Coalinga's proposed Sanitary Sewer Collection System and Wastewater Treatment Plant Improvements Project ("project"), and evaluates potential impacts to those resources that could result from the project. The project's area of potential effect, or "project site," consists of a discontinuous, 50,616-linear-foot alignment along which existing sewer mains will be rehabilitated or replaced ("sewer main work area"), and an approximately 30-acre portion of the City's wastewater treatment plant (WWTP) proposed for various improvements ("WWTP work area").

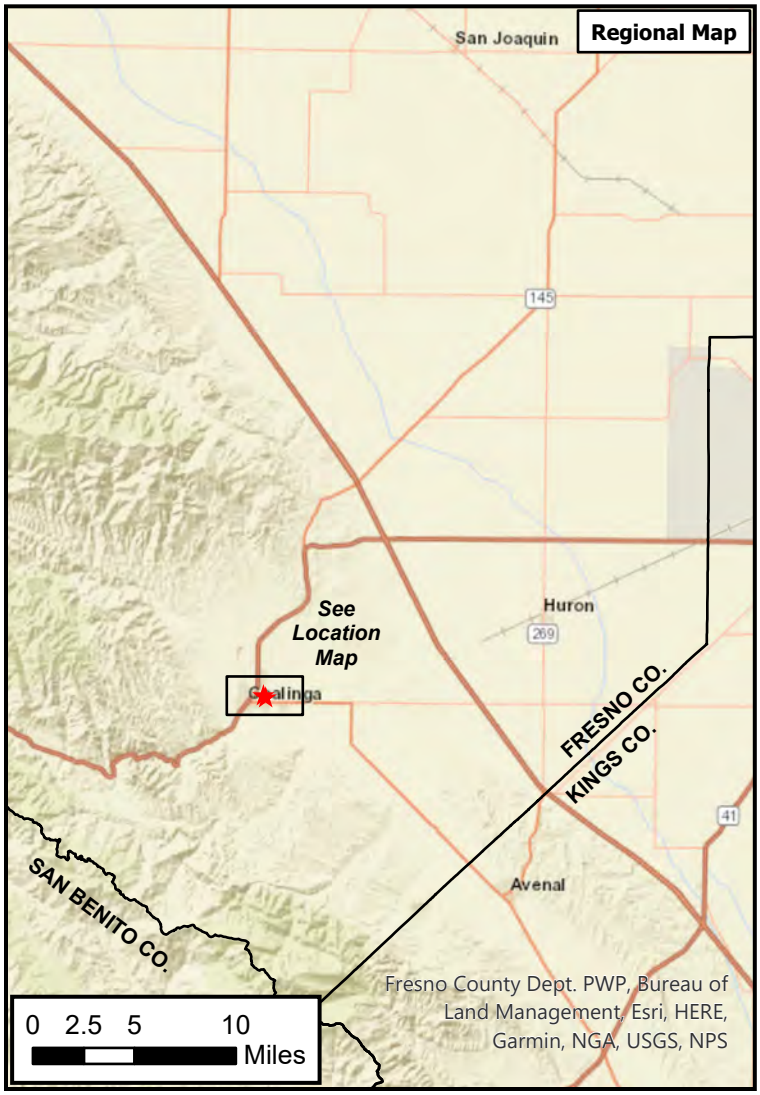
The project site is located within the City of Coalinga in Fresno County, California (Figure 1). It may be found on the *Coalinga* U.S. Geological Survey (USGS) 7.5-minute quadrangle in Sections 32, 33, and 34 in Township 20 South and in Sections 4 and 5 in Township 21 South, Range 15 East, Mount Diablo Base and Meridian (Figure 2).

1.1 PROJECT DESCRIPTION

The City of Coalinga owns and operates a citywide sewer collection system and wastewater treatment plant (WWTP) under Water Discharge Requirements (WDR) No. 94-184. A condition survey of the sewer collection system was recently conducted and revealed that approximately 19,801 linear feet (lf) of gravity sewer mains need rehabilitation and that approximately 30,815 lf of gravity sewer mains need replacing. In addition, improvements are needed at the City's WWTP due to lack of effluent disposal alternatives.

Two trenchless construction methods, cured-in-place pipe (CIPP) and pipe bursting, will be utilized to rehabilitate pipelines with cracks, light root intrusion, small sags, small holes with no void, small offset joints, and structurally deficient segments. The CIPP method uses a flexible fabric liner coated with a thermosetting resin to form a new pipe inside the existing pipe. The liner will be inserted into the pipes at existing manholes, and will be cured with heat, forming a strong bond between the tube and existing pipe. The pipe bursting method involves pulling the





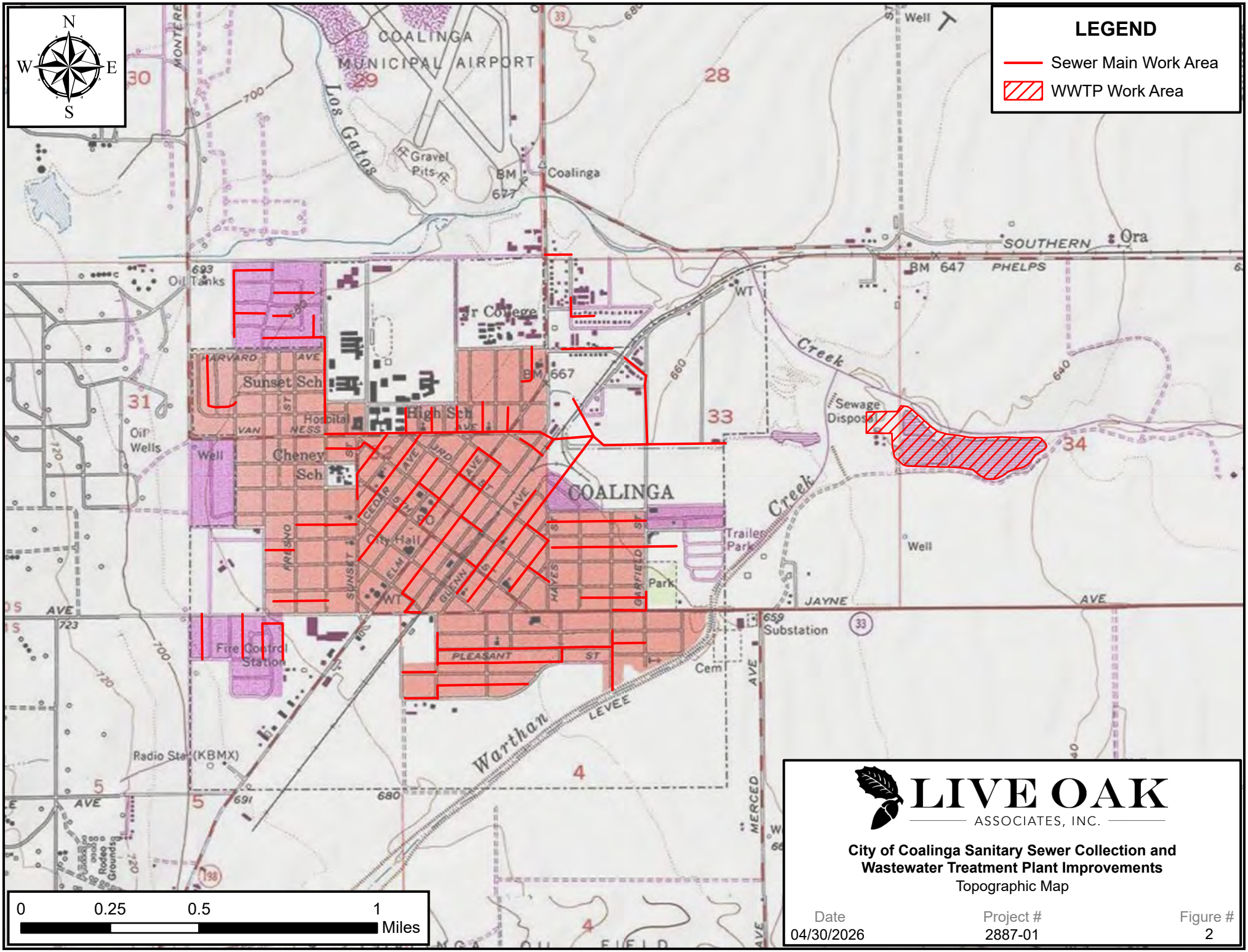


LIVE OAK ASSOCIATES, INC.

City of Coalinga Sanitary Sewer Collection and Wastewater Treatment Plant Improvements

Vicinity Map

Date	Project #	Figure #
04/30/2026	2887-01	1



LIVE OAK ASSOCIATES, INC.

City of Coalinga Sanitary Sewer Collection and Wastewater Treatment Plant Improvements

Topographic Map

Date	Project #	Figure #
04/30/2026	2887-01	2

new replacement pipe through the old pipe and breaking the old pipe into pieces during replacement. Laterals that need connecting are done via conventional excavation methods.

Pipes that cannot be rehabilitated will be replaced in kind with conventional open trench construction methods. Open trench widths will range from 1 foot to 2.5 feet depending on the diameter of the pipes to be replaced; pipe diameters range from 6 inches to 10 inches. Nearly all sewer line work will be confined to city streets and drives, with no construction activities outside the traveled way. In the few instances where the sewer lines to be rehabilitated or replaced are located outside of the traveled way, all project-related disturbance will be confined to an approximately 20-foot wide corridor centered on the pipe alignment.

The City's WWTP will be upgraded to an extended aeration system with biological nutrient removal with filtration and disinfection. The improvements will include a new aeration tank, two clarifiers, and five percolation ponds. The percolation ponds will be developed within the footprints of the facility's existing ponds, which comprise two aerated lagoons and three stabilization ponds. The existing ponds will be decommissioned and dewatered, following which heavy equipment will be used to remove the clay liners from the bottom of each pond, converting their function to evaporation/percolation. The WWTP improvements will serve to lower the nitrogen concentration of the resulting effluent before it is discharged to the percolation ponds and allowed to percolate into the underground aquifer. The upgraded WWTP will not require off-site effluent disposal; therefore, current effluent disposal practices on adjacent City-owned property would be discontinued following project implementation.

1.2 REPORT OBJECTIVES

This report summarizes a biological study conducted by LOA to facilitate environmental review pursuant to CEQA and NEPA, and to facilitate compliance with Section 7 of the federal Endangered Species Act. As such, the report's objectives are to:

- Characterize the project site's existing biological resources, including biotic habitats, flora and fauna, soils, and aquatic resources.
- Evaluate the project site's potential to support sensitive resources such as special status species, sensitive natural communities, and jurisdictional waters and wetlands.

- Summarize all state and federal natural resource protection laws that may be relevant to project implementation.
- Identify and discuss potential project-related impacts to biological resources within the context of CEQA, NEPA, and other state and federal laws.
- Identify avoidance and mitigation measures that would reduce the magnitude of project-related impacts in a manner consistent with CEQA, NEPA, and species-specific guidelines.
- Make preliminary effect determinations pursuant to Section 7 of the federal Endangered Species Act for listed species with the potential to occur in the project vicinity.

1.3 STUDY METHODOLOGY

A reconnaissance-level field survey of the project site was conducted on March 20 and 21, 2025 by LOA biologist Natalie Neff. The survey consisted of a meandering walk and drive through the project site while identifying its principal land uses and the constituent plants and animals of each land use. The field survey conducted for this study was sufficient to assess the significance of possible biological impacts associated with the development plans for the project site.

LOA conducted an analysis of potential project impacts based on the known and potential biotic resources of the project site discussed in Section 2.0. Sources of information used in the preparation of this analysis included: (1) results of the March 2025 reconnaissance-level surveys, (2) the *California Natural Diversity Data Base* (CDFW 2025), (3) the *Online Inventory of Rare and Endangered Vascular Plants of California* (CNPS 2025), and (4) manuals, reports, and references related to plants and animals of the San Joaquin Valley region.

LOA's field investigation did not include an aquatic resources delineation or focused surveys for special status species. The field survey was sufficient to generally describe those features of the project site that could be subject to the jurisdiction of the U.S. Army Corps of Engineers (USACE), California Department of Fish and Wildlife (CDFW), and/or the Regional Water Quality Control Board (RWQCB), and to assess the significance of possible biological impacts associated with development of the project site.

2.0 EXISTING CONDITIONS

2.1 REGIONAL SETTING

The project site is located in Pleasant Valley, which is itself situated in the southwestern portion of California's San Joaquin Valley. The San Joaquin Valley is a large, nearly flat alluvial plain bordered by the Sierra Nevada to the east, the Tehachapi Mountains to the south, the California coast ranges to the west, and the Sacramento-San Joaquin Delta to the north.

Like most of California, the San Joaquin Valley experiences a Mediterranean climate. Warm dry summers are followed by cool moist winters. Summer temperatures range from 56 to 101 degrees Fahrenheit, and the relative humidity is generally very low. Winter temperatures range from 37 to 72 degrees Fahrenheit. Annual precipitation in the vicinity of the project is about 8.2 inches, almost 85% of which falls between the months of October and March. Nearly all precipitation falls in the form of rain (NOAA 2025).

The principal drainages of the project vicinity are Warthan Creek and Los Gatos Creek. Both creeks initiate in the Diablo Range, approximately 15 miles west of the project site, at an elevation of approximately 3,000 feet. Warthan Creek flows approximately 22 miles southeast toward Pleasant Valley where it enters Los Gatos Creek just west of the Coalinga WWTP. Los Gatos Creek is a historical channel that originally terminated in a delta in the trough of the San Joaquin Valley, and together with the Kings River delta, formed a sill that marked the northern boundary of the historic Tulare Lake in very wet years.

2.2 PROJECT SITE

The project site is situated within Coalinga city limits, and consists entirely of lands modified for human use. While centered primarily on municipal roads and the WWTP, it also contains portions of parking lots, a public park, fallow agricultural lands, and residential lots. The topography of the project site is relatively flat with elevations averaging 640 feet National Geodetic Vertical Datum (NGVD) at the WWTP and ranging from 655 to 690 feet NGVD in municipal Coalinga.

The project site contains six soil mapping units (NRCS 2025). These soils are summarized in Table 1 below.

TABLE 1: SOILS OF THE PROJECT SITE

Soil Mapping Unit	Parent Material	Drainage Class	Hydric Rating
412: Yribarren clay loam, 0 to 2 percent slopes	Alluvium from calcareous sedimentary rock	Well drained	No
445: Excelsior sandy loam, 0 to 2 percent slopes	Calcareous coarse-loamy alluvium from sedimentary rock	Well drained	No
447: Excelsior sandy loam, sandy substratum, 0 to 2 percent slopes	Calcareous coarse-loamy alluvium from sedimentary rock	Well drained	No
451: Milham sandy loam, 0 to 2 percent slopes MLRA 17	Alluvium from igneous and sedimentary rock	Well drained	No
478: Cerini sandy loam, 0 to 2 percent slopes, MLRA 17	Alluvium from calcareous sedimentary rock	Well drained	No
981: Sewage Disposal Pond	-	-	No

None of the site's soil mapping units are considered hydric, meaning none have the propensity to pond water and support hydrophytic (water-loving) vegetation. Soils within the project site and surrounding lands have been subjected to decades of soil-disturbing activities associated with agricultural use, road and canal construction, and urban and rural development, and are not expected to exhibit their native soil characteristics or be particularly relevant to biological resource issues.

A list of vascular plants identified on the site is presented in Appendix A. A list of terrestrial vertebrates using or potentially using the project site is presented in Appendix B. Representative photos of the site are presented in Appendix C.

2.3 BIOTIC HABITATS / LAND USES

LOA identified three general land uses within the project site: urban, rural, and wastewater treatment facility (Figure 3). Within each land use were several different habitat types. The land uses and their constituent habitats are described in more detail in the following sections.

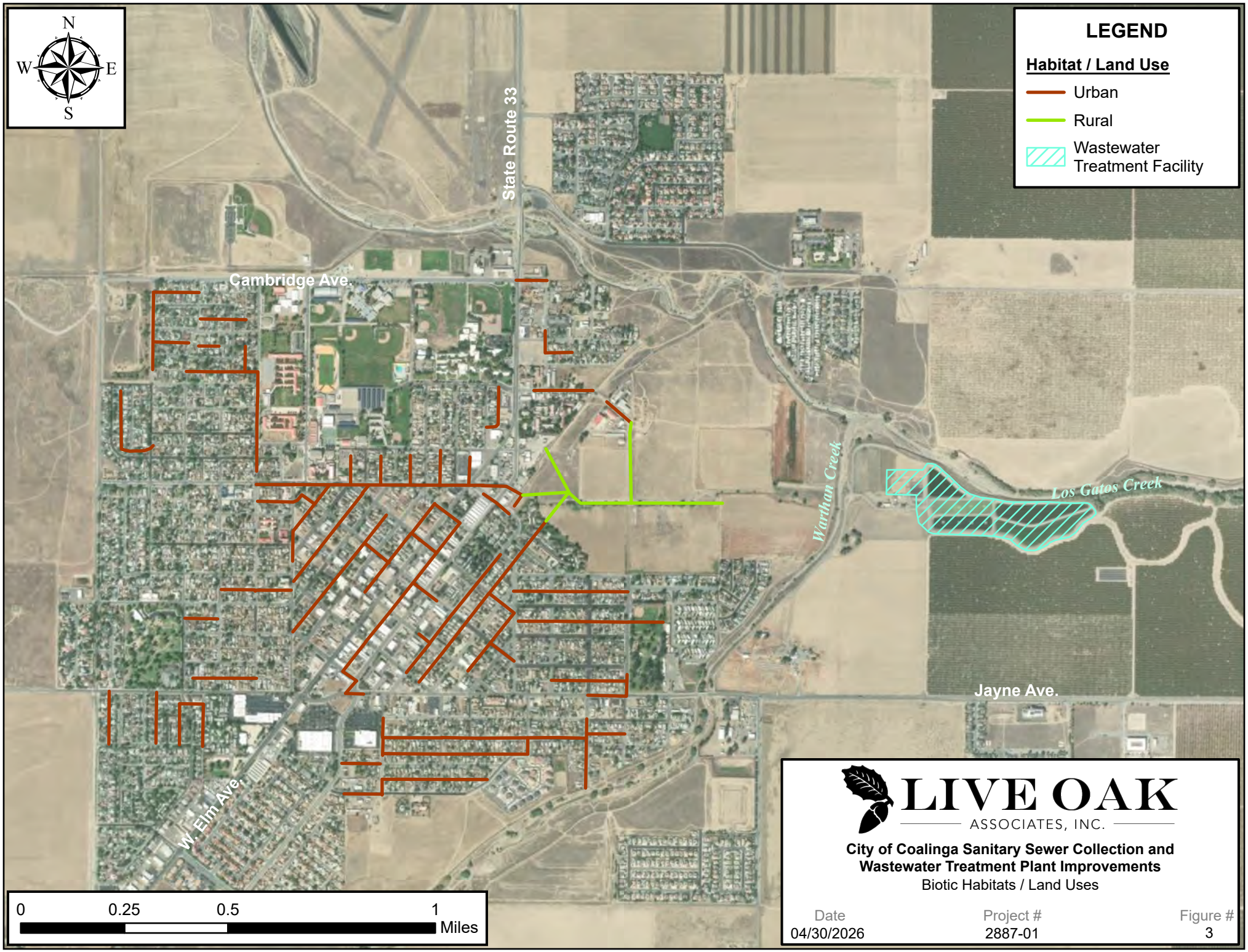
2.3.1 Urban

The sewer main work area is largely confined to municipal Coalinga and includes portions of streets, alleys, parking lots, residential and commercial properties, ruderal areas, and park lands that are collectively classified as "urban." The streets, alleys, and parking lots are developed features that are in most cases paved and entirely barren of vegetation. The residential properties are characterized by homes, outbuildings, and ornamental vegetation including trees, shrubs, turf, and other landscaping features. The project site's one commercial property is a motel; the portion of the property that falls within project boundaries is a landscaped strip with densely-spaced ornamental trees. The ruderal areas are disturbed roadside habitats that, at the time of LOA's survey, were characterized by unmaintained turf and/or common weeds. The park land is a portion of George E. Olsen Memorial Park that, at the time of the survey, contained maintained turf, ornamental trees, and fencing.

The project site's urban lands are of low habitat value for most native wildlife, given high levels of ambient disturbance and, in most areas, a lack of vegetative cover. Wildlife species expected to be found here would be those that are attracted to urban areas and/or tolerate disturbance, and those that are associated with adjacent lands and use or pass through urban areas incidentally.

Reptiles that could be found in the project site's urban lands include the western fence lizard (*Sceloporus occidentalisi*), California alligator lizard (*Elgaria multicarinata multicarinata*), and gopher snake (*Pituophis melanoleucus*). Amphibians are unlikely due to an absence of nearby breeding habitat.

A number of disturbance-tolerant avian species are likely to forage and nest in the site's urban lands. Trees and shrubs could support nesting by American robins (*Turdus migratorius*), Anna's hummingbirds (*Calypte anna*), northern mockingbirds (*Mimus polyglottos*), and mourning doves



LIVE OAK ASSOCIATES, INC.

City of Coalinga Sanitary Sewer Collection and Wastewater Treatment Plant Improvements

Biotic Habitats / Land Uses

Date	Project #	Figure #
04/30/2026	2887-01	3

(*Zenaida macroura*), among other species. Mourning doves may also nest in ground vegetation. The site's residential structures could potentially be used for nesting by the house finch (*Haemorhous mexicanus*). All of the aforementioned birds may also forage in the site's urban lands, as could winter migrants such as the savannah sparrow (*Passerculus sandwichensis*) and yellow-rumped warbler (*Dendroica coronata*).

Small mammal species likely to occur in the project site's urban lands include the deer mouse (*Peromyscus maniculatus),* house mouse (*Mus musculus*), and Norway rat (*Rattus norvegicus*), among others. Burrowing rodent activity is expected to be limited due to the preponderance of pavement in this land use type, as well as regular maintenance practices in most of the unpaved areas. Less-maintained areas could support California ground squirrels (*Otospermophilus beecheyi*) and Botta's pocket gophers (*Thomomys bottae*).

Disturbance-tolerant mammalian predators such as raccoons (*Procyon lotor*) and striped skunks (*Mephitis mephitis*) are expected to occasionally forage on or pass through the site's urban lands. Various bat species may roost in trees and buildings within this land use type and may forage on or over these areas.

2.3.2 Rural

The sewer main work area also includes lands outside of municipal Coalinga that, while all human-altered in some form, experience lower levels of ambient disturbance than the urban land use type and are of higher value for native wildlife species. These include portions of ruderal or fallow fields, unpaved roads, an irrigation ditch, and the minimally maintained margins of these uses. While the roads were barren of vegetation, the fields and margins were characterized by sparse to dense growth of common weeds such as foxtail barley (*Hordeum murinum*), ripgut brome (*Bromus diandrus*), red-stemmed filaree (*Erodium cicutarium*), and cheeseweed (*Malva parviflora*), among others. Where the sewer main alignment crossed and then paralleled an irrigation ditch between urban Coalinga and the WWTP, several native trees including valley oak (*Quercus lobata*) and willow (*Salix* sp.) overhung the work area.

The project site's rural lands may be used by a variety of native wildlife species associated with agricultural and other open habitats. Reptiles that could be found in the project site's rural areas

include the side-blotched lizard (*Uta stansburiana*), western whiptail (*Aspidoscelis tigris*), common kingsnake (*Lampropeltis californiae*), and gopher snake. Common amphibians such as the Sierran treefrog (*Pseudacris sierra*) and western toad (*Anaxyrus boreas*) may breed in nearby irrigation ditches and subsequently disperse through the site's rural lands.

Birds expected to nest within the project site's rural lands include common ground-nesting species such as the western meadowlark (*Sturnella neglecta*), killdeer (*Charadrius vociferus*), and mourning dove. Foraging species would include the western kingbird (*Tyrannus verticalis*) in the summer, savannah sparrow and American pipit (*Anthus rubescens*) in the winter, and American crow (*Corvus brachyrhynchos*), and Brewer's blackbird (*Euphagus cyanocephalus*) throughout the year. The site's rural lands are also likely to be used for foraging by open country raptors such as the red-tailed hawk (*Buteo jamaicensis*) and American kestrel (*Falco sparverius*). Trees within which these raptors could nest, while absent from the site's rural lands, are found immediately outside of project boundaries in some of these areas.

Small mammal species likely to occur in the site's rural lands include the deer mouse, California ground squirrel, Botta's pocket gopher, California vole (*Microtus californicus*), and Audubon's cottontail (*Sylvilagus audubonii*). Raccoons, striped skunks, and coyotes (*Canis latrans*) are likely to occur here from time to time. Various bat species may forage on or over the site's rural lands; however, roosting habitat is absent.

2.3.3 Wastewater Treatment Facility

The WWTP work area consists of lands and facilities used for wastewater treatment. It includes two aerated lagoons, each approximately 3 acres in size; three stabilization ponds collectively encompassing approximately 13 acres; two asphalt-bottomed sludge drying beds; a network of access roads around the pond perimeters; and other ruderal upland areas. At the time of LOA's field survey, most of these lands were highly maintained and barren of vegetation. Where present, vegetation consisted of patches of bermudagrass (*Cynodon dactylon*) and other non-native grasses and forbs. A small portion of the work area is outside of the fenced facility and appears infrequently maintained; this area, located immediately to the west of the aerated lagoons, supported dense cover of non-native grasses and forbs including ripgut brome, foxtail barley, and Russian thistle (*Salsola tragus*).

The WWTP's stabilization ponds are perennially inundated and support various wildlife species associated with aquatic environments. At the time of LOA's field survey, southwestern pond turtles (*Actinemys pallida*) were detected in all three stabilization ponds; this is a California Species of Special Concern that is also proposed for federal listing as threatened. Several amphibian species are likely to occur in the stabilization ponds; these include the Sierran treefrog, western toad, and American bullfrog (*Lithobates catesbeianus*). The stabilization ponds support both waterfowl and shorebirds. Examples of the former observed during LOA's survey include the ruddy duck (*Oxyura amicensis*), green-winged teal (*Anas crecca*), and mallard (*Anas platyrhynchos*), while examples of the latter include the great egret (*Ardea alba*), greater yellowlegs (*Tringa melanoleuca*), and black-necked stilt (*Himantopus mexicanus*). The ponds may serve as a source of mud for black phoebes and cliff swallows (*Petrochelidon pyrrhonata*) during nest-building, and black phoebes may also forage in flight over the ponds.

Upland areas of the WWTP may be utilized by basking turtles of the aforementioned species. Killdeer and black-necked stilts could nest on the ground in these areas. California ground squirrels were observed in upland areas of the WWTP at the time of LOA's survey, and other small mammals such as Botta's pocket gophers, deer mice, and California voles may also occur here. Raccoons and striped skunks are likely to use or pass through these areas from time to time.

2.4 SPECIAL STATUS PLANTS AND ANIMALS

Many species of plants and animals within the state of California have low populations, limited distributions, or both. Such species may be considered "rare" and are vulnerable to extirpation as the state's human population grows and the habitats these species occupy are converted to agricultural and urban uses. As described more fully in Section 3.0, state and federal laws have provided California Department of Fish and Wildlife (CDFW) and the U.S. Fish and Wildlife Service (USFWS) with a mechanism for conserving and protecting the diversity of plant and animal species native to the state. A sizable number of native plants and animals have been formally designated as threatened or endangered under state and federal endangered species legislation. Others have been designated as "candidates" for such listing. Still others have been designated as "species of special concern" by the CDFW. The California Native Plant Society (CNPS) has developed its own set of lists (i.e., California Rare Plant Ranks, or CRPR) of native

plants considered rare, threatened, or endangered (CNPS 2025). Collectively, these plants and animals are referred to as “special status species.”

The California Natural Diversity Data Base (CNDDB) was queried for special status plant and animal occurrences in the nine USGS 7.5-minute quadrangles containing and surrounding the project site (*Joaquin Rocks, Domengine Ranch, Harris Ranch, Alcalde Hills, Coalinga, Guijarral Hills, Curry Mountain, Kreyenhagen Hills,* and *Avenal*). A number of special status plants and animals were returned in the query and are summarized below in Table 1. Sources of information for this table included *California’s Wildlife, Volumes I, II, and III* (Zeiner et. al 1988-1990), *California Natural Diversity Data Base* (CDFW 2025), *The Jepson Manual: Vascular Plants of California, second edition* (Baldwin et al 2012), the *California Native Plant Society’s Inventory of Rare and Endangered Vascular Plants of California* (CNPS 2025), *Calflora.org, iNaturalist.org*, and *eBird.org*.

TABLE 2. LIST OF SPECIAL STATUS SPECIES POTENTIALLY OCCURRING IN THE PROJECT VICINITY

PLANTS

Species Listed under the State and/or Federal Endangered Species Act

Species	Status	Habitat	Occurrence on the Project Site
California Jewel-flower (*Caulanthus californicus*)	FE, CE, CRPR 1B.1	Occurs in chenopod scrub, pinyon and juniper woodland, and sandy valley and foothill grassland; blooms February–May; elevation 250-3,300 ft.	**Absent.** Any suitable habitat that may have once been present on the site has been eliminated through conversion to urban and agricultural uses. This species was generally mapped to Coalinga in 1926, but the population is considered extirpated due to habitat loss (CDFW 2025).
San Joaquin woolly threads (*Monolopia congdonii*)	FE CRPR 1B.2	Occurs in sandy grassland and chenopod scrub in sandy soils of the southwestern Central Valley between 200 and 2,625 feet in elevation. Blooms February-May.	**Absent.** Any suitable habitat that may have once been present on the site has been eliminated through conversion to urban and agricultural uses. This species was generally mapped to Coalinga in 1935, but was not found during a 1988 site visit; the population is considered possibly extirpated due to habitat loss (CDFW 2025).

CNPS-listed Species

Lost Hills Crownscale (*Atriplex coronata* var. *vallicola*)	CRPR 1B.2	Found in chenopod scrub and valley and foothill grasslands; alkaline soils; blooms April-August; elevations below 2,080 ft.	**Absent.** Any suitable habitat that may have once been present on the site has been eliminated through conversion to urban and agricultural uses.
Brittlescale (*Atriplex depressa*)	CRPR 1B.2	Occurs in chenopod scrub, valley and foothill grassland, and wetland habitats; blooms April-October; elevations below 1,050 ft.	**Absent.** Any suitable habitat that may have once been present on the site has been eliminated through conversion to urban and agricultural uses.
Lemmon's Jewelflower (*Caulanthus lemmonii*)	CRPR 1B.2	Occurs in grasslands, chaparral, and scrubland. Blooms March-May, elevation 260-3600 ft.	**Absent.** Any suitable habitat that may have once been present on the site has been eliminated through conversion to urban and agricultural uses.
Hall's Tarplant (*Deinandra halliana*)	CRPR 1B.2	Occurs in chaparral habitats in rocky soils; elevations 900-4,100 ft. Blooms May-June.	**Absent.** The project site is below this species' elevational distribution, and suitable habitat is absent.
Recurved Larkspur (*Delphinium recurvatum*)	CRPR 1B.2	Occurs in poorly drained, fine, alkaline soils in grassland and Atriplex scrub; blooms March-June; elevations up to 2,500 ft.	**Absent.** Any suitable habitat that may have once been present on the site has been eliminated through conversion to urban and agricultural uses.
Eastwood's Buckwheat (*Eriogonum eastwoodianum*)	CRPR 1B.3	Occurs in foothill woodlands, shale. Blooms May-September; elevation from 655 to 3,280 ft.	**Absent.** Any suitable habitat that may have once been present on the site has been eliminated through conversion to urban and agricultural uses.
Diablo Range Hare-Leaf *(Lagophylla diabolensis)*	CRPR 1B.2	Occurs in grassy openings in woodlands in heavy clay. Blooms April-July; elevation 1,150-3,300 ft.	**Absent.** The project site is below this species' elevational distribution, and suitable habitat is absent.
Alkali-Sink Goldfields (*Lasthenia chrysantha*)	CRPR 1B.1	Found in alkaline vernal pools below approximately 650 feet in elevation. Blooms February-April.	**Absent.** Any suitable habitat that may have once been present on the site has been eliminated through conversion to urban and agricultural uses.
Pale-Yellow Layia (*Layia heterotricha*)	CRPR 1B.1	Occurs in foothill woodlands, valley grasslands, pinyon-juniper woodlands, and wetland-riparian areas in clay or sandy soils. Blooms April- June; elevation 660-5,900 ft.	**Absent.** Any suitable habitat that may have once been present on the site has been eliminated through conversion to urban and agricultural uses.

TABLE 2. LIST OF SPECIAL STATUS SPECIES POTENTIALLY OCCURRING IN THE PROJECT VICINITY

PLANTS

CNPS-listed Species

Species	Status	Habitat	Occurrence on the Project Site
Panoche pepper-grass (*Lepidium jaredii ssp. album*)	CRPR 1B.2	Found on steep slopes associated with alluvial fans and washes; valley and foothill grassland association; clay soils; elevations 600-2,450 ft. Blooms February-June.	**Absent.** Any suitable habitat and microsite conditions that may have once been present on the site have been eliminated through conversion to urban and agricultural uses.
Showy Golden Madia (*Madia radiata*)	CRPR 1B.1	Occurs in foothill woodlands or grasslands in heavy clay. Blooms March- May; elevations up to 6,000 ft.	**Absent.** Any suitable habitat that may have once been present on the site has been eliminated through conversion to urban and agricultural uses.
Indian Valley Bushmallow (*Malacothamnus aboriginum*)	CRPR 1B.2	Found on granitic outcrops and sandy bar soil within chaparral and woodland habitats, often in burned areas; elevations 500-5,600 ft. Blooms April-October.	**Absent.** The project site does not contain chaparral or woodland habitats, or any recently burned areas.
Shining Navarretia (*Navarretia nigelliformis* ssp. *radians*)	CRPR 1B.2	Occurs in valley grassland, foothill woodland, freshwater-wetlands, and wetland-riparian between 525 and 1770 ft. in elevation. Blooms April-July.	**Absent.** Any suitable habitat that may have once been present on the site has been eliminated through conversion to urban and agricultural uses.
Panoche Navarretia (*Navarretia panochensis*	CRPR 1B.3	Known from a few locations in the Panoche region of Fresno and San Benito Counties. Found in grassland and scrub habitats in clay or gravelly soils. Elevation 1,310- 2,130 ft.	**Absent.** The project site is below this species' elevational distribution, and suitable habitat is absent.
Prostrate Vernal Pool Navarretia (*Navarretia prostrata*)	CNPS 1B.2	Occurs in wetlands of coastal scrub and alkaline grassland habitats in the western San Joaquin Valley and Coast Ranges at elevations up to 2,300 ft. Blooms April – July.	**Absent.** Any suitable habitat that may have once been present on the site has been eliminated through conversion to urban and agricultural uses.
Chaparral Ragwort (*Senecio aphanactis*)	CRPR 2B.2	Occurs in coastal scrub, foothill woodlands, alkali flats, and dry, open rocky areas. Blooms February- May; elevations up to 2,600 ft.	**Absent.** Any suitable habitat that may have once been present on the site has been eliminated through conversion to urban and agricultural uses.

ANIMALS

Species Listed under the State and/or Federal Endangered Species Act

Crotch's bumble bee (*Bombus crotchii*)	CCE	Once common in the Central Valley, this species is now largely absent from this portion of its historic range (CDFW 2019). Where present, it is associated with open grassland and scrub habitats, where it relies on food plants of the *Asclepias, Chaenactis, Lupinus, Medicago, Phacelia,* and *Salvia* genera (Williams et al. 2014).	**Unlikely.** Although rural portions of the project site contain some foraging resources for the Crotch's bumble bee, this species is unlikely to occur in the vicinity other than possible occasional transient movements. Xerces et al. (2018) reported no post-2002 detections of this species in the western San Joaquin Valley despite a relatively high sampling effort. The CNDDB lists two occurrences of Crotch's bumble bee within 3 miles of the site, but both are from more than 25 years ago (CDFW 2025). There are no iNaturalist or Bumble Bee Watch observation records within 15 miles of the project site (iNaturalist 2025, Bumble Bee Watch 2025).

TABLE 2. LIST OF SPECIAL STATUS SPECIES POTENTIALLY OCCURRING IN THE PROJECT VICINITY

ANIMALS

Species Listed under the State and/or Federal Endangered Species Act

Species	Status	Habitat	Occurrence on the Project Site
Monarch Butterfly (*Danaus plexippus*)	FPT	Overwinters in coastal California and Baja California and breeds throughout California in the spring and summer along its annual migration north and east. The adult monarch lays its eggs on obligate milkweed (*Asclepias* spp.) host plants, which the resultant larvae feed on before pupating and emerging as adults. In addition to milkweed, this species requires abundant nectar resources to nourish migrating adults, and trees for roosting during migratory stopovers.	**Possible.** Monarchs have been reported within Coalinga city limits, including a 2022 sighting in George E. Olson Memorial Park, approximately 300 feet south of the sewer main work area (iNaturalist 2025). The project site contains both flowering plants on which monarchs could forage and trees within which they could roost. LOA's survey was conducted early in the growing season, at a time when locally-occurring milkweeds may not be readily detectable. While not observed, milkweed could conceivably occur in the residential yards, park land, and ruderal/fallow fields of the sewer main work area, introducing some potential for breeding in these areas. Milkweed (and monarch reproduction) is not expected in the degraded habitats of the WWTP work area.
Vernal Pool Fairy Shrimp *(Branchinecta lynchi)*	FT	Found in vernal pools and swales, basalt flow depression pools, and depressions in sandstone rock outcrops; can occur in roadside ditches and puddles when in association with vernal pools.	**Absent.** Suitable wetland habitat for this species is absent from the project site and adjacent lands.
California Tiger Salamander *(Ambystoma californiense)*	FT, CT	Found primarily in annual grasslands; requires vernal pools for breeding and rodent burrows for aestivation. CTS are capable of overland travel of up to 1.3 miles (Orloff 2011).	**Absent.** The project site consists entirely of urban, agricultural, and other highly modified lands that would not attract or support this species. Moreover, suitable breeding habitat is absent from the site and surrounding lands within a distance that would enable CTS to access the site for aestivation. The nearest CNDDB occurrence of this species is nearly 20 miles from project boundaries (CDFW 2025).
Foothill Yellow-Legged Frog -Central Coast DPS *(Rana boylii pop. 4)*	FE, CE	Found in or near rocky streams in a variety of habitats. Use submerged rocks and debris for cover. Requires gravel or rocks in moving water near stream margins for reproduction.	**Absent.** Suitable aquatic habitat is absent from the project site and surrounding lands. There is a historic (1941) CNDDB occurrence of this species mapped generally to a location approximately 2 miles west of Coalinga; however, the species is considered extirpated from the vicinity (CDFW 2025).
California Red-Legged Frog *(Rana draytonii)*	FT	Perennial rivers, creeks and stock ponds of the Inner Coast Range foothills, preferring deep pools with overhanging vegetation.	**Absent.** Suitable aquatic habitat is absent from the project site and surrounding lands. The nearest CNDDB occurrence is over 30 miles from project boundaries (CDFW 2025).

TABLE 2. LIST OF SPECIAL STATUS SPECIES POTENTIALLY OCCURRING IN THE PROJECT VICINITY

ANIMALS

Species Listed under the State and/or Federal Endangered Species Act

Species	Status	Habitat	Occurrence on the Project Site
Western Spadefoot (*Spea hammondii*)	FPT, CSC	Occurs in grasslands of San Joaquin Valley, where it breeds in vernal pools or other seasonal wetlands and aestivates in underground refugia such as rodent burrows. Baumberger et al. (2019) recorded a maximum distance of around 860 feet between breeding and aestivation sites.	**Absent.** There is a historic (1941) CNDDB occurrence of this species mapped generally to a location approximately 2 miles west of Coalinga. While the western spadefoot may yet be present in the larger project vicinity, the project site itself consists entirely of urban and agricultural lands that would not attract or support this species. Suitable breeding habitat is absent from the site and surrounding lands within a distance that would enable western spadefoot individuals to access the site for aestivation.
Southwestern Pond Turtle (*Actinemys pallida*)	FPT, CSC	Found in ponds, marshes, rivers, streams, and irrigation ditches with aquatic vegetation. Requires partially submerged rocks or logs for basking sites. Nesting takes place in open areas, on a variety of soil types, and up to ¼ mile away from water. Overwintering and summertime aestivation may include use of upland habitat, generally with leaf litter or other loose substrate for burying themselves.	**Present.** This species is present at the WWTP. At the time of LOA's survey effort, 36 pond turtles were observed in the three existing stabilization ponds. Turtle age/size varied, indicating that this is a breeding population and not merely sustained through immigration. While highly maintained, upland portions of the WWTP may support nesting by this species, as has been observed at other such facilities (M. Jennings, Rana Resources, pers. comm.). The WWTP's pond turtles are likely to remain active through most of the winter, but during the coldest periods may overwinter underwater (M. Jennings, Rana Resources, pers. comm.). Pond turtles are not expected to occur in the sewer main work area.
Blunt-Nosed Leopard Lizard (BNLL) (*Gambelia sila*)	FE, CE, CP	Occurs in semiarid grasslands, alkali flats, and washes. Avoids densely vegetated areas. Inhabits the San Joaquin Valley and adjacent valleys and foothills north to southern Merced County.	**Unlikely.** The BNLL was historically known from the near vicinity. There is a historic (1935) CNDDB record of this species mapped to a general location 1.25 miles east of Coalinga, centered on the present-day WWTP. A second record, from 1989, documented several individuals along Los Gatos Creek, approximately 1 mile north of project boundaries. Since that time, BNLL sightings in the area have been scarce; the closest post-2000 CNDDB occurrence is located some 8 miles east of the site at a CDFW ecological reserve. There are no iNaturalist sightings within 20 miles of the project site. The site consists entirely of lands heavily modified by urban and agricultural uses and is unlikely to attract or support individuals of this species, even if they do persist in the vicinity.

TABLE 2. LIST OF SPECIAL STATUS SPECIES POTENTIALLY OCCURRING IN THE PROJECT VICINITY

ANIMALS

Species Listed under the State and/or Federal Endangered Species Act

Species	Status	Habitat	Occurrence on the Project Site
Temblor Legless Lizard (*Anniella alexanderae*)	CCE, CSC	A burrowing lizard that occurs in alkali desert scrub and annual grasslands of southwestern San Joaquin Valley within Kern and Fresno Counties. Consumes insects and other small invertebrates.	**Possible.** There is a recent (2022) CNDDB occurrence of this species from Warthan Creek, approximately 0.3 mile outside of Coalinga city limits and 1 mile south of project boundaries. Although the project site consists entirely of urban, agricultural, and other highly modified lands that do not constitute Temblor legless lizard habitat, there is some chance for individuals of this species to occur along Warthan or Los Gatos Creeks in the immediate vicinity and to occasionally wander onto the WWTP work area or rural portions of the sewer main work area.
Burrowing Owl (*Athene cunicularia*)	CCE	Frequents open, dry annual or perennial grasslands, deserts, and scrublands characterized by low-growing vegetation. May also utilize cropland, foraging in fields and roosting or nesting at field margins. Dependent upon burrowing mammals, most notably the California ground squirrel, for nest burrows.	**Possible.** Burrowing owls are not often documented in the project vicinity; the closest CNDDB record is approximately 3 miles northeast of the site, recorded at the Coalinga airport in 2009, and the closest eBird occurrence is approximately 9 miles northeast, recorded near an Interstate 5 off-ramp in 1983 (CDFW 2025, eBird 2026). Nevertheless, this species has some potential to forage and nest in rural portions of the project site.
Swainson's Hawk *(Buteo swainsoni*)	CT	This breeding migrant to California nests in mature trees in riparian areas and oak savannah, and occasionally in lone trees at the margins of agricultural fields. Requires adjacent suitable foraging areas such as grasslands or alfalfa fields supporting rodent populations.	**Likely.** This species is fairly well-documented in the project vicinity. There are three recent eBird sightings within 3 miles of project boundaries; two of these were logged at George E. Olson Memorial Park in Coalinga, between 300 and 700 feet from project boundaries (eBird 2025). A historic (1941) CNDDB record documented two Swainson's hawk nests in the general Coalinga area, while a modern (2016) record describes a nest along Jacalitos Creek, approximately 3.5 miles southeast of project boundaries. This species has the potential to nest in trees on or near the project site, particularly outside of the urban core of Coalinga, and to forage in rural portions of the site.
California Condor (*Gymnogyps californianus*)	FE, CE	Found in chaparral and valley and foothill grassland habitats; requires vast expanses of open natural land to meet its foraging needs. Nests in rock crevices, on overhung cliff ledges, and in old-growth conifers.	**Absent.** The project site lacks suitable condor nesting and roosting habitat, and does not contain or adjoin large blocks of natural land that could support foraging by this species.

TABLE 2. LIST OF SPECIAL STATUS SPECIES POTENTIALLY OCCURRING IN THE PROJECT VICINITY

ANIMALS

Species Listed under the State and/or Federal Endangered Species Act

Species	Status	Habitat	Occurrence on the Project Site
Tricolored Blackbird (*Agelaius tricolor*)	CT, CSC	Breeds colonially near fresh water in dense bulrush, cattails, or thickets of willows or shrubs, and increasingly in grain fields. Forages in grassland and cropland areas.	**Possible.** This species may forage in rural portions of the site, but nesting habitat is absent. The CNNDB lists one occurrence of this species in the project vicinity, a 2014 observation of a small nesting colony at a gravel pit approximately 1 mile north of project boundaries (CDFW 2025).
San Joaquin Antelope Squirrel (*Ammospermophilus nelsoni*)	CT	Found in arid upland scrub communities, and to a lesser extent grasslands, along the western margin of the San Joaquin Valley and in the adjoining hills and plains. Occupies modified kangaroo rat burrows or self-constructed burrows. Not usually found on steep slopes or in areas prone to flooding.	**Absent.** The project site consists entirely of urban, agricultural, and other highly modified lands that would not attract or support this species. There are four CNDDB occurrences of the San Joaquin antelope squirrel in the general vicinity, located between 3 and 5 miles south of the site in the Jacalitos Hills. All are from more than 30 years ago and are associated with natural lands typical of this species' habitat preferences (CDFW 2025). The nearest iNaturalist sightings are more than 20 miles from project boundaries (iNaturalist 2025).
Giant Kangaroo Rat (*Dipodomys ingens*)	FE, CE	Historically occurred from Merced County to Kern County and Carrizo Plain and Cuyama Valley in San Luis Obispo County, but has been reduced to fragmented populations encompassing only 5 percent of its historic range (USFWS 2010). Prefers annual grassland and shrubland communities where vegetation is sparse and soils are well drained fine, sandy loams. Does not inhabit areas where slopes exceed 10 percent or where water may pool.	**Absent.** The project site consists entirely of urban, agricultural, and other highly modified lands that would not attract or support giant kangaroo rats. The nearest CNDDB and iNaturalist records of this species are more than 20 miles from project boundaries (CDFW 2025, iNaturalist 2025).
San Joaquin Kit Fox (SJKF) (*Vulpes macrotis mutica*)	FE, CT	Frequents desert alkali scrub and annual grasslands and may forage in adjacent agricultural habitats. Utilizes enlarged ground squirrel burrows as denning habitat. May become adapted to urban environments, as has occurred in the cities of Bakersfield, Taft, and Coalinga. Urban-adapted kit foxes commonly use vacant lots, industrial and commercial areas, parks, golf courses, and lightly-disturbed rights-of-way such as canals and utility corridors. Residential areas are not commonly used as they have high levels of disturbance, numerous dogs, and fences and other features that limit movement (Cypher et al. 2012).	**Possible.** Coalinga is known to support a population of urban-adapted SJKF (Cypher et al. 2012). This species is also fairly well documented in outlying areas, with 12 CNDDB occurrences located within 10 miles of project boundaries (CDFW 2025). There is considerable potential for the SJKF to forage and den on the project site. Although this is a theoretical possibility for any portion of the site, Cypher et al. (2012)'s work suggests a higher potential for SJKF occurrence outside of Coalinga's residential neighborhoods.

TABLE 2. LIST OF SPECIAL STATUS SPECIES POTENTIALLY OCCURRING IN THE PROJECT VICINITY

ANIMALS

State Species of Special Concern

Species	Status	Habitat	Occurrence on the Project Site
Coast horned lizard (*Phrynosoma blainvillii*)	CSC	Ranges from the central and southern California coast inland through the western Sierra Nevada, where it is found in grassland and open areas within woodland and forest habitats. Often found in sandy areas including washes and floodplains.	**Unlikely.** The coast horned lizard is not known from the near project vicinity. There are several iNaturalist records in the hills generally west of Coalinga, but none from the Pleasant Valley floor (iNaturalist 2025). The closest CNDDB occurrences are more than 15 miles away (CDFW 2025). The project site consists entirely of lands heavily modified by urban and agricultural uses and is unlikely to attract or support individuals of this species, even if they do occur in the vicinity.
Northern California Legless Lizard (*Anniella pulchra*)	CSC	Occurs in sparsely vegetated areas of beach dunes, chaparral, pine-oak woodlands, desert scrub, sandy washes, and stream terraces with sycamores, cottonwoods, or oaks. Requires moist soils.	**Unlikely.** The northern California legless lizard is not known from the near project vicinity. The nearest iNaturalist records are more than 9 miles southwest of project boundaries, at undisclosed locations in the Inner Coast Range (iNaturalist 2025). The closest CNDDB occurrence is approximately 7 miles southwest in the Curry Mountain area (CDFW 2025). The project site consists entirely of lands heavily modified by urban and agricultural uses and is unlikely to attract or support individuals of this species, even if they do occur in the vicinity.
California glossy snake (*Arizona elegans occidentalis*)	CSC	Inhabits arid scrub, rocky washes, grasslands, and chaparral, where it forages nocturnally, hiding in underground burrows during the day. Prefers loose, sandy soils.	**Possible.** This species has been documented in the near project vicinity. Two historic (1935 and 1951) CNDDB records intersect the project site itself, while two additional records are located within 4 miles west and south of the WWTP work area (CDFW 2025). There are several iNaturalist records at undisclosed locations in the general project vicinity; at least one of these is along Los Gatos Creek on the floor of Pleasant Valley (iNaturalist 2025). Although the project site consists entirely of urban, agricultural, and other highly modified lands that do not constitute California glossy snake habitat, there is some chance for individuals of this species to occur along Warthan or Los Gatos Creeks in the immediate vicinity and to occasionally wander onto the WWTP work area or rural portions of the sewer main work area.

TABLE 2. LIST OF SPECIAL STATUS SPECIES POTENTIALLY OCCURRING IN THE PROJECT VICINITY

ANIMALS

State Species of Special Concern

Species	Status	Habitat	Occurrence on the Project Site
San Joaquin coachwhip (*Masticophis flagellum ruddocki*)	CSC	Occurs in open, dry areas including grassland and saltbush scrub. Takes refuge in rodent burrows and under shaded vegetation.	**Possible.** There are historical observations of this species in the near project vicinity. Two CNDDB records from the 1980s are located between 1 and 2 miles from project boundaries. Although the project site consists entirely of urban, agricultural, and other highly modified lands that do not constitute San Joaquin coachwhip habitat, there is some chance for individuals of this species to occur along Warthan or Los Gatos Creeks in the immediate vicinity and to occasionally wander onto the WWTP work area or rural portions of the sewer main work area.
Long-eared Owl *(Asio otus*)	CSC	Nests in dense patches of trees or tall shrubs and forages in adjacent open habitats such as grassland, shrubland, and fields. Utilizes nests built by other birds, particularly those built by corvids. Occurs year-round in California.	**Possible.** Suitable nesting habitat for the long-eared owl is absent from the project site itself, but occurs immediately adjacent to the WWTP work area along Los Gatos Creek. This species could forage over rural portions of the site. There is a CNDDB nesting occurrence of the long-eared owl along Los Gatos Creek approximately 6 miles downstream of the project site, logged in 2005, and an eBird sighting from the last ten years that is generally mapped to the Coalinga area (CDFW 2025, eBird 2025).
Le Conte's Thrasher *(Toxostoma lecontei*)	CSC	Occupies desert flats with scattered low shrubs. Requires well-drained, bare ground areas with litter layers near shrubs for foraging. Primarily eats insects but will occasionally eat plant seeds, bird eggs, and small lizards. Nests deep into dense shrubs where direct sunlight rarely reaches.	**Unlikely.** The project site does not contain suitable habitat for the Le Conte's thrasher. Although the dry channels of Warthan and Los Gatos Creeks may theoretically provide some habitat value, the creeks in the project vicinity are situated in a landscape highly modified for anthropogenic use and are therefore unlikely to support this species. The only known occurrence in the general vicinity is a historic (1934) CNDDB nest sighting along Los Gatos Creek, approximately 3 miles east of the WWTP work area (CDFW 2025).
Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*)	CSC	Occurs in California primarily as a breeding season migrant; however, small numbers winter in the southern Central Valley and the Imperial and Colorado River Valleys. Requires deepwater marshes and wetlands with tall emergent vegetation such as tules or cattails for breeding. Forages in wetlands and surrounding grasslands, croplands, and savanna.	**Unlikely.** The yellow-headed blackbird is not known from the project vicinity; all CNDDB, eBird, and iNaturalist occurrence records are more than 15 miles from project boundaries (CDFW 2025, eBird 2025, iNaturalist 2025). Suitable breeding habitat for this species is absent from the project site and surrounding lands.

TABLE 2. LIST OF SPECIAL STATUS SPECIES POTENTIALLY OCCURRING IN THE PROJECT VICINITY

ANIMALS

State Species of Special Concern

Species	Status	Habitat	Occurrence on the Project Site
Short-nosed Kangaroo Rat (*Dipodomys nitratoides brevinasus*)	CSC	Historically occurred on the western, southern, and extreme southeastern sides of the San Joaquin Valley typically above the valley floor. Currently, fragmented populations exist near Los Banos, Panoche and San Joaquin Valleys, Kettleman Hills, Antelope and Carrizo Plains, and Cuyama Valley. Prefer friable soils on flat or gently rolling terrain in grassland and desert-scrub vegetation.	**Absent.** The project site consists entirely of urban, agricultural, and other highly modified lands that would not attract or support short-nosed kangaroo rats. There are three CNDDB occurrences of this species in the general vicinity; all were recorded in 1992 between 3 and 4 miles east and northeast of the WWTP work area (CDFW 2025). While located on the Pleasant Valley floor, all three of these occurrences were in or immediately adjacent to large blocks of natural land.
Tulare Grasshopper Mouse (*Onychomys torridus tularensis*)	CSC	Known from arid shrubland communities in hot, arid grassland and scrub desert associations. Intensive trapping surveys conducted in the 1980s and 1990s suggest that this species no longer occupies fragmented native habitats, large or small, on the floor of the San Joaquin Valley (Bolster 1998).	**Absent.** The project site consists entirely of urban, agricultural, and other highly modified lands unsuitable for the Tulare grasshopper mouse. There is a historic (1905) CNDDB occurrence of this species that is generally mapped to Coalinga. The Tulare grasshopper mouse is unlikely to have persisted in this area following urban and intensive agricultural development.
Townsend's Big-eared Bat (*Corynorhinus townsendii*)	CSC	Found throughout California. Roosts most frequently in caves and cave-like structures, but has also been reported to utilize bridges, buildings, rock crevices, and hollow trees. Occurs in a variety of habitats.	**Possible.** This species has some potential to roost in buildings or trees within or adjacent to the project site, and to forage over the site.
Western Mastiff Bat (*Eumops perotis californicus*)	CSC	Frequents open, semi-arid to arid habitats, including conifer, and deciduous woodlands, coastal scrub, grasslands, palm oasis, chaparral and urban. Roosts in cliff faces, high buildings, and tunnels.	**Possible.** This species has some potential to roost in buildings within or adjacent to the project site, and to forage over the site. There is a 1995 CNDDB occurrence from central Coalinga, within a few hundred feet of the sewer main work area.
American Badger (*Taxidea taxus*)	CSC	Found in drier open stages of most shrub, forest, and herbaceous habitats with friable soils. Adult badgers are primarily nocturnal, foraging at night and remaining underground in sleeping dens during the day. Badgers mate in late summer to early fall, and the young are born in natal dens in March and April. While badgers rarely remain in a sleeping den for more than a day, natal dens may be used for a period of 4-8 weeks as the female gives birth to and raises her young.	**Possible.** This species has been documented in the general vicinity; there is a historic CNDDB occurrence approximately 4 miles southwest of the project site along Warthan Creek, and a more modern (2005) occurrence approximately 5 miles east of the site along Los Gatos Creek. This wide-ranging species has some potential to den and forage in rural portions of the sewer main work area. Degraded habitats and high levels of ambient disturbance are expected to preclude its occurrence from the WWTP work area and urban portions of the sewer main work area.

OCCURRENCE DESIGNATIONS AND STATUS CODES

Present: Species observed on the site at time of field surveys or during recent past.
Likely: Species not observed on the site, but it may reasonably be expected to occur there on a regular basis.
Possible: Species not observed on the site, but it could occur there from time to time.
Unlikely: Species not observed on the site, and would not be expected to occur there except, perhaps, as a transient.
Absent: Species not observed on the site and precluded from occurring there because habitat requirements not met.

STATUS CODES

FE	Federally Endangered	CE	California Endangered
FT	Federally Threatened	CT	California Threatened
FC	Federal Candidate	CCE	California Candidate Endangered
FPT	Federal Proposed Threatened	CFP	California Fully Protected
		CSC	California Species of Special Concern
		CR	California Rare

CRPR CODES

1A	Plants Presumed Extinct in California	2B	Plants Rare, Threatened, or Endangered in California, but more common elsewhere
1B	Plants Rare, Threatened, or Endangered in California and elsewhere		

2.5 JURISDICTIONAL WATERS

Jurisdictional waters are those rivers, creeks, drainages, lakes, ponds, reservoirs, and wetlands that are subject to the authority of the USACE, CDFW, and/or the RWQCB. In general, the USACE regulates navigable waters, tributaries to navigable waters, and wetlands with a continuous surface connection to these waters, where wetlands are defined by the presence of hydric soils, hydrophytic vegetation, and wetland hydrology. All waters under USACE jurisdiction are also regulated by the RWQCB as waters of the State. Additionally, the RWQCB asserts jurisdiction over certain isolated features disclaimed by the USACE. The CDFW has jurisdiction over waters that have a defined bed and bank. The regulation of jurisdictional waters is discussed in more detail in Section 3.9.

Waters subject to the jurisdiction of the USACE and CDFW are absent from the project site; however, the RWQCB may regulate activities within the site's wastewater treatment ponds and the irrigation ditch crossed by the sewer main alignment between urban Coalinga and the WWTP.

2.6 DESIGNATED CRITICAL HABITAT

As will be discussed further in Section 3.0, the USFWS often designates areas of "critical habitat" when it lists species as threatened or endangered. Critical habitat is a specific

geographic area(s) that contains features essential for the conservation of a threatened or endangered species and that may require special management and protection.

Designated critical habitat is absent from the project site and surrounding lands. The nearest units of critical habitat are located some 30 miles from project boundaries in the Inner Coast Range, and are designated for the protection of the vernal pool fairy shrimp (*Branchinecta lynchi*) and California red-legged frog (*Rana draytonii*).

2.7 SENSITIVE NATURAL COMMUNITIES

California contains a wide range of natural communities, or unique assemblages of plants and animals. These communities have largely been classified and mapped by CDFW as part of their Vegetation Classification and Mapping Program (VegCAMP). Natural communities are assigned state and global ranks according to their rarity and the magnitude and trend of the threats they face. Any natural community with a state rank of 3 or lower (on a 1 to 5 scale) is considered "sensitive" and must be considered in CEQA review.

Sensitive natural communities are absent from the project site.

2.8 WILDLIFE MOVEMENT CORRIDORS

Wildlife movement corridors are routes that animals regularly and predictably follow during seasonal migration, dispersal from native ranges, daily travel within home ranges, and inter-population movements. Movement corridors in California are typically associated with valleys, ridgelines, and rivers and creeks supporting riparian vegetation. Certain features of the project area have the potential to function as movement corridors for resident and migratory fish and wildlife species.

Wildlife movement corridors are absent from the project site itself, but Los Gatos Creek, immediately adjacent to the WWTP work area, is likely to function as an important movement corridor for locally-occurring wildlife.

3.0 RELEVANT GOALS, POLICIES, AND LAWS

3.1 CALIFORNIA ENVIRONMENTAL QUALITY ACT

In California, any project carried out or approved by a public agency that will result in a direct or reasonably foreseeable indirect physical change in the environment must comply with CEQA. The purpose of CEQA is to ensure that a project's potential impacts on the environment are evaluated and methods for avoiding or reducing these impacts are considered before the project is allowed to move forward. A secondary aim of CEQA is to provide justification to the public for the approval of any projects involving significant impacts on the environment.

According to Section 15382 of the CEQA Guidelines, a significant effect on the environment means a "substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project, including land, air, water, minerals, flora, fauna, ambient noise, and objects of historic or aesthetic interest." Although the lead agency may set its own CEQA significance thresholds, project impacts to biological resources are generally considered to be significant if they would meet any of the following criteria established in Appendix G of the CEQA Guidelines:

- 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 CDFW or USFWS.
- 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 CDFW or USFWS.
- 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.
- 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.
- Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance.

- Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan.

Furthermore, CEQA Guidelines Section 15065(a) requires the lead agency to make "mandatory findings of significance" if there is substantial evidence that a project may:

- 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, or substantially reduce the number or restrict the range of an endangered, rare or threatened species.

- Achieve short-term environmental goals to the detriment of long-term environmental goals.

- Produce environmental effects that are individually limited but cumulatively considerable, meaning that the incremental effects of the project are significant when viewed in connection with the effects of past projects, other current projects, and probable future projects.

3.2 NATIONAL ENVIORNMENTAL POLICY ACT

Projects that are proposed, funded, or authorized by federal agencies are generally subject to the provisions of NEPA. Signed into law in 1970 and amended by the Fiscal Responsibility Act of 2023, NEPA requires federal agencies to evaluate the environmental effects of their proposed actions prior to making decisions. Agencies must utilize systematic, interdisciplinary approach that includes the review of technically and economically feasible alternatives to the proposed action, and must ensure professional and scientific integrity in the environmental documents they prepare.

The level of NEPA review that is required is related to a project's potential to cause "significant" environmental effects. Projects with reasonably foreseeable significant effects on the quality of the human environment require an Environmental Impact Statement (EIS). Among other elements, an EIS requires detailed analyses of the project's environmental effects, development and study of a reasonable range of alternatives to the proposed action, and consideration of public comments received during the scoping process. Projects that do not have reasonably foreseeable significant effects on the quality of the human environment, and projects for which the significance of such effects is unknown, may meet their NEPA obligations with the

preparation of an Environmental Assessment (EA). An EA is a concise public document that either provides the basis for a federal agency's finding of no significant impact or culminates in a determination that an EIS is necessary.

3.3 GENERAL PLAN POLICIES OF THE CITY OF COALINGA

In compliance with CEQA, the lead agency must consider conformance with applicable goals and policies of the General Plan of the City of Coalinga. The City of Coalinga General Plan was adopted in 2009 and was intended to guide planning decisions through 2025. It presents the City's vision for long-term growth and development and establishes goals and policies to accomplish this vision. Current policies relevant to biological resources include (1) establishment/protection of a diverse network of open lands encompassing valuable natural and agricultural resources within and around urban Coalinga, (2) protection of streams, riparian corridors, and unique or sensitive habitats, (3) protection of special status plant and animal species and their habitats in accordance with local, state, and federal regulations, (4) preservation and enhancement of habitat linkages recognized by regulatory agencies and/or identified during the City's development review process, and (5) protection of threatened and endangered species and their habitats addressed in the future Coalinga Habitat Conservation Plan (HCP).

3.4 THREATENED AND ENDANGERED SPECIES

In California, imperiled plants and animals may be afforded special legal protections under the California Endangered Species Act (CESA) and/or Federal Endangered Species Act (FESA). Species may be listed as "threatened" or "endangered" under one or both Acts, and/or as "rare" under CESA. Under both Acts, "endangered" means a species is in danger of extinction throughout all or a significant portion of its range, and "threatened" means a species is likely to become endangered within the foreseeable future. Under CESA, "rare" means a species may become endangered if their present environment worsens. Both Acts prohibit "take" of listed species, defined under CESA as "to hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture or kill" (California Fish and Game Code, Section 86), and more broadly defined under FESA to include "harm" (16 USC, Section 1532(19), 50 CFR, Section 17.3). The USFWS commonly interprets "take" to include the loss of habitat utilized by a listed species.

When state and federally listed species have the potential to be impacted by a project, the USFWS and CDFW must be included in the CEQA process. These agencies review the environmental document to determine the adequacy of its treatment of endangered species issues and to make project-specific recommendations for the protection of listed species. Projects that may result in the "take" of listed species must generally enter into consultation with the USFWS and/or CDFW pursuant to FESA and CESA, respectively. In some cases, incidental take authorization(s) from these agencies may be required before the project can be implemented.

3.5 MIGRATORY BIRDS

The Federal Migratory Bird Treaty Act (FMBTA: 16 USC 703-712) prohibits killing, possessing, or trading in any bird species covered in one of four international conventions to which the United States is a party, except in accordance with regulations prescribed by the Secretary of the Interior. The name of the act is misleading, as it actually covers almost all birds native to the United States, even those that are non-migratory. The FMBTA encompasses whole birds, parts of birds, and bird nests and eggs.

Native birds are also protected under California state law. The California Fish and Game Code makes it unlawful to take or possess any non-game bird covered by the FMBTA (Section 3513), as well as any other native non-game bird (Section 3800), even if incidental to lawful activities.

3.6 BIRDS OF PREY

Birds of prey are also protected in California under provisions of the State Fish and Game Code, Section 3503.5, 1992), which states that it is "unlawful to take, possess, or destroy any birds in the order *Falconiformes* or *Strigiformes* (birds of prey) or to take, possess, or destroy the nest or eggs of any such bird except as otherwise provided by this code or any regulation adopted pursuant thereto." Construction disturbance during the breeding season could result in the incidental loss of fertile eggs or nestlings, or otherwise lead to nest abandonment. Disturbance that causes nest abandonment and/or loss of reproductive effort is considered "taking" by the CDFW.

3.7 NESTING BIRDS

In California, protection is afforded to the nests and eggs of all birds. California Fish and Game Code (Section 3503) states that it is "unlawful to take, possess, or needlessly destroy the nest or eggs of any bird except as otherwise provided by this code or any regulation adopted pursuant thereto." Breeding-season disturbance that causes nest abandonment and/or loss of reproductive effort is considered a form of "take" by the CDFW.

3.8 HABITAT CONSERVATION PLANS AND NATURAL COMMUNITY CONSERVATION PLANS

Section 10 of the federal Endangered Species Act establishes a process by which non-federal projects can obtain authorization to incidentally take listed species, provided take is minimized and thoroughly mitigated. A Habitat Conservation Plan (HCP), developed by the project applicant in collaboration with the USFWS and/or NMFS, ensures that such minimization and mitigation will occur, and is a prerequisite to the issuance of a federal incidental take permit. Similarly, a Natural Community Conservation Plan (NCCP), developed by the project applicant in collaboration with CDFW, provides for the conservation of biodiversity within a project area, and permits limited incidental take of state-listed species.

3.9 WETLANDS AND OTHER JURISDICTIONAL WATERS

Section 404 of the federal Clean Water Act (CWA) regulates the discharge of dredged or fill material into "navigable waters" (33 U.S.C. §1344), defined in the CWA as "the waters of the United States, including the territorial seas" (33 U.S.C. §1362(7)). The CWA does not supply a definition for waters of the U.S., and that has been the subject of considerable debate since the CWA's passage in 1972. A variety of regulatory definitions have been promulgated by the two federal agencies responsible for implementing the CWA, the Environmental Protection Agency (EPA) and USACE. These definitions have been interpreted, and in some cases, invalidated, by federal courts.

Waters of the U.S. are presently defined by the EPA and USACE's joint 2023 Revised Definition of 'Waters of the U.S.' Rule (2023 WOTUS Rule), issued in January 2023 and amended in August 2023. Generally speaking, waters of the U.S. include:

- Waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide
- The territorial seas
- Interstate waters
- Impoundments of waters otherwise defined as waters of the United States
- Tributaries to other waters of the U.S. that are relatively permanent, standing or continuously flowing bodies of water
- Wetlands adjacent to other waters of the U.S. that have a continuous surface connection to those waters

The 2023 WOTUS Rule also defines a number of exclusions from the definition of waters of the U.S., many of which are longstanding exclusions from earlier regulatory regimes. These generally include:

- Waste treatment systems
- Prior converted cropland
- Ditches excavated wholly in and draining only dry land that do not carry a relatively permanent flow of water
- Certain artificial features, e.g. irrigation basins, swimming pools, borrow pits, and artificially irrigated areas
- Swales and erosional features characterized by low volume, infrequent, or short duration flow

All activities that involve the discharge of dredge or fill material into waters of the U.S. are subject to the permit requirements of the USACE. Such permits are typically issued on the condition that the applicant agrees to provide mitigation that result in no net loss of wetland functions or values.

Under the Porter-Cologne Water Quality Control Act of 1969, the State Water Resources Control Board (SWRCB) has regulatory authority to protect the water quality of all surface water and groundwater in the State of California ("waters of the State"). Nine RWQCBs oversee water quality at the local and regional level. The RWQCB for a given region regulates discharges of

fill or pollutants into waters of the State through the issuance of various permits and orders. Discharges into waters of the State that are also waters of the U.S. require a Section 401 Water Quality Certification from the RWQCB as a prerequisite to obtaining a Section 404 Clean Water Act permit. Discharges into waters of the State that are not also waters of the U.S. require Waste Discharge Requirements (WDRs), or waivers of WDRs, from the RWQCB.

The SWRCB and RWQCBs also administer the federal National Pollution Discharge Elimination System (NPDES) program, which is concerned with the discharge of stormwater and other pollutants into water bodies. Projects that disturb one or more acres of soil must obtain coverage under the SWRCB's current NPDES Construction Stormwater General Permit. A prerequisite for permit coverage is the development of a Storm Water Pollution Prevention Plan (SWPPP) by a certified Qualified SWPPP Developer. Other types of pollutant discharges into waters of the U.S., such as wastewater, may require coverage under a different NPDES general permit, and in some cases an individual permit.

CDFW has jurisdiction over the bed and bank of natural drainages and lakes according to provisions of Section 1601 and 1602 of the California Fish and Game Code. Activities that may substantially modify such waters through the diversion or obstruction of their natural flow, change or use of any material from their bed or bank, or the deposition of debris require a Notification of Lake or Streambed Alteration. If CDFW determines that the activity may adversely affect fish and wildlife resources, a Lake or Streambed Alteration Agreement will be prepared. Such an agreement typically stipulates that certain measures will be implemented to protect the habitat values of the lake or drainage in question.

4.0 IMPACTS AND MITIGATIONS

This impact assessment assumes that: (1) all project-related disturbance associated with sewer mains in roadways will be confined to the traveled way, (2) all project-related disturbance associated with sewer mains outside of roadways will be confined to a 20-foot-wide corridor centered on the pipe segment, (3) the entirety of the project site's WWTP work area may be permanently or temporarily impacted by proposed activities at that location, (4) no tree or building removal will be required for any project component, and (5) where the sewer main alignment crosses an irrigation ditch between urban Coalinga and the WWTP, the ditch will not be physically disturbed because the pipe will be rehabilitated within its existing footprint using trenchless techniques.

4.1 POTENTIALLY SIGNIFICANT PROJECT IMPACTS

4.1.1 Project Impacts to Monarch Butterfly

Potential Impacts. As discussed, the monarch butterfly (*Danaus plexippus*) has some potential to reproduce, forage, and roost within the project site (see Table 2). Reproduction takes place solely on milkweed (*Asclepias* sp.) plants, which could conceivably be found in those portions of the sewer main work area that pass through residential yards or park land (urban land use type) or ruderal/fallow fields (rural land use type). Milkweed, and by extension breeding, is not expected in the highly degraded habitats of the WWTP work area. Foraging may take place in any vegetated portion of the project site; this includes portions of the WWTP work area that do not experience regular vegetation management. Finally, roosting is a possibility in the few trees of the sewer main work area.

If milkweed occurs in portions of the project site that are planned for impact, the project may result in mortality of monarch eggs, larvae, and pupae, as well as loss of monarch reproductive habitat. These are considered potentially significant impacts under CEQA and NEPA.

Project construction is not expected to adversely affect foraging or roosting monarchs. Monarchs are highly mobile while foraging and would presumably have the ability to avoid active construction zones. After construction, any habitats that provide nectar resources for monarchs

under existing conditions would be expected to naturally revegetate and return to their pre-project level of suitability for this species. Because the project will not remove any trees, it will not impact any monarchs that happen to be roosting on site at the time of construction and will not result in loss of monarch roosting habitat.

Mitigation. The following measures will be implemented to reduce the magnitude of potential project impacts to the monarch butterfly.

> ***Mitigation Measure 4.1.1a (Milkweed Survey).*** Prior to the start of construction, a qualified biologist will conduct a survey for milkweed plants in any portion of the sewer main work area that passes through residential yards, park land, ruderal/fallow fields, or other potentially suitable habitats. The survey will be conducted at a time of year when milkweed is readily identifiable. The objective of the survey will be to tally and map all milkweed plants that could potentially be impacted by project activities.
>
> ***Mitigation Measure 4.1.1b (Construction Timing).*** If feasible, no milkweed plants will be removed during the period when monarchs may be breeding in the project vicinity, March 15-October 31 (The Xerces Society 2019).
>
> ***Mitigation Measure 4.1.1c (Compensatory Mitigation).*** Any milkweed plants located within areas proposed for impact will be replaced at a 3:1 ratio in accordance with a revegetation plan prepared by a qualified biologist. The planting site(s) must be in similar or higher quality habitat to the habitat that was impacted, in area(s) that will not be treated with pesticides or herbicides.

Implementation of the above measures will reduce impacts to the monarch butterfly to a less than significant level under CEQA and NEPA.

4.1.2 Potential Project Impacts to the Southwestern Pond Turtle

Potential Impacts. As discussed, the southwestern pond turtle (*Actinemys pallida*) is present at the WWTP. At the time of LOA's survey, 36 individuals of this species were observed, evenly distributed among the three stabilization ponds. The turtles were of various growth stages, indicating that this is a breeding population. No turtles were observed in the aerated lagoons, and these features are presumably not suitable for this species due to surface turbulence and reduced water quality; the aerated lagoons represent an earlier stage of water treatment than the stabilization ponds. Pond turtles are likely to regularly bask in upland areas surrounding the three occupied ponds and may even nest within the fenced facility, as has been documented at

wastewater treatment facilities elsewhere in California (Davidson and Alvarez 2020; M. Jennings, Rana Resources, pers. comm.). Water temperatures at the WWTP are likely warm enough that pond turtles would be able to remain active through much of the winter; however, during the coldest periods individuals may brumate underwater (M. Jennings, Rana Resources, pers. comm.).

During construction activities at the WWTP, resident pond turtles will be at considerable risk of direct injury or mortality, as well as disturbance leading to indirect mortality. Direct injury or mortality may result from heavy equipment operation in and around the occupied ponds. Subterranean eggs or hatchlings may be crushed, and migrating turtles may be struck and killed. Turtles may also respond to pond dewatering and construction-related noise and vibration by attempting to leave the area, making them vulnerable to predation and vehicle strikes. Construction-related injury and mortality of southwestern pond turtles, both direct and indirect, is a potentially significant impact of this project under CEQA and NEPA.

During operation of the upgraded WWTP, pond turtles would not be at heightened risk of direct injury or mortality because operational activities will be similar to existing. However, indirect mortality is likely to be higher than under baseline conditions due to periodic dry-down of the percolation ponds. Following construction, any given percolation pond will receive treated effluent until percolation rates drop, at which point the pond will be allowed to dry down and will be disked prior to being placed back in service. Pond dry-down will force turtles on to land and potentially out of the WWTP facility altogether, increasing their vulnerability to predation and vehicle strikes. Indirect mortality of southwestern pond turtles during the operations phase is also a potentially significant impact of the project under CEQA and NEPA.

Proposed WWTP upgrades will increase the extent of potential aquatic habitat for the western pond turtle while decreasing its habitat value. Specifically, the project will convert approximately 12.5 acres of suitable, occupied ponds and approximately 6 acres of unsuitable, unoccupied ponds to approximately 18.5 acres of ponds with fluctuating suitability for southwestern pond turtles. On the one hand, the percolation ponds will have higher water quality than existing, with lower levels of biochemical oxygen demand (BOD), total suspended solids (NSS), and nitrogen. Improved water quality in the future percolation ponds may boost

invertebrate prey populations (M. Jennings, Rana Resources, pers. comm.) and otherwise benefit pond turtle fitness. On the other hand, unlike the stabilization ponds, the percolation ponds will not have a perennial inundation regime, but will cycle through inundated and dry periods based on percolation rates. At present, it is unknown how many months of the year any given pond will retain water. Habitat impacts are expected to have a net negative effect on southwestern pond turtles and are potentially significant under CEQA and NEPA.

Mitigation. The following measures will be implemented to reduce the magnitude of project-related impacts to the southwestern pond turtle.

> ***Mitigation Measure 4.1.2a (Construction Timing).*** Construction activities at the WWTP will take place entirely between the months of November and March to avoid the typical timeframe for southwestern pond turtle nesting and egg incubation in this locality.
>
> ***Mitigation Measure 4.1.2b (Preconstruction Survey).*** Within 24 hours prior to the start of construction at the WWTP, a qualified biologist will survey the WWTP work area to identify any locations of possible underground nests, as would be indicated by eggshells on the surface from predation. Because hatchlings sometimes overwinter underground in their nests, this survey is required even with the implementation of Mitigation Measure 4.1.2a above.
>
> ***Mitigation Measure 4.1.2c (Environmental Awareness Training).*** Prior to the start of construction at the WWTP, construction personnel will be trained on the identification, behavior, and ecology of the southwestern pond turtle, and the project-specific measures adopted for its protection. Attendees will be given a handout that summarizes the training material and provides a photographic key to differentiating between the southwestern pond turtle and the common non-native red-eared slider. Attendance at all training sessions will be documented on sign-in sheets.
>
> ***Mitigation Measure 4.1.2d (Refuge Ponds).*** Construction activities at the WWTP will be staged so that, at any given time, at least two ponds suitable for the southwestern pond turtles will be inundated to their full operational depth ("refuge ponds"). In the first stage, at least two of the existing stabilization ponds will remain inundated, as these (and not the aerated lagoons) are presently occupied by pond turtles. Construction activities may proceed at the remaining features. As any given feature is converted to a percolation pond and inundated to its full operational depth, it will become a refuge pond and one of the previous refuge ponds may be released for dewatering and construction.
>
> ***Mitigation Measure 4.1.2e (Construction Monitoring).*** One or more qualified biologists will continuously monitor construction activities at the WWTP for the protection of southwestern pond turtles. The biologist(s) will look for pond turtles attempting to leave the ponds or otherwise traveling through upland areas of the WWTP, and will hand-capture and relocate these individuals to the nearest refuge pond. Any red-eared sliders or

other introduced turtles that are discovered during this effort will be removed from the WWTP and either permanently rehomed or humanely dispatched. The biologist(s) will monitor all ground-disturbing activities in upland areas, looking for any subterranean nests or hatchlings that may be unearthed. The biologist(s) will have the authority to stop work if any nests or hatchlings are detected, and will appropriately secure the area before construction resumes. The number of biologists on site at any given time will be determined by the scope and extent of construction activities.

Mitigation Measure 4.1.2f (WWTP Operational Practices to Ensure No Net Loss of Aquatic Habitat). During operation of the upgraded WWTP, periodic dry-down and disking of the percolation ponds will be staged so that, at any given time, at least three ponds encompassing a minimum of 12.5 acres will be inundated to their full operational depth.

Mitigation Measure 4.1.2g (Habitat Enhancement). When inundated, each percolation pond will be equipped with at least three turtle basking structures. Such devices may consist of logs or floating boards, anchored with chains and weights, that can be removed during periods of dry-down and reinstalled once the pond is ready to be placed back in service.

Mitigation Measure 4.1.2h (Annual Monitoring). For the first five years post-construction, a qualified biologist will conduct annual monitoring of the WWTP's southwestern pond turtle population. Monitoring surveys will be conducted between May and July, when pond turtles are most active, and will target favorable weather conditions for basking. The biologist will assess aquatic habitat suitability by noting inundation levels, recording the species composition and cover of any emergent vegetation, conducting a dipnet survey for invertebrate food sources, and evaluating other parameters as appropriate. The biologist will record the number of all turtles observed by species and age class. An attempt will be made to capture any red-eared sliders or other introduced turtles that are discovered during annual monitoring; captured individuals will be removed from the WWTP and either permanently rehomed or humanely dispatched. The biologist will document their findings in an annual report, to be submitted to the City of Coalinga and other agencies as necessary. If any corrective actions are needed, they will be identified in the annual report and promptly implemented by the City.

Implementation of the above measures will reduce potential project impacts to the southwestern pond turtle to a less than significant level under CEQA and NEPA.

4.1.3 Potential Project Impacts to the Temblor Legless Lizard, California Glossy Snake, and San Joaquin Coachwhip

Potential Impacts. As discussed, three special status terrestrial reptiles, the Temblor legless lizard (*Anniella alexanderae*), California glossy snake (*Arizona elegans occidentalis*), and San Joaquin coachwhip (*Masticophis flagellum ruddocki*), have some potential to occur along the

Warthan and Los Gatos Creek corridors in the immediate project vicinity, and to wander onto the WWTP work area and/or rural portions of the sewer main work area from time to time. If any individuals of these species are present at the time of construction, they could be injured or killed by project activities. Construction-related injury or mortality of these three species is a potentially significant impact under CEQA and NEPA.

The project will not adversely affect the Temblor legless lizard, California glossy snake, or San Joaquin coachwhip through loss of habitat. The site consists of highly modified lands that do not constitute habitat for these special status reptiles but may nevertheless experience occasional use based on these species' potential presence along the adjoining creek corridors. Nearly all project impacts will be temporary, with the sewer mains located belowground and any disturbed surface habitats expected to return to their pre-project level of suitability following project implementation. Considerable habitat of similar or higher quality for these species will remain available in the project vicinity. Project-related loss of habitat for the Temblor legless lizard, California glossy snake, and San Joaquin coachwhip is not considered a significant impact under CEQA and NEPA.

Mitigation. The following measures will be implemented to avoid and minimize construction-related impacts to the Temblor legless lizard, California glossy snake, and San Joaquin coachwhip.

> ***Mitigation Measure 4.1.3a* (*Preconstruction Surveys*).** Within 24 hours prior to the start of construction activities at the WWTP and in rural portions of the sewer main work area, a qualified biologist will conduct preconstruction surveys for the Temblor legless lizard, California glossy snake, and San Joaquin coachwhip. The biologist will make an attempt to hand-capture any individuals of these species that are found and relocate them to suitable alternative habitat away from the work area.
>
> ***Mitigation Measure 4.1.3b (Environmental Awareness Training).*** Prior to the start of construction at the WWTP and in rural portions of the sewer main work area, construction personnel will be trained on the identification, behavior, and ecology of the Temblor legless lizard, California glossy snake, and San Joaquin coachwhip, and the project-specific measures adopted for its protection. Attendees will be given a handout that summarizes the training material. Attendance at all training sessions will be documented on sign-in sheets.
>
> ***Mitigation Measure 4.1.3c* (*Protective Measures During Construction*).** Workers will regularly inspect the work area for reptiles. At a minimum, this will include (1) checking

for reptiles under and around any parked vehicles or equipment prior to their operation, (2) scanning the ground for reptiles while operating vehicles or equipment, and (3) checking any open trenches or other excavations for trapped reptiles at the beginning and end of each work day. Any reptiles found during these inspections will be allowed to leave the area of their own volition, or will be captured and relocated out of harm's way.

Implementation of these measures will reduce project-related impacts to the Temblor legless lizard, California glossy snake, and San Joaquin coachwhip to a less than significant level under CEQA and NEPA.

4.1.4 Potential Project Impacts to the Swainson's Hawk

Potential Impacts. The Swainson's hawk, a California Threatened species, is likely to forage in rural portions of the project site from time to time, and may also nest in mature trees on or near the site, particularly outside of the urban core of Coalinga. No trees will be removed by the project; therefore, there is no appreciable potential for direct injury or mortality of nesting Swainson's hawks or their young. However, construction activities proximate to active nests may disturb the nests to the extent that the nests could fail or have reduced success. Project activities that injure, kill, or reduce the nesting success of Swainson's hawks would violate state and federal laws and be considered a significant impact under CEQA and NEPA.

Swainson's hawks would not be vulnerable to construction-related injury or mortality while foraging because they are highly mobile during this activity and are expected to avoid active work areas. The project is not expected to adversely affect this species through loss of foraging habitat. All impacts to potential Swainson's hawk foraging habitat will be temporary, as the sewer mains will be buried and surface habitats will be allowed to return to pre-project conditions. Loss of habitat for the Swainson's hawk is considered a less than significant impact of the project under CEQA and NEPA.

Mitigation. The following measures will be implemented to avoid and minimize construction-related impacts to Swainson's hawk.

> ***Mitigation Measure 4.1.4a* (*Construction Timing*).** If feasible, project construction will occur entirely outside of the March -September 15 Swainson's hawk nesting season.

***Mitigation Measure 4.1.4b* (*Protocol Nesting Surveys*).** If construction activities must occur between March 1 and September 15, then a qualified biologist will conduct protocol nesting surveys in accordance with the Swainson's Hawk Technical Advisory Committee (SHTAC) 2000 *Recommended Timing and Methodology for Swainson's Hawk Nesting Surveys in California's Central Valley*. Surveys will be conducted in at least the two SHTAC-defined survey periods immediately preceding construction. The survey periods are Period 1: January-March 20, Period II: March 20-April 5, Period III: April 5-20, Period IV: April 21-June 10, Period V: June 10-July 30.

***Mitigation Measure 4.1.4c* (*Avoidance of Active Nests*).** Should any active nests be discovered within the survey area, an appropriate disturbance-free buffer will be established by the biologist based on local conditions and agency guidelines. Disturbance free buffers will be identified on the ground with flagging, fencing, or by other easily visible means and will be maintained until a qualified biologist has determined that the young have fledged and are capable of foraging independently.

Implementation of these measures will reduce project-related impacts to the Swainson's hawk to a less than significant level under CEQA and NEPA and facilitate compliance with state and federal laws protecting this species.

4.1.5 Potential Project Impacts to the Burrowing Owl

Potential Impacts. Although LOA is not aware of any recent, nearby sightings of the burrowing owl, rural portions of the sewer main work area could potentially be used by individuals of this species if it occurs in the vicinity. Burrowing owls are particularly vulnerable to construction-related impacts while occupying underground burrows, either for nesting or roosting. In the unlikely event that one or more burrowing owls were to be occupying burrows within the project site at the time of construction, they could be injured or killed by construction activities, or, if nesting, could be disturbed such that they would abandon their eggs or young. Such an event would constitute a violation of the Migratory Bird Treaty Act and California Endangered Species Act, and would represent a significant impact of the project under CEQA and NEPA. Individuals of this species would not be vulnerable to construction-related injury or mortality while foraging because they are highly mobile foragers and would presumably avoid active work areas.

The project will not result in the loss of burrowing owl nesting or foraging habitat. All impacts to such habitats will be temporary, as the sewer mains will be buried and surface habitats will be allowed to return to pre-project conditions. Loss of habitat for the burrowing owl is considered a less than significant impact of the project under CEQA and NEPA.

Mitigation. The following measures will be implemented to avoid and minimize construction-related impacts to burrowing owls.

> ***Mitigation Measure 4.1.5a (Take Avoidance Survey).*** A take avoidance survey for burrowing owls will be conducted by a qualified biologist within 14 days prior to the start of construction, following methods described in the *Staff Report on Burrowing Owl Mitigation* (CDFG 2012). The survey area will include all potential roosting and nesting habitat on or within 200 meters of the project site.
>
> ***Mitigation Measure 4.1.5b (Avoidance of Active Burrows).*** If project activities are undertaken during the breeding season (February 1-August 31) and active nest burrows are identified within or near project impact areas, a 200-meter disturbance-free buffer will be established around these burrows. The buffers will be enclosed with temporary fencing to prevent construction equipment and workers from entering the setback area. Buffers will remain in place for the duration of the breeding season. During the non-breeding season (September 1-January 31), active burrowing owl burrows will be avoided by a minimum distance of 50 meters.
>
> ***Mitigation Measure 4.1.5c (CDFW Consultation)***. If it is not feasible to avoid burrows by the setback distances specified above, the applicant will develop other measures to fully avoid take of burrowing owls in consultation with CDFW. If full take avoidance is not possible, the applicant will obtain a Section 2081 Incidental Take Permit (ITP) for this species. If an ITP is required, it would include minimization and mitigation measures including a passive relocation effort, construction monitoring, replacement burrow creation/enhancement, and/or other forms of compensatory mitigation.

Implementation of these measures will reduce potential project impacts to the burrowing owl to a less than significant level under CEQA and NEPA and facilitate compliance with state and federal laws protecting this species.

4.1.6 Potential Project Impacts to the San Joaquin Kit Fox

Potential Impacts. Coalinga is known to support an urban-adapted population of the SJKF (Cypher et al. 2012). Individuals of this species have some potential to forage and den in both urban and rural portions of the sewer main work area, particularly outside of residential neighborhoods. SJKF are unlikely to occur within the fenced WWTP, but may occur within those portions of the WWTP work area outside of the fenceline. In the event that one or more SJKF individuals were to be occupying the project site at the time of construction, they could be injured or killed by construction activities. Such an event would constitute a violation of federal and state law and would represent a significant impact of the project under CEQA and NEPA.

The project will not result in the loss of denning or foraging habitat for this species. All impacts to such habitats will be temporary, as the sewer mains will be buried and surface habitats will be allowed to return to pre-project conditions. Loss of habitat for the SJKF is considered a less than significant impact of the project under CEQA and NEPA.

Mitigation. The applicant will implement the following measures derived from the USFWS 2011 *Standardized Recommendations for Protection of the San Joaquin Kit Fox Prior to or During Ground Disturbance*.

> ***Mitigation Measure 4.1.6a (Pre-construction Surveys).*** Between 14 and 30 days prior to the start of any project activity that could potentially affect the SJKF, a qualified biologist will conduct preconstruction surveys for this species following the USFWS 2011 *Standardized Recommendations for Protection of the Endangered San Joaquin Kit Fox Prior to or during Ground Disturbance* ("Standardized Recommendations"). The primary objective will be to identify potential SJKF habitat features and evaluate their use by kit foxes.
>
> ***Mitigation Measure 4.1.6b (Avoidance).*** Should one or more active kit fox dens be detected during preconstruction surveys, the USFWS and CDFW will be notified immediately. A disturbance-free buffer will be established around the dens in consultation with the USFWS and CDFW, to be maintained until an agency-approved biologist has determined that the dens have been abandoned.
>
> ***Mitigation Measure 4.1.6c (Minimization).*** The applicant will implement all minimization measures presented in the *USFWS Standardized Recommendations*. Such measures include, but are not limited to: restriction of project-related vehicle traffic to established roads, construction areas, and other designated areas; measures to prevent the inadvertent entrapment of kit foxes in holes, trenches, and pipes; restriction of rodenticide and herbicide use; and proper disposal of food items and trash.
>
> ***Mitigation Measure 4.1.6d (Environmental Awareness Training).*** A qualified biologist will provide training to all personnel who will be working on site. The training will include a description of the kit fox and its habitat needs; a report of the occurrence of kit fox in the project vicinity; an explanation of the status of the species and its protection under the Endangered Species Act; and a list of the measures being taken to reduce impacts to the species during project construction and implementation. A handout will be provided to all attendees that summarizes the information presented in the training and presents the contact name and number of a designated representative to contact in case SJKF individuals are observed in or near the work area during construction.

Implementation of these measures will reduce potential project impacts to the SJKF to a less than significant level under CEQA and NEPA and facilitate compliance with state and federal laws protecting this species.

4.1.7 Potential Project Impacts to the American Badger

Potential Impacts. Although badgers do not appear to be regularly sighted in the project vicinity, this wide-ranging species has some potential to pass through the area from time to time. If present in the vicinity, then individuals could potentially forage and den in rural portions of the sewer main work area and/or in that portion of the WWTP work area outside of the fenceline. Badgers are particularly vulnerable to construction-related impacts while in their dens. In the unlikely event that one or more badgers were to be occupying dens within the project site at the time of construction, they could be injured or killed by construction activities. Construction mortality of denning badgers is considered a potentially significant impact of the project under CEQA and NEPA. Individuals of this species would not be vulnerable to construction-related injury or mortality while foraging because they would presumably avoid foraging within active work areas, and because their nocturnal foraging behavior should prevent them from overlapping temporally with construction activities.

The project will not result in the loss of American badger denning or foraging habitat. All impacts to such habitats will be temporary, as the sewer mains will be buried and surface habitats will be allowed to return to pre-project conditions. Loss of habitat for the badger is considered a less than significant impact of the project under CEQA and NEPA.

Mitigation. The following measures will be implemented to avoid and minimize construction-related impacts to American badgers.

> ***Mitigation Measure 4.1.7a (Preconstruction Surveys).*** A preconstruction survey for American badgers will be conducted by a qualified biologist within 7 days prior to the start of construction activities in rural portions of the sewer main work area and at the WWTP. The surveys will target all potential denning habitat on or within 50 feet of these areas.
>
> ***Mitigation Measure 4.1.7b (Avoidance).*** Should an active sleeping den be identified during the preconstruction surveys, the den shall be identified in the field with brightly-colored fencing or flagging, and avoided until a qualified biologist has determined that it

has been abandoned. Should an active natal den be identified during the preconstruction surveys, a suitable disturbance-free buffer will be established around the den and maintained until a qualified biologist has determined that the cubs have dispersed or the den has been abandoned.

Implementation of the above measures will reduce potential project impacts to the American badger to a less than significant level under CEQA and NEPA

4.1.8 Potential Project Impacts to Nesting Migratory Birds and Raptors including the Long-eared Owl

Potential Impacts. The project site and adjoining lands have the potential to be used for nesting by a variety of migratory birds and raptors protected by the federal Migratory Bird Treaty Act and related state laws. This includes common species such as the mourning dove, killdeer, and American robin, but may also include several uncommon species. An example of the latter is the special status long-eared owl (*Asio otus*), which could nest immediately adjacent to the WWTP work area along the riparian corridor associated with Los Gatos Creek. If project construction takes place during the nesting season, birds nesting on the site could be injured or killed by construction activities, while birds nesting on or adjacent to the site could be disturbed such that they would abandon their nests. Construction-related mortality of nesting birds and disturbance leading to nest abandonment would violate state and federal laws and be considered a significant impact of the project under CEQA and NEPA.

The special status long-eared owl also has the potential to forage in rural portions of the project site. Individuals of this species would not be vulnerable to construction-related injury or mortality while foraging because they are highly mobile during this activity and because their nocturnal foraging behavior should prevent them from overlapping temporally with construction. The project is not expected to adversely affect this species through loss of foraging habitat. All impacts to such habitats will be temporary, as the sewer mains will be buried and surface habitats will be allowed to return to pre-project conditions. Loss of habitat for the long-eared owl is considered a less than significant impact of the project under CEQA and NEPA.

Mitigation. The following measures will be implemented to avoid and minimize construction-related impacts to nesting migratory birds and raptors including the long-eared owl.

Measure 4.1.8a (Construction Timing). If feasible, project construction will occur entirely outside of the February 1-August 31 general avian nesting season.

***Measure 4.1.8b (Preconstruction Surveys*).** If construction must occur between February 1 and August 31, a qualified biologist will conduct pre-construction surveys for active bird nests within 7 days prior to the start of any work within this period. The survey area will encompass the work area and surrounding lands within 250 feet for nesting migratory birds and 500 feet for raptors.

***Measure 4.1.8c (Avoidance of Active Nests*).** Should any active nests be discovered in or near proposed construction zones, the biologist will identify a suitable construction-free buffer around the nest. The buffer distance will be determined based on species biology, site-specific conditions, and the level of project-related disturbance that is anticipated near the nest(s) in question. Buffers will be identified on the ground with flagging or fencing and will be maintained until the biologist has determined that the young have fledged and are capable of foraging independently.

Implementation of the above measures will reduce project impacts to nesting migratory birds and raptors, including the special status long-eared owl, to a less than significant level under CEQA and NEPA and facilitate compliance with state and federal laws.

4.2 LESS THAN SIGNIFICANT PROJECT IMPACTS

4.2.1 Project Impacts to Special Status Plant Species

Potential Impacts. Eighteen special status plant species have been documented in the regional vicinity of the project site (see Table 2). All are considered absent from the project site due to the absence of suitable habitat and/or the site's being located outside of the species' distribution. The project is not expected to affect individuals or regional populations of these 18 species because they have no appreciable potential to occur on site.

Mitigation. Mitigation measures are not warranted.

4.2.2 Project Impacts to Special Status Animal Species that Would Use the Site for Non-sensitive Activities Only

Potential Impacts. Of the 13 special status animal species potentially occurring on site, one species, the tricolored blackbird (*Agelaius tricolor*) is not expected to use the site for sensitive activities such as breeding, nesting, or communal roosting, nor is it likely to breed, nest, or

communally roost close enough to the site that it would be vulnerable to construction-related disturbance during these activities (see Table 2). Any tricolored blackbird use of the site would be limited to foraging. Tricolored blackbirds are highly mobile during this activity and would be expected to simply avoid active work areas.

The project will not adversely affect tricolored blackbirds through loss of habitat. The site does not offer unique habitat for this species; similar and higher quality habitats are regionally abundant. Moreover, all impacts to potential tricolored blackbird foraging habitat will be temporary, as the sewer mains will be buried and surface habitats will be allowed to return to pre-project conditions. For these reasons, project-related impacts to the tricolored blackbird are considered less than significant under CEQA and NEPA.

Mitigation. Mitigation is not warranted.

4.2.3 Project Impacts to Roosting Bats including Townsend's Big-eared Bat and Western Mastiff Bat

Potential Impacts. The project site's trees and buildings have the potential to be used by roosting bats, possibly including the Townsend's big-eared bat (*Corynorhinus townsendii*) and western mastiff bat (*Eumops perotis californicus*), both California Species of Special Concern. No trees or buildings will be removed under current project design; therefore, roosting bats will not be at risk of construction-related injury or mortality.

The Townsend's big-eared bat and western mastiff bat may also forage over the project site. These species would not be vulnerable to construction-related injury or mortality while foraging because they are highly mobile during this activity and would be expected to simply avoid active work areas. Moreover, these species forage nocturnally, when construction will presumably not be taking place. The project will not adversely affect the Townsend's big-eared bat and western mastiff bat through loss of habitat. The site does not offer unique habitat for these species; similar and higher quality habitats are regionally abundant. Nearly all project impacts will be temporary, with the sewer mains placed belowground and surface habitats allowed to return to pre-project conditions.

For these reasons, project-related impacts to roosting bats, including the Townsend's big-eared bat and western mastiff bat, are considered less than significant under CEQA and NEPA.

Mitigation. Mitigation is not warranted.

4.2.4 Project Impacts to Special Status Animal Species Absent from, or Unlikely to Occur within, the Project Site

Potential Impacts. Of the 29 special status animal species that potentially occur in the general vicinity of the site, 16 are considered absent or unlikely to occur within the project site due to the absence of suitable habitat, and/or the project site's being situated outside of the species' known distribution (see Table 2). These are the Crotch's bumble bee (*Bombus crotchii*), vernal pool fairy shrimp (*Branchinecta lynchi*), California tiger salamander (*Ambystoma californiense*), foothill yellow-legged frog (*Rana boylii*), California red-legged frog (*Rana draytonii*), western spadefoot (*Spea hammondii*), blunt-nosed leopard lizard (*Gambelia sila*), California condor (*Gymnogyps californianus*), San Joaquin antelope squirrel (*Ammospermophilus nelsoni*), giant kangaroo rat (*Dipodomys ingens*), coast horned lizard (*Phrynosoma blainvillii*), northern California legless lizard (*Anniella pulchra*), Le Conte's thrasher *(Toxostoma lecontei*), yellow-headed blackbird (*Xanthocephalus xanthocephalus*), short-nosed kangaroo rat (*Dipodomys nitratoides brevinasus*), and Tulare grasshopper mouse (*Onychomys torridus tularensis*). The project has no appreciable potential to affect these species through construction mortality/disturbance or loss of habitat because there is little or no likelihood that they utilize the site.

Mitigation. Mitigation is not warranted.

4.2.5 Project Impacts to Riparian Habitat and Sensitive Natural Communities

Potential Impacts. The project does not contain riparian habitat or any sensitive natural communities. There will be no impact to such resources.

Mitigation. Mitigation measures are not warranted.

4.2.6 Potential Project Impacts to Waters of the State and U.S.

Potential Impacts. The project site's wastewater treatment ponds and irrigation ditch may be regulated by the RWQCB but do not meet the definition of a Water of the U.S. Although the treatment ponds will be impacted through the removal of clay liners and changed inundation regimes, the project is not expected to substantially alter the ecological function and value of these manmade features. The sewer main that crosses the irrigation ditch is proposed for rehabilitation using trenchless techniques; the ditch will not be physically disturbed. For these reasons, project impacts to Waters of the State are considered less than significant under CEQA and NEPA. The project will have no impact on Waters of the U.S.

Mitigation. Mitigation is not warranted.

4.2.7 Project Impacts to Wildlife Movement Corridors

Potential Impacts. As discussed, the project site itself does not contain any wildlife movement corridors, but Los Gatos Creek adjoins the WWTP work area and is likely to function as a regionally important corridor. The subject reach of Los Gatos Creek is likely to experience some amount of ambient disturbance under existing conditions, as WWTP operational activities include daily vehicular travel and occasional heavy equipment use. Noise disturbance during construction will exceed baseline levels, but for a relatively short period of time. Animals may temporarily shift their use of or movement along this reach of Los Gatos Creek while work is occurring, but following construction, wildlife use of the creek corridor is expected to return to baseline conditions. Project-related impacts to wildlife movement corridors are considered less than significant under CEQA and NEPA.

Mitigation. Mitigation is not warranted.

4.2.8 Project Impacts to Designated Critical Habitat

Potential Impacts. The project will have no effect on designated critical habitat because critical habitat is absent from the project site and adjacent lands.

Mitigation. Mitigation is not warranted.

4.2.9 Local Policies or Habitat Conservation Plans

Potential Impacts. It is assumed that the project will be implemented in a manner consistent with the City of Coalinga General Plan policies related to biological resources. No habitat conservation plans are known to pertain to the area containing the project site.

Mitigation. No mitigation is required.

4.3 SECTION 7 DETERMINATIONS FOR FEDERALLY LISTED SPECIES

Table 3 below presents LOA's preliminary FESA Section 7 effect determinations for federally listed and proposed species found on the USFWS IPaC list and CNDDB list generated for the project, based on currently available information and a level of analysis appropriate for a CEQA Mitigated Negative Declaration and/or NEPA Environmental Assessment. Candidate species are not included in Table 3 because they do not require Section 7 consultation.

TABLE 3: SECTION 7 EFFECT DETERMINATIONS FOR FEDERALLY LISTED SPECIES

Species	ESA Status	Determination	Rationale for the Determination
California Jewelflower *(Caulanthus californicus)*	Endangered	***No effect***	Species is absent (no suitable habitat)
San Joaquin Woollythreads *(Monolopia congdonii*)	Endangered	***No effect***	Species is absent (no suitable habitat)
Monarch Butterfly *(Danaus plexippus)*	Proposed Threatened	***No jeopardy***	This species may occur on site; conservation measures will be implemented to avoid take
Vernal Pool Fairy Shrimp (*Branchinecta lynchi*)	Threatened	***No effect***	Species is absent (no suitable habitat)
California Tiger Salamander *(Ambystoma californiense)*	Threatened	***No effect***	Species is absent (no suitable habitat)
Foothill Yellow-legged Frog *(Rana boylii)*	Threatened	***No effect***	Species is absent (no suitable habitat)
California Red-legged Frog *(Rana draytonii)*	Threatened	***No effect***	Species is absent (no suitable habitat)
Western Spadefoot (*Spea hammondii*)	Proposed Threatened	***No jeopardy***	Species is absent (no suitable habitat)
Southwestern Pond Turtle (*Actinemys pallida*)	Proposed Threatened	***No jeopardy***	This species occupies the WWTP work area; conservation measures will be implemented to avoid take

TABLE 3 (CONT'D)

Species	ESA Status	Determination	Rationale for the Determination
Blunt-nosed Leopard Lizard (*Gambelia sila)*	Endangered	***No effect***	No appreciable potential for species to occur on site (landscape-level factors, unsuitable habitat)
California Condor (*Gymnogyps californianus)*	Endangered	***No effect***	Species is absent (no suitable habitat)
Giant Kangaroo Rat (*Dipodomys ingens)*	Endangered	***No effect***	Species is absent (no suitable habitat)
San Joaquin Kit Fox (SJKF) (*Vulpes macrotis mutica*)	Endangered	***May affect, not likely to adversely affect***	This species may occur on site; conservation measures will be implemented to avoid take

5.0 LITERATURE REFERENCED

Baldwin, B.G., D.H. Goldman, D.J. Keil, R. Patterson, T.J. Rosatti, and D. G. Wilken, editors. 2012. The Jepson Manual: Vascular Plants of California, second edition. University of California Press, Berkeley.

Baumberger, K. L., M. V. Eitzel, M. E. Kirby, and M. H. Horn. 2019. Movement and habitat selection of the western spadefoot (*Spea hammondii*) in southern California. PLoS ONE 14(10): e0222532. Available at: https://doi.org/10.1371/journal.pone.0222532

Calflora. 2025. Calflora: An online database of plant identification and distribution [web application]. Calflora, Berkeley, California. Available: http://www.calflora.org.

California Department of Fish and Wildlife (CDFW). 2025. California Natural Diversity Database. The Resources Agency, Sacramento, CA.

_____. 2002. California Fish and Game Code. Gould Publications. Binghamton, NY.

California Native Plant Society. 2025. Inventory of Rare and Endangered Vascular Plants of California. Available online at: http://cnps.site.aplus.net/cgi-bin/inv/inventory.cgi.

California Soil Resource Lab. 2008. Streaming, seamless interface to USDA-NCSS SSURGO and STATSGO Soil Survey Products.

Cypher, B., C. Van Horn Job, and S. Phillips. 2012. Conservation strategies for San Joaquin kit foxes in urban environments. Prepared for the U.S. Bureau of Reclamation Agreement No. R11AP20502.

Davidson, K. A. and J. A. Alvarez. 2020. A review and synopsis of nest site selection and site characteristics of western pond turtles. Western Wildlife 7:42-49.

eBird. 2025. eBird: An online database of bird distribution and abundance [web application]. eBird, Cornell Lab of Ornithology, Ithaca, New York. Available: http://www.ebird.org.

iNaturalist. 2025. Available: https://www.inaturalist.org/

Natural Resources Conservation Service. 2011. National Hydric Soils List by State, California. U.S. Department of Agriculture.

Swainson's Hawk Technical Advisory Committee. 2000. Recommended Timing and Methodology for Swainson's Hawk Nesting Surveys in California's Central Valley. 5 pp.

The Xerces Society. 2019. A Quick Guide to Monarch Habitat on Farms in California's Central Valley. Publication 19-033_01.

U.S. Fish and Wildlife Service. 2025. IPaC Resource List, Information for Planning and Consultation (IPaC). Available: https://ecos.fws.gov/ipac.

USFWS. 2010. Giant Kangaroo Rat (*Dipodomys ingens*) 5-year Review: Summary and Evaluation. Sacramento Fish and Wildlife Office, Sacramento, CA.

Wetland Training Institute, Inc. 1991. Federal Wetland Regulation Reference Manual. B.N. Goode and R.J. Pierce (eds.) WTI 90-1. 281pp.

Zeiner, David C., William F. Laudenslayer, Kenneth E. Mayer and Marshal White. Ed. 1988. California's wildlife, volume I, amphibians and reptiles, volume II, birds, and volume III, mammals. Department of Fish and Game. Sacramento, CA. Online: http://www.dfg.ca.gov/biogeodata/cwhr/cawildlife.aspx

APPENDIX A: VASCULAR PLANTS OF THE PROJECT SITE

APPENDIX A: VASCULAR PLANTS OF THE PROJECT SITE

The plant species listed below were observed on the project site during surveys conducted by Live Oak Associates, Inc. on March 20 and 21, 2025. The wetland indicator status of each plant, derived from the USACE-administered National Wetland Plant List for the Arid West Region, has been shown following its common name if available.

OBL - Obligate
FACW - Facultative Wetland
FAC - Facultative
FACU - Facultative Upland
UPL - Upland
NR - No review
NA - No agreement
NI - No investigation

ANACARDIACEAE – Sumac Family		
Schinus molle	Peppertree	FACU
Searsia lancea	African Sumac	UPL
APOCYNACEAE – Dogbane Family		
Nerium oleander	Oleander	UPL
ARALIACEAE – Ginseng Family		
Hedera helix	English Ivy	FACU
ARECACEAE – Palm Family		
Washingtonia filifera	California Fan Palm	FAC
Washingtonia robusta	Mexican Fan Palm	FACW
ASTERACEAE – Sunflower Family		
Helianthus annus	Sunflower	FACU
Lactuca serriola	Prickly Lettuce	FACU
Matricaria discoidea	Pineappleweed	
Senecio vulgaris	Common Groundsel	FAC
Sonchus oleraceus	Sowthistle	UPL
BETULACEAE – Birch Family		
Alnus rhombifolia	White Alder	FACW
BRASSICACEAE – Mustard Family		
Brassica spp.	Mustard	UPL
Capsella bursa-pastoris	Shepherd’s Purse	FACU
Sisymbrium irio	London Rocket	UPL
BUXACEAE – Box Family		
Buxus spp.	Boxwood	UPL
CACTACEAE – Cactus Family		
Opuntia spp.	Prickly Pear	UPL
CHENOPODACEAE – C Family		
Salsola tragus	Russian Thistle	FACU
CUPRESSACEAE – Cypress Family		

Calocedrus decurrens	Incense Cedar	UPL
Juniperus californica	California Juniper	FACU
FABACEAE – Bean Family		
Albizia julibrissin	Mimosa Tree	UPL
Ceratonia siliqua	Carob	UPL
Cercis occidentalis	California Redbud	UPL
FAGACEAE – Oak Family		
Quercus spp.	Oak	
Quercus lobata	Valley Oak	FACU
Quercus suber	Cork Oak	UPL
Quercus wislizeni	Interior Live Oak	UPL
GERANIACEAE – Geranium Family		
Erodium cicutarium	Redstem Filaree	UPL
JUGLANDACEAE – Walnut Family		
Carya illinoinensis	Peacan	FAC
LYTHRACEAE – Mahogany Family		
Lagerstroemia spp.	Crepe Myrtle	UPL
Punica granatum	Pomegranate	UPL
MAGNOLIACEAE – Magnolia Family		
Magnolia spp.	Magnolia	UPL
MALVACEAE – Mallow Family		
Malva parviflora	Cheeseweed	UPL
MELIACEAE – Mahogany Family		
Melia azedarach	Chinaberry	UPL
MORACEAE – Fig Family		
Ficus carica	Fig	UPL
Morus alba	White Mulberry	FACU
MYTACEAE – Myrtle Family		
Eucalyptus spp.	Eucalyptus	
Myrtus communis	Common Myrtle	UPL
OLEACEAE – Olive Family		
Olea europaea	Olive	UPL
Ligustrum lucidum	Glossy Privet	
PINACEAE – Pine Family		
Cedrus deodara	Deodar Cedar	UPL
Pinus brutia	Turkish Pine	UPL
Pinus halepensis	Aleppo Pine	UPL
Pinus sabiniana	Foothill Pine	UPL
Pinus spp.	Pine	
POACEAE – Grass Family		
Bromus diandrus	Ripgut Brome	UPL
Bromus rubens	Red Brome	UPL
Cynodon dactylon	Bermuda Grass	FACU
Echinochloa crus-galli	Barnyard Grass	FACW
Hordeum murinum	Foxtail Barley	FACU
Poa annua	Lawn Grass	FAC

ROSACEAE – Rose Family		
Prunus sp.	Stone Fruit	
Prunus cerasifera	Cherry Plum	
Pyrus calleryana	Bradford Pear	UPL
Rosa spp.	Ornamental Rose	
RUTACEAE – Citrus Family		
Citrus x sinensis	Orange	UPL
Citrus x limon	Lemon	UPL
SALICACEAE – Willow Family		
Populus fremontii	Fremont's Cottonwood	FAC
Populus nigra	Italian Poplar	FAC
Salix spp.	Willow	
SAPINDACEAE – Soapberry Family		
Acer spp.	Maple	
Acer palmatum	Japanese Maple	
TAMARICACEAE – Tamarisk Family		
Tamarix ramossima	Saltcedar Tamarisk	FAC
ULMACEAE – Elm Family		
Ulmus parvifolia	Chinese Elm	UPL
VITACEAE – Elm Family		
Vitis spp.	Grape	

APPENDIX B: TERRESTRIAL VERTEBRATE SPECIES THAT POTENTIALLY OCCUR ON THE PROJECT SITE

APPENDIX B: TERRESTRIAL VERTEBRATE SPECIES THAT POTENTIALLY OCCUR ON THE PROJECT SITE

The species listed below are those that may be expected to routinely and predictably use or pass through the project site during some or all of the year. The list was not intended to include birds that are vagrants or occasional transients. Terrestrial vertebrate species observed on or adjacent to the project site during surveys conducted by Live Oak Associates, Inc. on March 20 and 21, 2025 have been noted with an asterisk.

CLASS: AMPHIBIA (Amphibians)
ORDER: SALIENTIA (Frogs and Toads)
FAMILY: BUFONIDAE (True Toads)
Western Toad (*Bufo boreas*)
FAMILY: HYLIDAE (Treefrogs and relatives)
Sierran Treefrog (*Pseudacris sierra*)
FAMILY: RANIDAE (True Frogs)
Bullfrog (*Lithobates catesbeianus*)

CLASS: REPTILIA (Reptiles)
ORDER: TESTUDINES (Turtles)
SUBORDER: CRYPTODIRA (Hidden-neck Turtles)
FAMILY: EMYDIDAE
*Southwestern Pond Turtle (*Actinemys pallida*)
Red-eared Slider (*Trachemys scripta*)
ORDER: SQUAMATA (Lizards and Snakes)
SUBORDER: SAURIA (Lizards)
FAMILY: PHRYNOSOMATIDAE
Western Fence Lizard (*Sceloporus occidentalis*)
Side-blotched Lizard (*Uta stansburiana*)
SUBORDER: SERPENTES (Snakes)
FAMILY: COLUBRIDAE (Colubrids)
Pacific Gopher Snake (*Pituophis catenifer catenifer*)
Common Kingsnake (*Lampropeltis getulus*)
Common Garter Snake (*Thamnophis sirtalis*)
FAMILY: VIPERIDAE (Vipers)
Western Rattlesnake (*Crotalus viridis*)

CLASS: AVES
ORDER: ANSERIFORMES (Ducks, Geese, and Swans)
FAMILY: ANATIDAE (Ducks, Geese, and Swans)
*Mallard (*Anas platyrhynchos*)
Gadwall (*Anas strepera*)
*American Wigeon (*Mareca americana*)
*Cinnamon Teal (*Anas cyanoptera*)
*Northern Shoveler (*Anas crecca*)
*Green-winged Teal (*Anas cyanoptera*)

Ring-necked Duck (*Aythya collaris*)
Lesser Scaup (*Aythya affinis*)
Bufflehead (*Bucephala albeola*)
*****Ruddy Duck (*Oxyura jamaicensis*)

ORDER: PELECANIFORMES (Wading Birds)

FAMILY: ARDEIDAE (Herons)
*Great Egret (*Ardea alba*)
Snowy Egret (*Egretta thula*)

ORDER: ACCIPITRIFORMES (Hawks, Eagles, Vultures, and Kites)

FAMILY: CATHARTIDAE (New World Vultures)
Turkey Vulture (*Cathartes aura*)

FAMILY: ACCIPITRIDAE (Hawks, Eagles, Kites, Old World Vultures, and Harriers)
Cooper's Hawk (*Accipiter cooperi*)
*Red-tailed Hawk (*Buteo jamaicensis*)
Red-shouldered Hawk (*Buteo lineatus*)
Swainson's Hawk (*Buteo swainsoni*)

FAMILY: FALCONIDAE (Caracaras and Falcons)
Merlin (*Falco columbarius*)
*American Kestrel (*Falco sparverius*)

ORDER: GALLIFORMES (Megapodes, Currassows, Pheasants, and Relatives)

FAMILY: ODONTOPHORIDAE (New World Quails)
California Quail (*Callipepla californica*)

FAMILY: PHASIANIDAE (Pheasants, Chickens, Turkeys and Allies)
Domestic Chicken (*Gallus gallus domesticus*)

ORDER: GRUIFORMES (Cranes and Rails)

FAMILY: RALLIDAE (Rails, Gallinules, and Coots)
American Coot (*Fulica americana*)

ORDER: CHARADRIIFORMES (Shorebirds, Gulls, and relatives)

FAMILY: CHARADRIIDAE (Plovers and relatives)
*Killdeer (*Charadrius vociferus*)

FAMILY: RECURVIROSTRIDAE (Stilts and Avocets)
*Black-necked Stilt (*Himantopus mexicanus*)
American Avocet (*Recurvirostra americana*)

FAMILY: SCOLOPACIDAE (Sandpipers and Allies)
Wilson's Snipe (*Gallinago delicata*)
*Greater Yellowlegs (*Tringa melanoleuca*)
*Least Sandpiper (*Calidris minutilla*)

ORDER: CUCULIFORMES (Cuckoos)

FAMILY: CUCULIDAE (Cuckoos)
*Greater Roadrunner (*Geococcyx californianus*)

ORDER: COLUMBIFORMES (Pigeons and Doves)

FAMILY: COLUMBIDAE (Pigeons and Doves)
*Rock Pigeon (*Columba livia*)
*Mourning Dove (*Zenaida macroura*)
*Eurasian Collared Dove (*Streptopelia decaocto*)

ORDER: STRIGIFORMES (Owls)

FAMILY: TYTONIDAE (Barn Owls)
Barn Owl (*Tyto alba*)
ORDER: APODIFORMES (Swifts and Hummingbirds)
FAMILY: TROCHILIDAE (Hummingbirds)
Black-chinned Hummingbird (*Archilochus alexandri*)
Anna's Hummingbird (*Calypte anna*)
ORDER: PASSERIFORMES (Perching Birds)
FAMILY: TYRANNIDAE (Tyrant Flycatchers)
*Black Phoebe (*Sayornis nigricans*)
Say's Phoebe (*Sayornis saya*)
Western Kingbird (*Tyrannus verticalis*)
FAMILY: CORVIDAE (Jays, Magpies, and Crows)
California Scrub Jay (*Aphelocoma coerulescens*)
*American Crow (*Corvus brachyrhynchos*)
Common Raven (*Corvus corax*)
FAMILY: ALAUDIDAE (Larks)
Horned Lark (*Eremophila alpestris*)
FAMILY: HIRUNDINIDAE (Swallows)
Cliff Swallow (*Petrochelidon pyrrhonota*)
Barn Swallow (*Hirundo rustica*)
Northern Rough-winged Swallow (*Stelgidopteryx serripennis*)
FAMILY: AEGITHALIDAE (Titmice)
*Oak Titmouse (*Baeolophus inornatus*)
FAMILY: AEGITHALIDAE (Bushtits)
Bushtit (*Psaltriparus minimus*)
FAMILY: TURDIDAE (Thrushes)
Western Bluebird (*Sialia mexicana*)
American Robin (*Turdus migratorius*)
FAMILY: MIMIDAE (Mockingbirds and Thrashers)
*Northern Mockingbird (*Mimus polyglottos*)
FAMILY: PARULIDAE (Wood Warblers and Relatives)
Yellow-rumped Warbler (*Dendroica coronata*)
FAMILY: STURNIDAE (Starlings and Allies)
*****European Starling (*Sturnus vulgaris*)
FAMILY: MOTACILLIDAE (Wagtails and Pipits)
*American Pipit (*Anthus rubrescens*)
FAMILY: EMBERIZIDAE (Sparrows)
*Savannah Sparrow (*Passerculus sandwichensis*)
*White-crowned Sparrow (*Zonotrichia leucophrys*)
Golden-crowned Sparrow (*Zonotrichia atricapilla*)
California Towhee (*Pipilo crissalis*)
FAMILY: ICTERIDAE (Blackbirds, Orioles and Allies)
Western Meadowlark (*Sturnella neglecta*)
Red-winged Blackbird (*Agelaius phoeniceus*)
Great-tailed Grackle (*Quiscalus mexicanus*)
*Brewer's Blackbird (*Euphagus cyanocephalus*)

Brown-headed Cowbird (*Molothrus ater*)
Bullock's Oriole (*Icterus bullockii*)

FAMILY: FRINGILLIDAE (Finches)

*House Finch (*Haemorhous mexicanus*)
*Lawernce's Goldfinch (*Spinus lawrencei*)
Lesser Goldfinch (*Carduelis psaltria*)

FAMILY: PASSERIDAE (Old World Sparrows)

*House Sparrow (*Passer domesticus*)

CLASS: MAMMALIA

ORDER: DIDELPHIMORPHIA (Marsupials)

FAMILY: DIDELPHIDAE (Opossums)

Virginia Opossum (*Didelphis virginiana*)

ORDER: INSECTIVORA (Shrews and Moles)

FAMILY: TALPIDAE (Moles)

Broad-footed Mole (*Scapanus latimanus*)

ORDER: CHIROPTERA (Bats)

FAMILY: VESPERTILIONIDAE (Vespertilionid Bats)

Pale Big-eared Bat (*Corynorhinus townsendii pallescens*)
Big Brown Bat (*Eptesicus fuscus*)
Yuma Myotis (*Myotis yumanensis*)
California Myotis (*Myotis californicus*)
Western Pipistrelle (*Pipistrellus hesperus*)

FAMILY: MOLOSSIDAE (Free-tailed Bat)

Brazilian Free-tailed Bat (*Tadarida brasiliensis*)

ORDER: LAGOMORPHA (Rabbits, Hares, and Pikas)

FAMILY: LEPORIDAE (Rabbits and Hares)

*Audubon's Cottontail (*Sylvilagus audubonii*)
Black-tailed Jackrabbit (*Lepus californicus*)

ORDER: RODENTIA (Rodents)

FAMILY: SCIURIDAE (Squirrels, Chipmunks, and Marmots)

*California Ground Squirrel (*Otospermophilus beecheyi*)

FAMILY: GEOMYIDAE (Pocket Gophers)

Botta's Pocket Gopher (*Thomomys bottae*)

FAMILY: MURIDAE (Mice, Rats and Voles)

Western Harvest Mouse (*Reithrodontomys megalotis*)
Deer Mouse (*Peromyscus maniculatus*)
Norway Rat (*Rattus norvegicus*)
House Mouse (*Mus musculus*)
California Vole (*Microtus californicus*)

FAMILY: HETEROMYIDAE (Kangaroo Rats)

Heermann's Kangaroo Rat (*Dipodomys heermanni*)

ORDER: CARNIVORA (Carnivores)

FAMILY: CANIDAE (Foxes, Wolves, and Relatives)

Red Fox (*Vulpes vulpes*)
Coyote (*Canis latrans*)

*Domestic Dog (*Canis familiaris*)

FAMILY: PROCYONIDAE (Raccoons and Relatives)

Raccoon (*Procyon lotor*)

FAMILY: MUSTELIDAE (Weasels and Relatives)

Striped Skunk (*Mephitis mephitis*)

FAMILY: FELIDAE (Cats)

*Feral Cat (*Felis catus*)

APPENDIX C: SELECTED SITE PHOTOGRAPHS

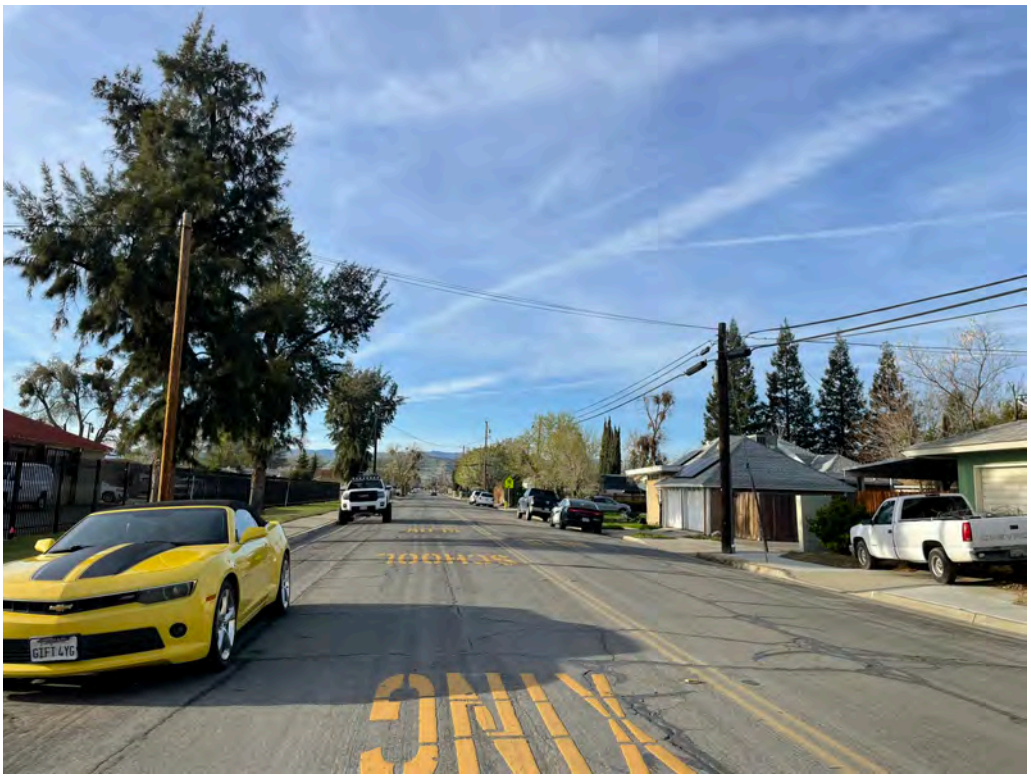


Photo 1 (above): Urban portion of the sewer main work area, showing a paved street. **Photo 2 (below):** Urban portion of the sewer main work area, showing an alley.





Photo 3 (above): Urban portion of the sewer main work area, showing park land. **Photo 4 (below):** Urban portion of the sewer main work area, showing a parking lot.





Photo 5 (above): Rural portion of the sewer main work area, showing unpaved road. **Photo 6 (below):** Rural portion of the sewer main work area, facing west along fallow field (center/right) and irrigation ditch (left). The irrigation ditch is outside of project boundaries at this location, but is crossed by the sewer main alignment farther to the west.





Photo 7 (above): Existing stabilization ponds at the WWTP; pictured are the two easternmost ponds. **Photo 8 (below):** Existing aerated lagoons at the WWTP.





Photo 9 (above): Disturbed uplands of the WWTP work area, inside fenced facility. **Photo 10 (below):** Disturbed uplands of the WWTP work area, outside fenced facility.





Photo 11 (above): Southwestern pond turtle observed at one of the existing stabilization ponds in March 2025.

APPENDIX D: USFWS INFORMATION FOR PLANNING AND CONSULTATION OFFICIAL SPECIES LIST

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

NOT FOR CONSULTATION

Location

Fresno County, California



Local office

Sacramento Fish And Wildlife Office

(916) 414-6600
(916) 414-6713

Federal Building

2800 Cottage Way, Room W-2605
Sacramento, CA 95825-1846

NOT FOR CONSULTATION

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Draw the project location and click CONTINUE.
2. Click DEFINE PROJECT.
3. Log in (if directed to do so).
4. Provide a name and description for your project.
5. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

---

1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information. IPaC only shows species that are regulated by USFWS (see FAQ).
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

NOT FOR CONSULTATION

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS
Giant Kangaroo Rat Dipodomys ingens Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6051	Endangered
San Joaquin Kit Fox Vulpes macrotis mutica Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/2873	Endangered

Birds

NAME	STATUS
California Condor Gymnogyps californianus There is **final** critical habitat for this species. Your location does not overlap the critical habitat. https://ecos.fws.gov/ecp/species/8193	Endangered

Reptiles

NAME	STATUS
Blunt-nosed Leopard Lizard Gambelia silus Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/625	Endangered
Northwestern Pond Turtle Actinemys marmorata Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/1111	Proposed Threatened

Amphibians

NAME	STATUS

NOT FOR CONSULTATION

California Red-legged Frog Rana draytonii — Threatened

Wherever found

There is **final** critical habitat for this species. Your location does not overlap the critical habitat.

https://ecos.fws.gov/ecp/species/2891

California Tiger Salamander Ambystoma californiense — Threatened

There is **final** critical habitat for this species. Your location does not overlap the critical habitat.

https://ecos.fws.gov/ecp/species/2076

Foothill Yellow-legged Frog Rana boylii — Threatened

There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat.

https://ecos.fws.gov/ecp/species/5133

Western Spadefoot Spea hammondii — Proposed Threatened

Wherever found

No critical habitat has been designated for this species.

https://ecos.fws.gov/ecp/species/5425

Insects

NAME	STATUS

Monarch Butterfly Danaus plexippus — Proposed Threatened

Wherever found

There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat.

https://ecos.fws.gov/ecp/species/9743

Crustaceans

NAME	STATUS

Vernal Pool Fairy Shrimp Branchinecta lynchi — Threatened

Wherever found

There is **final** critical habitat for this species. Your location does not overlap the critical habitat.

https://ecos.fws.gov/ecp/species/498

Flowering Plants

NAME	STATUS

NOT FOR CONSULTATION

California Jewelflower Caulanthus californicus Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/4599

San Joaquin Wooly-threads Monolopia (=Lembertia) congdonii Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/3746

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

There are no critical habitats at this location.

You are still required to determine if your project(s) may have effects on all above listed species.

NOT FOR CONSULTATION

Bald & Golden Eagles

Bald and Golden Eagles are protected under the Bald and Golden Eagle Protection Act [2] and the Migratory Bird Treaty Act (MBTA) [1]. Any person or organization who plans or conducts activities that may result in impacts to Bald or Golden Eagles, or their nests, should follow appropriate regulations and implement required avoidance and minimization measures, as described in the various links on this page.

The data in this location indicates that no eagles have been observed in this area. This does not mean eagles are not present in your project area, especially if the area is difficult to survey. Please review the 'Steps to Take When No Results Are Returned' section of the Supplemental Information on Migratory Birds and Eagles document to determine if your project is in a poorly surveyed area. If it is, you may need to rely on other resources to determine if eagles may be present (e.g. your local FWS field office, state surveys, your own surveys).

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management

- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide avoidance and minimization measures for birds https://www.fws.gov/sites/default/files/documents/nationwide-standard-conservation-measures.pdf
- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

Bald & Golden Eagles FAQs

What does IPaC use to generate the potential presence of bald and golden eagles in my specified location?

The potential for eagle presence is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are an eagle (Bald and Golden Eagle Protection Act requirements may apply).

Proper interpretation and use of your eagle report

On the graphs provided, please look carefully at the survey effort (indicated by the black vertical line) and for the existence of the "no data" indicator (a red horizontal line). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort line or no data line (red horizontal) means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list and associated information help you know what to look for to confirm presence and helps guide you in knowing when to implement avoidance and minimization measures to eliminate or reduce potential impacts from your project activities or get the appropriate permits should presence be confirmed.

How do I know if eagles are breeding, wintering, or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating, or resident), you may query your location using the RAIL Tool and view the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If an eagle on your IPaC migratory bird species list has a breeding season associated with it (indicated by yellow vertical bars on the phenology graph in your “IPaC PROBABILITY OF PRESENCE SUMMARY” at the top of your results list), there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

Interpreting the Probability of Presence Graphs

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. A taller bar indicates a higher probability of species presence. The survey effort can be used to establish a level of confidence in the presence score.

How is the probability of presence score calculated? The calculation is done in three steps:

NOT FOR CONSULTATION

The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.

To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

Breeding Season ()
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort ()
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data ()
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

NOT FOR CONSULTATION

Migratory birds

The Migratory Bird Treaty Act (MBTA) [1] prohibits the take (including killing, capturing, selling, trading, and transport) of protected migratory bird species without prior authorization by the Department of Interior U.S. Fish and Wildlife Service (Service). The incidental take of migratory birds is the injury or death of birds that results from, but is not the purpose, of an activity. The Service interprets the MBTA to prohibit incidental take.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Eagle Management https://www.fws.gov/program/eagle-management
- Measures for avoiding and minimizing impacts to birds https://www.fws.gov/library/collections/avoiding-and-minimizing-incidental-take-migratory-birds
- Nationwide avoidance and minimization measures for birds

- Supplemental Information for Migratory Birds and Eagles in IPaC https://www.fws.gov/media/supplemental-information-migratory-birds-and-bald-and-golden-eagles-may-occur-project-action

Measures for Proactively Minimizing Migratory Bird Impacts

Your IPaC Migratory Bird list showcases birds of concern, including Birds of Conservation Concern (BCC), in your project location. This is not a comprehensive list of all birds found in your project area. However, you can help proactively minimize significant impacts to all birds at your project location by implementing the measures in the Nationwide avoidance and minimization measures for birds document, and any other project-specific avoidance and minimization measures suggested at the link Measures for avoiding and minimizing impacts to birds for the birds of concern on your list below.

Ensure Your Migratory Bird List is Accurate and Complete

If your project area is in a poorly surveyed area, your list may not be complete and you may need to rely on other resources to determine what species may be present (e.g. your local FWS field office, state surveys, your own surveys). Please review the Supplemental Information on Migratory Birds and Eagles document, to help you properly interpret the report for your specified location, including determining if there is sufficient data to ensure your list is accurate.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, see the "Probability of Presence Summary" below to see when these birds are most likely to be present and breeding in your project area.

Review the FAQs

The FAQs below provide important additional information and resources.

NAME	BREEDING SEASON
Belding's Savannah Sparrow Passerculus sandwichensis beldingi This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/8	Breeds Apr 1 to Aug 15
Nuttall's Woodpecker Dryobates nuttallii This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/9410	Breeds Apr 1 to Jul 20
Yellow-billed Magpie Pica nuttalli This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9726	Breeds Apr 1 to Jul 31

NOT FOR CONSULTATION

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read "Supplemental Information on Migratory Birds and Eagles", specifically the FAQ section titled "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

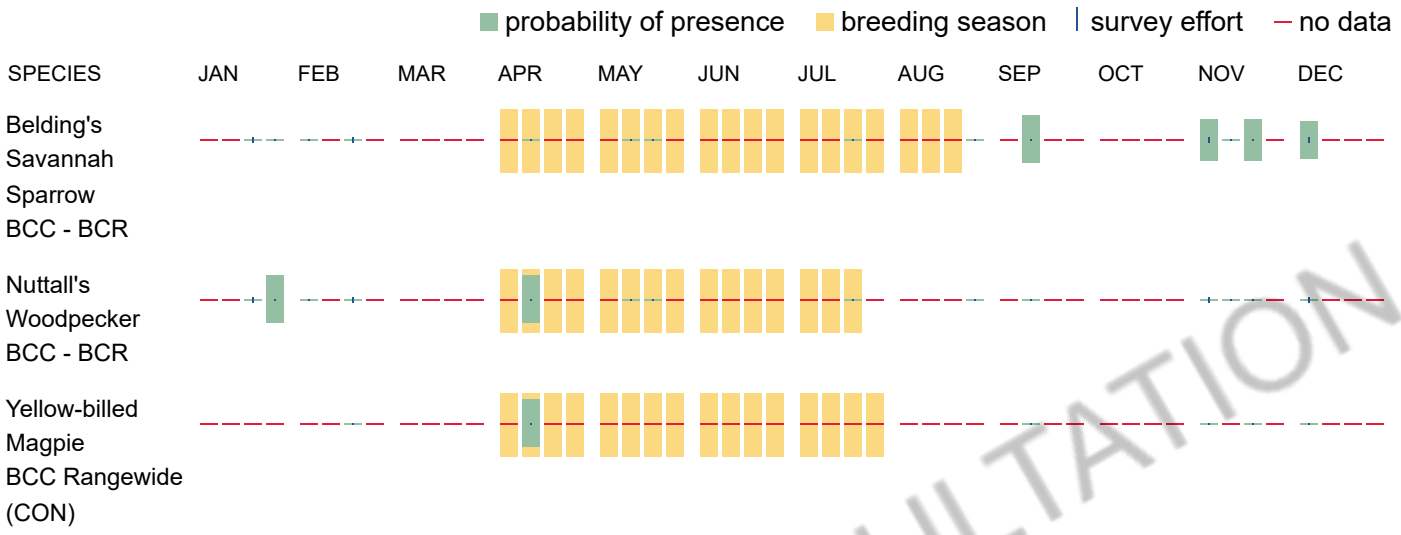
No Data (–)

NOT FOR CONSULTATION

A week is marked as having no data if there were no survey events for that week.

Survey Timeframe

Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



NOT FOR CONSULTATION

Migratory Bird FAQs

Tell me more about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Avoidance & Minimization Measures for Birds describes measures that can help avoid and minimize impacts to all birds at any location year-round. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is one of the most effective ways to minimize impacts. To see when birds are most likely to occur and breed in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the list of migratory birds that potentially occur in my specified location?

The Migratory Bird Resource List is comprised of Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location, such as those listed under the Endangered Species Act or the Bald and Golden Eagle Protection Act and those species marked as “Vulnerable”. See the FAQ “What are the levels of concern for migratory birds?” for more information on the levels of concern covered in the IPaC migratory bird species list.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) with which your project intersects. These species have been identified as warranting special attention because they are BCC species in that area, an eagle (Bald and Golden Eagle Protection Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, and to verify survey effort when no results present, please visit the Rapid Avian Information Locator (RAIL) Tool.

Why are subspecies showing up on my list?

Subspecies profiles are included on the list of species present in your project area because observations in the AKN for **the species** are being detected. If the species are present, that means that the subspecies may also be present. If a subspecies shows up on your list, you may need to rely on other resources to determine if that subspecies may be present (e.g. your local FWS field office, state surveys, your own surveys).

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets.

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go to the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, or migrating in my area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating, or resident), you may query your location using the RAIL Tool and view the range maps provided for birds in your area at the bottom of the profiles provided for each bird in your results. If a bird on your IPaC migratory bird species list has a breeding season associated with it (indicated by yellow vertical bars on the phenology graph in your “IPaC PROBABILITY OF PRESENCE SUMMARY” at the top of your results list), there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Bald and Golden Eagle Protection Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially BCC species. For more information on avoidance and minimization measures you can implement to help avoid and minimize migratory bird impacts, please see the FAQ “Tell me more about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds”.

NOT FOR CONSULTATION

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Proper interpretation and use of your migratory bird report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please look carefully at the survey effort (indicated by the black vertical line) and for the existence of the "no data" indicator (a red horizontal line). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list does not represent all birds present in your project area. It is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list and associated information help you know what to look for to confirm presence and helps guide implementation of avoidance and minimization measures to eliminate or reduce potential impacts from your project activities, should presence be confirmed. To learn more about avoidance and minimization measures, visit the FAQ "Tell me about avoidance and minimization measures I can implement to avoid or minimize impacts to migratory birds".

Interpreting the Probability of Presence Graphs
Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. A taller bar indicates a higher probability of species presence. The survey effort can be used to establish a level of confidence in the presence score.

How is the probability of presence score calculated? The calculation is done in three steps:
The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.

To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.

The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

Breeding Season ()
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

NOT FOR CONSULTATION

Survey Effort ()
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps.

No Data ()
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

Facilities

Wildlife refuges and fish hatcheries

Refuge and fish hatchery information is not available at this time

Wetlands in the National Wetlands Inventory (NWI)

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

This location overlaps the following wetlands:

FRESHWATER POND
PUBKx

LAKE
L2UBKx

RIVERINE
R4SBA
R4SBC

NOT FOR CONSULTATION

R5UBF

A full description for each wetland code can be found at the National Wetlands Inventory website

NOTE: This initial screening does **not** replace an on-site delineation to determine whether wetlands occur. Additional information on the NWI data is provided below.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate Federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

NOT FOR CONSULTATION

Appendix D

Cultural Resources Survey

Draft

CLASS III INVENTORY/PHASE I SURVEY, COALINGA SANITARY SEWER COLLECTION SYSTEM AND WASTEWATER TREATMENT PLANT IMPROVEMENTS PROJECT FRESNO COUNTY, CALIFORNIA

Prepared for:

Travis Crawford
Crawford & Bowen Planning, Inc.
113 N. Church Street, Suite 3
Visalia, CA 93291

Prepared by:

Dustin Merrick, MA, RPA,

Madeline Gonzalez, MA,

and

Sarah Stringer-Bowsher, MA, RPH

ASM Affiliates
4800 Stockdale Hwy, Ste 405
Bakersfield, CA 93309

July 2026
PN 36790.19

TABLE OF CONTENTS

Chapter Page

MANAGEMENT SUMMARY v

1. INTRODUCTION AND REGULATORY CONTEXT 1
1.1 PROJECT LOCATION 1
1.2 PROJECT DESCRIPTION AND AREA OF POTENTIAL EFFECTS 5
1.2.1 Sewer Main Replacement 5
1.2.2 Sewer Main Rehabilitation 5
1.2.3 Proposed Improvements to Wastewater Treatment Plant 6
1.2.4 Area of Potential Effect 7
1.3 REGULATORY CONTEXT 7
1.3.1 National Historic Preservation Act Section 106 7
1.3.2 California Environmental Quality Act 8
1.3.3 Eligibility Criteria for Wastewater Treatment Facilities in California 9

2. ENVIRONMENTAL AND CULTURAL BACKGROUND 17
2.1 GEOARCHAEOLOGICAL SENSITIVITY AND ENVIRONMENTAL BACKGROUND 17
2.1.1 Environmental Setting 17
2.1.2 Geology and Geomorphology 17
2.1.3 Soils 20
2.1.4 Buried Site Sensitivity 20
2.2 ETHNOGRAPHIC BACKGROUND 20
2.3 PRE-CONTACT ARCHAEOLOGICAL BACKGROUND 22
2.4 HISTORICAL BACKGROUND 25
2.4.1 Drinking Water and Wastewater Treatment Facilities in California 25
2.4.2 Coalinga Wastewater Treatment Plant Operations 97
2.4.3 Coalinga Wastewater Treatment Plant 99
2.4.4 Site Specific History 102
2.5 Historic-Era Archaeology: Refuse Deposits 114

3. RECORDS AND SACRED LANDS FILE SEARCHES 119
3.1 RECORDS SEARCH 119
3.2 TRIBAL OUTREACH 122

4. METHODS AND RESULTS 123
4.1 FIELD METHODS 123
4.2 SURVEY RESULTS 123
4.2.1 Archaeological Results 123
4.2.2 Built Environment Results 129

5. SUMMARY, ASSESSMENT OF EFFECTS, AND RECOMMENDATIONS 165
5.1 SUMMARY 165

5.2 ASSESSMENT OF EFFECTS 166
5.3 RECOMMENDATIONS 166

REFERENCES 169

CONFIDENTIAL APPENDICES .....

LIST OF FIGURES

Page

Figure 1. Coalinga Sanitary Sewer Collection System and WWTP Improvements Project, Fresno County, California. 3
Figure 2. Coalinga Sanitary Sewer Collection System and WWTP Improvements Project Geology Map 19
Figure 3. Portion of 1944 USGS Topographic Map Coalinga Quadrangle. Surveyed in 1935-1936 and 1940-1941. 103
Figure 4. Portion of 1956 USGS Topographic Map Coalinga Quadrangle. Aerial Photographs taken 1953. 104
Figure 5. 1967 historic aerial photograph of the Coalinga WWTP. Source: USGS 105
Figure 6. The Coalinga WWTP as depicted in the 1979 drawings by John Carollo Engineers. 107
Figure 7. Detail of the plant area of the WWTP as depicted in the 1979 drawings by John Carollo Engineers. 108
Figure 8. The Coalinga WWTP as depicted in the 1990 drawings by James Montgomery Consulting Engineers. 109
Figure 9. Detail of the plant area of the WWTP as depicted in the 1990 drawings by James Montgomery Consulting Engineers. 110
Figure 10. Photograph of the construction occurring at the Coalinga WWTP, dated May 28, 1991. The clarifier is visible in the foreground, and the animal shelter building is visible in the background. 111
Figure 11. Photograph of the construction occurring at the Coalinga WWTP, dated May 28, 1991. This photograph depicts the materials that were removed for the modernization and expansion of the facility. 112
Figure 12. Photograph of the construction occurring at the Coalingag WWTP, dated May 28, 1991. The clarifier structure is depicted, and the primary pump station is visible under construction. 113
Figure 13. Project APE overview along Van Ness Street, facing east. 124
Figure 14. Project APE overview along Cherry Lane, facing west. 124
Figure 15. WWTP APE infrastructure overview, facing east. 125
Figure 16. WWTP APE infrastructure overview, facing northwest. 125
Figure 17. Northwestern WWTP APE overview, facing southwest. 126
Figure 18. WWTP-SITE-1 overview, facing north. 128
Figure 19. WWTP-SITE-1 refuse scatter. 128
Figure 20. Location Map of Coalinga WWTP APE and potential WWTP historic district boundary 131
Figure 21. Aerial map that identifies the components of the Coalinga WWTP and the potential WWTP historic district boundary. 133
Figure 22. Building One, the Operations Building. Primary façade, view toward east. 138
Figure 23. Building One, the Operations Building. Side and primary façade, view toward southwest. 138

Figure 24. Building One, the Operations Building. Rear façade, view toward west. 139
Figure 25. Building One, the Operations Building. Side and primary façade, view toward northeast. 139
Figure 26. Detail of the plaque on the primary façade of Building One, the Operations Building. 140
Figure 27. Building Two, the Animal Shelter Building. Rear and side façade, view toward southwest. 143
Figure 28. Building Two, the Animal Shelter Building. Rear and side façade, view toward northwest. 143
Figure 29. Building Two, the Animal Shelter Building. View of concrete pad and pathway. View toward east. 144
Figure 30. Building Two, the Animal Shelter Building. Primary façade, view toward east. 144
Figure 31. Building Three, the Primary Pump Station. Rear and side façade, view toward northwest. 147
Figure 32. Building Three, the Primary Pump Station. Primary and side façade, view toward northeast. 147
Figure 33. Building Three, the Primary Pump Station. Rear façade, view toward west. 148
Figure 34. Building Four, the Shed. View toward south. 151
Figure 35. Building Four, the Shed. Rear façade, view toward southwest. 152
Figure 36. Building Four, the Shed. Primary façade, view toward northeast. 152
Figure 37. Building Four, the Shed. Detail of interior. 153
Figure 38. Structure One, Digester Tank. View toward northwest. Building Four visible in background. 154
Figure 39. Structure One, Digester Tank. View toward southwest. 155
Figure 40. Structure One, Digester Tank. View toward southeast. 155
Figure 41. Structure Two, Clarifier Tank. View toward southeast. 158
Figure 42. Structure Two, Clarifier Tank. View toward north. Structure One visible in background. 158
Figure 43. Showing exposed ditch feature within the Pipelines APE. 166

LIST OF TABLES

Page

Table 1. Proposed Sewer Main Replacement 5
Table 2. Proposed Sewer Main Rehabilitation 5
Table 3. Proposed Evaporation/Percolation Pond Characteristics 7
Table 4. Previous Reports within 0.5 mi. of the APE 119
Table 5. Previously Recorded Resources 121

MANAGEMENT SUMMARY

This report documents the results of an intensive Class III inventory/Phase I survey for the Coalinga Sanitary Sewer Collection System and Wastewater Treatment Plant Improvements Project (Project) Fresno County, California.

The Project is within the city of Coalinga in Fresno County. This places the Project on the open flats of the San Joaquin Valley, directly east of the Coast Range. Specifically, the Project is within Sections 31, 33, 34, Township 20 South, Range 17 East (T20S/R15E) and Section 4 and 5 T21S/ R15E, Mount Diablo Base and Meridian (MDBM), as illustrated on the Coalinga USGS 7.5-minute topographic quadrangle. The proposed Project site consists of developed infrastructure including a water treatment facility, unpaved and paved roads throughout the city of Coalinga, as well as agricultural fields. Elevations within the Project area, which is mostly flat, range from 640 feet (ft.) above mean sea level (amsl) to 690 ft. amsl. The Area of Potential Effect (APE) for the Project was defined as the area of potential ground surface disturbance. The horizontal APE for the Project totals approximately 174.7 acres (ac.) and contains all construction areas, staging and laydown areas, and access roads. The vertical APE, defined as the maximum depth of excavation of the Project, is not expected to exceed 10 ft. below ground surface.

ASM Affiliates (ASM) conducted this study, with Senior Archaeologist Dustin Merrick, MA, RPA, serving as principal investigator and main author of this report. Associate Archaeologist Robert Azpitarte, BA, and Assistant Archaeologist Margarita Medina Lemus, BA, conducted the fieldwork. Geoarchaeologist Maya Klinger, MA, RPA, prepared the geoarchaeological sensitivity and environmental background. Architectural Historian Madeline Gonzalez, MA, prepared the evaluation of the built environment resources under National Register of Historic Places (NRHP) and California Register of Historic Resources (CRHR) criteria. Sarah Stringer-Bowsher, MA, RPH, was the peer reviewer of the built environment evaluations. The study was undertaken to assist with compliance with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, and the California Environmental Quality Act (CEQA).

To determine whether the Project APE had been previously surveyed for cultural resources, and/or whether any such resources were known to exist within or near to it, staff of the Southern San Joaquin Valley Information Center (SSJVIC) conducted an archival records search on May 29, 2024. According to the SSJVIC, six previous studies have been conducted within the Project APE, and 31 previous studies were identified within a 0.5-mile (mi.) buffer. Based on SSJVIC data, approximately 30 percent of the Project APE has been previously surveyed. Dates for previous studies in the APE range from 1995 to 2016 with the majority of studies being greater than 20 years old. The SSJVIC results identified a single previously recorded cultural resource (P-10-003930) within the APE. An additional 17 resources were identified within the 0.5-mi. buffer.

Geoarchaeological review of the project indicates the deposits within the APE(s) formed between the historical era/modern times (<150 years before present [YBP]), and latest Holocene (2000–150 YBP). Whereas the Pipelines APE is marked by high buried site potential, the Waste Water Treatment Plant (WWTP) APE is marked as having low buried site potential (Meyer et al. 2010:140, Table 18). Historic aerial and topographic map review shows the project APE has been

heavily disturbed by agricultural activities and industrial development as far back as the mid-twentieth century.

As part of the CEQA process, a search of the Native American Heritage Commission (NAHC) Sacred Lands File was completed on May 9, 2024. Based on the NAHC records, the APE is negative for sacred sites or traditional cultural places. Outreach letters were sent on July 23, 2024, to tribal organizations on the NAHC contact list. Follow-up emails were sent on April 16, 2024. On August 12, 2024, Table Mountain Rancheria responded stating the Project was out of their area of interest. No other responses were received as a result of this outreach.

The Class III inventory/Phase I survey of the Project APE was conducted from August to September 2024. Parallel survey transects spaced at maximum intervals of 15 meters (m) apart were employed for pedestrian survey of the 174.7-ac. Project APE, which consists of two areas referred to as the Pipeline APE and the WWTP APE. The proposed Project consists of improvements to a water treatment plant first constructed in 1963 and its associated pipelines. The Pipeline APE consists largely of paved roads. As such, the vast majority of the Pipeline APE has been hardscaped over. Approximately 1,700 ft. of the Pipeline APE, along both O Street and 16th Street, is undeveloped. Visibility within undeveloped areas was good (approximately 75 percent).

The majority of the WWTP APE was developed between 1963 and 1991. The visibility within the water treatment facility was excellent (approximately 90 percent) outside of developed areas. Diffuse modern refuse was observed throughout the APE. Non-native vegetation inhibited visibility in undeveloped areas.

One previously recorded resource, a segment of the Southern Pacific Railroad (P-10-003930), was observed within the Pipeline APE, and is described in Section 4.2.1. The Project proposes trenchless drilling under P-10-003930. As such, it is outside of the APE. No other previously recorded resources and no further cultural resources were identified within the Pipeline APE.

ASM was tasked with the evaluation of all buildings and structures within the WWTP APE. In this report, buildings and structures that were constructed more than 45 years ago are individually evaluated for their eligibility for the NRHP, CRHR, and as CEQA historical resources, and buildings and structures that were constructed less than 45 years ago were considered under NRHP Criterion Consideration G. ASM additionally considered the potential for a historic district associated with the Coalinga WWTP. ASM considered the possibility of a historic district within the WWTP APE, but there is no historic district. The buildings and structures within the WWTP APE are recommended not individually eligible for the NRHP and CRHR. Therefore, the buildings and structures are not considered historic properties pursuant to the NHPA, and they are not considered historical resources pursuant to CEQA. These resources are further described in Section 4.2.1. ASM was not tasked with the evaluation of the pipelines within the Pipelines APE.

Based on the above analyses and findings, the proposed Coalinga Sanitary Sewer Collection System and WWTP Improvements Project will not result in adverse effects to historic properties or significant impacts to historical resources. ASM recommends a determination of ***no adverse effect*** under Section 106 and ***no significant impact*** under CEQA. It is further recommended that, in the unlikely event that previously unrecorded cultural resources are identified during Project

construction, work be halted within a 100-ft. radius of the find and a qualified archaeologist be contacted to evaluate the newly discovered resource.

1. INTRODUCTION AND REGULATORY CONTEXT

ASM Affiliates (ASM) was retained by Crawford & Bowen Planning, Inc. to conduct an intensive Class III inventory/Phase I survey for the Coalinga Sanitary Sewer Collection System and Wastewater Treatment Plant (WWTP) Improvements Project (Project) Fresno County, California (Figure 1). The study was undertaken to assist with compliance with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, and the California Environmental Quality Act (CEQA). The investigation was conducted, specifically, to ensure that significant impacts or adverse effects to historic properties or historical resources do not occur as a result of Project construction.

This current study included:

- A background records search and literature review to determine if any known cultural resources were present in the project zone and/or whether the area had been previously and systematically studied by archaeologists;
- An on-foot, intensive inventory of the Project site to identify and record previously undiscovered cultural resources and to examine known sites; and
- A preliminary assessment of any such resources found within the subject property.

Senior Archaeologist Dustin Merrick, MA RPA, served as principal investigator and main author of this report. Associate Archaeologist Robert Azpitarte, BA, and Assistant Archaeologist Margarita Medina Lemus, BA, conducted the fieldwork. Geoarchaeologist Maya Klinger, MA, RPA, prepared the geoarchaeological sensitivity and environmental background. Architectural Historian Madeline Gonzalez, MA, prepared the evaluation of the built environment resources according to NRHP and CRHR criteria. Sarah Stringer-Bowsher, MA, RPH, was the peer reviewer of the built environment evaluations.

This document constitutes a report on the Class III inventory/Phase I survey. Subsequent chapters provide background to the investigation, including historic context studies; the findings of the archival records search; a summary of the field surveying techniques employed; and the results of the fieldwork. We conclude with management recommendations for the Project.

1.1 PROJECT LOCATION

The Project is within the city of Coalinga (City) in Fresno County, spanning throughout the city. This places the Project on the open flats of the San Joaquin Valley, directly east of the Coast Range. Specifically, the Project is within Sections 31, 33, 34, Township 20 South, Range 17 East (T20S/R15E) and Section 4 and 5 T21S/ R15E, Mount Diablo Base and Meridian (MDBM), as illustrated on the Coalinga USGS 7.5-minute topographic quadrangle. The proposed Project site consists of developed infrastructure including a water treatment facility, unpaved and paved roads throughout the city of Coalinga, as well as agricultural fields. Elevations within the Project area, which is mostly flat, range from 640 feet (ft.) above mean sea level (amsl) to 690 ft. amsl.

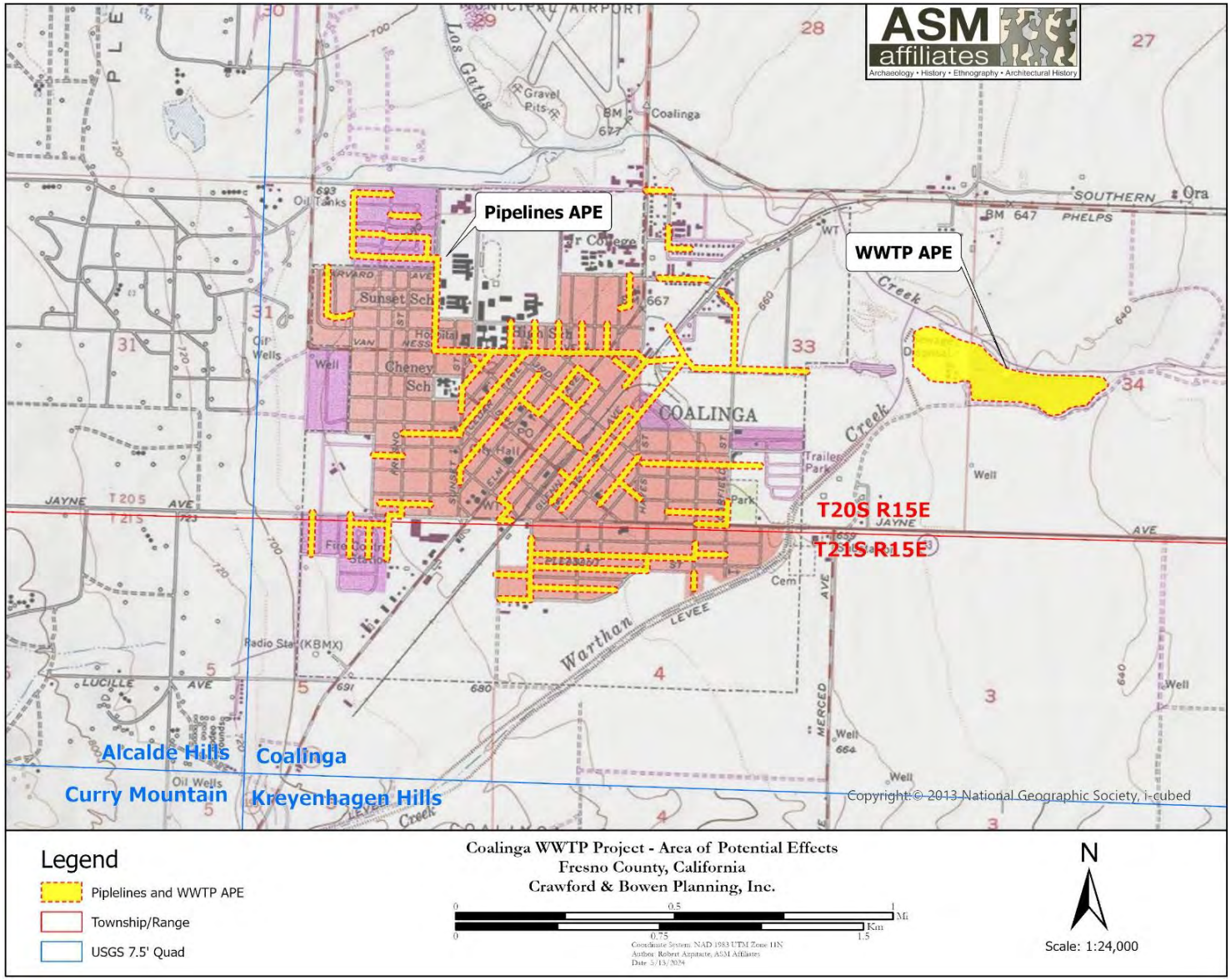


Figure 1. Coalinga Sanitary Sewer Collection System and WWTP Improvements Project, Fresno County, California.

1.2 PROJECT DESCRIPTION AND AREA OF POTENTIAL EFFECTS

Based on the condition assessment conducted, the recommended improvements for the City's sewer collection system are summarized in the following paragraphs.

1.2.1 Sewer Main Replacement

CCTV inspection conducted on 104,618 linear feet (LF) of the City's sewer collection system revealed several defects in portions of the collection system. Defects found in the sewer mains included root intrusion, fractured and broken pipe, cracked pipe, sags greater than 60 percent, defective and intruding laterals, joint displacements, and attached deposits (grease and concrete). The segments of the sewer collection system recommended for replacement have been selected based on sorted NASSCO ratings and the condition of the existing sewer mains. For this proposed Project, it is recommended that approximately 41,073 LF of gravity sewer mains be replaced with new sewer pipes before failure occurs. Table 1 provides a summary of the sewer mains that will be replaced using the conventional construction method of dig and replace.

Table 1. Proposed Sewer Main Replacement

Parameter	Total Length (ft)
6" PVC Pipe	13,838
8" PVC Pipe	4,226
10" PVC Pipe	1,738
Total	19,802

1.2.2 Sewer Main Rehabilitation

Trenchless sewer rehabilitation is recommended where applicable to reduce surface disturbance over traditional dig and replace methods, reduce the number of traffic and pedestrian detours, spare tree removal, decrease construction noise, and reduce air pollution from construction equipment. Table 2 provides a summary of the sewer mains that will be rehabilitated using the trenchless construction method known as cured-in-place (CIP).

Table 2. Proposed Sewer Main Rehabilitation

Parameter	Total Length (ft)
6" PVC Pipe	15,914
8" PVC Pipe	7,297
10" PVC Pipe	2,071
15" PVC Pipe	2,558
18" PVC Pipe	2,975
Total	30,815

1.2.3 Proposed Improvements to Wastewater Treatment Plant

The existing aerated lagoons and stabilization ponds will be decommissioned for the construction of percolation ponds. In this proposed project, an extended aeration system with biological nutrient removal with filtration and disinfection will be constructed. For this proposed project, Aero Mod extended aeration system was selected. The moving aeration chains are equipped with diffuser and provide efficient mixing of the basin contents as well as high oxygen transfer at low energy usage. Aeration will be provided by aeration blowers, which will be operated by VFDs. Mixed liquor will flow across the aerated tank reactor and will enter a distribution box that will split flow between two clarifiers. One clarifier will be required to handle the plant's design flow of 1.34 MGD, while the other will be provided for redundancy. Mixed liquor will settle in the clarifier, and clear liquid will overflow into a peripheral weir channel and into the RAS/WAS pumpstation. Settled sludge will be recirculated back to the aeration basin or wasted to a sludge-drying bed. Treated effluent will be conveyed to the facility's new percolation ponds that will be constructed.

Extended Aeration and Biological Nutrient Removal

The proposed aeration tank will be constructed in the existing WWTP facility. Aero-Mod SEQUOX for biological nutrient removal offers the benefits of sequencing aeration and continuous clarification. Flow enters through an anoxic tank, where the raw sewage is combined with returned activated sludge (RAS) from the clarifiers. The combination of cyclical aeration in the four basins creates excellent aerobic conditions for BOD and ammonia removal when aerating. When the air is off, the nitrate laden MLSS settles and becomes oxygen deprived, creating anoxic conditions for the nitrates to become the oxygen source and allow for denitrification to occur. The plug flow process repeats this cyclical on/off aeration several times as the liquid mass progresses through the SEQUOX process and on to the clarifier. The effluent quality is achieved with TN levels as low as 3 milligrams per liter (mg/L). The process is energy efficient, has a small footprint, and does not require recycling pumps or mixers. Table 3 contains the required dimensions for the aerated treatment system.

Clarifier

The SEQUOX process often incorporates the ClarAtor clarifier where the biomass is settled and returned to the selector tank. The clarified effluent is withdrawn and discharged. This technology is low maintenance, featuring stainless steel and fiberglass components with no moving parts below the water, while its unique flow-regulation system provides in-basin surge storage. For this proposed project, a center configuration will be used for influent entering the secondary clarifier. Mixed liquor will be carried to the center of the clarifier, which will radially distribute flow from the top of the basin. A peripheral weir will collect effluent, and a surface skimmer will collect floating scum.

Effluent Disposal

The purpose of upgrading the existing WWTP to an extended aeration activated system with biological nutrient removal facility is to lower the nitrogen concentration of the effluent before it is discharged to percolate the underground aquifer. Nitrogen is a nutrient normally present in domestic wastewater at a concentration that can degrade groundwater quality. Currently, the

existing WWTP is not protective of the current beneficial use of the groundwater and is not consistent with RWQCB's policy of beneficial reuse. By upgrading the WWTP to include secondary/tertiary treatment and discharging the higher effluent quality to percolation ponds on site, the City will provide an incidental recharge of the groundwater aquifer, which will ultimately help demonstrate groundwater sustainability. By removing nitrogen, treated effluent will be allowed to percolate and be protective of the groundwater's beneficial uses. The City would need to decommission the existing aerated lagoons and stabilization ponds to construct five percolation ponds to increase the facility's disposal capacity. According to the water balance calculations, a total percolation area of 18.34 acres would allow the City to dispose 1.34 MGD. Table 3 displays the surface areas and estimated volumes of each percolation pond.

Table 3. Proposed Evaporation/Percolation Pond Characteristics

Pond No	Top Surface Area (ac.)	Depth (ft.)	Volume (ac. ft.)	Volume (gallon)
Pond 1	3	6	18	5,866,200
Pond 2	3	6	18	5,866,200
Pond 3	2.45	5	12.25	3,992,275
Pond 4	4.83	5	24.15	7,870,485
Pond 5	5.06	5	25.30	8,245,270
Total	18.34	-	97.7	31,840,430

1.2.4 Area of Potential Effect

The Area of Potential Effect (APE) for the Project was defined as the area of potential ground-surface disturbance. The horizontal APE for the Project totals approximately 174.7 ac. and contains all construction areas, staging and laydown areas, and access roads. The vertical APE, defined as the maximum depth of excavation for sewer replacement for the Project, is not expected to exceed 10 ft. below ground surface.

1.3 REGULATORY CONTEXT

1.3.1 National Historic Preservation Act Section 106

NHPA Section 106 is applicable to federal undertakings, including projects financed or permitted by federal agencies regardless of whether the activities occur on federally managed or privately owned land. Its purpose is to determine whether adverse effects will occur to significant cultural resources, defined as "historical properties" that are listed in or determined eligible for listing in the National Register of Historic Places (NRHP). The criteria for NRHP eligibility are defined at 36 CFR § 60.4 as follows:

> The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and that:
>
> (A) are associated with events that have made a significant contribution to the broad patterns of our history; or
>
> (B) are associated with the lives of persons significant in our past; or

(C) embody 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; or

(D) have yielded or may be likely to yield, information important in prehistory or history.

There are, however, restrictions on the kinds of historical properties that can be NRHP listed. These have been identified by the Advisory Council on Historic Preservation (ACHP), as follows:

> Ordinarily cemeteries, birthplaces, or graves of historical figures, properties owned by religious institutions or used for religious purposes, structures that have been moved from their original locations, reconstructed historic buildings, properties primarily commemorative in nature, and properties that have achieved significance within the past 50 years shall not be considered eligible for the National Register. However, such properties will qualify if they are integral parts of districts that do meet the criteria or if they fall within the following categories:
>
> (a) A religious property deriving primary significance from architectural or artistic distinction or historical importance; or
>
> (b) A building or structure removed from its original location but which is significant primarily for architectural value, or which is the surviving structure most importantly associated with a historic person or event; or
>
> (c) A birthplace or grave of a historical figure of outstanding importance if there is no appropriate site or building directly associated with his productive life.
>
> (d) A cemetery which derives its primary significance from graves of persons of transcendent importance, from age, from distinctive design features, or from association with historic events; or
>
> (e) A reconstructed building when accurately executed in a suitable environment and presented in a dignified manner as part of a restoration master plan, and when no other building or structure with the same association has survived; or
>
> (f) A property primarily commemorative in intent if design, age, tradition, or symbolic value has invested it with its own exceptional significance; or
>
> (g) A property achieving significance within the past 50 years if it is of exceptional importance. (ACHP n.d.)

1.3.2 California Environmental Quality Act

CEQA is applicable to discretionary actions by state or local lead agencies. Under CEQA, lead agencies must analyze impacts to cultural resources. Significant impacts under CEQA occur when "historically significant" or "unique" cultural resources are adversely affected, which occurs when such resources could be altered or destroyed through project implementation. Historically significant cultural resources are defined by eligibility for or by listing in the California Register of Historical Resources (CRHR). In practice, the federal NRHP criteria (below) for significance

applied under Section 106 are generally (although not entirely) consistent with CRHR criteria (see PRC § 5024.1, Title 14 CCR, Section 4852 and § 15064.5(a)(3)).

Significant cultural resources are those archaeological resources and historical properties that:

(1) Are associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage;

(2) Are associated with the lives of persons important in our past;

(3) Embody the distinctive characteristics of a type, period, region, or method of construction, or represent the work of an important creative individual, or possess high artistic values; or

(4) Have yielded, or may be likely to yield, information important in prehistory or history.

Unique resources under CEQA, in slight contrast, are those that represent:

> An archaeological artifact, object, or site about which it can be clearly demonstrated that, without merely adding to the current body of knowledge, there is a high probability that it meets any of the following criteria:
>
> (1) Contains information needed to answer important scientific research questions and that there is a demonstrable public interest in that information.
>
> (2) Has a special and particular quality such as being the oldest of its type or the best available example of its type.
>
> (3) Is directly associated with a scientifically recognized important prehistoric or historic event or person (PRC § 21083.2(g)).

Preservation in place is the preferred approach under CEQA to mitigating adverse impacts to significant or unique cultural resources.

1.3.3 Eligibility Criteria for Wastewater Treatment Facilities in California

In 2023, JRP Historical Consulting LLC in conjunction with the State Water Resources Control Board prepared the *Drinking Water and Wastewater Treatment Facilities in California Historic Context and Research Design for National Register Evaluation*. This report identified Wastewater Treatment Plants as a distinct Property Type and presented evaluation procedures and processes for the identified property types. Relevant sections from the report are reproduced below:

> ***Property Type: Wastewater Treatment Plants***
> Municipal wastewater treatment plants resemble drinking water treatment facilities in many respects, and they use much of the same equipment for screening, clarifying, filtering, and disinfecting water. The wastewater plants differ chiefly in their use of biological methods during secondary treatment that have no parallel for drinking water systems. Wastewater plants are classified by the level of treatment that they offer. Older plants might offer only primary treatment, using clarifiers to decrease the quantity of suspended matter. All modern plants will also include secondary treatment with trickling filters or activated sludge tanks, and

disinfection by chlorine contact. Some plants will include tertiary treatment for nutrient and contaminant removal using filters or modifications to the activated sludge tanks. As with drinking water plants, separate process chains handle effluent purification and the processing and disposable of sedimentation sludge. And, as always, most major equipment is duplicated to provide flexible capacity and to allow for treatment to continue while one piece of hardware is serviced. The Yountville Wastewater Reclamation Facility that is used as a case study in this project offers a typical example of small-sized municipal plant combining historic-aged components with modern tertiary treatment refinements.

Application of Criteria

Drinking water and wastewater systems or components may be found eligible under any of the NRHP/CRHR criteria, although some criteria are more commonly relevant than others. These systems are more likely to have significance under Criterion A/1 (events) and C/3 (type or style of construction), while Criterion B/2 (people) and D/4 (information potential) will apply in fewer cases. More than one of the criteria may apply to a system or feature, for example when a treatment plant is eligible under both A/1 and C/3 for its association with important events and its engineering values.

Criterion A/1

A drinking water or wastewater system may qualify for listing in the national and/or state register under Criterion A/1 if it has a demonstrably significant association with an important historic event, trend, or theme. Like other kinds of public-works facilities, sanitary water systems are inherently important to the communities they serve, providing infrastructure essential for municipal development. Such value, however, does not necessarily equate to historical significance under Criterion A/1, lest every treatment plant, pumping station, and the like be judged historically important. Rather, this type of infrastructure is best evaluated for significance based on its impact relative to other comparable, contemporaneous systems. This requires determining if a water system feature had historic importance above and beyond fulfilling its ordinary role of purifying water or disposing of sewage as was done by similar systems in innumerable communities.

A wastewater or drinking water facility may have significance if it introduced or proved the efficacy of an important new technology (may also be applicable under Criterion C/3, see below), public health measure, or environmental treatment standard; if it is closely associated with the creation of a type of political organization, such as a municipal utility district, that itself has importance in comparison to earlier organization models; or if it was the clearly identified focus of important social or political conflicts.

This document has established historic contexts for these themes at a state-wide level, but other events may also be significant, and evaluators will need to consider the potential for local historic importance.

Mere coexistence with an important historic trend is not enough to grant a resource significance. Rather, the property must be an important example of the trend or theme. Thus, for example, a plant that provided chlorination of a drinking water supply is not automatically significant merely because disinfection was an important public health advancement. The plant

must have fulfilled an important role in the introduction of chlorination by being a site of experimentation, quelling a major disease outbreak, validating a new regulatory regime, or similar such measure. A resource such as a cistern or pumping station might be eligible under Criterion A/1 if it was important to providing a significant new public service.

If a water or sewer system is evaluated as having significance, it is further required to determine what parts of the system are most directly associated with the significant contribution. A program of drinking water chlorination requires a treatment plant but also watermains, laterals, service connections, and a source of supply. Not all of these are equally important to the chlorination program. The waterlines are necessary for disinfection, but they are not by themselves sufficient for disinfection, as the mere existence of waterlines does not presuppose chlorination treatment. Conversely, the chlorination equipment is both necessary and sufficient for disinfection as the existence of a treatment plant does presuppose a functioning water supply and distribution system. Therefore, while all the parts of the water system—supply, treatment, and distribution—participate in the historically significant introduction of chlorination, as used in this example, only the treatment plant itself might have direct and important association with that significance necessary for individual eligibility under these criteria. Other components could demonstrate a direct, significant association if, for example, they were constructed at the same time and as part of a single program of modernization. An evaluator needs to use judgement in assessing how broadly or narrowly to ascribe direct association with a significant innovation, but should avoid bringing in unrelated system components.

The technologies of drinking water and wastewater purification involve the engineering of both physical structures (mixing basins, sedimentation tanks, etc.) and biological and chemical components (nutrient-digesting microorganisms and flocculants, for example). Engineering innovation is generally recognized under Criterion C/3, but that applies principally to the physical features of a property. If the engineering innovation was primarily of a biological or chemical nature, and the physical structure shows few specific modifications, the innovation might be better recognized under Criterion A/1 if, for example, it demonstrably changed patterns of development of the community it served. A property may qualify under both sets of criteria if the engineering combined structural and biochemical elements.

Criterion B/2

A drinking water or wastewater system that is closely associated with an individual of historic importance may be found eligible for listing in the national and/or state register under Criterion B/2. Standards of significance under Criterion B/2 are very specific and relatively few properties meet them. Eligible properties must be associated with the productive life of the historically important individual and must be the best representation of the person's historic contributions. NRHP guidelines emphasize that Criterion B is only applicable to the achievements of individuals, not groups of persons. Further, if an individual's association with a property was through his or her role in its engineering design, this would be better captured under Criterion C/3 as the work of a master engineer.

A drinking water or wastewater system feature may have significance under this criterion if it is directly associated with a scientific, public policy, or social change that best represents the

productive life of an historically important individual. This historic context has specifically identified individuals of importance within the context of the development of water sanitation including Thomas Logan, Charles Hyde, Wilfred Langelier, Chester Gillespie, and C. E. Grunsky, though other pioneering or influential individuals in the field may certainly exist. The association of one of these individuals with a property could confer historical significance under Criterion B/2 if their involvement was primarily in the realm of science or policy, rather than engineering, and if the property was an important one within the context of their career and contributions to their profession or field. Individuals must also be considered for importance at a local level and might be recognized for such actions as campaigning to extend sanitary services to a neglected community or adding protection for a natural resource.

Drinking water and wastewater systems do not commonly have strong, direct association with single individuals. They are instead usually the creation of municipal governments where credit and responsibility for the planning and construction of infrastructure are diffused among elected officials, city managers, and public works departments.

Criterion C/3

A drinking water or wastewater system or water system feature that exhibits important engineering or design characteristics may qualify for listing in the national and/or state register under Criterion C/3. A property can qualify either by being an important representative example of its type, period, or method of construction, or by having unique value as the work of a master or one that possesses high artistic value.

A water system feature may qualify if it is the earliest, best preserved, or a rare surviving example of its type; if it introduced a design innovation; or if it represents a transition between different expressions of the property type. Examples could include a nineteenth-century sewerage pipe if it is of a type that survives in few locations; an early trickling filter that shows transition between fill-and-drain practices and later continual spray methods; or the first water softening plant constructed in the state. Trade press publications can help to determine if a property was innovative for its time or exceptional for its size, expense, design challenges, unique combination of features, or in some other way. To be considered a good representative of its type, a property must possess “distinctive characteristics” that illustrate either a pattern of features common to the type or an important variation on the common features. It should be kept in mind that many water systems followed standard designs that were widely constructed. It is thus necessary to compare the subject property to other similar surviving examples to establish its importance as a representative of its type.

A water system feature can be significant as the work of a master if it was designed by a figure of acknowledged greatness in the field and is an important example of their work. The individuals listed in Criterion B/2 above were all major figures in the field of sanitary engineering who worked at times as consultants in designing drinking water and wastewater systems. Research will reveal other designers whose importance is evident by the number and types of projects they engaged in or by the testimony of their contemporaries. Not every building or structure designed by a master has historic importance, and it is necessary to situate the evaluated property within the context of the individual’s body of work to determine if it was one of their highest achievements or marked an important phase of their career.

A property with high artistic value is one that articulates a particular concept of design so well that it expresses an aesthetic ideal. While many water systems features were of utilitarian design, it was not uncommon for municipalities to carefully consider issues of architectural style when constructing buildings and structures that required considerable public investment and represented a commitment to the civic good. In general, the styling of water systems followed architectural trends employed in other contemporaneous public or utility buildings, using, for example, Neoclassical design around the turn of the century, the Art Deco style in the 1930s, and Modern styles in the 1940s and later. A water system feature might have significance for its design if it expressed one of these styles with a purity of form and a level of sophistication that exceeded that used in other comparable buildings. A property would not qualify if it made superficial use of a style or was of only average execution.

Not all features of drinking and wastewater systems are equally likely to possess significance under this criterion. Some water system components perform routine functions that remain consistent across treatment eras without showing more than incremental refinement. These include such features as sewer lines, waterline laterals, service connections, and wells. Technological innovation is more likely to be found in the principal components of treatment plants and in such property types as large water storage towers. Ubiquitous property types that were constructed using common designs and materials for their era are highly unlikely to be significant for their engineering. Note, however, that if the significance was for architectural styling, then even the most common storage shed could share in the design and contribute to the property's significance. Additionally, these features may contribute to the significance of a larger historic property (such as a historic district; see below) comprised of multiple elements working in concert as part of a larger system.

Criterion D/4

Drinking water and wastewater systems may be eligible for listing under Criterion D/4 if they are likely to yield information important to the study of history or prehistory. The properties most commonly found eligible under Criterion D/4 are archaeological sites, though historic built-environment features might also qualify for their information potential. These properties must be situated within an appropriate historic context, and they must possess the potential to answer specific important research questions through a study of their physical features. Potentially relevant research issues for water system features include those related to vernacular practices and construction methods and might apply to indigenous, Spanish, Mexican, and early Euro-American systems. For instance, remnants of drinking and wastewater infrastructure from nineteenth century California may exhibit a local variation of a standard construction technique and provide insight into the availability of materials or construction expertise at a time when drinking and wastewater infrastructure were more localized and potentially non-standard. In order to make such a determination, construction dates would need to be ascertained using either the built-environment or archaeological record to identify associated temporally sensitive architectural elements of standing resources, documentation in primary sources, and/or temporally sensitive artifacts.

Certain water sanitation systems may possess research value for their associations with other types of resources. As the use of water and disposal of waste are essential to every form of

settlement and most economic activities, establishing the location and time period of a water feature's use may aid in the broader study of a region's development.

However, oftentimes the archaeological remnants of water and waste disposal features or the material culture of the people that operated these systems, do not contain enough data to impart new knowledge about the design or operation of a facility.

Integrity

Working drinking water and wastewater systems will almost invariably have been altered to meet expanded demand, incorporate new technologies, replace worn-out components, and comply with changing regulations. Over time, these incremental changes leave most working systems with few original components that have not been modified or expanded. It is thus critical that evaluators carefully consider the integrity of historically significant systems and components under consideration. Even when systems meet one or more NRHP/CRHR criteria for significance, they will be ineligible for listing by state and federal standards if they do not retain the integrity needed to convey the significance they may once have possessed.

To retain historic integrity, a system must possess at least several, and usually most, of the seven aspects of integrity: location, design, setting, materials, workmanship, feeling, and association. Determining which of these aspects are most critical to a property requires clearly defining why the property is important and the time period (period of significance, see below) of that importance. The evaluator must weigh the cumulative loss of integrity across the seven aspects, balancing each by its relative importance, and arrive at a conclusion to what is ultimately a yes-or-no question: Does the resource retain adequate integrity to its period of significance to convey its significance? An answer of "yes" makes a significant resource eligible for listing in the NRHP and/or CRHR, while a "no" answer means that the resource is ineligible for listing in either register despite having historical significance.

As with other types of historic properties, the fundamental test of the integrity of a drinking water or wastewater system consists of the relationship between its current appearance and its appearance during the period of significance, which the evaluator will establish after placing the resource in its appropriate historic context and determining which significance criterion or criteria it meets. Integrity will not be lost as the result of modifications made during the system's period of significance, and indeed, these alterations may actually contribute to its importance if they illustrate the adaptability and evolving role of the property. Modifications made after the period of significance may adversely affect the resource's integrity. However, these modifications must be assessed to determine if they are of a scope, scale, and nature sufficient to cause the loss of one or more aspects of integrity.

It will not always be possible to assess the integrity of underground resources. Construction plans or other documentary materials may record the type, age, and materials of below-ground pipes, vaults, and other such features, but it might not be possible to determine if the original items have been replaced or altered without exposing the resource through excavation. The evaluation may then contain language to indicate the uncertainty, noting that the resource would contribute to the significance of the larger property if it was constructed during the period of significance and maintains historic integrity to the period.

Not all alterations made to a system are of equal importance in assessing integrity. Changes that result from routine maintenance are usually less detrimental to integrity than are alterations made to the plant's fundamental processes, and especially so when the changes affect only smaller, secondary components such as motors, pumps, electronic sensors, and computer systems. However, it is necessary to consider the cumulative effect of various additions and alterations over time. At the other extreme, replacing a major component of the treatment process, for example, replacing a septic tank with a separate clarifier and sludge digestor, would greatly degrade resource integrity of design and would likely disqualify it for listing in state and national registers.

Historic Districts

Drinking water and wastewater features may be evaluated as independent resources or as contributors to a historic district composed of related elements. A historic district consists of a significant concentration, linkage, or continuity of sites, buildings, structures, or objects that are interrelated visually or by function. A district may contain resources that are also individually eligible for listing or consist entirely of resources that lack individual distinction, but which achieve significance when grouped as a whole. A drinking water system district might consist of a treatment plant and related support features such as pumping stations and storage tanks, or of a series of wells that are united by common design and function. A district usually consists of a definable geographic area that is distinguishable from surrounding properties, but it may also be discontiguous (composed of two or more areas separated by nonsignificant areas) if the elements are spatially discrete and the space between them is not significant to the district. A discontiguous district may work well for a water system where the piped connections between resources are below ground and not of visual or historic importance to the district. Note, however, that if the district was significant for its engineering achievement and the subsurface pipe configuration or materials were an important part of that accomplishment, then the district might need to include the non-visible pipes within the property boundaries.

Drinking water features may also contribute to historic districts that are significant for reasons unrelated to water development. Indeed, the majority of California water features that have been determined eligible for listing in the NRHP and/or CRHR are of this type and owe their significance to the role they played in a larger enterprise rather than for their merits as engineered water features per se. Examples of this include the water system and sewage treatment plant within the Sonoma State Home Historic District and the water treatment plant in the Presidio National Historic Landmark District. It is thus always necessary to consider how water or sewage infrastructure was used in the pursuit of other economic, social, and cultural ends and to assess if the larger context has independent historic importance.

2. ENVIRONMENTAL AND CULTURAL BACKGROUND

2.1 GEOARCHAEOLOGICAL SENSITIVITY AND ENVIRONMENTAL BACKGROUND

2.1.1 Environmental Setting

The Project area is located within/near the city of Coalinga in Fresno County, California. Located approximately 0.40 mi. apart, the APE consists of two discontinuous parcels: 1) Pipelines APE and 2) WWTP APE (see Figure 1). Whereas the Pipelines APE is associated with the city of Coalinga, the WWTP APE is associated with Coalinga's Wastewater Treatment Plant (see Figure 1). The Pipelines APE is west of the WWTP APE, and the parcels are bisected by Warthan Creek. Elevations within the APE range between 640 ft. and 690 ft. amsl, with slopes ranging between zero and two percent. Both parcels are bounded to the north by Los Gatos Creek, which coalesces with Warthan Creek near the Project area. As outlined below, the APE consists of alluvial fans and historical era/modern anthropogenic deposits.

2.1.2 Geology and Geomorphology

The Project area is located within Pleasant Valley, which consists of a small valley within the southern Diablo Range. Pleasant Valley is technically part of the San Joaquin Valley but is separated from San Joaquin Valley proper via the Guijarral Hills and Anticline Ridge, which is bisected by Los Gatos Creek (Figure 2). Coalinga is partially surrounded by oil fields, with the first oil production beginning in 1890 (Hughes et al. 1990:399). These oil fields, as well as the city of Coalinga, were damaged by a magnitude 6.7 earthquake originating from Anticline Ridge in 1983 (Rymer and Ellsworth 1990). The earthquake engendered several thousand landslides, some of which occurred along the cutbanks paralleling Los Gatos Creek (Harp and Keefer 2017:344). The APE is located within the southwestern portion of Pleasant Valley and is marked by extensive alluvial fans originating from adjacent hillslopes. The APE consists of (Qa) deposits composed of surficial sediments (i.e., alluvial gravel, sand and clay of valley areas; includes gravel and sand of stream channels) (see Figure 2).

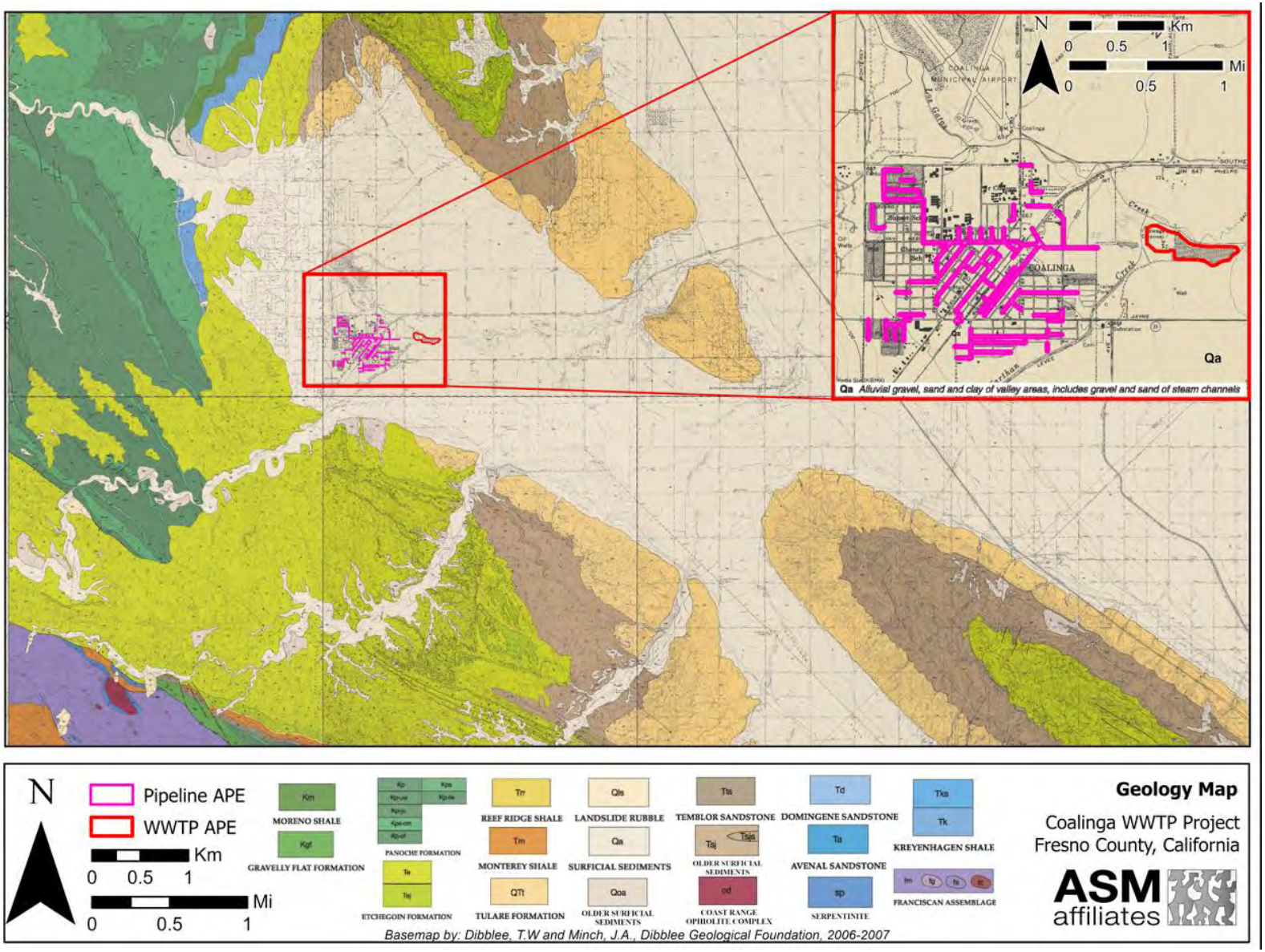


Figure 2. Coalinga Sanitary Sewer Collection System and WWTP Improvements Project Geology Map

2.1.3 Soils

Soils in the APE were identified through the US Department of Agriculture's National Resource Conservation Service (USDA-NRCS 2019) Soil Survey Geographic (SSURGO) soil data. The Pipelines APE is mapped as the Excelsior soil series, which formed during the latest Holocene (2000–150 cal YBP) and consists of mixed alluvium originating from igneous and calcareous sedimentary rocks (Meyer et al. 2010: Appendix C). In contrast, the WWTP APE is mapped as "Sewage Disposal Pond" and dates to the historical era/modern times (<150 YBP) (Meyer et al. 2010: Appendix C). Although SSURGO does not list the native soil type(s) associated with the WWTP APE, the surrounding soils predominantly consist of the Excelsior series. Soil types accounting for less than six percent of the APE were not included. Soil map units are as follows:

Pipelines APE

- Excelsior; (latest Holocene; 2000–1000 cal YBP)

WWTP APE

- Sewage Disposal Pond; (historical era/modern times; <150 cal YBP)

Soils in the APE(s) consist of young to very young soils formed in alluvium originating from adjacent areas of higher elevation. Although both parcels are marked by anthropogenic disturbances, the WWTP APE is mapped entirely as "Sewage Disposal Pond" which Meyer et al. (2010: Appendix C) confirms is a historical era/modern (<150 cal YBP) deposit.

2.1.4 Buried Site Sensitivity

As outlined above, the deposits within the APE(s) formed between the historical era/modern times (<150 YBP), and latest Holocene (2000–150 YBP). Whereas the Pipelines APE is marked by high buried site potential, the WWTP APE is marked as having low buried site potential (Meyer et al. 2010:140, Table 18). It should be noted that areas within the WWTP APE lacking modern disturbances via the construction of Coalinga's Wastewater Treatment Plant would be classified as having high buried site potential, as it likely is marked as the Excelsior soil series.

2.2 ETHNOGRAPHIC BACKGROUND

Penutian-speaking Yokuts tribal groups occupied the southern San Joaquin Valley region and much of the nearby Sierra Nevada. Ethnographic information about the Yokuts was collected primarily by Powers (1971, 1976 [originally 1877]), Kroeber (1925), Gayton (1930, 1948), Driver (1937), Latta (1977) and Harrington (n.d.). For a variety of historical reasons, existing research information emphasizes the central Yokuts tribes who occupied both the valley and particularly the foothills of the Sierra. The northernmost tribes suffered from the influx of Euro Americans during the Gold Rush and their populations were in substantial decline by the time ethnographic studies began in the early twentieth century. In contrast, the southernmost tribes were partially removed by the Spanish to missions and eventually absorbed into multi-tribal communities on the Sebastian Indian Reservation (on Tejon Ranch), and later the Tule River Reservation and Santa Rosa Rancheria to the northeast. The result is a scarcity of ethnographic detail on southern Valley tribes, especially in relation to the rich information collected from the central foothills tribes where native speakers of the Yokuts dialects are still found. Regardless, the general details of indigenous

lifeways were similar across the broad expanse of Yokuts territory, particularly in terms of environmentally influenced subsistence and adaptation and with regard to religion and belief, which were similar everywhere.

Following Kroeber (1925: Plate 47), the Project APE most likely lies in *Tachi* territory. The closest village to the APE for this group was *Udjiu*, northeast of the APE.

The Yokuts settlement pattern was largely consistent, regardless of the specific tribe involved. Winter villages were typically located along lakeshores and major stream courses (as these existed circa 150 YBP), with dispersal phase family camps located at elevated spots on the valley floor and near gathering areas in the foothills.

Most Yokuts groups, again regardless of specific tribal affiliation, were organized as a recognized and distinct tribelet, a circumstance that almost certainly pertained to the tribal groups noted above. Tribelets were land-owning groups organized around a central village and linked by shared territory and descent from a common ancestor. The population of most tribelets ranged from about 150 to 500 people (Kroeber 1925).

Each tribelet was headed by a chief who was aided by a variety of assistants, the most important of whom was the *winatum*, a herald or messenger and assistant chief. A shaman also served as a religious officer. While shamans did not have any direct political authority, as Gayton (1930) has illustrated, they maintained substantial influence within their tribelet.

Shamanism is a religious system common to many Native American tribes. It involves a direct and personal relationship between the individual and the supernatural world enacted by entering a trance or hallucinatory state (usually through the ingestion of psychotropic plants, such as jimsonweed or more typically native tobacco). Shamans were considered individuals with an unusual degree of supernatural power, serving as healers or curers, diviners, and controllers of natural phenomena (such as rain or thunder). Shamans also produced the rock art of this region, depicting the visions they experienced in vision quests believed to represent their spirit helpers and events in the supernatural realm (Whitley 1992, 2000).

The centrality of shamanism to the religious and spiritual life of the Yokuts was demonstrated by the role of shamans in the yearly ceremonial round. The ritual round, performed in the same manner each year, started in the spring with the jimsonweed ceremony, followed by rattlesnake dance and (where appropriate) first salmon ceremony. After returning from seed camps, fall rituals began in the late summer with the mourning ceremony, followed by first seed and acorn rites, and then bear dance (Gayton 1930:379). In each case, shamans served as ceremonial officials responsible for specific dances involving a display of their supernatural powers (Kroeber 1925).

Subsistence practices varied from tribelet to tribelet based on the environment of residence. Throughout Native California, and Yokuts territory in general, the acorn was a primary dietary component, along with a variety of gathered seeds. Valley tribes augmented this resource with lacustrine and riverine foods, especially fish and wildfowl. As with many Native California tribes, the settlement and subsistence rounds included the winter aggregation into a few large villages, where stored resources (like acorns) served as staples, followed by dispersal into smaller camps,

often occupied by extended families, where seasonally available resources would be gathered and consumed.

Although population estimates vary and population size was greatly affected by the introduction of Euro-American diseases and social disruption, the Yokuts were one of the largest, most successful groups in Native California. Cook (1978) estimates that the Yokuts region contained 27 percent of the aboriginal population in the state at the time of contact; other estimates are even higher. Many Yokuts people continue to reside in the southern San Joaquin Valley today.

2.3 PRE-CONTACT ARCHAEOLOGICAL BACKGROUND

The southern San Joaquin Valley region has received minimal archaeological attention compared to other areas of the state. In part, this is because the majority of California archaeological work has been concentrated in the Sacramento Delta, Santa Barbara Channel, and central Mojave Desert areas (see Moratto 1984). Although knowledge of the region's prehistory is limited, enough is known to determine that the archaeological record is broadly similar to south-central California as a whole (see Gifford and Schenk 1926; Hewes 1941; Wedel 1941; Fenenga 1952; Elsasser 1962; Fredrickson and Grossman 1977; Schiffman and Garfinkel 1981). Based on these sources, the general prehistory of the region can be outlined as follows.

Initial occupation of the region occurred at least as early as the *Paleoindian Period*, or prior to about 10,000 YBP. Evidence of early use of the region is indicated by characteristic fluted and stemmed points found around the margin of Tulare Lake, in the foothills of the Sierra, and in the Mojave Desert proper.

Both fluted and stemmed points are particularly common around lake margins, suggesting a terminal Pleistocene/early Holocene lakeshore adaptation similar to that found throughout far western North America at the same time; little else is known about these earliest peoples. More than 250 fluted points have been recovered from the Witt Site (CA-KIN-32), located along the western shoreline of ancient Tulare Lake south of the APE, demonstrating the importance of this early occupation in the San Joaquin Valley specifically (see Fenenga 1993). Additional finds consist of a Clovis-like projectile point discovered in a flashflood cut-bank near White Oak Lodge in 1953 on Tejon Ranch (Glennan 1987a, 1987b). More recently, a similar fluted point was found near Bakersfield (Zimmerman et al. 1989), and a number are known from the Edwards Air Force Base and Boron area of the western Mojave Desert. Although human occupation of the state is well-established during the Late Pleistocene, relatively little can be inferred about the nature and distribution of this occupation with a few exceptions. First, little evidence exists to support the idea that people at that time were big-game hunters, similar to those found on the Great Plains. Second, the western Mojave Desert evidence suggests small, very mobile populations that left a minimal archaeological signature. The evidence from the ancient Tulare Lake shore, in contrast, suggests much more substantial population and settlements which, instead of relying on big-game hunting, were tied to the lacustrine lake edge. Variability in subsistence and settlement patterns is thus apparent in California, in contrast to the Great Plains.

Substantial evidence for human occupation across California, however, first occurs during the middle Holocene, roughly 7500 to 4000 YBP. This period is known as the *Early Horizon*, or

alternatively as the Early Millingstone along the Santa Barbara Channel. In the south, populations concentrated along the coast with minimal visible use of inland areas. Adaptation emphasized hard seeds and nuts with tool kits dominated by mullers and grindstones (manos and metates). Additionally, little evidence for Early Horizon occupation exists in most inland portions of the state, partly due to a severe cold and dry paleoclimatic period occurring at this time, although a site deposit dating to this age has been identified along the ancient Buena Vista shoreline in Kern County to the south (Rosenthal et al. 2007). Regardless of specifics, Early Horizon population density was low with a subsistence adaptation more likely tied to plant-food gathering than hunting.

Environmental conditions improved dramatically after about 4000 YBP during the *Middle Horizon* (or Intermediate Period). This period is known climatically as the Holocene Maximum (circa 3800 YBP) and was characterized by significantly warmer and wetter conditions than previously experienced. It was marked archaeologically by large population increase and radiation into new environments along coastal and interior south-central California and the Mojave Desert (Whitley 2000). In the Delta region to the north, this same period of favorable environmental conditions was characterized by the appearance of the Windmiller culture which exhibited a high degree of ritual elaboration (especially in burial practices) and perhaps even a rudimentary mound-building tradition (Meighan, personal communication, 1985). Along with ritual elaboration, Middle Horizon times experienced increasing subsistence specialization, perhaps correlating with the appearance of acorn-processing technology. Penutian-speaking peoples (including the Yokuts) are also posited to have entered the state roughly at the beginning of this period and, perhaps, to have brought this technology with them (cf. Moratto 1984). Likewise, it appears the so-called "Shoshonean Wedge" in southern California, the Takic-speaking groups that include the Gabrielino/Fernandeño, Tataviam, and Kitanemuk, may have moved into the region at that time (Sutton 2009), rather than at about 1500 YBP as first suggested by Kroeber (1925).

Evidence for Middle Horizon occupation of interior south-central California is substantial. For example, in northern Los Angeles County along the upper Santa Clara River, to the south of the San Joaquin Valley, the Agua Dulce village complex indicates occupation extending back to the Intermediate Period, when the population of the village may have been 50 or more people (King et al n.d.). Similarly, inhabitation of the Hathaway Ranch region near Lake Piru, and the Newhall Ranch near Valencia, appears to date to the Intermediate Period (W&S Consultants 1994). To the west, little or no evidence exists for pre-Middle Horizon occupation in the upper Sisquoc and Cuyama River drainages; populations first appear there at roughly 3500 YBP (Horne 1981). The Carrizo Plain, the valley immediately west of the San Joaquin, experienced a major population expansion during the Middle Horizon (W&S Consultants 2004; Whitley et al. 2007), and recently collected data indicates the Tehachapi Mountains region was first significantly occupied during the Middle Horizon (W&S Consultants 2006). A parallel can be drawn to the inland Ventura County region where a similar pattern has been identified (Whitley and Beaudry 1991), as well as the western Mojave Desert (Sutton 1988a, 1988b), the southern Sierra Nevada (W&S Consultants 1999), and the Coso Range region (Whitley et al. 1988). In all of these areas a major expansion in settlement, the establishment of large site complexes, and an increase in the range of environments exploited appear to have occurred sometime roughly around 4,000 years ago. Although most efforts to explain this expansion have focused on local circumstances and events, it is increasingly apparent this was a major occurrence throughout southern California, and any explanation must

be sought at a larger level of analysis (Whitley 2000). Additionally, evidence from the Carrizo Plain suggests the origins of the tribelet level of political organization developed during this period (W&S Consultants 2004; Whitley et al. 2007). Whether this same demographic process holds for the southern San Joaquin Valley, including the Project APE, is yet to be determined.

The beginning of the *Late Horizon* is set variously at 1500 and 800 YBP, with a growing archaeological consensus for the shorter chronology. Increasing evidence suggests the importance of the Middle-Late Horizons transition (AD 800 to 1200) in the understanding of south-central California prehistory. This corresponds to the so-called Medieval Climatic Anomaly, followed by the Little Ice Age, and this general period of climatic instability extended to about A.D. 1860. It included major droughts matched by intermittent "mega-floods," and resulted in demographic disturbances across much of western North America (Jones et al. 1999). It is believed to have resulted in major population decline and abandonments across south-central California, involving as much as 90 percent of the interior populations in some regions, including the Carrizo Plain (Whitley et al. 2007). It is not clear whether site abandonment was accompanied by a true reduction in population or an agglomeration of the same numbers of peoples into fewer but larger villages in more favorable locations. Population along the Santa Barbara coast appears to have spiked at about the same time that it collapsed on the Carrizo Plain (ibid). Along Buena Vista Lake, in Kern County, population appears to have been increasingly concentrated toward the later end of the Medieval Climatic Anomaly (Culleton 2006), and population intensification also appears to have occurred in the well-watered Tehachapi Mountains during this same period (W&S Consultants 2006).

What is then clear is that Middle Period villages and settlements were widely dispersed across the south-central California landscape, including in the Sierra and the Mojave Desert. Many of these sites are found at locations that lack existing or known historical freshwater sources. Late Horizon sites, in contrast, are typically concentrated in areas where fresh water was available during the historical period, if not currently.

One extensively studied site that shows evidence of intensive occupation during the Middle-Late Horizons transition (~1500 – 500 YBP) is the Redtfeldt Mound (CA-KIN-66/H), located south of the current APE, near the north shore of ancient Tulare Lake. There, Siefkin (1999) reported on human burials and a host of artifacts and ecofacts excavated from a modest-sized mound. He found that both Middle Horizon and Middle-Late Horizons transition occupations were more intensive than Late Horizon occupations, which were sporadic and less intensive (Siefkin 1999:110-111).

The Late Horizon can then be understood as a period of recovery from a major demographic collapse. One result is the development of regional archaeological cultures as the precursors to ethnographic Native California, suggesting that ethnographic lifeways recorded by anthropologists extend roughly 800 years into the past.

The position of southern San Joaquin Valley prehistory relative to patterns seen in surrounding areas is still somewhat unknown. The presence of large lake systems in the valley bottoms appears to have mediated some of the desiccation seen elsewhere. But, as the reconstruction of Soda Lake in the nearby Carrizo Plain demonstrates (see Whitley et al. 2007) environmental perturbations had serious impacts on lake systems too. Identifying certain prehistoric demographic trends for the

southern San Joaquin Valley, and determining how these trends (if present) correlate with those seen elsewhere, is a current important research objective.

2.4 HISTORICAL BACKGROUND

2.4.1 Drinking Water and Wastewater Treatment Facilities in California

JRP Historical Consulting, LLC and AECOM prepared the historic context below:[1]

1. The Pre-Treatment Era: Sanitation in the Nineteenth Century
The mid-nineteenth century saw the emergence of the first social-reform "Sanitarians" in England and America who linked cleanliness and good health. The reformers lacked a specific causal mechanism to explain waterborne disease transmission, but they succeeded in creating state and local boards of health with limited powers to enforce hygienic measures. No practical method for treating drinking water or sewage yet existed, so municipal engineers simply sought to direct sewage away from populated areas as rapidly as possible and to secure safe drinking water drawn from deep wells or remote mountain streams. The ad hoc nature of water procurement and sewer construction meant these efforts frequently failed, and cholera and typhoid fever took a frightful toll on urban populations through the century.

Knowledge
Modern sanitary sewage and drinking water systems first emerged in mid-nineteenth-century England. Prior to that time, systems of water supply and waste disposal were local in nature with limited public oversight. Individuals were responsible for procuring their own water and disposing of their own waste. So long as population densities remained low, these traditional methods functioned satisfactorily. However, as urbanization and industrialization took hold in Victorian England, the streams of human and industrial waste began to overwhelm the limited physical and legal infrastructure that governed the flows of pure and soiled waters. London, Birmingham, and Manchester choked on their own filth and suffered through regular epidemics that the medical theories of the day could neither explain nor ameliorate.

In the 1830s, English social reformers—the so-called Sanitarians—began to link dirt, disease, and moral disorder. A cholera epidemic of 1831–1832 killed great numbers of people and particularly devastated the poorest and dirtiest districts of London. A nascent reform movement that aimed to improve living conditions for the laboring class seized on the moment to promote the idea that cleanliness and health were inextricably linked. Theorists began to conceive of the city as an organic entity that depended upon a regular flow of clean water for nourishment and as an aid in the disposal of waste. They pressed for improved public health systems, with a focus on securing clean sources of drinking water and, to a lesser extent, providing public sewerage systems.

The sanitarian position was associated with miasmic theory, the then-dominant medical model. Miasmic theory held that disease arose from the putrefaction of organic wastes and was transmitted through the inhalation of contaminated airs (miasmas) such as vapors arising from stagnant ponds or sewer gases leaking through a storm grate. Scientists debated the exact nature of miasmas, but

[1] ASM did not include any of the mentioned figures, and Table 2 has been excluded. Please see original source.

were in general agreement that they arose from a combination of warm temperatures, damp environments, and an overabundance of organic matter. A physician's proper duties thus extended beyond individual care to encompass social reform of the unsanitary conditions that endangered public health. Because many of the illnesses that the Sanitarians first combatted were intestinal in nature—cholera, dysentery, typhoid fever—their environmental campaigns produced real improvements that vouched for the theory among scientists, politicians, and the public. However, the miasmic theory always remained vague about the precise vectors of contagion, and by the end of the nineteenth century it had been largely replaced by the germ theory that identified bacterial pathogens as the agents responsible for spreading disease.

Edward Chadwick was the great popularizer of sanitary ideas. A lawyer by profession, Chadwick led several government investigations of epidemics that established firm connections between poor sanitary conditions and disease outbreaks. His 1842 Report on the Sanitary Conditions of the Labouring Population of Great Britain was widely read, selling more copies than any prior government publication. Chadwick argued that improving sanitary conditions required a strong centralized authority with the power to construct comprehensive public works systems that integrated water deliveries and sewage removal. He was too impatient to accept the more limited political realities of his time, and none of his proposals ever achieved full implementation. However, his forceful advocacy of sanitarian ideas shifted the public debate. His work brought together for the first time an environmental context for public health, an argument for the role of government in improving conditions for the greater good, and the identification of infrastructure technologies that could realize those goals.

Sanitarian ideas crossed the Atlantic in the mid-1840s. A small but influential group of American physicians had closely followed developments in Europe and were eager to apply the new environmental models of health to their own country, which was then in the midst of its first great wave of urban expansion. John H. Griscom, the New York City Inspector at the time, corresponded with Chadwick and in 1845 published The Sanitary Conditions of the Laboring Population of New York that was modeled on Chadwick's report. Among other proposed reforms, the study called for an expanded public drinking water system and the construction of underground sewers. Griscom joined with other physicians in organizing the New York Academy of Medicine that made sanitarian reform one of its chief objectives.

The American Medical Association (AMA) established a committee on public hygiene in 1848. The committee took a broad view of public health that included infrastructure improvements alongside quarantine laws, smallpox vaccinations, temperance advocacy, vital statistics gathering, pure food and drink measures, and mental health programs. The group urged the creation of state and local boards of health and called for medical schools to include instruction in the sanitary sciences. In 1857, the AMA staged the first national sanitary convention in Philadelphia, with annual meetings following in Baltimore, New York, and then Boston in 1860. The outbreak of the Civil War interrupted the gathering momentum of the American sanitarian movement, but public health had established itself as a key element in progressive medical thought.

Political Organization

For all the gains that sanitarian ideas made among physicians and social reformers, the movement realized far fewer practical achievements. Americans shrank from accepting the sort of centralized authority that Chadwick and Griscom believed was needed to implement sanitarian reforms. State

and local governments largely assumed public health responsibilities only when compelled to by an epidemic and the resulting regulations were typically allowed to lapse once the crisis had passed. Local governments lacked clear authority to do more even if they had so desired. A lack of definite knowledge about the causes of illness contributed to this reluctance as most early efforts at halting the spread of epidemics proved futile and divisive.

A few Northeastern cities broke from this general pattern of passivity to take an active role in passing sanitary ordinances and establishing public health bodies. The city leaders of Boston in 1634 prohibited the dumping of fish or garbage near the common docks in what was apparently the first formal sanitary law in the American colonies. The city authored quarantine regulations in 1647 and began to regulate the construction of privies five years later. In 1797, Boston established the first permanent local board of health in the nation, though the body had limited formal powers and was staffed by political appointees. The New York state legislature in 1866 passed the New York Metropolitan Health Law that established the Metropolitan Board of Health. This was the first effective board of health in a major city, and it provided a model for subsequent developments. Massachusetts created the first state-level board of health in 1869. Still, few states immediately followed the lead of New York and Massachusetts, and as late as 1875 many major cities had no permanently empowered health departments.

Rather than adopting formal ordinances to regulate sanitary matters, most cities and states chose to rely on broad but vaguely articulated nuisance laws. The State of California later defined a public nuisance as "anything which is injurious to health, or is indecent, or offensive to the senses, or an obstruction to the free use of property, so as to interfere with the comfortable enjoyment of life or property."10In most circumstances, noxious odors and unsightly trash dumps posed more of an annoyance than a serious public health threat. However, because these sorts of nuisances were commonly limited to individual properties, they could be more easily addressed than systemic problems. And critically, the courts, rather than politicians, took the lead in enforcing nuisance laws. Americans were willing to accept litigation in private property disputes more so than government-imposed regulations. Thus, public nuisance lawsuits and abatement orders played the chief role through the nineteenth century in protecting water purity.

Nineteenth-Century California

Nineteenth-century California was progressive in establishing public health organizations, but lagged in constructing effective infrastructure. While California generally followed national trends in sanitation and looked towards the Northeastern states and Western Europe for its models, the peculiarities of the Gold Rush in the late 1840s and early 1850s shaped the state's early experiences with water and sewage systems. The mass movement of population and the sudden emergence of urban centers, especially in San Francisco and Sacramento, fueled pandemics that galvanized early public health campaigns. Physicians strenuously advocated for improved sanitary conditions, but the actual development of water and sewage systems occurred in a piecemeal fashion that befit an era of limited governments. Systems constructed for the "instant cities" of the 1850s remained in use a half century later despite obvious inadequacies. Only in the twentieth century did California emerge as a national leader in sanitation matters.

Boards of Health

The public health systems of nineteenth-century California emerged in response to the severe disorder that accompanied the Gold Rush. The surge of hundreds of thousands of global migrants into a region almost entirely lacking in public health infrastructure produced a calamitous series of disease outbreaks, including most notably the cholera epidemic of 1850. Cholera struck horror wherever it appeared in the nineteenth century. The intestinal illness, transmitted by food and water contaminated with fecal matter, caused violent vomiting and diarrhea that left victims with an unquenchable thirst and dehydration so severe that the skin pulled taut around skeletal features. Nearly half of cases resulted in death, often within hours of the onset of symptoms.

Cholera arrived in San Francisco aboard an unquarantined ship in early October 1850. Within a week and a half, the disease had spread to Sacramento, where it had its most devastating impact. No authority then existed to keep a reliable count of the dead, but an estimated 800 to 1000 people, roughly 15 percent of Sacramento's population, are thought to have perished during the month-long outbreak. Of the 40 physicians based in Sacramento, 17 died while tending to the ill, one of the highest mortality rates ever recorded among medical first responders. This encounter with cholera and subsequent waves of smallpox, diphtheria, typhoid fever, and other communicable illnesses deeply impressed upon the state's physicians the need to organize in support of quarantine laws and public sanitation measures.

Sacramento physician Thomas M. Logan took a leading role in establishing the institutions of public health. Born and educated in South Carolina, Logan spent a year of study in Britain and France during a cholera epidemic that allowed him to learn firsthand the latest in sanitary science. Back in the United States, he served as a university lecturer, authored a compendium on surgery, and accepted a hospital appointment in New Orleans before the Gold Rush lured him to California in time for the 1850 cholera epidemic. Logan began compiling statistics on mortality in Sacramento and was ahead of his time in insisting that the control of disease depended largely upon the sanitation of the community. He took an active role in organizing the Sacramento Medical Society in 1855, the California Medical Society in 1856, and the Sacramento Society for Medical Improvement in 1868. Logan regularly served as corresponding secretary for these organizations, and he ranked among the most prolific writers of medical literature in the state.

Logan and the medical societies campaigned for the organization of boards of health that would place matters of sanitation and quarantine under the direction of medical school-trained physicians rather than political patronage appointees. Both San Francisco and Sacramento established local boards in the mid-1860s, closely following the example set by New York Metropolitan Board of Health. Logan served as a charter member and secretary for the Sacramento board.

Local boards held responsibility for a complex array of health matters. The enacting legislation charged the boards with managing quarantine procedures at the ports; keeping records of birth, deaths, and interments; supervising the sanitary conditions of all public hospitals, jails, almshouses, and schools; providing guidance on the location and staffing of hospitals; and establishing "pest houses" for isolating contagious disease. While the boards held general authority to make and enforce any sanitary regulation deemed necessary, in practice their involvement with municipal water and sewage systems was limited to ordering the abatement of nuisances. The boards did not take a hand in planning such systems or in supervising their construction, which

remained the purview of private developers and municipal engineers. The boards could order an individual source of pollution from a tenement house or butcher shop cleaned up at the owner's expense, but the larger failures common in the ad hoc construction of sewage networks remained unaddressed.

In 1870, Logan authored legislation to establish the California State Board of Health. Massachusetts had created the nation's first state board of health only a year prior in 1869, and California was the second state to take the consequential step. Logan had been frustrated by the smallpox epidemic of 1868-69, when popular resistance to vaccinations cost hundreds of lives that might otherwise have been saved. He desired a strong state board that could coordinate the efforts of mandatory local health boards but accepted that politics required a less powerful organization. The law he crafted created a board of seven physicians, appointed by the governor and hailing from throughout the state. Logan was the first appointee to the board and served as secretary. In his opening address to the newly formed body, he stressed that the board would avoid sanitary measures that "might press too heavily on the individual and lessen too much the freedom of personal action." "Our duties are not executive, but advisory," he declared, and in most all cases, "the observation of our sanitary rules will be voluntary and not compulsory."

As one of its first orders of business, the state board drafted the "Act for Sanitary Purposes," by which it hoped to empower local boards of health to construct and manage sewage collection systems. As drafted, the act would have compelled every incorporated city and town to establish a local board of health staffed by medical professionals. These local boards were to have sole authority over the management of sewage and drainage pipes. All new buildings constructed within incorporated towns would be required to complete sewers that either drained to the sea or connected to a sewage collection system if one were within 100 feet of the building. Those outside of 100 feet from an existing system would need to install privies and covered cesspools with the construction overseen by local health officials "for the preservation of the purity of streams and springs, or other sources of fresh water."

The California Legislature declined to enact such an ambitious bill, and instead merely authorized (rather than required) city governments to appoint boards of health or health officers as they saw fit. County supervisors might likewise appoint boards of health, but only as a temporary measure during epidemics. Few cities immediately availed themselves of their appointment authority and only Stockton and Oakland created new boards to join those previously existing in San Francisco and Sacramento. In 1878, the legislature amended the law to make the formation of a local board of health mandatory for incorporated communities. Enforcement of the measure was limited, and many cities delayed appointing a board that might shift power away from city councilmembers. By the mid-1880s, a total of 19 local boards of health existed, representing less than one third of the 60 incorporated cities and towns in the state. In 15 counties, no incorporated towns existed and therefore there were no boards of health.

The local boards of health had executive power to enforce nuisance abatement laws, but only a few cities had ordinances specific to sanitation. Serving on a health board was generally a thankless task that invited hostility from those who were served with abatement orders, so most boards acted only after receiving a formal complaint. The state board attempted to prompt the local boards into taking greater responsibility for their drinking water and sewage systems by sending out periodic

questionnaires that asked for an assessment of current conditions and plans. However, the survey results tended to be more dispiriting than motiving. Of the 23 cities that responded to an 1879 survey, only one was judged to have a complete sewerage system, while seven others had partial systems that left out many neighborhoods. The remaining cities had no integrated systems but included disconnected sections of sewage pipe that were constructed by private interests to serve individual buildings or small developments. The state board concluded that the responses showed "an absence of a spirit of enterprise to overcome obstacles, and an apparent want of appreciation of the real importance of the subject."

Professorships of Hygiene

In 1873, the regents of the University of California (UC) created a Professorship of Hygiene within the medical school at Berkeley, the fourth such position in the nation, and they appointed Thomas Logan, the founder and secretary of the State Board of Health, to the role. Logan had achieved national prominence in the years following the 1870 creation of the state board. He arranged for the 1871 annual convention of the AMA to be held in San Francisco, and he used his address to the body to tout the state's achievements and urge the nation's 37 medical schools to appoint chairs of hygiene. Logan was elected president of the AMA for the 1872 year. Although the UC regents appointed a leading man of medicine with a record of scientific and administrative innovation to head the new course of study, Logan died three years later without leaving a permanent, substantive plan of research and instruction.

The University of California, Stanford University, and the University of Southern California all created professorships of hygiene or sanitary science in the nineteenth century, but the broad program of instruction gave limited attention to matters of drinking water supply or sewage management. Courses focused largely on what might be termed healthy living, covering such subjects as diet, exercise, sexual relations, and mental health. There was thus little university research conducted on public sanitation in nineteenth-century California that might have shaped the infrastructure being created.

Nineteenth-Century Technology Waterworks

Prior to the 1870s, only about half of American towns had any sort of public water system and these were concentrated in the larger cities of the Northeast. In all other areas, individuals procured their daily water supplies for drinking, cooking, and bathing in essentially the same manner as had European peasants for centuries. They dipped pails in surface streams, drew groundwater from springs or wells, and collected rainwater in cisterns. What public systems did exist, with a few exceptions, were nearly as crude. A town might dig an open ditch from a nearby river or enclose a hillside spring and run a log pipe to a community trough. More commonly, town leaders simply excavated a large central well. The Spanish and Mexican settlements of pre-1850 California made use of such public systems as the Zanja Madre (Mother Canal) in the Los Angeles pueblo and artesian wells and small dams at the missions to meet both agricultural and domestic needs.

Some of these early Spanish and Mexican-period systems included rudimentary treatment facilities; such as the filtration building ("El Caballo") at San Buenaventura Mission, where aqueduct water flowed through layers of sand and charcoal to purify the drinking water. Few towns had any sort of distribution system, so households had to carry their water in buckets or purchase a daily supply from water carriers who hauled water by wagon or hand. Consequently, most

individuals limited themselves to between three and five gallons of water per day, equivalent to a few flushes of a modern toilet.

These local systems functioned adequately so long as populations remained low, but any town looking to grow needed a supply of abundant, reasonably pure water for domestic and industrial consumption as well as firefighting purposes. The challenge of obtaining such a supply frequently served as the catalyst for organizing a municipal government, and for many towns the construction of a public water system was their first and largest financial undertaking. In states dominated by rural legislatures, towns were frequently constrained in their abilities to tax citizens or finance infrastructure projects through debt. Municipal government thus commonly turned to private companies that could borrow from capital markets. In nineteenth-century California, only Sacramento developed a water system that was predominantly publicly owned; all other cities and towns relied on private enterprise to meet their supply needs. Governments regulated the water companies through the granting of franchises. The companies were offered access to water supplies, use of public rights-of-way, monopoly control over distribution networks, the right to exercise eminent domain in constructing their systems, and certain tax privileges. In exchange, the government could specify terms of service to include the distribution area and minimum water pressure requirements, as well as exercise a measure of control over pricing. Franchises also generally required that water be provided free for fire hydrants and public parks.

Selecting a water source required weighing expense, convenience, safety, and palatability. The English River Pollution Commission ranked water supplies with respect to their comparative wholesomeness, palatability, and general fitness for drinking and cooking. Springs, deep wells, and mountain streams or lakes provided the most desirable supply, while lowland rivers and shallow wells were both hazardous to health and undesirable for consumption. Throughout California, wells were the most common source of water and most were relatively shallow at 35 feet of depth or less. Water from such wells was essentially surface water that had been lightly filtered by percolating through the soil. This removed the larger contaminants and the water was generally clear and cool, though shallow filtration did not capture the smaller microorganisms that caused disease. In trickling through stone, the water also acquired quantities of dissolved calcium and magnesium that rendered it hard and alkaline. This decreased the water's palatability and made it less effective in laundering and some industrial uses. In an era when water purity was assessed directly through the senses, the off-putting odor and flavor of hard water suggested contamination to many consumers. Where feasible, towns made use of deep wells, and deep artesian wells remained common in the nineteenth century through such locations as the Santa Clara Valley and the Los Angeles Basin. When located within a reasonable distance of mountains, cities diverted pure water from upland sources and ran it through earthen ditches to reservoirs for distribution.

Infiltration galleries offered one practical method for improving the safety of non-mountainous surface water sources. Infiltration galleries consisted of perforated pipes, generally of concrete construction, that ran horizontally through the sand and gravel bedding that surrounded and lay beneath watercourses. The pipes collected the subsurface river flow and then discharged it by gravity at a lower point or carried it to a pumping station for lifting to the surface. Percolating through the sand and gravel naturally filtered the subsurface flows. This cleansed the water of most organic matter and improved its safety, though the addition of dissolved minerals increased the water hardness and diminished its palatability. Los Angeles constructed an early gallery system in

1886, consisting of two 3,656-foot-long pipes installed 10 to 15 feet beneath the Los Angeles River through the Glendale Narrows, north of downtown. The city expanded the existing system and completed additional galleries in 1904, 1905, and 1906. The largest of these burrowed through bedrock 115 feet beneath the riverbed. Nine vertical wells connected the bedrock tunnel to the river and collected the subsurface flow through their perforated linings. Collectively, these systems drained so much underground flow that the Los Angeles River routinely ran dry at the surface. The improved water quality, however, allowed the city to abandon several chlorine treatment stations that had proven expensive and inefficient to operate.

Diverted water generally flowed first to a service reservoir or water tower before entering the distribution network. This provided a reserve of water for use in firefighting, allowed for pumps to shut down overnight to save on fuel and labor costs, and helped to balance pressure through the distribution system. A typical design for a small municipal system was to place reservoirs at opposite ends of the distribution system, with a main reservoir near the source supply and an elevated tank at the other end of town. Water was pumped overnight across town into the tower, and then during the day water was available at both ends of the distribution system. This prevented a loss of pressure for users at the far end of town. Some small, early water systems dispensed with reservoirs in favor of direct-pressure systems (discussed below), but these fell in popularity as populations increased and towns opted for the flexibility offered by storage. Reservoirs also helped to deal with variable surface-stream turbidity (water clarity) as towns could fill their storage while a stream ran clear and then draw from that supply after a storm when river turbidity increased. Some larger suspended solids might also fall out of the water while in a reservoir, though the regular in and out flow prevented the water from calming enough to deposit the smaller bits of clay and organic matter that caused the most problems with turbidity and off-putting colors and odors.

Reservoir design balanced cost versus storage capacity. Ideally, the system could store several days of water supply, but this required a large area and high construction costs. Earthen reservoirs were serviceable, but they benefitted from being lined on bottoms and slopes to make them watertight. Early linings were principally of puddle, a mixture of clay and sand, with dry stone paving reinforcing the slopes. As concrete quality improved over the nineteenth century, engineers increasingly used it for lining, though the large sheets were subject to cracking if exposed to temperature changes when a reservoir was drained for maintenance. Covering the concrete with asphalt improved its watertightness, and asphalt could also be applied over a brick lining as a sealant. Roofing the reservoir protected it from contamination and freezing during severe weather. Large city reservoirs sometimes featured elaborate groined arches to support roof structures, but simpler construction of brick, wood, or iron was more common. A standpipe was a contained tank, constructed of concrete or steel, that stood at ground level rather than being elevated. The distinction between a reservoir and standpipe was one of relative dimensions: a storage tank that was taller than it was wide was commonly classified as a standpipe while one wider than it was tall was identified as a reservoir.

Water tanks replaced reservoirs in level terrain that lacked an elevation suitable for a storage basin, or where the needed supply was small enough that the expense of a tank was favorable compared to land acquisition and construction costs of an in-ground reservoir. Early tanks were wood barrels set on rooftops or girder platforms. The tanks were constructed of vertical staves bound by steel

hoops, with the hoops more tightly spaced towards the tank bottom where the pressure was greatest. Wood tanks were common features on rooftops in older urban areas through the mid-twentieth century and they continue to serve today in small water systems. Riveted or bolted steel replaced wood for larger municipal tanks beginning in the 1890s. These usually consisted of a steel cylindrical tank with a conical roof mounted on a steel girder platform. A riser pipe delivered water to and from the tank and a ladder provided maintenance access. Enclosing the base of the tower with wood or masonry material improved the tank appearance. Some communities transformed their water towers into monumental works of architecture with Gothic, Neoclassical, or other stylistic design elements. While this practice was more common in the East and Midwest than in California, some examples such as the 1894 tank in Fresno are found in the state.

The construction of a distribution network for delivering water by pipe to individual users was among the first improvements made to any water system. Main lines carried water through the public streets and connected to homes by service pipes. A variety of materials have been used over the decades for manufacturing pipes for municipal use in drinking water and wastewater systems. Table X below includes the major materials used with an approximate date range for their period of peak popularity.

Table 1. Pipe materials and approximate date range of primary usage in United States.

Material	Approximate Date Range of Peak Use
Wood	1600s–1800s
Clay	1800s–present
Lead	1800s–1920s
Cast Iron	Early 1800s–1960s
Wrought Iron	1850s–1930s
Copper	1850s–present
Concrete	1900s–present
Steel	Early 1900s–present
Asbestos Cement	1930s–1980s
Ductile Iron	1950s–present
Thermoplastics (PVC, HDPE)	1950s–present

Early watermains were made principally from bored and charred logs. Later pipes used milled timber of selected dimensions. Wire wrapped spirally along the pipe length added strength, and rings of iron fit around the pipe ends limited splitting. The pipes could be dipped in hot tar and sanded to add a protective coating. Wood pipes were reasonably durable in well-drained soil, but they were bulky, difficult to join, and generally came in only short lengths. Larger banded stave pipes (Figure 5) were introduced around 1850 and these later came into common use in the West for watermains and sewage outfalls, as well as on large irrigation and hydroelectric projects. Stave pipes constructed of redwood continued to be used occasionally for new construction in California into at least the 1930s.

Cast iron pipes were introduced in England around 1800 and began to replace wood pipes for watermains. Philadelphia made the first use of cast iron watermains in the United States in 1807, but the city needed to import the pipe from Great Britain. Iron pipe casting involved considerable technical challenge and the early pipes manufactured domestically were prone to inconsistencies in thickness and strength.

Most pipe continued to be imported from Scotland prior to the Civil War, after which major foundries emerged in Pennsylvania, New Jersey, Ohio, and Kentucky. Pipe from these foundries remained relatively expensive until the financial Panic of 1873; the concomitant reduction in railroad construction caused a steep drop in iron prices and made distribution systems increasingly affordable. The durability, ease of manipulation, and comparatively low cost of cast iron pipe made it the standard product for water distribution by the end of the nineteenth century. As a protection against corrosion, manufacturers commonly dipped pipe in a hot bath of coal tar, asphalt, and linseed oil to create a smooth, hard, glossy coating. Techniques for galvanizing the iron or lining it with concrete or lead were introduced later in the nineteenth century. A confusing and often incompatible variety of pipe thicknesses, dimensions, and connection styles came into use during the following decades of growth before the American Water Works Association finally adopted standardized measurements in 1908. Improvements in the metallurgy of cast iron in the 1940s led to the introduction of ductile iron pipe in the 1950s. Under pressure, this more flexible material would deform slightly rather than cracking, making it more durable. Ductile iron pipe is distinguishable from older cast iron pipe by its smoother texture, gray versus black color, and the ringing sound it produces when struck by a hammer, versus the dull thud of cast iron.

Initially, use of cast iron pipe was rare on the West Coast as no regional foundries existed and transportation costs were prohibitive. Hydraulic mining in California demanded a metal pipe capable of withstanding great pressure, so local manufacturers substituted wrought iron sheets riveted into tubes. When lined internally with concrete or asphalt, these pipes could be used for watermains. Wrought iron bands connected adjacent sections of pipe and a coating of cement mortar encased the whole exterior surface of the pipes. Hermann Schussler drew upon these mining experiences when he laid out the San Francisco Water-Works in the 1860s using concrete-lined wrought iron pipes. The pipes were serviceable but lacked durability as water pressure frequently eroded the poorly-mixed concrete and eventually rusted the metal shell.

Techniques for welding, rather than riveting, wrought iron sheet into pipes developed gradually over the nineteenth century and started to enter common usage in the 1880s. These pipes were light, easily handled, resistant to damage, and came in lengths of up to 20 feet. Their smooth interiors presented low frictional resistance so that a welded pipe could carry more water than a cast iron or riveted pipe of the same diameter. The early joints were formed from iron sleeves welded into place, but these were later replaced by butt weld joints that directly connected two pipe sections. California manufacturers commonly coated the pipes with asphalt, but chemical processes also existed to oxidize the metal or plate it with copper to prevent further corrosion. Steel sheets were rolled and riveted to form pipes beginning in the 1850s, but the low tensile strength of the early steel limited its application. Manufacturers began successfully welding steel sheets into pipes in the 1880s. Gradual refinements to the process brought down costs and improved consistency, so that by the 1930s welded steel pipes largely replaced earlier riveted steel and welded iron for use in transmission and distribution mains.

Clay pipes appeared frequently in sewerage systems but were less common in drinking water systems as they were susceptible to breaking under higher pressures. Manufacturers produced a variety of natural clay pipes that differed chiefly by the firing temperature in the kiln. When fired at comparatively low temperatures (below1,800 degrees Fahrenheit), the material produced was known as earthenware pipe. The material remained somewhat porous and would absorb water,

making it useful for drainage systems but less so for sewage and drinking water systems. Higher firing temperature, up to around 2,300 degrees Fahrenheit, caused the clay to vitrify (turn to glass), making it a dense, durable, corrosion-resistant, non-porous material that was widely used in sewage, irrigation, and drainage systems. This material was generally known as stoneware or as vitrified clay pipe when a specialized mixture of clay and shale was used in manufacturing. To maintain water tightness, bands of wrought iron were wrapped around the joints between pipe segments, and as clay pipes were generally short, the joints needed to be spaced frequently. This increased the amount of friction in the pipes and therefore reduced their carrying capacity.

Concrete pipe was used in sewage systems, storm drains, and agricultural irrigation, but was comparatively rare in drinking water distribution systems. While concrete pipes were inexpensive, easy to maintain, and could be constructed without skilled labor, the pipes could not well withstand the high water pressures of the distribution system and tended to leak. The pipes were also difficult to repair and generally required replacement if damaged. In the 1920s, manufacturers began mixing asbestos fibers into the cement slurry to form composite asbestos-cement pipes, also known as transite. This made for a stronger and more durable material that was resistant to chemical erosion. With the ability to withstand high pressures, asbestos-cement pipes were more widely used for drinking-water mains. A growing recognition of the health effects of asbestos exposure led to declining use in the 1960s and 1970s, until the material was largely phased out in the 1980s.

Because of cost and their physical properties, lead pipes did not appear in main distribution systems, but were used extensively for service connections that linked individual homes and tenement buildings to street mains (Figure 6). These are now commonly referred to as lead service lines. Lead pipe was more expensive than the iron or steel alternatives, but it offered advantages in durability and flexibility. Lead provided superior protection against exterior soil corrosion and was second only to cement-lined iron pipe in guarding against interior corrosion. A line that rusted from the inside could clog, and as no practical means existed for flushing lines prior to 1910, stopped pipes needed to be excavated and manually cleaned or replaced. To avoid such costly and disruptive repairs, many municipalities opted for the higher upfront cost of building with lead pipe. Lead's malleability also favored its use in dense urban areas where water pipes needed to be routed around existing gas and sewer lines and other obstructions. In the early twentieth century, manufacturers introduced lead lining for iron pipes that combined the greater corrosion resistance of lead with the lower cost of iron. Lead pipe was also widely used for household plumbing and in the solder used to connect iron pipes.

The material advantages of lead pipe led to its wide adoption, particularly in large cities. By the end of the nineteenth century, about half of all American municipalities and 70 percent of cities with populations greater than 30,000 used lead service connections either exclusively or in combination with some other pipe type. By contrast, two-thirds of communities with fewer than 8,000 people made no use of lead service connections. Large cities had both the financial resources needed to make an upfront investment in more expensive lead piping and the complicated infrastructure that made the durability and flexibility of the material attractive. Small towns were less likely to have paved roads and could more readily access the buried pipes and handle the occasional failure of an iron service connection. Public water companies were also more likely to invest in lead pipes than were private utility companies, and such public utilities were also more common in large cities.

The chief objection to the use of lead pipe, as was understood at the time, was its potential to contribute to lead poisoning. In low doses, lead exposure produced subtle symptoms that were difficult to diagnosis such as headaches, dizziness, and hypertension. At higher exposures, lead poisoning produced joint and muscle pain, gastro-intestinal distress, infertility, difficulties with memory and concentration, and mood disorders. Extreme levels could cause seizures and death. Children were particularly vulnerable to lead poisoning and could experience serve developmental delays, hearing loss, and a general failure to thrive. Despite this knowledge, most nineteenth-century physicians worried little about the potential for lead poising through the drinking water supply, but focused instead on occupational exposures and the use of lead tubing in distilleries. The sheer ubiquity of lead pipes in major cities and the difficulty in recognizing the signs of low-level lead exposure led many to assume that no major problem existed. Recent studies, however, suggest that the use of lead piping in nineteenth century cities increased stillbirth and infant mortality rates by as much as 400 percent. Effects varied between communities based on the acidity of the water supply and age of the pipes, as older lines developed a protective coating of corrosion that limited the leaching of lead. Upgrading water systems to add filtration and chlorination could increase water acidity, and when combined with new lead pipelines, the results could be disastrous. Lowell and Milton, Massachusetts, for example, overhauled their water systems around the turn of the twentieth century, leading to a sudden increase in lead levels that caused several deaths and multiple documented cases of nerve damage and cognitive disability. These widely publicized cases helped to discourage the use of lead pipe in new construction going into the twentieth century. Copper piping offered the chief alternative, with tin and brass following. Like lead pipe, copper pipe is more expensive and harder to work with that its alternatives, but its strength, corrosion resistance, and heat tolerance make it a common material for household plumbing and the smaller-diameter service lines that connect individual buildings to watermains.

For all the improvements made by water companies, distribution networks remained highly inequitable through the nineteenth century. Frequently, central business districts and wealthy residential neighborhoods were the first to receive pipe service, while Black, immigrant, and working-class districts were more likely to continue to draw water from polluted wells. Even when distribution networks were run to more neighborhoods, individual expense was required to connect the public pipe end to private plumbing fixtures. Tenement owners rarely undertook such efforts, so renters continued to haul buckets of water up steep stairwells from the streetside taps.

Water pressure through distribution networks was also inconsistent, owing to the leaky nature of early piping and plumbing. Many homeowners thus constructed water tanks in their attics or on rooftops to regulate the flow. The tanks would fill with water overnight and then the resident would release it for household use during the day when the distribution system pressure was at its lowest. These tanks, however, were troubling subjects for sanitarians as they often contained decaying organic matter and served as breeding grounds for mosquitos Urban water systems began to proliferate in the 1870s owing largely to the promotional efforts of water-works equipment manufactures. Birdsill Holly of Lockport, New York, was the leading figure in this transition. The Holly Company manufactured steam-powered rotary and gang pumps that injected water at pressure directly into a town’s watermains without need for a reservoir. This allowed pipes to maintain a desired pressure with relative consistency, facilitating firefighting and simplifying the

overall waterworks systems, though the lack of flexibility in handling variable demands led to the obsolescence of direct-pressure systems by the end of the nineteenth century.

Holly canvased for towns lacking in water systems and offered to complete waterworks in exchange for an annual payment based on the number of fire hydrants provided. The practical and financial success of his system inspired other manufacturers to follow his example. Increased competition, in turn, spurred rapid innovations in waterworks technology, financing, and promotion, inducing many small towns to install their first public water systems.

Throughout the nineteenth century, most cities had water supplies that were separate from sewage discharges, with the exception being communities that relied entirely upon shallow wells or which were located along major interior rivers downstream from other population centers. In the era before effective water filtration, the usual solution to pollution was simply to go further afield in tapping a supply. The largest cities could accomplish this, such as New York City, which in 1842 completed the Groton Aqueduct which carried water by gravity for 41 miles. Most communities, however, lacked the political and financial power to create such systems.

In California, pollution concerns were particularly acute in Sacramento. The upstream towns of Redding, Red Bluff, Chico, Colusa, Marysville, and Yuba City all sat along the Sacramento River or its tributaries north of the capitol city, and all discharged raw sewage into the waterways. The agricultural land immediately north of Sacramento also posed hazards as dead hogs were routinely disposed of in the river and washed up on sandbars to rot in the heat of summer. The State Board of Health held Folsom Prison responsible for "probably the most flagrant pollution of potable waters in California," as it discharged the raw sewage of several thousand convicts into the American River at a point only 22 miles above Sacramento to the east.52Logan, as board secretary, had recommended constructing a well into the gravels of the Sacramento River so that the water might be at least filtered before being collected by a Holly pump for distribution to the city. However, to his great frustration, the residents of the city expressed a clear preference for softer, if more hazardous, river water over hard well water. The city thus continued to consume surface water from the Sacramento and American rivers, while the State Board of Health redirected its attention to limiting pollution from Folsom Prison and other upriver sources.

Wastewater

Municipal officials paid little attention to waste disposal prior to the mid-nineteenth century. Even as towns began to develop drinking water systems, they saw no need to construct parallel systems for disposing of the wastewater. The ancient civilizations of Babylon, Mesopotamia, and Rome had constructed sophisticated systems of drainage, but these practices had all but vanished in Medieval Europe. Primitive, folk methods of waste management, with an emphasis on individual responsibility, prevailed through the seventeenth and eighteenth centuries, and these habits were reproduced in the American colonies. These practices centered around the so-called "cesspool–privy vault system" (discussed below). The rapid growth of cities in the nineteenth century and particularly the introduction of water closets eventually overwhelmed the system by flooding the cesspools and privies beyond capacity.

While the terms cesspool and privy vault were sometimes used interchangeably, the two structures were intended for different waste types and were designed accordingly. Privy vaults handled

human fecal and urine waste (what is today termed blackwater), while cesspools received graywater from kitchens, laundries, and animal stalls. Cesspools were large pits constructed in the yard or cellar of a building. They were commonly lined with brick or stone, but mortar generally was not used so that the water might leach into the surrounding soil, leaving kitchen scraps behind to decompose. In areas too underdeveloped for cesspools, liquid household waste might be piped to a nearby drainage or merely be cast upon the ground.

Privy vaults were little more than shallow holes dug in the ground, usually without lining. In rural areas, the privy would be covered with soil when filled and a new hole could be dug. In denser settlements, it was necessary to periodically empty privies to keep them in use. Individuals either did this work for themselves or contracted with private scavengers. Later, specialized collection companies employed odorless excavators to rapidly suction privies. Many cities required that privies be emptied only at night, giving rise to "night soil" as a euphemism for human waste. The collected material might be sold to outlying farmers for fertilizer or be dumped in a convenient waterway or refuse pile. In built-up neighborhoods, privies posed a danger to nearby wells as waste leached through the soil. The problems were compounded when heavy rains caused privies to overflow through a neighborhood, mixing their raw waste with the general flooding.

Sewers were uncommon before the mid-nineteenth century, and where they existed, they were used primarily for carrying storm runoff. Early sewers were largely of private construction without any systematic planning. Open ditches or brick-lined street gutters carried away rainwater and allowed for the drainage of cellars. Later the ditches were covered with brick, creating the first partially enclosed sewers. Municipalities began to specify construction techniques and the division of costs among neighbors in the 1820s, and commonly prohibited the dumping of solid waste, and particularly fecal matter, into the systems. However, these regulations were frequently ignored, and the surface sewers frequently carried kitchen waste, offal, manure, and the industrial byproducts of dye works or tanneries.

The introduction of piped water seriously disrupted the cesspool–privy vault system. The availability of freely running water at the household tap led to a surge in per capita use, increasing from the prior three to five-gallon range to between 50 and 100 gallons per day. This increase alone threatened to overwhelm cesspools, but the problem was compounded by the introduction of water closets. Flush toilet technology had been around for some time, but it required the wide availability of piped water to make the system practical. Water closets were introduced in England around 1810 and the first models were patented in the United States in 1833. Affluent homeowners quickly adopted the modern technology which promised greater convenience and sanitation than outhouses and privies. By 1880, approximately one-third of urban households had installed water closets.

The increased flow into cesspools and privy vaults overwhelmed the ability of the soil to absorb the leach water. In city after city through the late nineteenth century, the old regime of waste management collapsed before a new system could be put in place. Cites attempted to order homeowners to empty their cesspools and privies more frequently, but compliance was poor. Many households constructed surreptitious connections to the city sewer system, illegally draining their water closets into pipes that were not designed for the task of carrying off human waste. Fecal matter began to spread over large areas, posing particular problems for low-lying neighborhoods

that were generally populated by the poor and immigrants. Ironically, the piped water and water closet technologies that had been sold with the promise of improved sanitary health had the opposite effect. Incidents of waterborne disease surged as overflowing privies became a ubiquitous feature of urban life.

Sanitarians proposed as a remedy a system of "water carriage," in which waste would be transported by hydraulic flow through a network of self-cleaning sewer lines. This meant abandoning privies and cesspools and repurposing the storm sewers to carry wastewater in addition to rain runoff. New interceptor lines needed to be constructed to tie together the patchwork of existing sewer lines. Brooklyn completed the first American combined sewage–stormwater system in 1857, followed by Chicago in 1859. These sewerage systems dumped the untreated waste into nearby riverways, where it was presumed that dilution would render the stream water safe. It was then widely believed among sanitarians and others that running water was self-purifying, though experiences in London with the highly polluted Thames River had already called that convenient assumption into doubt. The issue was largely a moot one anyway as no practical form of sewage treatment was yet available. (As a term, "sewerage" referred to the drainage and disposal of waste without treatment; when treatment was later introduced, the term "sewage system" was commonly used for the combined process of collection, treatment, and disposal).

As an alternative to the combined sewer system, some engineers proposed constructing separate lines for stormwater and sewage. In England, a great debate over the relative merits of the combined and separate systems had raged since the 1840s, but the separate system got a toehold in America only in 1880, when Memphis, Tennessee, constructed the first such system of large scale in the country. The presumed advantage of the separate system was that it could more quickly evacuate waste from a city, so that the sewage left the populated area in fresh condition before putrefaction of organic material reached a critical point of giving off miasmic gases. The system attracted considerable attention but was not widely duplicated as the National Board of Health held that both combined and separate systems were of equal sanitary value and that the selection of one system over the other depended upon local circumstances. As most cities already had storm sewers, it was less expensive to construct a combined system. Only when sewage treatment became more widely adopted in the late nineteenth century did separate sewage systems begin to be constructed, as it was far easier to treat sewage that was separated from stormwater.

Unlike drinking water systems that were largely constructed by private industry, municipal governments were almost solely responsible for building and operating sewers. Private utility companies naturally gravitated towards services that generated revenue such as providing drinking water, electricity, telegraph or telephone lines, and streetcars or railroads. Non-revenue generating activities such as refuse disposal, street construction, firefighting, and code enforcement remained principally the domain of government. Private industry participated in building sewerage systems as construction contractors and the manufacturers of pipe. Later, industry played important roles as engineering consultants and as patent holders on various mechanical devices and biochemical processes.

California Sewerage

Early sewerage construction in California occurred piece by piece, completed primarily by private interests in an unplanned, unsystematic fashion. At least 59 Californian cities constructed sewerage

systems in the nineteenth century, and while many made efforts to bring order to their network of public and private pipes, few achieved anything more than patchwork solutions. Sanitarians and municipal engineers might have envisioned comprehensive systems that collected and disposed of sewage in an orderly manner, but the reality was far messier. F. Walton Todd, a state board member from Stockton, wryly summarized the usual course of development:

A drain is made from somebody's hotel, and another from a livery stable is allowed to connect with it, and so on until an interest is established that has weight in a Common Council, and thus, from step to step, a system grows up altogether vicious, which sooner or later, and always after large sums of money have been spent, has to give way to another, the work of a competent engineer, but not until some serious damage has been inflicted, which the engineer, Board of Health, and Common Council combined cannot repair.

Table 2. Year of construction for nineteenth-century California sewerage works.

Year	City	Year	City
1850	San Francisco	1895	Belmont
1850 (circa)	Sacramento	1895	Emeryville
1863 (circa)	Los Angeles	1895	Fort Bragg
1869 (circa)	Oakland	1895	Ontario
1876	San Buenaventura	1896 (circa)	Martinez
1877	San Jose	1896	Piedmont
1878	Alameda	1896	San Mateo
1879	Napa	1896	Ukiah
1880 (circa)	San Rafael	1897	Hollister
1880	Santa Barbara	1897	Modesto
1880 (circa)	Suisun	1897	Salinas
1880	Vallejo	1897	Santa Rosa
1885	Coronado	1898	Red Bluff
1887	San Diego	1899	Belvedere
1888	Berkeley	1899	Ferndale
1888	Santa Cruz	1899	Palo Alto
1890	Fresno	1899	Paso Robles
1890	Redding	1899	Ross
1890	Redlands	1899	San Anselmo
1890	Redwood City	1899	Watsonville
1890	San Bernardino	1900	Beverly Hills
1890	Santa Ana	1900 (circa)	Daly City
1890	Woodland	1900 (circa)	Monterey
1892	San Luis Obispo	1900	Nevada City
1893	Auburn	1900	Pomona
1893	Los Gatos	1900 (circa)	Porterville
1893	Stockton	1900 (circa)	Sonora
1894	Mount Shasta	1900	Visalia
1894	Richmond	1900 (circa)	Wheatland
1894	Riverside	n/a	n/a

At the end of the century, the eminent civil engineer C. E. Grunsky surveyed sewage systems throughout the state and found that most remained a tangled web of pipes of various ages, materials, and designs. He concluded that nearly all the works operated by "a haphazard method that is really beyond all comprehension [as quoted from Grunsky 1901]."

Most of the early California sewer systems were of the combined sewage–stormwater variety. It made little sense, at an early date, to construct separate conduits for stormwater runoff as these would receive little use through the long dry season. Combined systems also allowed for subsoil drainage in low-lying areas like the Mission Flats district of San Francisco and downtown Sacramento. This drainage improved public health by limiting the formation of stagnant pools and made cellar storage feasible. The combined sewage pipes were necessarily large to handle winter runoff. The main pipes in Oakland, for example, were five feet wide by five and one-half feet high, while the San Francisco pipes were occasionally wide enough to drive a wagon through. The larger size also allowed sewage workers to physically enter pipes and move through them in a stooped position or by crawling so as to remove the sediment that invariably entered the combined pipes.

Cities began to construct separate sewage systems in the final decades of the nineteenth century. These systems were more common in Southern California where urban development occurred later and rainfall totals averaged lower than in the northern part of the state. San Diego, Los Angeles, Santa Barbara, and San Luis Obispo all had separate sewage systems by the 1890s, as did the campus of Stanford University on the San Francisco Peninsula. These systems utilized smaller pipes, with the main line in San Diego, for instance, being 24 inches in diameter.

Main combined sewer lines were customarily constructed of brick because of their large size. Early construction used whatever bricks and mortar were readily available, but too often these eroded away as sand and silt washed through the pipes. Later work called for hard, thoroughly burnt bricks with smooth surfaces to reduce frictional drag. Where cost was an overriding consideration, common brick might be used on the sides and upper arch of the sewer as these were less subject to wear and tear. Blocks of terra-cotta or stoneware were frequently used at the bottom of the sewer for their enhanced durability and smoothness. Termed “invert blocks,” these came in both solid and hollow forms. The hollow blocks helped drain subsoil moisture during construction, but were weaker than solid forms and builders sometime filled them with cement at the conclusion of work. An egg shape was most frequently used in the main sewer lines as the profile placed low volume flows in the constricted bottom width to maintain velocity while widening above to increase capacity in large flow events.

The smaller branch lines were generally constructed of vitrified clay or concrete, though specially curved bricks could be used for small diameter pipes. Concrete and vitrified clay were favored for their economy, durability, water tightness, and smooth internal surfaces (Figure 10). Concrete pipes could be manufactured locally and allowed for patch repairs in a way that vitrified clay pipes did not, but care had to been taken to ensure that contractors correctly mixed the concrete as a poorly constructed concrete line quickly eroded. Vitrified clay pipes had the smoothest surfaces and were the easiest to work with, but into the 1870s the best quality pipe still had to be imported from Scotland. Redwood pipes were less durable over the long term, but received wide-spread use owing to the ubiquity of the material and low cost. Wooden pipes were also useful where sewer lines crossed marshy terrain as heavier brick sewer lines would require constructing piling foundations. Cast iron pipes were used nationally in sewerage systems in the mid-nineteenth century, but the extent of their employment in California is not well documented.

Manholes were placed at regular intervals along sewer lines to allow for maintenance and the clearing of obstructions. In most cases, this permitted repair work to be done without requiring the expensive and disruptive excavation of roadways. Manholes were generally constructed on a

circular plan, being approximately three to five feet in diameter at bottom and tapering towards the surface, with brickwork lining the manhole well. Square manholes were used occasionally where larger entrances were needed, but these required additional brickwork and were thus more expensive to provide. Smaller lamp holes were added along lines to assist in locating and removing stoppages (Figure 11). A sewer worker would suspend a light in a lamp hole and then enter the adjacent manhole. He would know the obstruction had been cleared when he could see the lamp light shining down the pipe. Manholes also provided a means of ventilating the sewers through the holes left in the manhole covers, though these frequently clogged with dirt and manure on busy streets.

Combined sewer lines required manual clearing or periodic flushing during periods of low rainfall. The low volume of fluid passing through a large pipe during the summer could not generate adequate velocity to clear accumulated silt and organic matter. The problem was compounded by the irregularities of nineteenth-century construction that caused velocities to vary through a sewer line owing to changes in grade, pipe diameter, surface friction, and other variables. The simplest system of flushing involved directing a hose from a fire hydrant into openings that were constructed along the sewer line. The water of several hydrants was combined to flush the main line. Sacramento, as a typical example, constructed flush holes at the head of every branch line and periodically along larger lines. Once or twice a month, maintenance workers began flushing at the bottom of the system and worked their way towards the heads.

Automated flushing systems allowed for daily clearance of the lines and reduced the required labor but involved greater initial expense. These systems consisted of a network of tanks installed at the head of the sewer lines. Taps running from watermains slowly filled the tubs. The fill rate could be adjusted to provide for flushing intervals ranging from every two hours to twice per day. Once full, the tank tipped under its own weight, emptied its contents, and returned to the upright position to fill again. Alameda purchased 130 of these flushing tanks in the late 1880s to clear its 41 miles of sewage line. Each tank held 50 gallons of water and dumped every six hours. The tanks were installed just below sidewalk grade, in brick receptables covered by iron lids, to provide easy access for adjusting the flushing frequency.

More elaborate flushing systems were proposed in San Francisco and implemented in Oakland. San Francisco suffered from particularly bad problems of pooling sewage that ordinary fire hydrant flushing could not clear. In the early 1870s, State Board of Health member A. B. Stout proposed constructing a series of reservoirs along the ridges and hilltops above the city and filling these with salt water pumped from the bay. Great volumes of water could then be released to clear obstructions before flowing back to the sea. City officials never constructed the expensive proposal, but it remained under consideration through the end of the century. In Oakland, City Engineer T. W. Morgan designed an ingenious system that caused waters from Lake Merritt, then still connected to the bay tidelands, to flush the line twice daily. Floodgates in a dam at the bottom of the lake permitted water to enter on the flood tide, but prevented it flowing out with the ebb. Workers manually opened a gate at the head of the main sewer line to send a scouring burst of stored water through the sewer and back to the tidelands. Oakland thus treated Lake Merritt like the tank on a toilet bowl that was flushed and refilled by the regular motion of the earth beneath the moon.

Engineers during this same period devoted considerable attention to finding means of venting sewer gases. Indeed, because of the influence of miasma theory, sanitarians regularly gave greater priority to the control of vapors than to the disposal of liquid waste. When homeowners caught a whiff of sewage coming up from a kitchen sink, they worried about the illnesses that their neighbors might be transmitting to them through the shared sewer lines. Despite intense study, however, sanitarians developed no practical method for dispersing sewer gas. Experiments were made with air vacuums, blowers, furnaces, and charcoal filters, but none were economical to deploy at scale. Oakland considered building towers through the city to vent gases above the rooflines, but never pursued the idea. Attention thus focused on simply keeping the gas out of homes and businesses through the use of drain traps. These basic U-shaped traps were installed beneath sinks and water closets to retain a small quantity of water in the pipe after draining. The trapped water formed a seal against rising gases and odors. While simple drain traps had been in use since the eighteenth century, the design continued to evolve through a great number of patented forms as the quantity and types of drains in households multiplied.

Sewage Farms

The disposal of sewage on land offered the only practical alternative in the nineteenth century to the dumping of raw waste into bodies of water. The practice variously termed "sewage farming," "sewage irrigation," or "broad irrigation" both prevented river pollution and allowed for sewage effluent to be put to beneficial use as fertilizer. Sewage farming proved particularly well adapted to the arid American West, and Californians adopted the practice on a wider scale than did any other state. At least 50 California cities and 39 public and private institutions made use of sewage farms over a span of half a century between the late 1880s and World War II.

Sanitarians were almost universally in favor of the use of sewage farms. The British reformer Edwin Chadwick advocated the practice beginning in the 1840s and argued that the entire cost of municipal sewer systems could be paid for through selling the output to farms. The Massachusetts Sanitary Commission echoed the recommendation in the 1850s, and by the 1870s American scientific journals and the popular press were regularly running articles on the practice. Sewage farming even showed up in the utopian writings of Victor Hugo and Edward Bellamy. The California State Board of Health joined the call for sewage farming beginning with its second annual report in 1873 and remained in support of the method into the 1930s.

The use of human and animal waste on farms to boost productivity was, of course, an ancient practice. The Romans used human waste as fertilizer and the tradition remained common throughout Europe well into the nineteenth century. Particularly refined methods of gardening with night soil were in use in China, Japan, and Korea for centuries. These early methods utilized the waste of privies and cesspools. Scavengers with ladles and buckets or service companies with odorless excavators collected the waste and sold it either directly to farmers for depositing on the land or to processing plants for conversion into compost or fertilizer.

The introduction of water carriage sewer systems (discussed above) in the nineteenth century required a change in practices. By one contemporary estimate, the sewage from a water carriage system consisted of 998 parts water, one part mineral matter, and one part organic matter. The intent of sewage farming was to neutralize that one-thousandth part organic matter while retaining its valuable nitrogen, phosphorous, and potash. The chief challenge was finding a way to dispose

of the water, which could easily run to tens of thousands of gallons a day from even a mid-sized town. The land selected for a sewage farm should be well drained with a sandy or gravelly subsoil, accessible by gravity flow, and of low cost. The character of the surrounding habitations needed to be considered to avoid complaints about nuisance odors, although sewage farming advocates claimed the smells were no worse than those arising from pigsties and barnyards. The practice was particularly valued in the western states because low summer river flows made instream disposal an unbearable nuisance and there was always high demand for any irrigation source.

The method of irrigating with sewage did not differ greatly from ordinary irrigation practices. A somewhat greater degree of care was needed to minimize direct contact between the sewage and growing plants and to control the ponding of sewage when effluent was placed on saturated soils during winter rains. Pipes were generally used to carry sewage to the farming grounds, but then the effluent could be run through ordinary, unlined, earth ditches. The land was leveled and prepared with furrows and ridges for row crops or divided into check basins for flood irrigation. As irrigation was not required during the winter months, it was necessary to set aside some land for uncropped infiltration. Most any crop could be grown by sewage farming, though in 1918 the State Board of Health issued regulations prohibiting the use of sewage on garden vegetables intended to be eaten raw. Fruit trees, melons, grains, and vegetables intended for cooking or canning all remained permissible.

Public institutions were the first to use sewage farming in the United States, beginning in the 1870s. Asylums, prisons, alms houses, and reformatories could supply labor without expense and had a built-in market for the crops produced. Pullman, Illinois, was the first municipality to employ a sewage farm to dispose of its waste in 1881, though the practice did not long endure there owing to the heavy clay soils and natural abundance of rain. Pasadena in 1888 was the second American city to establish a sewer farm and it became a model for many of the other municipal programs that followed. By the early 1890s, municipal sewage farms were operating in Redding, Santa Rosa, Stockton, Fresno, and Los Angeles.

The Redding sewage farm provides a typical example of a medium-scaled municipal operation. The city constructed a separate sewage system in 1889, designed by the city engineer. The system, serving a population of around 2,000, included 2.9 miles of line and seven 112-gallon automatic flushing tanks. The city had intended to dispose of its waste into the Sacramento River, but objections from the State Board of Health led to a search for alternatives. The city called for bids on a contract to dispose of the waste for a 40-year period at a beginning payment of $300 yearly, to be increased in proportion to the community's growth. L. F. Bassett, the former Sacramento city engineer, secured the contract and purchased 100 acres of land at the city fairgrounds, about a mile south of Redding, in the location of today's civic center (Figure 13). About 10 acres were initially prepared for irrigation by leveling the land and running furrows. Bassett laid a 12-inch-diameter pipe through the racetrack grounds and excavated open ditches to carry the sewage to the prepared land. The sewage irrigated a variety of crops including asparagus, turnips, beets, and potatoes, but was used primarily for raising fruit trees as nursery stock. The acreage had a soil of loamy sand underlain with a deep bed of gravel and did not require a separate system of drainage.

Rather than run the sewage continually, Bassett constructed a 75,000-gallon reservoir—equal to one day's average flow—to hold the material overnight. In the morning, the reservoir gate was

opened and the sewage flowed onto the land for two to four hours before the gate was again closed. The reservoir was covered by a wood lid and included a 60-foot-tall timber chimney to disperse odors and prevent the site from becoming a nuisance to the adjacent county road. A screen above the irrigated lands removed any large objects that might obstruct the irrigation ditches. During the winter, when no crops were growing, it was necessary to run the sewage onto one piece of land for several days and then to plough it under when the ground had sufficiently dried. The greatest odor occurred at this time as the sewage ponded before being absorbed into the saturated soil.

The construction and operation of the sewage farm was not without opposition. Neighboring landowners objected to the approval of the farm prior to its completion, and in 1892 they had Bassett arrested for maintaining a public nuisance. The courts, however, sided with the sewage farm, and the local press also offered support. The State Board of Health added its endorsement later in the year when a delegation visited the Redding sewage farm to ascertain its impact on the Sacramento River. Pleased with what they found, they declared the system satisfactory and "commendable to that progressive city [as quoted from State Board of Health 1901]."

Nationally, sewage farming achieved its peak popularity in the 1890s and then declined. The adoption of new and generally superior technologies for sewage treatment around the turn of the century, including septic tanks, chemical precipitation, and sprinkling filters, was the chief cause of the decline. Advocates of sewage farming claimed that these new methods wasted the nutritional and economic value of sewage, but sanitary engineers countered that the fertilizing power of sewage had always been overrated. The large volume of water applied in sewage farming in many cases leached nutrients from the soil quicker than they could accumulate. Public health concerns about applying raw sewage to edible crops had been relatively muted when no better sewage treatment option was available, but the increase in alternatives brought greater attention to the problems. Rising land values on the margins of towns, where sewage farms were initially constructed, also favored abandoning the older plants. Sewage farming remained a viable option only in locations where irrigation water was in great demand, as in much of Southern California. The practice continued there in adjunct to other treatment methods, so that sewage was first processed by a septic tank or sprinkling filter before the treated effluent was discharged as irrigation water. In this way, the method prefigured the later practice of using reclaimed wastewater for irrigating roadsides and other public lands.

2. The Era of Sanitary Engineering, 1900–1949

The first half of the twentieth century witnessed rapid advances in sanitation science and technology, but slower progress in policy. The creation of two new academic and regulatory bodies epitomized the era. In 1905, the University of California established a department of sanitary engineering at Berkeley, headed by Charles Gilman Hyde, and a decade later, the State Board of Health created the Bureau of Sanitary Engineering, led by Hyde's former student, Chester Gillespie. The careers of both men extended into the late 1940s and coincided with the emergence of modern sanitary engineering practices.

The first decades of the twentieth century saw the creation of nearly all the major processes and pieces of infrastructure employed at drinking water and wastewater treatment plants today. These included the processes of chlorine disinfection and rapid sand filtration for drinking water, and the biological wastewater treatment methods used in trickle filters and activated sludge tanks. These

advances largely halted the scourge of typhoid fever except in locations that lacked modern services because of their remoteness or economic marginality. Still, the laxness of state regulations meant that few municipalities constructed modern sewage treatment plants prior to World War II. The newest and most sophisticated systems tended to be constructed in Southern California, where communities were young and growth rapid, while Northern California employed more legacy systems from the nineteenth century.

Knowledge

Germ Theory

By 1900, the germ theory of disease, more formally known as bacteriology, had replaced the earlier miasma theory in sanitary planning. Among public health professionals it became accepted fact that it was not filth in general that caused disease, but the presence of particular microorganisms. Expectations faded for the sort of broad social reforms that had animated the sanitarian movement and were replaced with the more narrowly focused task of ridding public water supplies of disease-causing organisms. The application of this knowledge, particularly through the chlorination of drinking water, produced sharp drops in death rates from typhoid fever and other intestinal illnesses. Ironically, the decline in disease led to greater tolerance for sewage dumping as the public came to see pollution as a mere nuisance rather than a public health crisis. It was only when officials later began to worry about the economic impacts of pollution that they again made efforts to limit raw sewage discharges.

At its core, germ theory held that discrete, microscopic organisms penetrated bodies and caused disease through their growth and reproduction. These pathogens, or "germs," could be bacterial, viral, or fungal. Ideas related to the germ theory had been in circulation for centuries, but they gained dominance among medical professionals only in the late nineteenth century. The investigations of Louis Pasteur and Robert Koch between the 1860s and 1880s were the first to identify specific organisms responsible for disease and to demonstrate conclusively the shortcomings of alternative theories. Still, the theory was slow to find full acceptance. Most physicians were flexible in their thinking and for decades continued to freely combine the germ theory with their long-standing beliefs about miasmas and the influences of climate and topography on health.

The impact of germ theory on public health measures was thus initially subtle, but it ultimately proved transformative. Physicians shifted their focus from society to the individual and from preventing disease to curing it. Medical practitioners and engineers grew irritable with the efforts of sanitarian reforms, which while well-meant and often at least indirectly beneficial, seemed to miss the essential scientific point. "Smells are not dangerous," claimed San Francisco engineer Ernest McCullough. "They are rarely, if ever, a cause of illness. They are simply unpleasant to our modern sense of what is right and proper." Local boards of health shifted their efforts from supervising sanitary systems to measures that more directly aligned with the new science such as vaccination campaigns and inspecting health conditions among the increasing immigrant population. By the First World War, municipal health departments had largely turned over their former responsibility for water and sewage systems to engineers and public works departments.

Sanitary Engineering

Sanitary engineering emerged as a distinct professional field at the start of the twentieth century. The field had its roots in the larger English sanitarian movement, and the term "sanitary engineer" was first used in the 1870s to describe anyone with a concern for using technology to clean the environment, including plumbers, building contractors, asylum superintendents, and municipal engineers. Over the remainder of the nineteenth century, the field gradually shed its association with the building trades and came to define itself as a science-based profession. The series of technological triumphs that emerged from the field in the early twentieth century, from the chlorination of water supplies to the activated sludge treatment of sewage, allowed sanitary engineers to displace physicians and sanitarian reformers as the chief figures in public health.

In 1887, the Massachusetts State Board of Health founded the Lawrence Experiment Station that was transformative to the practice of sanitary engineering in the United States. The station brought together experts in engineering, chemistry, and biology to conduct basic research across disciplines related to water filtration and sewage treatment. The station biologist, William T. Sedgwick, also headed the Department of Biology at the Massachusetts Institute of Technology (MIT). He introduced a public health orientation to his department that drew heavily on the new field of bacteriology, but he knew that applying that knowledge required engineering skill. Engineers had always constructed sanitary systems, but they had taken their direction largely from their clients and built basic systems for water or sewage collection and transport. Sedgwick desired to train engineers in the sciences of biology and chemistry so that they might innovate solutions to the problems of treatment. In 1892, MIT started the first sanitary engineering program in the nation. The University of Illinois followed a year or two later, and in 1905 the University of California president, Benjamin Ide Wheeler, organized the nation's third department of sanitary engineering at Berkeley.

Wheeler hired Charles Gilman Hyde to head the newly created program, and Hyde—the recognized "Dean of Sanitary Engineering of the West"—exercised a profound influence on the development of the field in California. Hyde graduated in the first class of sanitary engineers to emerge from the MIT program in 1896. He worked as an assistant engineer with the Massachusetts State Board of Health for four years and then in Pennsylvania on major water supply projects for the cities of Philadelphia and Harrisburg. When Hyde moved to Berkeley in 1905, he was the first well-trained and experienced sanitary engineer to locate on the Pacific Coast. He remained at UC Berkeley through 1944 except for two years spent with the US Army Sanitary Corps during the First World War. He closely mentored two generations worth of students, and "Hyde's boys" went on to fill major positions in government, industry, research, and education.

Hyde served as Engineering Consultant to the California State Board of Health and advocated for the establishment of a State Bureau of Sanitary Engineering that was then headed by his student Chester Gillespie. He also worked as an industry consultant and designed wastewater and drinking water treatment plants in Sacramento, San Francisco, the East Bay, Los Angeles, San Diego, and beyond. His colleagues remembered him as "an engineer's engineer – a designer, a builder, and an innovator.

To teach the necessary chemistry courses, Hyde recruited Wilfred Langelier in 1916 from the Illinois Water Survey where Langelier had been involved in pioneering work in chlorine

disinfection. The two men comprised almost the entirety of the UC Berkeley sanitary engineering program through World War II and earned a reputation as one of the most effective engineer-chemist teams in the evolving field. Water chemistry was then a neglected subject among municipal engineers, limited to little more than water testing, and Langelier was able to make fundamental advances in the field. In an attic laboratory, Langelier developed methods to "jar test" coagulation procedures that allowed for careful control of variables and became standard scientific practice. His study of the corrosive potential of water is still recognized today through use of the Langelier Saturation Index. And in his work with Hyde in the early 1920s on designing the Sacramento water filtration plant, he developed a process for inducing flocculation (removal of colloidal particles from a suspension to form a sediment) through agitation with mechanical paddles that soon became standard in plants worldwide. In addition to teaching chemistry courses within the specialty, Langelier lectured architectural students on plumbing practices (including future modernist architect William Wurster with whom he later designed the San Leandro Filtration Plant) and taught a basic sanitation class to women students within the gender-segregated Domestic Science program.

Professional organizations emerged concurrently with the creation of the university programs. The American Society of Sanitary Engineers was founded in 1906, though it reflected an earlier understanding of the field in accepting plumbers and building contractors for membership. The American Public Health Association created a sanitary engineering section in 1911, and the US Public Health Service granted civil service classification status to the title "Sanitary Engineer." Finally, in 1922, the American Society of Civil Engineers (ASCE) organized a Sanitary Engineering Division with 526 initial members, offering full recognition of the standing of the field.

Biological Treatment of Sewage

The introduction of biological sewage treatment methods in the 1890s revolutionized sanitary practices, and today's secondary treatment methods all trace their origins to that turn of the century moment. Biological treatment methods were discovered more or less independently on four occasions, giving rise to different technologies. In the early 1890s, the Lawrence Experiment Station in Massachusetts performed the initial studies that led eventually to the trickling filter, while William Joseph Dibdin, chief chemist for the London Metropolitan Board of Works, developed the contact filter. In 1896, Donald Cameron, City Surveyor for Exeter, England, invented the septic tank. And finally, in 1912, a group of scientists and engineers associated with the University of Manchester and the Manchester Disposal Works introduced the activated sludge process, the most advanced of the biological treatment techniques. This section deals with the new knowledge that informed and arose from the experiments; for specifics on the various treatment methods.

Biological treatment methods employed microorganisms to digest (decompose) organic matter within sewage in an orderly and controlled fashion. This largely eliminated the pathogens that cause disease and rendered the effluent safe for discharge. These methods differed fundamentally from prior sewerage techniques that had simply evacuated waste as rapidly as possible from populated areas so as to avoid decomposition and the production of miasmic gases. The greater knowledge of microbiology that developed towards the end of the nineteenth century allowed for a better understanding of both the causes of disease and the biochemical processes of

decomposition. While the microorganisms necessary to digest organic wastes occurred naturally within sewage, researchers learned that their numbers and effectiveness could be greatly increased by providing them with a favorable environment. The biological treatment methods thus consisted principally of supplying the proper living conditions for the desired organisms (largely bacteria) by regulating the food supply, oxygen saturation, temperature, pH levels, and other variables.

Digestion occurred both in the presence of oxygen (aerobic) and in its absence (anaerobic). Anaerobic digestion liquefied organic solids, greatly reducing the volume of waste while producing methane gas as a byproduct. Aerobic digestion allowed for more complete decomposition as it could reduce large organic polymers such as cellulose to carbon dioxide and water, whereas anaerobic processes left behind more complex, partially digested substances. Complete digestion required both aerobic and anaerobic conditions, and sewage treatment plants thus commonly divided the digestion process into two or more parts with each devoted to a particular class of microbes. Biological treatment altered the character of the organic matter in sewage, but it did not necessarily remove the material, and in some circumstances the discharged treated water might contain more suspended matter than the raw influent, though the material had been rendered safe for disposal. Treatment plants thus commonly used additional clarifiers at the end of the treatment process to settle out the remaining material and produce a final, clear effluent.

A sewage farm provided a basic form of biological treatment, though it was not understood as such prior to the late nineteenth century. Sanitarians recognized that filtering sewage through soil cleansed it of some of its organic material. However, they could not agree as to whether this was simply a matter of the soil particles mechanically screening the sewage or if there was some "essence" of the soil that participated in the process. Work conducted at the Lawrence Experiment Station began to demonstrate that the process was essentially a biological one, driven by living microorganisms in the soil. If the soil within an experimental plot was sterilized, for example, it lost its capacity for cleansing organic matter from sewage, though there had been no alteration to its character as a mechanical filter

Near simultaneous work by William Didbin on the Thames River started to develop a practical understanding of the conditions required to nurture populations of beneficial microorganisms. According to historian Christopher Hamlin, Didbin began his experiments without any real understanding of the biology involved or with any conviction that bacteria could effectively deal with the immense stream of pollution flowing from London. Rather, he was under enormous political and legal pressure to show that the city was making efforts to address its problems, and his experiments bought him time without generating costs his employers would be unwilling to pay Didbin placed various filter media (sand, gravel, baked clay, coke) within sewage basins and intermittently filled and drained them, measuring the change in quantities of organic matter and bacteria. He came to recognize that an inverse relationship existed between the two: greater quantities of bacteria meant lower levels of organic matter. And he learned that he could influence the size of the bacterial populations by regulating the rate at which they were fed waste and controlling how often the tanks were reoxygenated by draining the liquid sewage. This led to the realization that the successful use of the contact beds relied entirely upon nurturing and sustaining beneficial bacteria. The bacteria did the real work and the sanitary engineer became a sort of zookeeper, tending to the wants and needs of his microorganisms.

While the work by Didbin and the Lawrence Experiment Station focused primarily on aerobic processes, Donald Cameron discovered the capacity for anaerobic digestion to consume the sludge that accumulated at the bottom of sedimentation tanks. Anaerobic bacteria developed within the tank over a period of a couple weeks to several months, and then worked continuously on digesting the organic matter of the sludge into gases of methane, carbon dioxide, and nitrogen as well as finely divided organic compounds. This greatly reduced the volume of sludge and thus the expense and difficulty involved in disposing of it. Cameron named his invention the "septic tank" to emphasize its reliance on bacteria and to contrast it with the deliberately antiseptic systems that proceeded it. To showcase his discovery, Cameron constructed an observation chamber in the City of Exeter tank so that visiting engineers could descend into the belly of the device and watch the digestion in action through a porthole. Large modern treatment plants use separate sludge digestion tanks, rather than septic tanks, for anaerobic digestion, but the fundamental process remains the same.

In contact or trickling filters, the biological treatment occurred in a narrow film that surrounded the filter particles. The bacteria and algae physically lived upon the bits of stone, plastic, or other media that filled the beds. The breakthrough of the activated sludge process was to realize that the microorganisms could live suspended within the sewage itself, feeding and reproducing rapidly in a highly oxygenated environment. Experiments with aerating sewage had been conducted since the 1870s but without great success. In 1912, Gilbert Fowler of the University of Manchester observed one such experiment at the Lawrence Experiment Station, and he persuaded Edward Ardern and W. T. Lockett, engineers with the Manchester Disposal Works, to add oxygenation to research they were doing on using retained sludge to treat fresh influent.

When sludge from a prior treatment was retained, decanted of its liquid, and returned to a tank of fresh sewage, it arrived preloaded ("activated") with a high concentration of aerobic bacteria that seeded the treatment tank. Blowers or paddles supplied the bacteria with copious oxygen to enhance its metabolism and thoroughly mix it through the sewage. The bacteria attached themselves to bits of suspended matter and served as a flocculant, causing the organic matter to clump together and fall out of suspension. After the sludge was separated in a sedimentation tank, the remaining effluent was clear, odorless, and safe for discharge. A portion of the separated sludge was then returned to the aeration tank, beginning the process anew. A landmark 1914 publication announced the discovery of the activated sludge process and attracted immediate attention. The outbreak of World War I shortly thereafter suspended additional research within Europe and allowed American engineers to take the lead in further developing the process.

The refinement of the biological treatment process, from simple sewage farming to sophisticated activated sludge plants, allowed for ever smaller plants to treat ever greater volumes of sewage. The need to conserve real estate was an overriding concern that justified the higher energy inputs and greater technical skill required to operate the more complex processes. Sewage farming had the advantage of simplicity, but it required access to more land than any decent-sized community could reasonably provide. Turn-of-the-century Berlin, for instance, operated the most efficient sewage farms in all of Europe, but at 23,000 acres, the sewage farms were larger than the city itself.

The adoption of biological treatment methods marked a shift towards a more scientific approach to wastewater management as it required a greater degree of process control and an ever-evolving understanding of microbiology. It spurred the introduction of new technologies in the form of pumps, aeration equipment, and tools for laboratory testing. On the downside, biological treatment methods were vulnerable to greater disruption. Bacteria are living organisms that behave in sometimes unpredictable manners. A cold snap or the inadvertent introduction of a toxic chemical could cause a collapse of bacterial populations. Recovery from such a disaster was slow as the colony needed to rebuild itself organically. Particularly in the early years, when biological knowledge remained limited, many communities were reluctant to embark upon such a potentially perilous course and loose regulations did not require them to make the risky investment. The practical adoption of biological treatment methods thus lagged behind the rapid pace of scientific advancement.

Political Organization

Federal Drinking Water Oversight

The federal government established the first national water quality standards in 1914 when the US Public Health Service (USPHS) set requirements for the water used on common carriers in interstate travel, including ships and trains crossing state lines. The standards initially applied only to bacteriological agents associated with contagious diseases, but they were later revised and expanded in 1925, 1946, and 1962 to cover broader criteria. Every state eventually adopted the standards with minor modifications. By the 1930s, USPHS was certifying nearly a hundred California water supply systems per year to allow for their use in interstate transportation. Even local inspections adhered to the federal standards, so that for decades all water analyses performed in California included a statement about the sample's conformity with USPHS standards for drinking water.

State Oversight

The State of California also increased its oversight of sanitary matters during the first decades of the twentieth century and granted the State Board of Public Health its first formal permitting powers over water and sewage systems. The board had passed through a period of reduced activity at the end of the nineteenth century as it turned largely to managing the state hospital system. The 1906 San Francisco earthquake revived state interest in sanitary issues as a wave of epidemics afflicted the displaced population. The Public Health Act of 1907 required communities to receive a permit from the State Board of Health for new sewage system construction. The Sanitary Water Systems Act of 1913 extended the permit system to water systems having 200 or more connections or supplying a hotel or labor camp. However, the permitting was done on a case-by-case basis rather than establishing general standards that all dischargers had to meet, and it depended on whatever review the underfunded and understaffed board could provide. Permits also applied only to new construction so that systems that predated the 1907 law were not subject to state review.

The state elections of 1910 and 1911 launched California to the forefront of progressive reform. Hiram Johnson was elected governor in 1910 on a promise to end corporate and municipal corruption, and in 1911 the voters approved a sweeping array of progressive voting reforms including women's suffrage, ballot initiatives, referendum, and recall. Collectively these measures displayed an eagerness to have the state tackle issues that previously had been accepted as

intractable. Additional funding and staffing allowed the State Board of Health to expand its reach, and it created six new bureaus or divisions between 1911 and 1920, including the Bureau of Sanitary Engineering. A reorganization of the state government in 1927 to reflect its expanded scope promoted the board to become the Department of Public Health.

The staff of the state board began performing regular sanitary inspections of towns and private establishments in 1913. The inspections aimed at nuisance abatement without making pretext to proposing systematic improvements to water or sewage systems. A typical inspection from 1914 examined conditions at the Gregory Hotel outside of Fresno:

> Said premises consist of a large frame building used as a hotel. The toilet facilities were complained of. They consist of one modern water flushed toilet, located in the building for the women, which discharges into a dilapidated cesspool in the barn yard about three hundred feet from the hotel, also a dilapidated privy in the yard about twenty feet from the building, close to the county road, which is open to flies, etc. and it is in filthy condition, and one urinal inside of the building which discharges into the vault of the privy. The refuse water from the sinks, bathtubs, etc. is being disposed of by means of open wooden drains, which discharge in the yard.

The state inspectors had authority to examine public accommodations and to make recommendations (in the case of the Gregory Hotel to demolish the privy, construct a sealed cesspool, and add a flush toilet for men) but lacked any enforcement powers. Only local authorities could compel the proprietor to comply with the recommendations.

The Progressive Era also saw the state centralize control over utility regulations. The Public Utilities Act of 1911 extended the authority of the California Railroad Commission to cover all private utility and transportation companies. In 1946, the agency was renamed the California Public Utilities Commission to better reflect its expanded scope of authority. Commission approval was required for rate increases, service area expansions, mergers, and changes to service. This effectively replaced the municipal franchise system and reduced the chances for local corruption or favoritism to interfere with the rational development of services. Private water companies generally favored the transition as they expected better, more scientific management from state officials. They also hoped that increased regulation would temper demands for public ownership of water systems. Because state regulation did not extend to municipal systems, the new order conversely provided an incentive for local governments to reassert their
authority by taking ownership of utilities.

Municipal Reforms

The multiple impulses of reform that pulsed through Progressive Era California transformed the character of municipal government and its relationship to the delivery of sanitary services. No single, overall plan guided the reform movements and different causes regularly acted at cross purposes to one another. Efforts to strengthen municipal governments, for example, clashed with competing impulses to centralize power in state bureaus. And every water dispute in California came deeply enmeshed in local rivalries with their own idiosyncratic histories that defy easy generalization. More than 700 municipal water and sewage systems operated in California by 1936, along with approximately one hundred smaller institutional systems. Each system had its own distinct set of local circumstances and trajectory of development. Nonetheless, several broad

patterns of change can be identified through the early twentieth century that led to greater public ownership of water supplies, the increased professionalization of municipal utility services, and the creation of special districts to serve multiple communities.

Nineteenth-century Californians largely welcomed private water companies, viewing them as an efficient means of developing resources without high taxation. However, that support gave way to distrust and dissatisfaction in the early twentieth century. The politics of Progressive Era California were largely shaped by opposition to the monopoly powers of the Southern Pacific Railroad and the heavy-handed ways in which it intervened in state and local politics. Anti-monopoly politics then broadened to include resistance to a wide array of corporate interests that were seen as conspiring against the public good. Private water companies found themselves on the defensive as they sought to prevent their systems being forced into competition with public utilities. For decades, the companies were largely successful in that fight as they held monopoly control of local water rights, but they faced rising discontent among consumers as their aging systems struggled to provide water in adequate quantity and quality at a reasonable price.

In the early twentieth century, the largest cities in California all outgrew the local creeks and wells that had fed their water systems. This required them to reach further afield for water sources and opened the possibility for creating new, publicly owned water systems. Los Angeles seized control of the Owens River and later tapped the Colorado River; San Francisco developed the Tuolumne River behind the Hetch Hetchy Dam; and the East Bay communities of Oakland, Berkeley, and Richmond turned to the Mokelumne River in the Sierra Nevada foothills. Each of these far-reaching systems originated through public ownership, financed with municipal bonds. The private water companies that served these cities recognized that a transition had occurred and they generally sold their remaining systems to the public. Many smaller cities followed the example in acquiring private water systems, though not every campaign for public ownership was successful as many voters continued to view local government as more inclined to corruption and ineptitude than was private enterprise.

Ironically, providing better service—making abundant pure water conveniently and cheaply available—led to a surge in demand that frequently exceeded planning expectations for the new municipal water systems. This inevitably produced disappointment among citizens and fueled accusations of political incompetency. To protect vital services from the corrupting influences of patronage politics, many communities transferred control of their systems from politicians to engineers. Progressive reforms had introduced the city manager form of government to California and increasingly a nonpartisan, technocratic class of sanitary workers had responsibility for managing municipal systems and advocating for their improvement.

The expanded reach of water and sewer systems beyond traditional city boundaries led to the creation of regional utility districts. The East Bay Municipal Utility District (EBMUD), organized by Oakland, Berkeley, and Richmond in 1923, and the Metropolitan Water District of Southern California, established in 1928, typified the new organizational model. This trend reflected a national movement towards the creation of special districts in the decades between 1880 and 1930 to provide a wide variety of services from fire protection and flood control to port management and mosquito abatement. Districts enjoyed substantial administrative and financial independence from county or municipal governments in pursuit of a narrowly defined set of functions, and

seemed to offer the best hope for professional, science-based management. Because state law limited cities to bonded debt equal to 15 percent of a community's assessed valuation, independently funded districts appealed to small, fast-growing towns that had many competing needs to meet. Regional districts could also better match services to the natural boundaries that governed the distribution of water and disposal of sewage, rather than requiring a wasteful duplication of services within artificial political boundaries.

Bureau of Sanitary Engineering

The State Board of Health established the Bureau of Sanitary Engineering in 1915 following the advocacy of Charles Hyde. Chester Gillespie, one of "Hyde's Boys" from the class of 1907, headed the bureau and he remained as chief until 1947. The early bureau had a two-year budget of $30,000 and consisted of Gillespie, two sanitary engineers, and a couple of stenographers. The group operated out of the UC Berkeley civil engineering building in an office adjacent to Hyde's and they shared the attic laboratory space with Langelier. The bureau remained on the UC Berkeley campus until 1942 when it moved two blocks west to Shattuck Square. Bureau staff were responsible for reviewing the water and sewage plants plans submitted by cities, conducting field inspections, and making recommendations on permits to the State Board of Health. They also had responsibilities for inspecting shellfish production, mosquito control, and other assorted issues.

The bureau contributed to professionalizing municipal utility operations. Gillespie recognized early on that operating personnel were not advancing in their knowledge as rapidly as was the complexity of sewage science and technology. The turnover rate among sanitary engineers was a problem as those drawn to the field soon mastered the issues and left to find few more meaningful challenges and job prospects. In 1928, Gillespie took the lead in organizing the California Sewage Works Association to encourage the sharing of information among municipal sewage workers and managers. The association began publishing the California Sewage Works Journal. Nationally, the Federation of Sewage Works Association formed in the same year and published Sewage Works Journal.

Typhoid Fever

The Bureau of Sanitary Engineering's strong focus through its first five years was combatting typhoid fever. Chlorinating the public water supply was the chief tool for reducing typhoid fever and was highly effective. Secondarily, bureau staff inspected sewage systems to locate and correct potential sources of cross contamination between sewage and water services. This was the case, for example, during a 1924 outbreak in Santa Ana that was among the worst of the twentieth century in California. An undersized sewer line habitually overflowed on Mondays, the local washday, and the runoff made its way into an open drinking water reservoir, carrying raw sewage with it. Expanding and relocating the line solved the problem. Other practices for reducing outbreaks included pasteurizing milk, improving general sanitation habits, and identifying carriers of typhoid fever through medical examination.

Typhoid fever death rates dropped dramatically with the effort. In 1906, the death rate was calculated at 34.9 per 100,000 population, a number that was somewhat elevated by the aftermath of the San Francisco earthquake. The following year the rate was a more typical 27.9. By 1920, the rate had fallen to 4.9 and it continued a downward trajectory to 1.7 in 1930 and finally below

0.9 in 1937. Within years of starting the campaign, the efforts were saving in excess of a thousand Californian lives annually and municipal water systems had been rendered almost entirely safe.

Still, smaller outbreaks of typhoid fever continued to occur nearly every year in a few specific locations, particularly among the farm labor camps of the Sacramento-San Joaquin Delta and Imperial County. The camps, both temporary and semi-permanent, tended to be located along levees, and irrigation ditches served as both sewers and drinking water sources. The droughts of the 1930s compounded the problem as the Sacramento River fell so low that sewage did not wash out to sea but sloshed back and forth with the tides through an 8–12 mile stretch below the city of Sacramento. The Bureau of Sanitary Engineering installed emergency chlorination units at sites with identified problems, but too many labor camps were remotely located and all but unknown to authorities.

The bureau was inclined to blame the sanitary habits of the farm laborers for these outbreaks, writing in 1938 that "it is not always easy to obtain the cooperation of the some of the foreign-born races in the observance of preventative measures." However, as legal scholar Camille Pannu has demonstrated, many rural communities made deliberate decisions to exclude labor camps from municipal water and sewer systems in order to keep laborers dependent upon farm owners for essential services and to discourage permanent settlement by Dust Bowl migrants or ethnic minority groups. As late as 1971, the Tulare County General Plan continued to argue for underinvestment as a strategy of population removal:

> Public commitments to communities with little or no authentic future should be carefully examined before final action is initiated. These non-viable communities would, as a consequence of withholding major public facilities such as sewer and water systems, enter a process of long term, natural decline as residents depart for improved opportunities in nearby communities.

In 1938, the bureau noted with pride that 94 percent of the population within incorporated cities or service district boundaries had sewage systems. That figure, however, excluded precisely the sort of unincorporated communities on the margins of agricultural towns that were intentionally left beyond the reach of municipal services. Because of de jure and de facto segregation, those communities were largely populated by ethnic minorities. The Central Valley today still has more than 450 unincorporated communities, many of which are a legacy of pre-World War II settlement patterns, and these areas remain among the least well provided with essential sanitary services.

Environmental Pollution

In contrast to the successful campaign against typhoid fever, California's Bureau of Sanitary Engineering had decidedly more limited success in combatting the environmental pollution of streams, rivers, lakes, and bays. This effort took the bureau beyond the immediate issue of public health and was met with resistance from the cities that were being urged to clean up their sewage discharges. Tax funds spent on sewage treatment provided little immediate return to the community making the investment, but instead benefitted downstream areas. Most municipalities thought that the solution to river pollution was for every town to treat their drinking water while cleaning up only the most noxious sources of nuisance dumping. This attitude changed only when economically valuable tourism or industry were directly impacted.

When Gillespie assumed his position as bureau chief in 1915, he found conditions along many of the state's rivers to be deplorable. The Merced River, he wrote, was "receiving sewage in the heart of Yosemite"; Tuolumne River "was a source of endless complaint"; Truckee River "was useless even for fishing"; the upper Sacramento River "was notorious for the piles of sewage along its edge"; Sonoma Creek "was a source of stench through a famous vacation belt"; and Napa River reeked of "offensive odors [that] prevented picnicking on its banks."

Many of the state's famous beaches needed to be closed regularly for quarantines. In Northern California, communities dumped untreated sewage into the shallow water of bays and harbors. Conditions in Southern California were somewhat better as outflows were commonly into deep ocean water where currents could disperse the waste. Most southland cities also provided at least preliminary sewage treatment with sedimentation or screening. San Diego, Long Beach, and the San Pedro Harbor were exceptions, as they continued to use short outfalls into the late 1930s. And even where deep water outfalls existed, regular breaks in the lines meant that sewage periodically washed up onto beaches.

The sanitary bureau had its greatest success in halting environmental pollution where it originated in relatively small institutions, most of which were state or federally operated. Folsom Prison, Sonoma State Home, Patton State Hospital, Yosemite National Park, Weimer Sanitarium, and UC Davis all installed trickling filters or activated sludge plants in the 1910s or 1920s that provided a high level of sewage treatment. Success was also possible in areas valued for their recreational potential. The bureau cooperated closely with the National Forest Service to clean up formerly squalid campgrounds and received support from Lake Tahoe resorts to end the practice of running sewers directly into the lake. Elsewhere, the bureau had to accept partial improvements. Towns such as Gilroy, Watsonville, and Yuba City replaced river dumping with sewage farms, but still provided limited treatment. Ukiah, St. Helena, Winters, and Paso Robles used land disposal during the summer months of low river flow, but continued to dump minimally processed effluent into rivers during the winter. And large areas through the Mother Lode and the California Delta dumped raw sewage into rivers year-round along with large quantities of unprocessed industrial waste from wineries, dairies, and fruit canneries.

Regional Variation

Distinct regional variation in the sophistication of water and sewage systems emerged in the early twentieth century. These systems developed through path-dependent processes so that decisions made in the mid-nineteenth century had an outsized influence on subsequent events well into the middle of the twentieth century. A divide thus opened between the older population centers of Northern California and the newer cities of Southern California that grew out of the oil, citrus, and real estate booms of the early twentieth century. Neither region was monolithic and in both halves of the state the fastest growing communities were most likely to embrace new technologies while outlying areas continued to accept older solutions as adequate. Nonetheless, real differences existed between the cutting-edge practices common in Los Angeles and the creeping progress that was made around the San Francisco Bay.

The location of sewage disposal—whether into freshwater, saltwater, or on land—was important in influencing how rapidly a community advanced its level of sewage treatment and drinking water

chlorination. Few new systems for disposing of raw sewage into freshwater streams were constructed after 1920, and many existing freshwater systems began treating their sewage. Land disposal at sewage farms remained common through the 1920s, though increasing regulation meant that most added partial or advanced treatment methods. The chlorination of drinking water supplies advanced most rapidly in communities that drew their water from wells within groundwater basins that included sewage farms. Treatment advances were slowest in areas that discharged their waste to seawater. Two-thirds of the new disposal projects involving raw sewage through 1930 discharged into bays or sloughs, mostly in Northern California. No advanced treatment of sewage was applied at any seawater location, though partial treatment became the norm along Southern California's recreational beaches.

Physical and economic realities underlay the different trajectories of the regions, but Gillespie and others also saw issues of human psychology playing a major role. In older areas, people had grown accustomed to disposing of raw sewage and it was difficult to persuade them to abandon familiar practices. Older communities through the Mother Lode and the San Joaquin Valley, Gillespie wrote, proved "to be the most refractory cases with which the sanitarian has to deal." Conversely, new cities took it for granted that they would need to treat their sewage before disposing of it, and "once a community puts in sewage treatment, no matter how meager, it has been a psychological truth that the people there are ready for further sewage treatment when plausible reasons appear. "Naturally, the areas most open to change attracted the engineers and managers who were prepared to deliver it.

Southern California

The national idealization of California shifted around the turn of the century so that images of Los Angeles's pristine beaches and suburban orange groves replaced the earlier gold fields and timber empires of the north state. Fitting its reputation as a land of health, Southern California assumed a position of national leadership in innovating practices of drinking water treatment and sewage disposal.

Los Angeles led the state in providing chlorination treatment for drinking water supplies. The region's success was built upon a robust network of public health laboratories that continually monitored water supplies and fine-tuned chlorination levels. The Los Angeles County Health Department alone maintained 11 full-time public health laboratories from the San Fernando Valley to Pomona. There were additionally three city health departments with their own laboratories in Los Angeles, Pasadena, and Long Beach. This contrasted with a single laboratory serving the City and County of San Francisco and four laboratories in the East Bay.

The state's southern region also innovated methods for improving the palatability of drinking water. In part, this was driven by necessity as Southern California could not draw upon pure mountain river water with the same ease as the north state. Large parts of the Los Angeles Basin relied upon well water as their primary supply, and as groundwater levels sank the remaining waters carried high concentrations of minerals that imparted undesirable tastes and appearances. Colorado River water imported into the basin after 1939 also required extensive treatment for its hardness and turbidity. Private water companies experimented with sand and carbon filters to improve the palatability of the supply, and in 1941 the Metropolitan Water District constructed the

world's largest water softening plant in La Verne, with an ultimate capacity of 400 million gallons a day.

In sewage treatment, the southland was particularly active in creating joint sewerage projects that channeled the waste of multiple communities to a central treatment facility. By 1936, nine treatment plants handled the sewage of 43 separate communities. So, while Southern California had built only about one-third of all the high-grade treatment plants in the state, those served one-half of all the communities in the state receiving the top level of sewage processing. Exemplary of this trend was the City of Los Angeles's Hyperion plant near Santa Monica that treated the combined waste from seven cities and several unincorporated communities. The Los Angeles County Sanitation Districts, organized 1923-1925, handled waste from 32 other incorporated cities located through the county, treating most of the sewage at an activated sludge plant near the Palos Verdes Peninsula.

These joint plants had the financial resources to experiment with innovative technologies. The Tri-City plant serving Pasadena, South Pasadena, and Alhambra enjoyed a national reputation as a proving ground for new sewage treatment practices, and the facility constructed an activated sludge pilot plant in 1917, the first in the state. The Los Angeles City Hyperion plant was the first in the state to employ fine sewage screens and its 12-foot-diameter drums were then the largest in the nation.

The cities of Southern California also paid unusual attention to the beautification of their water and sewage treatment plants. The Pasadena Tri-City plant was among the first sewage treatment facilities in the nation to landscape its grounds with lawns and ornamental trees. The City of Beverly Hills water filtration and softening plant, constructed in the mid-1920s, was a particularly ornate example Nicknamed the "Public Water Cathedral," the building resembled a Spanish-Romanesque church and had a soaring Moorish-style bell tower that disguised a chimney used for burning off sulfur above roof level of the surrounding neighborhood. Landscape architect Seymour Thomas designed the grounds in a hacienda layout to serve as a public park for visitors. No longer in use for water treatment, the building now houses a library and film archives for the Academy of Motion Picture Arts and Sciences.

The rapid progress made in drinking water and sewage treatment through Southern California resulted not from a genial consensus about the need for high standards, but from intense conflict between neighboring communities. Pasadena in the nineteenth century operated what was widely regarded as a model sewage farm, but the conversion of surrounding citrus groves into suburban tracts led to increasing odor complaints. The city added a septic tank in 1910 to treat the sewage prior to irrigation, and an Imhoff tank (a two-story septic tank with separate chamber, discussed further below) was completed in 1913. Among sanitary engineers, these improvements were believed to satisfactorily address the problem, but the neighbors were not appeased. In 1916, the areas surrounding the sewage farm incorporated as the City of Monterey Park and promptly passed an ordinance prohibiting sewage treatment facilities within city limits. It was this action that forced the Tri-City partners into developing the activated sludge treatment plant. Later, a plan to dump the dried sludge in Alhambra led 6,000 residents to sign a protest to the Los Angeles County Board of Supervisors and necessitated the addition of a kiln drier that converted the sludge to marketable fertilizer.

Similar conflicts occurred through the southland in the first decades of the twentieth century. When Anaheim began searching for territory for a sewage farm in 1911, the Speaker of the California State Assembly and local resident, Philip Stanton, led an effort to block the project by incorporating 16 square miles of rural land as the community of Stanton. Succeeding in their efforts, the community later disincorporated in 1924 in order to receive state funding for road improvements. West Covina, with a population of less than 1,000, incorporated in 1923 to block Covina from building a sewage project. West Covina later annexed additional territory to frustrate a second proposed plant. The organization of the Los Angeles County Sanitation Districts was in part a response to opposition against local sewage disposal in Compton, Watts, and Huntington Park. Similar experiences in Glendale, Burbank, and among the beach communities from Santa Monica to Hermosa drove the planning of the Los Angeles City Hyperion plant.

As Gillespie wrote in 1936, "Just why this Los Angeles area should be so universally sewered and at the same time be so violently opposed to sewage disposal forms an interesting subject on which to muse." He credited the suburban boom that attracted great numbers of Midwestern migrants who came seeking a better and more modern way of life than what they had left behind. Escalating land values made every corner of the coastal plains a potential subdivision gold mine if the proper utility and transportation connections could be managed. And each subdivision required a sewer system, and yet no developer could tolerate a disposal plant next door. The result was a pattern of growth that consolidated sewage treatment into fewer and fewer plants, while demanding a continually higher level of odor control and facility beautification.

The great sensitivity to sewage and the escalating levels of treatment was a phenomenon largely confined to the major metropolitan areas. In more outlying areas, people adjusted themselves to the realities of sewage disposal and lived at peace with conditions that elicited bitter conflict among suburbanites. There, Gillespie concluded, "the pattern of sewage disposal will probably continue along its present course with sewer farming the rule, accompanied by high grade plants in critical neighborhoods, and cheaper plants elsewhere.

San Francisco Bay Area

The progress made in Southern California was not matched by the communities around the San Francisco Bay. Cities there largely remained tied to antiquated combined sewage systems without treatment plants. On the eve of World War II, some one million people continued to dump raw sewage through short outfalls into the Bay's harbors, sloughs, and mudflats. That accounted for 80 percent of all the raw sewage disposed of by California's urban population. An estimated 205 municipal sewer outlets discharged into the Bay, while oil refineries, industrial manufacturers, and innumerable fruit canneries used it indiscriminately as a dumping ground. Surveys of the Bay shores found them littered with vegetable scraps, chemical slicks, and floating fecal matter. A putrescent sludge covered the mudflats, and on warm days the smell of sewage carried several miles inland.

Still, there were few immediate health problems associated with the sewage and local concerns focused predominately on the economic impacts. The Bay Area drinking water supply was entirely separated from the saltwater sewage disposal, with much of the water being piped in from the Sierra Nevada mountains, and the cold waters of the San Francisco Bay did not attract bathers as

did the beaches of Southern California. The pollution was instead seen as an impediment to industrial development. Hydrogen sulfide that arose from the anerobic digestion of waste caused corrosive damage to ships, buildings, and harbor structures. The oxygen-deprived waters starved nearshore habitats of life, and sewage threatened to contaminate shellfish, making them a potential source of cholera, hepatitis, and other infectious diseases. Trade organizations and local boosters also worried that the foulness of the Bay made the region appear backwards in comparison with their rivals in Southern California.

San Francisco was the largest offender in sewage production, but the city also did the most to address the problem. The first, relatively small, advanced treatment plant was constructed in Golden Gate Park in 1932 using New Deal relief funding Raw sewage had previously been used in the early twentieth century to irrigate the western portion of the park. After odor complaints, a septic tank was installed in 1912 and the treated effluent filled the ornamental lakes of the park. A lawsuit forced the abandonment of that practice in 1931, leading to the construction of the activated sludge plant the following year. The plant operated only during the irrigation season, running from mid-February to November, and produced around 500,000 gallons of treated effluent daily as well as dried sludge for fertilizer. Fitting its location in Golden Gate Park, the facility was beautified with flowerpots and landscaping. The plant (decommissioned in 1982) has been recognized as the first recycled water facility in California.

In 1933, the citizens of San Francisco voted approval for issuing $2.6 million in Public Works Administration (PWA) bonds to improve the sewer network and construct limited sewage treatment plants. When C. E. Grunsky undertook a study of sewage conditions in 1899, he found 125 separate sewer outlets and his plan called for consolidating those into six main outlets. In the intervening years, the expenditure of $17.5 million allowed for the total number of outlets to be reduced to 31, with 19 discharging to the Bay, 11 to the Golden Gate Strait, and one to the Pacific Ocean. With the WPA funds, the city hired a board of consulting engineers that included Charles Hyde of UC Berkeley to prepare a plan for improvement. The board recommended construction of three treatment plants, but had funding adequate to complete only the Richmond-Sunset facility. The 15 million-gallons-a day (mgd) plant was completed in 1939 and provided only basic treatment with an Imhoff tank and sludge digester. Chlorination of raw sewage was used ahead of the tank for odor control year-round, and the final effluent was chlorinated for bacterial disinfection when the beaches were in use. The bulk of the city's sewage, however, remained untreated.

The East Bay communities appreciated the need for sewage improvements, but could not find a way to coordinate their efforts prior to World War II. EBMUD was the obvious agency to manage a joint venture, but the district directors believed they lacked the authority to create special subdivisions for sewage disposal. Only after the state legislature amended its authorizing act in 1941 did the district feel enabled to engage in sewage planning, but then the outbreak of war delayed any further efforts. Nine individual East Bay cities made attempts to apply for WPA funding, but the inability of the applicants to reach agreement on essential issues prevented any of them from receiving funding.

Along the San Mateo Peninsula, Burlingame, Redwood City, and Palo Alto installed limited treatment plants, largely funded with WPA grants, to remove suspended solids from the sewage

before discharging effluent onto mud flats or sloughs. Marin County did the same north of the Golden Gate. These plants, combined with those in San Francisco, provided basic treatment for the sewage of some 230,000 people, less than 20 percent of the region's population. This fell far short of what the Bureau of Sanitary Engineers regarded as minimal conditions, which should include sedimentation, with or without chemicals, and sufficiently long outfalls to reach ocean currents. Grease removal would be required to prevents slicks, and to minimize land use, sludge should be disposed of by digestion and compact mechanical filters.

In reviewing the minimal progress made in the San Francisco Bay Area, Gillespie was sympathetic to challenges faced by the communities. The legacy sewer lines were expensive to operate and maintain. Merely mapping the lines was a challenge and attempting to link them required extensive construction in heavily built-up areas. Treatment plants necessarily needed to be located along the shores, as that was where gravity carried the waste. This meant acquiring expensive real estate and competing with industry for the land. The historic reliance on combined sewer lines also made it impractical to fully treat the flow during winter months and required that some overflow be tolerated. Gillespie was willing to accept lower standards of treatment for Bay pollution over freshwater streams, both because of the lower health hazard posed and because the heavy ship traffic made a certain level of pollution inevitable.

Still, Gillespie saw a dark cloud on the horizon in 1940 in the lack of preparation for dealing with industrial expansion. Already, studies in the East Bay indicated that the organic waste from industry, primarily canneries, was twice as great as that from human sewage. The refineries and heavy manufactures introduced chemical waste that was little understood in terms of effects or potential treatments. And of course, World War II would vastly increase the scale of industry in the San Francisco Bay Area and throughout the state.

Technology

Sewage and water treatment technologies advanced rapidly at the start of the twentieth century, giving rise to most of the processes that are still in use today. Chlorination was introduced for drinking water treatment in 1908 and rapid sand filtration entered common use in the 1920s. The era saw the beginning of the biological treatment of sewage with the introduction of trickling filters around the turn of the century and the activated sludge process in 1914. The biological treatment of sewage marked a shift to a more scientific process as they required a greater degree of control and an understanding of microbiology. It required new technologies in the form of pumps, aeration equipment, and tools for laboratory testing. Still, the technology was adopted only gradually, hindered by the slower rate of regulatory change, and as late as 1929 fewer than 20 percent of all sewage treatment plants used the activated sludge process.

Water Works

Most of the fundamental processes of modern drinking water treatment emerged during a brief period at the beginning of the twentieth century. The years between 1909 and 1916 saw the adoption of three major advances: the application of chlorine for disinfection; the use of rapid sand filters for treating turbidity; and the employment of the zeolite or ion exchange process for reducing water hardness. These techniques allowed municipalities to effectively treat drinking water for the first time, rather than just seeking out ever-more-remote sources of uncontaminated supply. By 1936, nearly 150 Californian communities provided at least some form of water

treatment, predominately chlorine disinfection, and 36 cities had constructed full-scale filtration plants that treated surface waters for public use.

The common methods of water treatment consisted of disinfection, coagulation, sedimentation, filtration, aeration, and softening. The type and level of water treatment provided depended ultimately upon the source of supply. Coagulation, sedimentation, and filtration worked together to reduce turbidity and were used in treating surface waters at large filtration plants. Groundwater extracted by wells, the most common municipal water source, required comparatively little treatment beyond disinfection and thus needed little infrastructure. A chlorinator could fit into a small room at a pumphouse or be located at a centralized collection and distribution facility. If the water had a high mineral content, it might benefit from additional softening and aeration to improve palatability and remove minerals that could interfere with industrial processes. Surface water treatment required a larger investment in infrastructure than did groundwater because of the issues with turbidity, but it generally benefited from greater gravity flow
and thus had lower on-going energy demand and pumping costs.

Water distribution systems, in contrast to water treatment, changed only modestly from the nineteenth into the twentieth century. The physical infrastructure benefited from incremental improvements in materials and energy sources. Pipes of galvanized steel, reinforced concrete, asbestos cement (transite), and ductile iron gradually replaced cast iron pipes, leading to greater durability and lower costs. Thermoplastic pipes, including those of Polyvinyl Chloride (PVC) and later High-Density Polyethylene (HDPE), began being manufactured in the 1930s and entered water system usage from the 1950s onward. The plastic pipes were light weight, corrosion resistant, versatile, and inexpensive and soon found many applications in drinking water and wastewater systems. Electricity replaced steam and oil in operating most pumps, allowing for smaller engines and plant footprints. Of greater direct consequence, engineers improved distribution networks to remove potential sources of contamination. Many of these occurred in factories or institutions that made primary use of a public municipal water supply but maintained a private auxiliary supply of untreated water for backup purposes. If a connection between the two systems lacked an air gap it was possible for untreated, contaminated water to find its way into the public supply. The Bureau of Sanitary Engineering identified and removed more than 1,000 such cross-connections through the first half of the twentieth century. This painstaking and labor-intensive service received little public recognition, though it was essential to ensuring safe municipal water supplies and guaranteeing public health.

Chlorination

The permanent, continual chlorination of American drinking water supplies beginning in 1908 was one of the great public health achievements of the twentieth century. Chlorine is a strong oxidizing agent that, when applied in the correct dosage, can quickly kill the microorganisms that cause cholera, dysentery, typhoid fever, and other illnesses, without causing adverse effects in humans. The introduction of chlorination promptly saved tens of thousands of lives that waterborne illnesses would otherwise have claimed. Chlorination also improved the efficiency and palatability of water systems by reducing the mold, algae, and slime that grew in water intakes and distribution systems.

The first experiments in using chlorine compounds to disinfect water occurred in the late nineteenth century. British and German sanitarians in the 1890s used bleaching powder to sterilize watermains and other equipment following outbreaks of typhoid fever and cholera. These short-term efforts succeeded in preventing reoccurrences of the epidemics, but they did not attempt to provide continual disinfection of the water supply. In 1905, officials again used chlorine to halt a typhoid epidemic in Lincoln, England, but then as a precautionary measure they continued a slow feed of chloride solution for a period of years until a new water source became available. This marked the first continual disinfection of a public water system and prompted further experimentation in Europe and America.

The earliest American efforts at continual disinfection occurred in 1908. Wilfred Langelier of the Illinois Water Survey and later professor of chemistry at UC Berkeley participated in the first experiment at the Union Stock Yards of Chicago. The engineers selected the site as only animals would be affected, and the heavily contaminated water supply made an ideal test case. The introduction of a minute quantity of chlorine continually fed into the supply line almost completely sterilized the stockyard water, leaving it in better condition than Chicago's municipal supply. Shortly after, the same engineers applied the technique to the drinking water of Jersey City, with chlorination beginning on September 26, 1908. The city received many complaints about the odor and taste of chlorine, which could not yet be administered with precise control, but the results were so promising that the objections were overruled. In the years immediately following the experiments, sanitary officials constructed many emergency chlorination plants in areas affected by flooding or disease outbreaks.

The introduction of improved chlorine gas feeders around 1913 allowed the process to spread into wide municipal use. Compressing chlorine gas under pressure converted it into a liquid that could be stored and transported in tightly sealed metal containers. A British officer in the Indian Medical Service was the first to use liquified chlorine gas on a small scale in 1903. The US Army experimented with the technology in the Philippines in the early 1910s, and a Niagara Falls plant began using liquid chlorine for temporary treatment in 1912. Philadelphia installed the first permanent liquid chlorine plant in 1913. The Wallace & Tiernan Company of New Jersey designed nearly all the early chlorinators that allowed for the controlled application of dosages, and according to Langelier, many of the first graduates of the UC Berkeley sanitary engineering program found employment with the firm.

All large treatment plants used liquefied chlorine gas as it was the most economical option. However, as the gas is highly toxic, it could be difficult to safely store and an accidental release would endanger employees and nearby communities. Smaller plants therefore sometimes used chlorine in a powdered bleach form. In either case, the chemical was administered through chlorinators of various and evolving designs that connected to the water main with non-corrosive tubing. The chlorine and water mixed within a baffled chlorine contact basin for a specified period of time to produce effective disinfection. Duplicate equipment allowed chlorination to continue in the event of a failure of the primary apparatuses. The chlorine and dosing equipment occupied a dedicated room so that any leaks could be isolated. This room commonly had a separate entrance from the building exterior and no direct connection between it and any other room in the treatment plant or pumping house. Good ventilation facilitated repairs in case of a minor leak. Because liquified chlorine was commonly delivered in large steel cylinders weighing up to a ton,

chlorination rooms generally included loading docks built to truck bed height for easy on and off loading.

Sedimentation

Sedimentation is an ancient technology used to clarify muddy waters. Most surface waters carry quantities of clay, silt, and sand that are too fine to catch on a screen. Allowing the water to stand in or pass slowly through a settlement basin causes much of the suspended matter to settle to the bottom of the reservoir. This process of plain sedimentation could greatly improve water clarity, and in some cases was sufficient in and of itself to prepare the water for public consumption. However, the finest particles of clay and silt did not settle readily and could remain in suspension even after months of storage. It was therefore more common to use sedimentation as a preliminary treatment step preparatory to more thorough filtration. The addition of coagulating chemicals aided sedimentation, especially in highly turbid waters.

Sedimentation at its most basic required a bare minimum of infrastructure. Any natural or artificial basin with enough capacity to retain water for several hours could remove some portion of the suspended matter. These simple reservoirs could be left as exposed earth or be lined with stone, brick, asphalt, or concrete. The primitive basins lacked means for removing deposited settlement and thus required periodic draining and clearing. Gillespie recalled that, prior to 1915, such "small weed grown settling basins" provided the only form of water treatment through most of California.

More sophisticated sedimentation basins (also known as sedimentation tanks or clarifiers) allowed for greater process control. Early, purpose-built sedimentation basins followed the fill-and-draw method in which tanks were filled, held for a specified retention period, and then drained and cleaned. This method was labor intensive, and managers soon abandoned it in favor of the continual flow method with inlets and outlets always open. The concrete basins came in rectangular, square, and circular forms. Rectangular basins used baffles of concrete, wood, or metal to prevent water flowing directly from the inlet to outlet. A circuitous route ensured an adequate retention time and limited the formation of eddies that would inhibit sedimentation. In circular basins, untreated water entered the center of the tank from below and passed through a perforated baffle. Flow velocities declined rapidly away from the middle of the tank, so most materials fell out into a sump near the tank center. The cleaned water flowed out over an overflow weir that circled the tank and connected to an outlet pipe. As with most items in treatment plants, sedimentation basins generally came in pairs so that one basin could continue to operate while the other was taken offline for cleaning, repair, or maintenance. The use of sedimentation basins increased with the introduction of mechanical equipment for automatically removing sedimentation around 1919. In rectangular basins, chain loops dragged scrapers in a straight line down the tank towards a collection sump and then returned the scrapers raised above the tank bottom. In circular tanks, a series of arms with bottom scrapers revolved around a central axis. In both cases, the scrapers moved at barely perceptible speed to avoid disturbing the calmed water. Numerous patented variations on mechanical cleaning equipment existed to meet different specific needs.

The addition of coagulating chemicals facilitated sedimentation by causing suspended matter to clump together, forming a jelly-like precipitate known as floc. The clumped floc readily settled to the tank bottoms. Sanitary engineers experimented with many chemicals, using the jar test

developed by Langelier, to ascertain their coagulating properties under different conditions. The most widely used substance through the twentieth century was aluminum sulfate, also known as alum. Ferrous sulfate, ferric chloride, ferric sulfate, and chlorinated copperas were common substitutes. The chemicals functioned most efficiently within narrow pH limits, and the addition of soda ash, lime, or similar helped to fine tune acidity.

Small mixing basins, located ahead of the sedimentation tanks, served to thoroughly mix the coagulates and raw water. The basins employed a range of methods for mixing the chemicals including baffles located within the flow stream, mechanical stirring paddles, and air blowers. The simple baffles generally worked adequately, but equipment manufacturers patented and marketed more complex apparatuses that promised some particular advantage.

Sand Filters

British sanitarians began experimenting with sand filters in the early nineteenth century. In 1829, a private water company constructed a sand filter to serve their customers in the London area, creating the world's first treated municipal water supply. These British sand filters, also known as slow sand filters, differed in design and operation from the later rapid sand filters that became dominant in America in the early twentieth century, but they provided a model for subsequent developments.

A slow sand filter consisted of a large watertight basin, generally of concrete, that contained a layer of sand of uniform small size over a bed of gravel with drainage tiles below. The sand layer had a minimum depth of 12 inches up to a maximum of around 40 inches. The slow percolation of water through the sand caused suspended materials to settle out, depositing a thin layer of sediment on the surface of the sand bed. As the sediment layer increased in thickness, it produced increasing resistance to infiltration and operators thus needed to increase the depth of the water above to maintain an even filtration rate. When the sediment layer became too thick, the operators drained the tank, scraped off the top layer of sand, and began the process again with a fresh bed. The layer of sediment, known as shmutzedecke (German for "dirty skin"), functioned as a biofilm that digested organic matter in the water, serving to purify as well as clarify it, though the nature of this biological treatment was not understood in the nineteenth century. Because of their creeping rate of infiltration, slow sand filters required large basins of at least a quarter acre in size, with a half-acre or full acre more common.

Americans constructed their first slow sand filter in 1872 in Poughkeepsie, New York, and completed a number of similar plants through New England over the following decades. However, the design proved ill adapted for American conditions where rivers were far more turbid than the sedate English streams. The filters rapidly filled and choked on sediment, making them inefficient and uneconomical. In the 1890s, the eminent sanitary engineer George Fuller experimented with rapid sand filtration techniques in Louisville, Kentucky, to treat Ohio River water. By introducing a coagulant immediately prior to the sand filter, Fuller was able to process a large quantity of water in a relatively small tank. However, the great quantity of floc that settled on the sand bed required more frequent cleaning than did British slow sand filters, up to several times a day versus a monthly cleaning. To address this problem, Fuller adopted a system of backwashing that forced water under pressure up through the sand layer to cleanse it. This combination of features—small basin size,

use of a coagulant, and backwashing—distinguished the American rapid sand filter from the predecessor models.

Several decades of incremental improvement gradually refined Fuller's process until it operated with enough consistency and efficiency to be widely adopted. Much of the effort focused on improving the backwashing process to avoid forming mudballs that could clog the filter. In the 1920s, John Baylis developed a system of auxiliary scour that used horizontal water spray from a grid of pipes to enhance the cleaning action during backwashing. A decade later, the introduction of rotary sweeps improved the cleansing of the sand bed surface. Both scour types allowed for using aerated water, with air injected under pressure to enhance the scrubbing action. Researchers also adjusted the ordering of the filtration process, adding sedimentation basins ahead of the filtering, and thus reduced the required frequency of cleaning. By the late 1920s, the treatment chain of chemical coagulation, mixing, flocculation, sedimentation, and then filtration became known as "conventional treatment" and was used wherever muddy surface rivers were a principal water source.

The layout of municipal rapid sand filtration plants followed some general conventions, even as the particulars responded to the individual demands of the site, water source, available funding, and the decisions of the designer. Most large plants grouped small, rectangular, concrete tanks into two rows and placed a pipe gallery between the rows and beneath the floor of the tanks. During normal operations, the water level in the beds stood above the top of the lateral half pipe troughs. After trickling through the sand, gravel, and underdrains, the water filled a reservoir or clear-water well below the beds. During backwashing, water from an elevated tank was forced up through the filter beds and drained through the troughs. The plant operators generally piped the removed sludge to a drying basin, where the water content was drawn down prior to disposal. Small plants were more likely to use circular units of concrete or steel, and equipment manufacturers sold many such patented apparatuses ready for rapid assembly and use.

A pressure filter was a variation of rapid sand filter that contained the process within an air-tight cylindrical shell and functioned by virtue of water pressure rather than gravity flow (Figure 25). The small cylinders could operate vertically or horizontally and required little space. With their limited capacity, pressure filters were suited for industrial use or on small private or public water systems with low turbidity sources. Engineers commonly designed such water systems with a single set of pumps that removed water at its source, forced it through a pressure filter, and conveyed it to the point of consumption. When used in combination with chlorine disinfection, pressure filters allowed for small-scale water systems to operate safely and economically. Light weight pressure filters replaced the sand media with engineered fabric or paper filters. These systems lacked durability, but were suited for temporary installation at labor and military camps or the like.

Aeration and Water Softening

Groundwater drawn from certain geological formations by wells could contain high quantities of dissolved minerals including iron, calcium, and magnesium. These dissolved solids make water hard, which detracts from its palatability and interferes with industrial uses by forming scales in boilers and other equipment and requiring greater quantities of soap in laundry applications. Water softening is the process of removing these hardening minerals. The iron from an anaerobic well

occurred in an invisible, soluble form, but as it oxidized following exposure to the atmosphere, it produced rust that gave the water an unappealing color, clogged distribution lines, and made it unfit for some industrial purposes.

Aeration provided the simplest means of oxidizing and removing dissolved iron. Aerators came in a variety of forms as there were many methods of exposing water to air. Spray nozzles could throw water into the air ahead of a storage basin, or a series of baffles, steps, or protruding stones could be placed within a shallow channel leading to the basin. A tray-type aerator (Figure 26) distributed water to the top of a series of shallow trays with perforated bottoms, allowing the water to aerate as it dripped between levels. The trays commonly contained coke or rock on which a coating formed that sped the process of oxidation. A number of patented devices employing nozzles, paddles, and propellers were also available.

Two different techniques existed for softening water: the lime-and-soda-ash process and the zeolite ion-exchange process. Lime and soda ash acted through a series of chemical reactions to convert soluble compounds of calcium and magnesium into insoluble forms that either precipitated out through sedimentation or were removed by filtration. The process was similar to that used in rapid sand filtration. Operators added lime and soda ash to raw water either separately or in combination, and thoroughly stirred the materials together in a mixing basin to produce flocculation. The heaviest material settled out in a sedimentation tank. The partially treated water was then recarbonized by injecting carbon dioxide gas into the water as it flowed from the sedimentation tank towards the filter. The carbon dioxide interacted with any excess lime to form soluble bicarbonates which helped to minimize the buildup of calcium carbonates deposits in the filter and distribution system. A final pass through a filter removed most of the remaining coagulant and prepared the water for consumption.

The zeolite process used ion exchange to replace the soluble calcium and magnesium in water with sodium. Ions are molecules that have acquired a net electrical charge as the result of gaining or losing electrons. As opposite charges attract, positively charged ions, known as cations, will adhere to their negatively charged anion partners. In ion exchange, molecules within solution are swapped with like-charged particles that are adhering to an oppositely charged solid that is immersed in the solution. Ion exchange is a common, natural process that is fundamental to soil fertility as the negative charges of clay soil and organic matter attract and hold plant nutrient cations such as potassium, calcium, and magnesium. British soil scientists in the mid-1840s were the first to study the ion exchange process and to recognize that any single cation in the soil could be replaced with any other cation by saturating the soil with water rich in the replacement nutrient.

European chemists began experimenting with ion exchange using zeolites in the 1850s, but without immediately recognizing the material's potential for water softening. The term zeolite refers to a group of natural materials (and today, synthetic products) that combined iron, aluminum, and sodium in a silicate form. Greensand, a marine sandstone, was the most common natural zeolite. When hardwater ran through a bed of zeolite, it exchanged its calcium and magnesium cations for the sodium cations adhering to the zeolite until the sodium was exhausted. Flooding the zeolite with a brine solution then reversed the process, releasing the calcium and magnesium for disposal and replenishing the sodium for another softening cycle. Coating the zeolite with manganese dioxide allowed it to also strip the water of iron. The potential to use zeolites for water softening

was recognized by the early twentieth century, and the German scientist Robert Gans patented the process in 1906.

Over the next two decades, small zeolite softeners found their way into many industrial processes as they demineralized water for use in steam boilers, laundry plants, pulp mills, and the like. A zeolite softening unit was essentially a rapid sand filter but with a bed of zeolite replacing the sand quartz and with a special lining to protect against corrosion caused by the brines used in regeneration. Depending on the size of the operation, the units could be either of the gravity-fed basin type or pressurized steel tanks. The plant then blended the fully treated water with raw or partially treated water to produce a finished product with a desired level of hardness. The Ohio Valley Water Company constructed the first municipal softening plant below Pittsburgh in 1926.

The company added a second plant in 1929, and the area served as a working laboratory for experimenting with the zeolite process on a large scale. The plants entered wide use in the 1930s, appearing in every part of the country. In 1941, the Metropolitan Water District of Southern California constructed its large water softening plant in La Verne using a combination of lime treatment and zeolite filter beds. After a later expansion, the La Verne facility had the distinction of being the largest zeolite softening plant in the world.

Reservoirs

The design and construction of water tanks and reservoirs evolved in the early twentieth century to make more efficient use of materials. In 1894, Horace E. Horton of the Chicago Bridge & Iron Works constructed the first steel plate water tank with a full hemispherical bottom. The curved shape required less steel and was more watertight than a flat-bottomed tank, and because the rigid bottom was self-supporting, it did not need to sit on a platform. By the early twentieth century, this had become the dominant type of elevated water-storage structure in the United States. In 1905, George T. Horton, son of Horace Horton, created the first tank with an elliptical bottom, which had a shallower profile than the hemispherical form. The ellipsoidal form became nearly flat at its center and allowed for using larger risers that provided greater support. Further innovation in 1922 allowed for using the ellipsoidal shape for both the top and bottom of the tank. This eliminated the need for the interior trusses that supported a conical roof and gave a more pleasing, modern form.

In 1928, Chicago Bridge & Iron (CBI) introduced the first true spherical tank. Set on single pedestal supports, these small tanks, trademarked under the name Watersphere, looked like golf balls sitting on tees. The use of welding, rather than riveting, to join tank plates beginning in 1933 allowed for greater flexibility in design and led to larger forms, including a 100,000-gallon capacity Watersphere introduced in 1939. The Watersphere became the most popular elevated tank design in the 1940s and were especially common for small systems with low storage needs. Other CBI advances allowed for constructing high-capacity tanks holding up to two million gallons. These design types included radial-cone and toro-spherical tanks, both of which placed the convex steel plates under tension to allow for the use of thinner materials.

The tubular steel legs that supported the large tanks also required less material than prior truss support systems. Central towers under the tanks housed risers, overflow pipes, and ladders for access. By World War II, tanks in these modern forms and several other variations became

common on large systems. Form followed function for elevated steel tanks, and while they were frequently painted with town names or high school mascots, they rarely had architectural decoration beyond their own striking industrial forms.

Sewage Works

Public sewerage systems for collecting household waste became nearly universal among incorporated Californian communities in the first half of the twentieth century, while the treatment of sewage advanced somewhat less rapidly. By the eve of World War II, 95 percent of the state's urban population and about three-quarters of the total population benefited from public sewerage systems. However, nearly four in ten of those systems, including most of the older legacy works of Northern California, continued to discharge raw sewage without treatment. Where people had grown accustomed to disposing of raw sewage, state officials found it difficult to persuade them to abandon existing practices. Conversely, newer cities took it for granted that they would need to treat their sewage before disposing of it, and 80 percent of systems constructed after 1913 included treatment from the outset. Naturally, the communities most open to improvement attracted the engineers and managers who were prepared to deliver it.

The location of sewage disposal—whether into freshwater, saltwater, or on land—was important in determining how rapidly a community advanced in sewage treatment. By 1920, state and local officials well understood the hazards of disposing of raw waste into freshwater streams. Nearly every new freshwater-discharge system included treatment, and many existing systems were overhauled to add treatment options. Land disposal at sewage farms remained common through the 1920s, although increasing regulation meant that most added partial or advanced treatment methods. Communities that discharged their waste to seawater were the slowest to advance. Two-thirds of the new disposal projects involving raw sewage through 1930 discharged into bays or sloughs, mostly in Northern California. No seawater location added advanced biological treatment methods prior to 1930, although partial treatment by screening or septic tanks became the norm along Southern California's recreational beaches.

Sanitary engineers experimented with a wide variety of treatment methods as they sought practical means of implementing the scientific advances occurring in the field of microbiology. Septic tanks and the related two-chamber Imhoff tanks dominated the first decades of the twentieth century, but options soon diversified. The era of advanced biological treatment began with two designs by the Bureau of Sanitary Engineering for a trickling filter in Reedley in 1915 and an activated sludge plant at Folsom Prison in 1917. In 1929, Gillespie compiled an inventory of the various treatment plants in operation across the state.

Imhoff and septic tanks were by far the most common, although Gillespie described these as "mostly relics of the past." Trickling filters were the most common advanced treatment option, producing a fully digested final effluent. While only six activated sludge plants were online, these were largely in joint sewerage plants that handled the waste of multiple communities. The somewhat older technologies of sand filters, contact beds, and fine screen continued to exist but in shrinking numbers. The survey did not include sewage farms, though a number remained in use in 1929. "All in all," Gillespie noted, "California has adopted practically everything that has appeared on the horizon for sewage treatment."

Private consultants and equipment manufacturing firms played an increasingly important role in designing sewage treatment systems as their complexity advanced, even as the system remained in municipal or institutional ownership. Academic researchers worked extensively as consultants in the early period because there were few other practitioners experienced in the specialized design of water and sewage treatment plants. Professor Hyde, in particular, consulted on numerous treatment plants throughout the state. Eventually Hyde's students organized their own consulting firms, with Clyde Kennedy (class of 1911) and Harry Jenks (class of 1917) being among the most prominent in Northern California. The larger equipment manufacturers, such as the Dorr Company, employed consulting engineers who could draw plant plans for small towns or institutions that utilized the company's equipment.

The reliance on private consultants had the disadvantage of pushing municipalities towards technologies that benefited patent holders more than the communities. Professor Harold Gray of UC Berkeley noted a tendency for sewage treatment methods to cycle in and out of fashion in a manner unrelated to obvious changes in knowledge or technology. Activated sludge treatment found favor in the late 1930s, followed by increased interest in chemical precipitation and then later a revival in trickling filters. Gray linked this pattern to changes in patent status. Several patents for activated sludge treatment, for instance, ran out around the time that the trend away from it began, while the rediscovered interest in trickling filters coincided with the issuing of new patents for particular filter features.

A P. Banta of the Los Angeles County Sanitation Districts commented drolly on the persistence of equipment salesmen, even as he relied upon their services:

> Larger treatment plants are the Mecca of budding inventive genius. Scarce a week goes by but that some gentleman or salesman arrives with a new panacea of sewage treatment. Sometimes it is the addition of tons of newspaper, or some patented chemical, or some mysterious settling media, or perhaps it is the simpler matter of just distilling the sewage. Paint and building material exponents are legion. Wonder-last-forever metals are nearly as common, and one must expect to have the lubrication system experted [sic] several times a year by all the oil companies.

The following sections highlight the major treatment technologies that came into widespread use during the first half of the twentieth century.

Sewage Pumps

Communities resorted to sewage pumping plants, also called lift stations, in any situation where sewage needed to be lifted above where gravity flow would naturally carry it. This could occur in hilly cities where isolated low-lying districts could not be served by gravity flow outlets. All the sewage through the district would then be collected at a single convenient location and pumped through a force main to join a higher sewer main operating under gravity flow. In flat topography, the need to maintain an adequate grade for flow velocities required excavating continually deeper towards the sewage outlet. In some situations, it proved less expensive to raise the sewage by pumping at one or more places rather than to do deep excavation over long stretches. Pumping stations were also commonly used immediately ahead of treatment plants in order to generate adequate head for plant operation.

A sewage pumping station consisted of a storage well, two or more pumps, and the engines required to operate them. Storage was necessary as pumps operated at a continual rate while sewage inflow varied with the time of day, day of the week, and other factors. Adequate storage capacity also allowed for pumps to be taken offline for maintenance. Pumps could be submerged within the storage well, but it was often preferable to locate them in an adjacent dry well to facilitate servicing.

Screens at the sewage inlets removed large materials that could clog or damage pumps, but smaller materials including toilet paper and organic solids were allowed to pass through as these created odor problems at the stations if retained. Centrifugal pumps were favored over reciprocating pumps as they were less likely to clog from the smaller bits of trash. Any type of motor could be used to operate the pump, but electrical motors became standard as they were the easiest to automate

Sewage pumps generally operated automatically by way of a switch connected to a float within the storage well. When the sewage rose above a certain level, the rising float started the pump, and it operated continually until the sewage fell back below the trigger level. If the sewage continued to rise during pumping, another float would trigger a second pump into operation. A third pump might be present as an emergency reserve and to add additional pumping capacity along lines with high peak flows.

A properly maintained sewage pump plant would produce little odor and thus could be located wherever most convenient. Smaller plants could be contained in below ground vaults, while larger plants frequently had a motor room above ground and pumps below. Early pumping stations were crude, consisting of a wood or brick-lined tank, with a pump mounted on a platform above, and the whole system enclosed in a corrugated metal building. Greater attention was given to the stations as they started to encroach on residential neighborhoods. Some pumping stations constructed in the 1920s adhered to the City Beautiful movement and often featured Neoclassical or period revival design elements and landscaped grounds to emphasize the dignity of municipal service. One design manual argued that "such structures tend to remove the popular prejudice from sewerage and to arouse interest in sewerage questions." In other cases, pump stations were designed to blend in with their surroundings. A pump station of the Los Angeles County Sanitation Districts near the Palos Verdes Peninsula, for example, was set below ground and landscaped above with a pergola that hid ventilation outlets. Likewise, when Long Beach constructed 14 new pump stations, the city disguised some as common stucco bungalows and built another into the central pier of a canal bridge.

Screens

Coarse or fine screens physically removed large items and some portion of the smaller suspended solids from sewage flows. Coarse screening was the first step in nearly all sewage treatment as it was necessary to remove large material—rags, timber, golf balls, and the like—that could clog or damage machinery. A bar screen, composed of parallel iron bars of one-quarter to one-half-inch thickness with openings of between one-half and six inches, was the simplest device. The screen was set with the bars oriented vertically and at an angle of between 30 and 60 degrees so that captured materials were pushed up the screen for easier removal. The screen was cleaned either

periodically by manual raking or continually by automated processes of various sorts. Chain loops on sprocket wheels pulled a rake up the face of the screen and dumped collected materials into a receptacle for later disposal. Medium-sized mesh screens of galvanized wire fabric provided filtering for smaller objects such as toilet paper and leaves preparatory to passing sewage through reciprocating pumps, trickling filters, or other machinery that were readily clogged.

Fine screens provided a basic form of sewage treatment by removing a portion of the suspended organic solids. Long Beach was the first to use fine screens for sewage treatment in 1915, followed by Santa Barbara in 1916 and Stockton in 1919. Most fine screens consisted of perforated metal plates, rather than wire mesh, for greater strength and ease of replacement in the machines. The perforations ranged between 1/32 and 1/14 of an inch wide by 2 to 4 inches long. Fine screens were estimated to remove approximately 20 percent of suspended organic materials, though results varied with circumstances and the screens often underperformed expectations. For planning purposes, they were used only for treatment requiring less than 10 percent removal of suspended solids. That low level of cleaning was considered sufficient when sewage was discharged into an environment where it would be diluted quickly, such as at the Santa Cruz screening plant designed by Charles Hyde that discharged into the ocean.

Screens were also widely used for industrial waste at pulp mills or fruit canneries where the finer organic material that passed through the screen did not pose an immediate health risk. Because screens removed fewer suspended solids than did sedimentation, there was less sludge requiring disposal, and this could be an advantage where land use was at a premium.

Fine screens operated continuously and were cleaned while in motion by brushes or jets of air, water, or steam. Equipment manufacturers marketed a wide variety of patented screen systems. Among the most common in the United States were the disc and drum types, though many variations existed. In large treatment plants, the fine screens were major pieces of equipment, with sizes ranging from 8–12 feet in length or diameter. Electric motors powered the screen as well as operated sewage pumps and water or air compressors. A dedicated operator was generally required to ensure smooth functioning.

The materials removed by screening were disposed of by incineration or burial. The materials were sometimes dewatered by rolling presses or centrifugal units before disposal. The Hyperion plant in Los Angeles, for example, removed 30 tons of wet screenings per day which dried down to 4.2 tons requiring incineration. Alternately, the screened materials could be sent through a shedder or grinder. Small shredders reduced organic matter to a pulp that could then be fed back into the raw influent, while harder inorganic materials were separated for disposal. Large grinders used toothed disks or swinging hammers to reduce even the hardest matter into particles small enough to be discharged with the effluent. In some cases, grinders were used in lieu of screens so that everything entering the plant was pulverized prior to treatment.

Golf Chambers

In combined storm-sewage systems, large quantities of sand entered the pipes and needed to be removed to avoid clogging the system. Early grit chambers were crude retention basins located along the sewer lines that allowed sand and some organic matter to settle out of suspension. Because organic waste would putrefy in these chambers, they produced considerable odor and

needed to be cleaned regularly. Later refinements allowed for greater control of the flow velocity, maintaining a current of around one foot per second, so that only the heaviest mineral materials settled out.

In sewage treatment plants, grit chambers were generally located immediately behind bar screens at the entrance to the plant. The velocity of the influent was reduced through the grit chamber by gradually flaring the sides and bottom of the channel to increase its width and depth. Grit settled out to the depths of the chamber which was set below the bottom level of the incoming and outgoing pipes. To maintain proper velocity, two or more chambers could be constructed in parallel. During times of low flow, a single chamber was used and the other chambers were put into use as flows increased.

Grit chambers needed to be cleaned periodically and particularly after storms. This could be done manually by temporarily taking the chamber out of service. Apparatuses for mechanical cleaning were introduced in 1927 and became common in the 1930s. Most of these consisted of a scraping device that ran over the bottom of the chamber and a moving rake or elevator that raised the material on an incline while agitating it to wash out any organic matter. Grit that retained any organic waste needed to be buried. Clean grit could be used as fill material or dumped as convenient.

Septic Tanks

The septic tank was the dominant sewage treatment technology of the early twentieth century, from 1900 to approximately 1913, after which it was superseded by the related Imhoff tank. Donald Cameron introduced the septic tank in England in 1896 and received a US patent in 1899. He organized the Cameron Septic Tank Company to license use of the technology in America at a fee of five percent of construction costs. However, Cameron immediately encountered resistance from engineers who objected to his effort to patent the septic process itself rather than a particular tank design. Municipalities refused his royalty demands on the grounds that the septic process was a natural one that relied upon anaerobic bacteria that was already in the sewage itself. The municipal engineers initially prevailed in the ensuing lawsuits, winning a 1907 court decision that generated a boom in septic tank construction, but an appeals court later reversed the ruling and declared the septic process patentable. The drawn-out suit and the uncertainty and animosity that surrounded it caused engineers to ultimately shy away from the technology and welcome the emergence of the Imhoff tank (see below) as an alternative. Only in 1919 did Cameron settle the final outstanding claims, but by then numerous competing technologies existed in the marketplace.

The municipal septic tank was a one-story, continuous-flow sedimentation tank through which sewage was permitted to slowly pass so that suspended matter would settle to the bottom and undergo anaerobic decomposition. The tanks were designed to hold sewage from 6 to 12 hours before discharging the effluent. The tanks thus needed a volume equivalent to a quarter or half-day's average flow. If the tanks were too large and the sewage remained overlong in the chamber, undesirable levels of anaerobic activity would give the effluent an objectionably dark appearance and offensive odor. Too short of a stay and not enough organic matter would settle out of the effluent. As the volume of sewage flows varied, it was desirable to have two or more tanks so that capacity could be added or removed to match flows. Most small plants lacked that flexibility and thus produced results that were less than satisfactory.

Septic tanks were constructed of wood, brick, or concrete in all different sizes and plans. They could be rectangular, square, or circular; deep or shallow; roofed or open-topped. The bottoms could be horizontal, sloping, or contain hoppers for settled sludge. The chief concern in design was to reduce the velocity of flow through the tank and prevent material from moving directly from inlet to outlet. Effluent passed over weir 'c' into the siphon chamber 'd', from which it was discharged by automatic pump 'e' into the outlet pipe 'f'. A baffle near the inlet slowed the sewage entering the tank, while a scum bar near the weir extended 6 to 18 inches below the surface to prevent floating materials from escaping the tank.

Anaerobic bacteria developed within a new septic tank over a period of a couple weeks to several months. It would then work continuously on the layer of sludge that settled to the tank bottom, digesting organic matter into gases of methane, carbon dioxide, and nitrogen as well as finely divided organic compounds that entered solution and left the tank with the effluent. Some organic matter resisted decomposition and formed a permanent layer on the bottom of the tank that needed to be drained or pumped out roughly once or twice a year. The effluent discharged from a septic tank had between 25 to 50 percent less suspended matter than raw sewage, including the bulk of the material that was most inclined to putrefaction and thus public offense. Septic tanks were used both as the sole sewage treatment prior to discharge or as a preparatory stage for further treatment.

In California, Willits of Mendocino County was the first to employ a municipal septic tank in 1904, while Bishop, Santa Rosa, and Fresno added tanks the following year. The municipal use of septic tanks declined after the introduction of the Imhoff tank, though they remained in use for longer at institutions and small treatment works. Septic tanks remain ubiquitous in rural areas without sewage systems. Modern septic tanks are manufactured of concrete, plastic, or fiberglass. They generally operate in connection with a drain field in which subsurface perforated pipes discharge effluent into a porous underlayer.

Imhoff Tanks

Karl Imhoff developed his namesake tank in Germany in 1907 to address a chief failing of the septic tank. As the sludge at the bottom of a septic tank decomposed, it gave off gases that bubbled up through the sludge layer and liquid sewage. During the heat of summer, the bubbling could become vigorous enough to stir up the sludge and mix it into the effluent. This greatly increased the quantity of suspended solids and prevented effective sedimentation.

The Imhoff tank (also known as an Emscher tank) operated by dividing sedimentation and digestion into separate chambers across a two-story structure so that gases, scum, and regurgitate particles from the decomposing sludge could not agitate or reenter the flowing sewage above. The upper sedimentation chambers were long, narrow basins through which the liquid influent flowed at a rate of around a foot per minute, giving a retention period of two to three hours. The chambers had a maximum length of around 100 feet and a relatively narrow width to avoid creating crosscurrents in the flow. Angled bottoms on the sedimentation chambers sloped down to a narrow slot through which the deposited solids fell into the lower digestion chamber. The slot was designed in such a manner to prevent gas from entering from below. Concrete was favored for construction as its smoothness assisted the sludge in slipping down the sedimentation chamber walls. Still, it was necessary to include a walkway on top of the tanks so that workers could scrape

the side walls of accumulated deposits twice a week or so. Two or more sedimentation chambers were sometimes used over a single digestion chamber to avoid the depths required by the long sloping of a single chamber.

The digestion chambers stored sludge for between six and 12 months, with longer times required in small plants or during cold weather. It was desirable to make the digestion chamber as deep as possible as this improved decomposition by maintaining more uniform temperatures. This desire had to be balanced against the increased cost of deep excavation, and tanks generally had a maximum depth of 30 to 35 feet. Gas and scum produced by digestion bubbled up into spaces surrounding the exterior of the sedimentation tanks. Vents of various designs allowed the gas to escape. Digested sludge was removed from the bottom of the tank by gravity where feasible or more commonly by pumping. The bottom of the digestion chamber was in the form of a hopper. A vertical sludge pipe drew digested sludge from the hopper bottom and fed it into a horizontal pipe that led to sludge drying beds. A valve opened the pipe and pressure from the water above forced the digested sludge through the pipes. Operators closed the valve as soon as the emerging sludge showed signs of not being fully digested. The sludge produced by Imhoff tanks was generally in better condition that than from traditional septic tanks and was more easily dried.

Imhoff tanks gained quick popularity in America because of increasing dissatisfaction with septic tanks and weariness of the protracted patent litigation. Fullerton, Hanford, Mill Valley, and Winters constructed the first four tanks in California in 1912. The effluent released from an Imhoff tank was in most circumstances superior to that from septic tanks and lacked dark coloring and offensive odors. The improved quality of digested sludge also made Imhoff tanks attractive to municipalities that hoped to sell the material as fertilizer to partially recoup operating costs. However, the tanks had several notable drawbacks. Because of their great depth, Imhoff tanks required deep excavation during constructing, which made them more expensive than alternatives (Figure 41). Operating costs were also generally higher than for other tank types as Imhoff tanks could not be neglected for more than a few days at a time without detrimental results. The tanks tended to be temperamental and they sometimes failed to produce adequate digestion or generated excessive quantities of scum without clear cause. Imhoff tanks also lacked means of heating the sludge to aid digestion and the fixed relationship between settling capacity and sludge digestion space limited their flexibility. Some very large Imhoff tanks were constructed in the United States, including a 472 mgd tank in Chicago, but they eventually fell out of favor for all but small treatment plants, replaced by plain sedimentation tanks with separate digestors.

Clarifies

Clarifiers or plain sedimentation tanks followed the same basic principle inherent in septic or Imhoff tanks in using a controlled, slow flow of sewage to cause mineral and organic solids to settle out of suspension. They differed in that the sediments were removed before septic conditions could develop and the sludge was digested separately. Settlement basins (also called settling basins) were a basic technology that had been used in the nineteenth century to treat turbidity in drinking water and to provide minimal treatment of sewage before discharge. However, they did not come into wide use until after 1919 when mechanical equipment for removing sludge and grease from the tanks was introduced in the United States. In comparison to Imhoff tanks, clarifiers were simple to operate as they did not require scraping or manual skimming and the separate digestion could be more readily controlled with less unpredictable foaming or digestive failures.

A primary clarifier unit was used with raw sewage at the start of treatment, while a secondary or final clarifier unit was sometimes required to provide additional settlement at the end of treatment following a trickling filter or activated sludge tank. Sludge from final clarifiers was frequently returned by pipe back to the primary clarifier where it again settled and was removed.

Early clarifier-style settlement tanks operated on an intermittent fill-and-drain schedule, but by 1904 it was known that a continual flow in, through, and out of the basin provided just as good results and with increased throughput capacity. Settlement periods were commonly between one and three hours. Less retention time was required ahead of trickling filters and more might be used on a small system with relatively fresh sewage and no secondary treatment. Settlement tanks for sewage systems followed similar designs to those used in drinking water treatment (see above section) and came in rectangular and circular plans. Square tanks featured rounded corners to facilitate sludge collection, but these proved difficult to fully clean and the design fell from favor

A wide variety of devices for mechanical sludge collection were available that promised savings in construction, labor, and maintenance, or particular advantages with different types of sewage. These devices generally consisted of scrapers and skimmers that moved sludge and scum respectively towards collection points. In some designs, a scraper moved across the bottom of the tank from end to end before being raised on a chain loop and returning along the top of the tank as a skimmer. Rotary skimmers sometimes used jets of water rather than physical blades to collect fats from the surface. The collectors could operate continuously or could be used once or twice a day for around half an hour at a time. The collection sumps were pumped at least daily, and pumping continued until sewage started to flow through the outlet pipe.

Intermittent Sand Filters and Contact Beds

Neither intermittent sand filters nor contact beds ever found wide use in California, though both were important transition technologies in introducing biological treatment methods. Intermittent sand filtration offered a refinement on sewage farming in which the wastewater flowed onto specially prepared beds of sand, gravel, or other porous materials.

The practice was first developed in England in the late 1860s and was further studied at the Lawrence Experiment Station in 1886-87. The sand filter treatment area was commonly divided into three or more beds so that sewage distribution could be rotated between fields. This allowed beds to dry out and reabsorb oxygen between uses. Compared to sewage farming, intermittent filters could support ten times the population on the same amount of land, but required more intensive management. Workers needed to carefully grade and rake the beds to ensure even distribution. Organic waste that dried onto the surface of the soil needed to be scraped and removed periodically. In some cases, it was necessary to install drainage tiles beneath the bed surface. The tiles of hard-baked clay admitted water at their joints and removed excess moisture. Intermittent filtration was used extensively on the East Coast and particularly in New England where natural sand beds were abundant, but it was not widely adopted elsewhere in the United States and examples in California are limited. Redlands in San Bernardino County began disposing of raw sewage on natural sand filter beds in 1890, and Monrovia, Manteca, Kingsburg, and Ojai all later disposed of septic, Imhoff tank, or trickling filter effluent on sand beds.

The contact bed, developed by William Didbin in early-1890s London, involved a water-tight basin, four to eight feet deep, that was filled with particles ranging in size from a pea to a walnut. The maximum basin size was around one-half acre as anything larger required too much time to fill. On the bottom of the basin, a network of drains led to an outlet pipe. Experiments were made with a wide variety of filter materials including coal, slag, cinder, gravel, burnt clay, glass, and broken bricks. Roughness, porosity, and small size were desired to increase the surface area to volume, though material that was too small led to clogging. The beds operated on cycles, allowing, for example, an hour for filling, two hours of standing full, an hour to drain, and four hours to stand empty. A degree of sedimentation occurred during the period of slow filling, followed by a degree of anerobic decomposition while the pool was full. The majority of the digestion occurred aerobically on the wet surfaces of the filter materials while the tank stood empty. Aerobic digestion could be increased by operating basins in pairs and passing the effluent from the first-contact filter into a second-contract filter. An experimental plant in Marion, Ohio, achieved a high level of treatment by having sewage receive primary treatment in septic tanks prior to flowing in sequence into two contract beds followed by a final cleaning in a sand filter. Gillespie recorded a total of four contact beds constructed across California, with the first being a 1910 plant in Roseville, followed by Dixon in 1911. Only one contact bed remained in use by 1930.

Trickling Filter

The trickling filter, also known as "trickle filter," "sprinkling filter," or "biofilter," was the most common secondary treatment method employed in California prior to World War II. The method differed from a contact bed in that there was no period where the basin filled with sewage and engaged in anaerobic digestion. Tests at the Lawrence Experiment Station demonstrated that better results were obtained by maintaining a consistent environment that favored aerobic microbes. Early efforts were made at distributing sewage over a contact bed at a slow, trickling pace by use of troughs, but uniform and consistent distribution could not be obtained. Joseph Corbett of Salford, England, first made use of spray jets to create a true trickling filter in 1893. Madison, Wisconsin, constructed the first such filter in the United States for institutional use in 1901, and Redding, Pennsylvania, completed the first municipal plant in 1908. California's Bureau of Sanitary Engineering designed the first trickling filter in the state in Reedley in 1915.

Early trickling filters were built in much the same fashion as a contact bed. Concrete basins were constructed with depths between six and ten feet and filled with rough, hard, and angular particles, between 1.5 and 3 inches in size, over a drainage system. Multiple units were generally constructed in series to provide flexibility in operation.

The exterior dimensions of the tanks varied with local circumstances and needs. The tanks could be recessed in the ground or built up, as at the plant in Lemoore. The practice at early plants was to provide rest periods between applications of sewage. This required large surface areas as parts of the plant were regularly taken out of use. Later studies showed that the trickling filters could be used continuously around the clock, which allowed for higher rates of throughput and consequently smaller basins. Much of the innovation of design in trickling plants involved the nozzles and the quest to provide even spray coverage. Revolving distributors on circular tanks eventually replaced stationary nozzles in most plants. The distributors could be motorized to revolve or be propelled by the force of the spray emitted from the nozzles.

Trickling filters generally operated in conjunction with automatic dosing tanks to ensure an even spray distribution over the bed. The tanks filled with influent and automatically discharged through a siphon when full. Small air-lock piping (not depicted in the figure) opened and closed the siphon at set levels. The sides of the tanks were angled to cause the head to decline at a rate calculated for even spray distribution. Dosing tanks were usually paired so that one tank was filling while the other was discharging.

Activated Sludge Process

San Marcos, Texas, constructed the first American activated sludge plant shortly after the technology debuted in 1914. The first plant in California followed three years later when the Pasadena Tri-City facility completed an experimental pilot project in January 1917.

Partitions divided the 9-by-20-foot aerating tank (also called an aeration tank) to produce 60 feet of channel for sewage to flow through, while blowers at the bottom of the tank mixed and aerated the liquid. Experiments showed promising bacterial reduction rates between 96 and 99.6 percent. The Bureau of Sanitary Engineering constructed the first full-scale treatment plant at Folsom Prison later in 1917. As the bureau lacked experience with activated sludge treatment, they hired Ralph Hilscher away from the Illinois Water Survey. The prison plant answered the long-standing concern of the Bureau of Public Health with having minimally processed sewage dumped into the American River upstream from the state capitol. Municipal plants followed in Turlock (1921), Lodi (1923), Pasadena (1924—expansion of the pilot project), Los Angeles County Sanitation Districts (1928), and the City of Los Angeles (1930).

The activated sludge process was innovative in its biochemical approach but relatively simple in the required physical infrastructure. Sewage first passed through a primary clarifier or fine screen to remove the largest suspended solids before arriving in a concrete aeration tank. Activated sludge equal to about 20 percent of the sewage volume was added to the partially clarified sewage. Air blowers or (less commonly) mechanical agitators then mixed and aerated the sewage over a retention period of several hours. The concrete aeration tanks came in various shapes and sizes but usually included multiple chambers that could operate in series or independently. An air blower was located near the tanks, sometimes contained within a separate blower house. Perforated pipes or diffuser plates along the sides or bottoms of the chambers maintained a continual flow of air that generated a rotational motion in the liquid sewage.

When these were used in rectangular tanks, the longitudinal flow of the sewage through the tank combined with the rotational motion to produce a spiral flow pattern that mixed the sewage and prevented sludge from accumulating on the tank bottoms. After the prescribed period of aeration, sewage flowed to a secondary clarifier to remove the large volume of sludge generated in the process. A portion of the activated sludge was then returned to the aeration tank to seed the next batch of influent while the remainder was sent to a sludge digestion tank or drying bed for further treatment and disposal.

Sludge Treatment and Disposal

Early sewage management practices focused principally on the liquid effluent that was discharged at the end of treatment and gave comparatively little attention to the sludge that accumulated at the bottom of sedimentation tanks. The goal at most plants was simply to dispose of sludge as quickly

and cheaply as possible, generally by burying it on land or dumping it at sea. Plants could manage this so long as the volume of sludge remained low. However, as operators gained efficiency in removing a larger share of suspended organic solids from liquid sewage, they invariably produced more sludge. The activated sludge process in particular produced very large quantities of waste that required treatment and disposal. Sanitary engineers thus turned towards developing more effective methods of digesting and drying sludge.

Sludge emerged from a sedimentation, Imhoff, or septic tank as a semiliquid slurry with a moisture content of around 95 percent and a strong, offensive odor. Basic treatment required dewatering the sludge to reduce the moisture content to 70 percent or lower, at which point it could be handled as a solid. Plants could then dispose of it through incineration, burial, dumping at sea, or by marketing it as fertilizer. Sludge drying beds, also called sand beds, were the essential tool for dewatering sludge and they remained common at smaller plants. Drying beds have the advantage of low capital costs and require little skill to operate, but need a large amount of land and are labor intensive to empty. In a conventional sand bed, a layer of sand approximately 12 to 24 inches thick lay over a bed of course gravel 6 to 8 inches deep that was drained from below by tile pipes. The walls of the bed could be of earth, wood, or concrete. The area of the bed would depend upon the population served, the characteristics of the sludge, and the local climate. In more recent practice, the beds are divided into multiple cells. Sludge was spread over the sand bed in a layer 8 to 12 inches thick to dry by drainage from below and evaporation from above. The organic matter continued to putrefy during this process and gave off strong odors, so a remote location was required. Greenhouse covers were sometimes installed over the beds to increase heat, keep out rain, and contain the odors. Drying times depended upon the weather. During cold, damp winters, sludge could take months to dry, while two weeks might suffice during summer. Workers could remove the sludge as soon as it was dry enough to be handled by a rake or fork. Sludge drying beds could also be paved with cement. Paved beds required more area than conventional sand beds, but involved lower maintenance costs and allowed for heavy equipment to be used in mixing the sludge for drying and for removing the dried cake.

Mechanical devices aided dewatering, though some time on a drying bed was still generally required. These devices consist of three basic types: presses, centrifuges, and vacuum filters. A sludge press consisted of metal plates that could be hand-tightened by screws or compressed by machine to force water out of sludge. Centrifuges placed wet sludge within a metal tub lined with porous cloth and then spun the tub at high rotation to force the liquid through the cloth. Centrifuges also made use of hollow drums lined with porous cloth but used vacuum pressure to pull liquid from the sludge.

Various chemicals including sulfuric acid, sulfur dioxide, alum, peat, lime, and bone ash could be added to the sludge prior to treatment to aid in drying. With all the processes, the removed liquid was returned to the plant influent for further treatment while the sludge went to the sand beds or drying basin. Manufacturing fertilizer required an exceptionally dry sludge and gas-powered heat dryers helped to reduce the moisture below 10 percent.

Sludge digestion tanks allowed for a more thorough processing of the sludge. Anaerobic bacteria reduced the volume of sludge by liquifying organic matter and producing methane gas. Digestion shrank the sludge layer at the bottom of the tank to about a third of its original volume, while the

liquid that bubbled to the top—referred to as "supernatant liquor"—accounted for most of the remaining two-thirds. The supernatant liquor overflowed the tank as new sludge entered and was piped back to the primary sedimentation tank for further treatment. In some cases, it was necessary to pretreat the liquor by running it through a sand bed filter or adding aluminum sulfate or other chemicals. The byproduct gasses of anerobic digestion, being between 60 and 80 percent methane, collected in a dome at the top of the tank. Plants commonly used the gas as fuel to heat the digestion tanks or to operate gas powered engines.

Early sludge digestion tanks took a variety of forms, including rectangular or square, though circular tanks later became the norm. Tanks were usually covered to minimize odors and allow for greater control. Floating covers helped to maintain a constant, uniform gas pressure and became increasingly common.

Heating and stirring the sludge aided digestion. Heating coils wrapped around the interior walls of the tank and were fed by water heated through the burning of the captured methane gas. Partially or fully burying the tanks helped to maintain uniform temperatures. Because heating increased the speed of digestion, smaller tanks could be used while still maintaining the same volume of processing. In cold climates, heating could reduce the tank size by around half, but gains were less significant in mild winter environments as prevailed through Southern California. A variety of mechanical stirring devices kept the sludge in circulation and ensured even heating and digestion.

A two-stage digester divided the process between primary and secondary tanks. The primary tank handled approximately three-quarters of the digestion and most of the gas production before passing the partially digested sludge through a pipe to the secondary tank. Secondary tanks were larger than the primary tanks but were generally unheated. This allowed for a slow but economical digestion that produced a cleaner final product with lower disposal costs.2

3. The Era of Advanced Treatment, 1950 – c.1980

Regulatory policy evolved rapidly in postwar America, catching up with the technological advances made in the first half of the century. The emergence of environmentalism as a political force compelled higher standards of water and sewage treatment that were codified in state and federal law. By the end of the era, secondary treatment was required for nearly all municipal wastewater discharges and most plants met this standard by using technologies that had been created in the early twentieth century. New environmental and health threats posed by synthetic nutrients and industrial toxins led to advanced wastewater treatment methods that processed effluent to near potable standards. These new processes largely built upon existing biological treatment methods, adding new bacterial populations or coagulating chemicals, rather than representing a fundamental break from established methods.

Knowledge

Environmentalism
Environmental concerns largely supplanted public health as the principal driver of sanitation policy in postwar America. Environmentalism emerged as a major force in popular culture in the early 1960s as it gave form to shifting attitudes about the economic, recreational, scientific,

aesthetic, and spiritual values of nature. It coalesced as a mass political movement in the 1970s and found expression in a series of state and federal acts that provided the basis for modern natural resource policy. For the managers of public drinking water and wastewater systems, this required meeting more exacting standards of chemical and biological purity and led to a greater degree of uniformity across systems. Still, the American public and policy makers continued to trust science and technology to overcome the problems of pollution, and the focus was on improving existing treatment methods to meet rising demands, rather than challenging deeply held ideals of economic growth and material progress.

Environmental policy, as it related to water treatment systems, reflected changing understandings of health risks and new insights from the study of ecology. The advances of the early twentieth century had largely eliminated waterborne disease as an issue for public water systems. Focus thus shifted from biological contaminants to chemical toxins. Canneries, refineries, foundries, and chemical manufacturers had long dumped their waste products into coastal waters and interior rivers, but the scope and scale of industry expanded dramatically leading up to and during America's entry into World War II in 1941. Aircraft plants in Southern California and shipyards around the San Francisco Bay introduced novel chemicals into the water supply with little monitoring or regulation, owing to the emergency nature of wartime production. The thick, acidic smog that filled the Los Angeles basin in the late war years was the most visible sign of increasing pollution, but the problem was also evident in tests of surface and groundwater quality. The eutrophication (excessive growth of aquatic plants) of inland waterways, caused by an excess of synthetic plant nutrients, produced striking evidence of environmental harm in the form of reoccurring toxic algae blooms and fish kills.

Cancer became the defining illness in the new era, replacing typhoid fever as the primary water-quality health concern among the public. By the late 1970s, it was estimated that one in four Americans would contract cancer during their lifetimes and two-thirds of those would die from it. Studies showing cancer rates to be twice as high in cities as in rural districts pointed to the polluted environment as a chief cause. For decades, federal and state authorities were unable to gather even basic data about the chemicals being released into waterways. Industrial interests strenuously resisted disclosing information about their chemical use for fear that it would reveal trade secrets and make them liable for cleanup efforts. Only with the passage of the Clean Water Act in 1972 did the federal government gain legal power to require reporting by industrial dischargers. Court action by the Natural Resources Defense Council later compelled the Environmental Protection Agency (EPA) to begin actively regulating toxic pollutants, and amendments to the Clean Water Act in 1977 established a list of toxins that were subject to strict control on a set timeline.

The science of ecology, which matured during the postwar era, allowed for an intellectual understanding of the threat through its study of natural cycles and complex biological and chemical webs. The 1962 publication of Rachael Carson's Silent Spring on the danger of synthetic pesticides crystalized these concerns and alerted the public to the ability of persistent toxics to accumulate through the food chain. Support for environmental protection cut across partisan and demographic lines, but was strongest among the young, well-educated residents of New England and the Pacific Coast states. California, with its booming population and unrivaled natural riches, emerged as an obvious leader of the movement. The state pioneered environmental legislation including creating air pollution control districts in Los Angeles (1947) and the San Francisco Bay counties (1955);

passing the nation's first automobile anti-smog law (1960); organizing regional planning bodies such as the San Francisco Bay Conservation and Development Commission (1965) and Coastal Zone Conservation Commission (1972); and enacting both the California Endanger Species Act and California Environmental Quality Act in 1970. The key water quality acts, the Dickey Water Pollution Act (1949) and Porter-Cologne Water Quality Control Act (1969), are discussed further below. Federal legislation often coincided with or followed the lead of California, including the Clean Air Act (1963), National Environmental Policy Act (1969), Clean Water Act (1972), and the Endangered Species Act (1973).

Sanitary engineers struggled at times to keep up with the shifting focus. In the 1920s and 1930s, engineers had generally been ahead of the public in advocating for high standards of purity in the state's waterways. By the 1960s, however, the situation had reversed. The public treated almost all forms and quantities of pollution as illegitimate while engineers worried over the economic cost of rigid standards. Wilfred Langelier, the UC Berkeley chemist, expressed what he felt was a common belief among scientists that the public could not appreciate "the exorbitant cost" involved in attempting to remove "the last few degrees of pollution."269Advanced wastewater treatment methods (discussed below) were effective at removing heavy metals, excess nutrients, pathogens, and other potential toxins, but came with high chemical, energy, and construction costs. Langelier and others of his generation regarded environmentalists as lacking in the cleareyed pragmatism needed to confront the problems.

Some younger sanitary engineers, however, found a new center of identity for the discipline in environmentalism. They critiqued the energy- and chemical-intensive methods required for conventional wastewater treatment and advocated for processes more integrated with ecological cycles. They developed an assortment of treatment systems using aquatic plants, natural or constructed wetlands, and various types of lagoons. The Arcata Marsh and Wildlife Sanctuary in Humboldt County is exemplary of this new approach. The City of Arcata and Humboldt State University began experimenting with wastewater aquaculture in 1969 and determined that juvenile salmon and trout could develop in mixtures of partially treated wastewater and

seawater, demonstrating that wastewater could enhance wildlife habitat rather than presenting merely a problem of disposal. Between 1979 and 1983, the city and associated partners developed a test program for using constructed wetlands to treat wastewater in a cost-effective and environmentally sound manner. By 1986, the city had completed 100 acres of freshwater and salt marshes, brackish ponds, tidal sloughs, and estuaries that received treated effluent from the adjacent existing wastewater treatment plant. The marshes further clarified the effluent while providing habitat for fish and wildlife. The wildlife sanctuary is now recognized as one of the premiere locations for seeing migratory birds along the Pacific Coast, and the innovative system has become an international model for ecologically responsible wastewater reuse.

Advanced Wastewater Treatment

Advanced wastewater treatments target nutrients and contaminants that conventional primary and secondary treatments cannot fully remove. These treatments aim at two principal goals: preventing eutrophication in inland waters through the removal of nitrogen and phosphorous, and allowing for the reclamation of wastewater effluent by cleansing it of heavy metals, organic chemicals, inorganic salts, and pathogens. Advanced treatments differ in their specifics from conventional

treatment but largely employ familiar processes of chemical coagulation, biological digestion, and mechanical filtration. While advanced treatment methods are sometimes identified as "tertiary treatments," the two terms are not strictly synonymous. Advanced treatments may follow secondary biological treatment in a plant's flow, but they may also consist of a modification or replacement of an existing conventional treatment step so that they operate concurrently with primary or secondary treatment. Research into advanced treatment methods began in the early 1960s and pilot plants were in operation by mid-decade in the most environmentally sensitive locations such as Lake Tahoe. The tightening of state and federal environmental standards, combined with improved technology and knowledge, spurred wider construction of full-scale plants in the late 1970s and 1980s.

Nutrient Removal

Nitrogen and phosphorous are the primary culprits in human-caused eutrophication. Under natural conditions, algae populations are limited by the available supply of nitrogen and/or phosphorous, both of which are essential for plant growth. When human activities cause an increase in lake, river, or estuary nutrient levels, aquatic plant growth accelerates and the resulting algal blooms can interfere with water uses, in addition to being potentially toxic. Under severe conditions, the bacterial decomposition of algae depletes water of its oxygen supply, leading to fish kills and "dead zones" within water bodies. Eutrophication in the Great Lakes in the 1960s attracted national attention and was a major factor in the passage of the Clean Water Act.

Manufactured fertilizers and synthetic laundry detergents were the chief source of excess nitrogen and phosphorous, respectively, and the production of both increased dramatically in the postwar decades. The United States government invested heavily in nitrogen production during World War II, building large nitrogen-synthesizing factories to manufacture high explosives for munitions; at war's end, these plants shifted to producing fertilizer. The first all-purpose synthetic laundry detergent appeared near the same time, in 1948, and by 1953 the sale of synthetic detergents surpassed those of traditional soaps. The American public made enthusiastic use of these cheap and effective marvels of modern chemistry, but the excess nutrients readily found their way into streams and groundwater basins.

Conventional wastewater treatment removed only a portion of the dissolved nitrogen and phosphorous that entered a plant. Most of the forms taken by phosphorous are soluble and therefore plain sedimentation did not act upon them. In biological treatments, microorganisms absorbed some 20 to 30 percent of the phosphorous in support of their growth, but the remainder passed through to the effluent. Likewise, only about 25 percent of nitrogen was removable by sedimentation or biological uptake. These substances also caused problems within the treatment plants as operators blamed detergents for causing foaming within activated sludge basins and hindering sedimentation by emulsifying solid particles.

Engineers developed chemical methods for removing phosphorous and nitrogen from wastewater in the 1960s. Phosphorous removal was by chemical precipitation using metal salts or lime as a coagulant. Pickle liquor, a waste product of the steel industry, provided an inexpensive source of iron salt in industrial regions and was the most commonly used coagulant. The salts could be added at any stage of the treatment process. Some plants mixed it with raw influent before primary clarification, others added it to their activated sludge tanks as part of secondary treatment, and still

others mixed it with the secondary effluent for a tertiary stage of treatment prior to final clarification. Lime was used in either primary or tertiary treatment. When used as tertiary treatment, the chemicals required mixing and sedimentation basins and the effluent was commonly filtered before discharge.

Nitrogen exists in a variety of forms including as ammonia, nitrate, nitrite, gaseous nitrogen, and bound to organic matter as in ammino acids and DNA. In wastewater, its principal forms were organic from fecal matter and kitchen or agricultural waste and as ammonia from urine. Biological decomposition as part of secondary treatment converted most of the organic nitrogen to ammonia. Ammonia could then be air stripped from wastewater if the pH was first raised to around 11 (extremely alkaline) with a heavy addition of lime. The water was pumped into a stripping tower where it dripped downward while forced air blew around it. This converted liquid ammonia to a gas and released it to the atmosphere, reducing effluent ammonia levels by 90 to 95 percent. This process was fairly simple but involved additional pumping expenses and functioned poorly at low temperatures. Heavy chlorination (called breakpoint chlorination) could also reduce ammonia by converting it to nitrogen gas, nitrous oxide, and other forms. However, the process raised the total level of dissolved solids in the effluent and could leave excessive levels of chlorine, both of which required additional treatment steps before effluent discharge. An ion exchange process, similar to that used in water softening, also existed for nitrogen removal, though it remained a poorly understood and experimental technology.

Chemical treatments were successful and generally uncomplicated to manage, but they were also expensive as they needed continual large chemical inputs and produced copious volumes of sludge that required disposal. In the 1970s, James Barnard, a South African engineer, sought biological methods of nitrogen and phosphorus removal that would be better adapted to the requirements of his country. This required manipulating environmental conditions in biological treatment tanks to encourage the growth of microorganisms that could feed upon the nutrients. Biological treatment had developed with a narrow goal of reducing organic matter, but once the plants were in place, they provided the means for addressing other pollutant problems. Retaining and returning a greater volume of activated sludge to the aeration tanks allowed for slower-growing bacteria to develop. This exposed pollutants to a larger variety of organisms with unique biochemical strategies for converting organic and inorganic matter into the energy and materials needed to sustain life and reproduce.

The digestion of nitrogen involved a two-part nitrification-denitrification process in which bacteria first oxidized ammonia to nitrate and then different groups of bacteria biologically reduced the nitrates to nitrogen gas. Nitrification occurred in presence of oxygen, while denitrification required anoxic conditions with very low oxygen levels. Phosphorous removal relied on microorganisms that stored phosphorous in excess of what they required for biological growth (known as phosphorous-accumulating organisms or PAOs). PAOs also had a two-phased growth cycle that required alternating anoxic and aerobic conditions. Generating the two-phase aerobic and anoxic environments required either modifying existing activated sludge aeration tanks to wall-off an anoxic chamber or constructing new anoxic tanks following the aeration chambers.

By 1974, Barnard had established pilot projects capable of removing nitrogen and phosphorous separately. After several additional years of experimentation, he found means of combining the

processes, allowing for the simultaneous removal of both nutrients through biological means. This process became known as Biological Nutrient Removal or BNR. Florida constructed the first combined phosphorous-nitrogen BNR plant in the nation in 1979. A half-dozen BNR plants operated across the county by the mid-1980s, testing and refining the processes. Ultimately, BNR proved to be less expensive to operate than chemical methods and was capable of purifying effluent to a higher standard. However, these biological methods required much more monitoring and adjusting of environmental conditions, necessitating a high level of technical skill among operational staff. The combination of chemical and biological methods was often the most cost effective, particularly where it allowed for existing equipment to be modified without requiring new construction. By 1994, some 300 BNR plants were in operation, including 16 in California.

Lake Tahoe, on the California-Nevada border, was one of the first bodies of water in the nation to benefit from advanced nutrient control. The clear blue waters of Lake Tahoe were a major tourist draw for the region and warranted a high level of protection. The Bureau of Sanitary Engineering had prohibited all direct sewage disposal to the lake since the 1920s, but effluent continued to be disposed of by spray irrigation to land within the Tahoe Basin and runoff from these sites contributed to eutrophication. In 1961, the South Tahoe Public Utility District began laboratory and pilot plant studies in Oregon to test the effectiveness of chemical coagulation, filtration, and carbon absorption on nutrients. The district constructed a small-scale plant in the Lake Tahoe Basin in 1965 and expanded it over the following years. The plant design mixed secondary effluent from activated sludge tanks with a lime coagulant and then passed it through filter beds and columns of activated carbon. The district added a nitrogen stripping tower in 1969. The plant served as a national testing ground for innovative technologies, both for the direct treatment process and for such secondary tasks as coagulant recovery and carbon regeneration. The recovery of lime saved little on chemical costs, but reduced the volume of sludge requiring incineration by about half.

Additional facilities added throughout the Tahoe Basin in later years included a 1974 biological-chemical phosphorous removal plant to treat the waste returned from sludge digestion at the Truckee Meadows plant; tertiary chemical phosphorous removal and ion exchange ammonia removal facilities at Tahoe-Truckee in 1976; and a denitrifying trickling filter at Truckee Meadows in 1985. Cold winter conditions required that many of these processes be contained in covered tanks or sheltered in buildings. Biological processes later replaced most of the original chemical ones as technology continued to evolve.

Wastewater Reclamation

Californians have made planned reuse of municipal wastewater since at least 1888, when Pasadena established the first municipal sewage farm in the state. The State Board of Health crafted regulations governing the agricultural reuse of wastewater in 1918, and ultimately more than 100 cities or institutions disposed of their wastewater effluent to agricultural users at some point prior to World War II. For the most part, however, these users valued sewage farms as a convenient means of disposing of wastewater and treated the reuse of water as only a secondary, almost incidental benefit. San Francisco's Golden Gate Park activated-sludge treatment plant, completed in 1932, was the first facility in the state specifically created to provide a source of recycled water. The purified effluent irrigated the park landscaping, filled scenic ponds, and cascaded down manufactured waterfalls. In 1961, the Santee County Water District outside of San Diego used treated effluent to fill a series of artificial lakes that provided public access for boating, fishing,

and swimming, making it the first planned use of reclaimed water for recreational purposes. The Santee Lakes did not include tertiary treatment methods, which were not yet economically viable, but instead discharged the activated-sludge treatment plant effluent into a spreading basin a mile from the lakes. The effluent combined with subsurface creek flow and percolated horizontally through the gravel bed to fill the lakes. Extensive testing demonstrated that the water was safe for bodily contact, but the facility struggled with high nutrient levels that caused algae blooms and necessitated expensive deodorizing and disinfecting agents. The introduction of viable tertiary treatment methods in the 1970s increased the diversity of uses for reclaimed water in California to include industrial applications, groundwater recharge, landscape and golf course irrigation, and environmental enhancement.

The term "recycled water" refers to wastewater that has been treated to a quality suitable for beneficial use in either potable (groundwater recharge) or nonpotable (irrigation, industrial) applications. In common practice, recycled water referred chiefly to purified wastewater originating from a municipal treatment plant, while "water reuse" applied to the repeated cycling of graywater at a single facility such as an industrial plant or golf course. Historically, the term did not specify a particular level or type of treatment, nor did it apply to highly treated water that discharged to natural waterbodies. All the processes used in nutrient removal were also employed in treating recycled water (and to a lesser degree vice-versa), so the two differed primarily in the handling of the final effluent by either discharge or reuse. However, because some applications of water reuse involved great probability of human contact, higher standards applied for the removal of organic matter, inorganic salts, heavy metals, and viruses. While recycled water could achieve high levels of purity, public perception remained an obstacle to greater use of the resource. Though some 300,000 visitors made annual use of Santee Lakes, the facility was still jokingly derided as "piss lake." Only one comparable recreational project in Lancaster opened during the historic period and no domestic use was made of recycled water despite it exceeding drinking water standards.

The wastewater recycling process started with conventional treatment in an activated-sludge tank, perhaps with iron-salt coagulant enhancement for nutrient removal. Coagulation with lime commonly followed, using tertiary mixing and sedimentation basins. The lime precipitated heavy metals, suspended and dissolved organics, and phosphates, while the alkaline conditions at a pH above 11 killed bacteria and viruses. The alkaline solution could then be sent to a stripping tower for removal of ammonia and volatile organics. In cold climates, ionic exchange might substitute for air stripping. Recarbonization by injection of carbon dioxide returned pH levels to near neutral (7) to prevent the buildup of calcium carbonate scale in subsequent equipment and to recover some portion of the lime. Filtration beds or pressured tanks with activated carbon then removed fine matter and any remaining coagulant. Disinfection by chlorination, ozone, or ultraviolet (UV) exposure followed. Finally, reverse osmosis, a technology first developed for drinking water desalinization, removed inorganic salts, trace metals, and dissolved organics.

The Central Contra Costa Sanitary District, in conjunction with the Contra Costa County Water District, constructed one of the first modern wastewater recycling plants in the early 1970s in order to supply nearby industrial users along the southern shore of Suisun Bay. The sanitary district constructed a full-scale test facility at its existing wastewater treatment plant in Martinez in 1971. The facility used preliminary lime treatment ahead of an activated sludge tank enhanced for

nitrification, followed by ammonia stripping. On a larger scale, Orange County Water District completed its Water Factory 21 in 1975. The plant, named for the belief that it would serve as a prototype for meeting twenty-first-century water needs, treated wastewater with chemical coagulation, air stripping, filtration, and reverse osmosis. The effluent was blended with deep well water and then injected into the groundwater basin through a series of wells to replenish local groundwater basins and buffer against saltwater intrusion.

Advanced Drinking Water Treatment

Drinking water treatment prior to World War II focused on the major public health impacts caused by pathogenic microorganisms. The heightened environmental consciousness of the 1960s and 1970s shifted attention to other pollutants, including synthetic organic compounds and such inorganic contaminants as arsenic, chromium, fluoride, lead, mercury, nitrates, and silver. These substances entered the water supply either as naturally occurring minerals or as industrial and agricultural waste byproducts. No single treatment method was effective for the removal of all contaminants, so different processes were developed to target particular problems. As relatively little was known about the effectiveness of removal technologies, the EPA conducted pioneering research at its Robert A. Taft Sanitary Engineering Center in Cincinnati, Ohio. The basic philosophy of treatment was to employ conventional techniques such as coagulation and lime-and-soda-ash softening first and to use more advanced techniques only as needed. These new technologies, discussed below, included ion exchange, reverse osmosis, the use of activated carbon, and disinfection by ultraviolet (UV) radiation. Electrodialysis and distillation were also experimented with, but these methods were expensive and were employed only in special cases, such as for industrial processes that required high levels of water purity. All these technologies were also used in wastewater treatment, with some minor modifications of procedures.

Ion Exchange

Ion exchange had been a common feature of water treatment since the early twentieth century when it was introduced for water softening. Subsequent developments expanded the range of materials that ion exchange could strip from the water beyond just the hardwater minerals of calcium and magnesium to include nitrate, tannin, fluoride, barium, arsenic, and uranium. The earliest progress was made by altering the chemical and physical properties of greensand, the rock used in water softening, to increase its effectiveness. Later work experimented with other natural materials that had intrinsic qualities favorable to ion exchange, as for example with bone char's ability to absorb fluoride. USPHS constructed a full-scale deflouridation plant in Britton, South Dakota, in 1953 that utilized ground and charred animal bone for ion exchange with a caustic soda used for regeneration. However, natural materials had limits that were difficult to overcome. Because bone is soluble in acid, the South Dakota plant had to carefully regulate the pH levels of the raw water. This added expense that made the plant cost inefficient and it closed in 1971.

The introduction of synthetic resins allowed for far greater control over the ion exchange process. English chemists manufactured the first synthetic resins in 1935. While greenstone worked only with positively-charged cations such as calcium, magnesium, and barium, the new synthetic material could be modified to attract negatively-charged anions such as nitrate, arsenic, and uranium. Extensive research conducted after World War II led to the discovery of organic polymers that produced a resin of superior strength and stability with less pH sensitivity. Having greater control over the molecular structure of the resin allowed for assembling materials with

large surface-area-to-volume ratios, and the typical resins resembled beads with a porous whiffle ball structure. This permitted processing far greater quantities of water using the same sized tanks, and the tougher materials could withstand stronger salt brines so that regeneration occurred in a matter of minutes rather than hours. Customizable resins also allowed for engineering the ion exchange process to optimally target particular contaminants. By the late-1970s, dozens of different synthetic resins were commercially available to deal with a wide range of mineral removal needs.

Municipalities began to construct full-scale facilities using the new ion exchange processes in the mid-1970s. A 1974 plant constructed by the Garden City Park Water District on New York's Long Island was indicative of these facilities. The plant design was based on a prototype facility operated by Oak Ridge National Laboratory in Tennessee beginning in 1970. Its innovative features included a process for continuous resin regeneration. A hydraulic pulse flow pushed the resin material through a closed loop that included treatment, regeneration, and rinse phases. Each phase lasted around 15 minutes, followed by a hydraulic pulse of a few seconds duration. The sodium chloride regeneration thus operated continuously, recharging a portion of the resin at a time, rather than requiring the ion exchange to halt while the full load of resin was recharged as in conventional batch operations. The continuous regeneration process became standard in desalination plants and was later expanded to other ion-exchange facilities.

The vessels used in the new ion exchange systems did not differ substantially from their water-softening predecessors. The tanks continued to resemble pressure filters with components to regulate the in- and out-flow of treatment water, regeneration solution, and backwash water, along with sampling taps. As with most treatment equipment, the tanks commonly were paired to allow processing to continue while one tank was regenerated. Two nearby holding tanks, constructed with special lining to resist corrosion, contained the fresh and used regeneration solution. As the ion exchange process became increasingly specialized, plants sometimes added multiple pairs of tanks in serial, with each pair focused on removal of a particular contaminant.

Reverse Osmosis

Osmosis is the process by which a solvent liquid naturally moves from an area of low dissolved mineral concentration, through a membrane, to an area of high concentration until an equilibrium is reached with both sides having equal solvent to dissolved mineral ratios. In reverse osmosis, pressure is applied to the high concentration side of the membrane so that the flow of solvent is reversed. The semipermeable membrane was engineered to selectively allow water molecules to pass through but not larger mineral or biological molecules. This process could extract pure water from high-concentration inputs, such as salt water, or treat raw water to remove microbiological pathogens and essentially all dissolved organic or mineral contaminants. Reverse osmosis differed from ordinary water filtration in that it processed solutions at a molecular level and could remove dissolved chemicals, while filters could only screen suspended, not dissolved, matter. Filters also trapped the removed particles and thus required regular backwashing. Membranes acted as a barrier but did not physically capture the impurities, so they remained cleaner and required less maintenance. A chief disadvantage of reverse osmosis technology was its high energy inputs. The pressure required to purify water, using 1970s technology, was usually several orders of magnitude greater than the natural osmotic pressure, and ranged from 200 to 1,500 psi.

Efforts to desalinate seawater drove innovation in reverse osmosis technology. Researchers at the University of California, Los Angeles (UCLA) and the University of Florida created the first workable membranes in the 1950s, though the practice remained impractical until improved membranes became available in the mid-1960s (see discussion of desalination below). Researchers recognized the potential for reverse osmosis to be of use in purifying drinking water, but technical challenges and energy costs prevented it from being widely adopted by public utility companies during the historic period. Instead, industrial manufactures were the leading adopters as they required high-purity water for making pharmaceuticals, semiconductors, and consumer food and beverage products.

A typical reverse osmosis treatment unit consisted of a high-pressure pump connected to a rack of filter cartridges (Figure 61). The cartridges commonly contained two flat sheets of membrane material separated by porous sheets through which the feed water and treated water flowed. The sheets were laid flat then spiral wound within the cartridges like rolls of giftwrap. Most units were automated to regulate flow rates and pump pressure.

Activated Carbon

Carbon's ability to purify water of foul tastes and odors has long been recognized. For centuries, sailors charred the inside of their wooden water barrels to keep the water fresh. However, only in the twentieth century did activated carbon begin to be produced on an industrial scale. Carbon could be made from a variety of substances including wood, nutshells, peat, and petroleum products. Much of the activated carbon used in water treatment was manufactured from coal that was converted to carbon by heating it in the absence of oxygen to prevent burning. The material was then exposed to steam at high temperatures, fracturing the carbon and forming many interconnected pores of various sizes. This gave the activated carbon a very large surface area, so that one pound of activated carbon could have a total surface area of more than 150 acres. Organic compounds of various sizes would adhere to the surfaces and thus be filtered from the water.

Activated carbon came in two commercially available forms, powdered or granular, determined by the particle size. Powdered activated carbon (PAC) was the first form to be used for water treatment beginning in the late 1920s. Plants mixed the dry powder or a prepared slurry into raw water prior to the normal coagulation and sedimentation step. With adequate contact time, the carbon absorbed the organic compounds that caused undesired tastes, odors, and colors. Sedimentation or filtration removed the PAC to prevent it entering the distribution system. The carbon could not be easily recovered, as it mixed with sedimentation sludge, so it was disposed of as a waste product. By 1943, about 1,200 American treatment plants made at least occasional use of PAC for odor and taste control.

The advantage of granular activated carbon (GAC) was that it could be reused, allowing for continual removal of organics. GAC was first mass produced during World War I for use in gas masks, and further manufacturing improvements were realized during the 1940s. A Hopewell, Virginia plant installed the first major GAC filter for odor and taste control in 1961. Where the total organic load of the water source was not exceptionally high, GAC was simply added to an existing rapid sand filter. A layer of GAC, approximately two feet deep, was either laid on top of the filter layers or replaced the existing media, in which case it acted as both an absorbent and a

filter. The effective life of GAC varied between a few months and several years, depending on the quantity and type of organics being removed.

The early use of GAC focused on traditional issues of odor and taste, but by the late 1960s concern had shifted to the presence of synthetic organic compounds (SOCs) in the water supply. These included a wide variety of pesticides, industrial chemicals, and oils. By the late 1970s, the EPA had identified 253 SOCs in municipal water distribution systems, post treatment, that were suspected carcinogens. Reducing the concentration of these compounds to presumed safe levels required more intensive filtration. Carbon columns, also known as GAC contractors, resembled pressure filters, being cylindrical tanks with beds of media through which the water was forced under pressure. These columns were similar in design to those used in wastewater treatment plants, as with the South Tahoe facility. Carbon columns were generally included at the end of the drinking water treatment process, just ahead of final disinfection. Portable GAC contractors, mounted on trucks or skids, allowed for emergency decontamination of small systems, as when a rural well was found to have high pesticide levels. These portable systems were designed for temporary use while permanent solutions were arranged.

UV Disinfection

The use of UV radiation to disinfect drinking water and wastewater emerged from regulatory pressures in the late 1970s that discouraged an overreliance on chlorine. Scientists had known since the late nineteenth century that UV light could kill microorganisms, and UV radiation was used to disinfect drinking water as early as 1906. However, the introduction of chlorination two years later effectively ended experimentation with UV disinfection. Later, as environmental concerns grew, regulators sought to balance the need to control pathogens with the impact of chlorine residuals on the environment. In the late 1970s, the EPA began funding research into chlorination alternatives and making grant funds available for construction. Experiments were made with ozone, bromine chloride, and chlorine dioxide as disinfectants, but UV radiation emerged as the principal alternative to chlorine.

UV light offered several advantages as a disinfectant, chief of which was that it did not produce any toxic by-products during the treatment process. UV light operated with relatively simple equipment, principally mercury arc lamps, and because it killed viruses and bacteria almost instantly, it required shorter retention times and thus smaller contact chambers. UV light also dispensed with the need to handle and store dangerous chemicals and there was no chance of overapplication. However, because UV light left no residual disinfectant in the water, it was necessary to still add a low dose of chlorine to handle any microorganisms living in the distribution system.

Prompted by the EPA research and grant program, several small companies emerged to develop UV light systems that could handle the unique issues of drinking water and wastewater treatment. Many first-generation systems were made operational in the late-1970s and early-1980s, but most suffered from basic design flaws that rendered the equipment inefficient and unreliable. A lack of scientific information and industry standards made it difficult for plant operators to determine the right size and configuration for their equipment, and repairing the rapidly evolving equipment was challenging. As a result, even at the end of the twentieth century, less than one percent of the nation’s drinking water supply was treated with UV radiation.

Fluoridation

The fluoridation of public water supplies proved to be the most controversial water treatment issue in the postwar decades. Fluoride occurs naturally in many groundwaters and is particularly prevalent in mountainous regions with volcanic geology. Where fluoride levels are exceptionally high, dental fluorosis can result, producing an aesthetically undesirable mottling of tooth enamel. It was such cases of excessive fluoridation that first attracted scientific interest, with the earliest studies occurring in Colorado Springs in 1909. Investigations by USPHS linked the condition to water supplies in the 1920s and identified fluoride as the culprit in 1931. During their studies, researchers had noted that children with mottled teeth also had low incidences of tooth decay. This led the National Institute of Health (NIH) to try to determine if there was an ideal level of fluoride that would strengthen teeth without marring them. By the late 1930s, NIH had identified an upper limit of one part per million that would cause only minor fluorosis in a small portion of the population.

In 1945, Grand Rapids, Michigan, installed the world's first municipal fluoridation facility, followed the same year by Newburgh, New York, and Evanston, Illinois. NIH and the US Surgeon General closely studied the pilot programs and found that the rate of tooth decay among children declined by as much as 60 percent. By the end of the decade, USPHS, the AMA, the American Dental Association, and the National Research Council all endorsed drinking water fluoridation as safe, effective, and inexpensive. A major public health breakthrough, fluoridation made tooth decay a preventable disease for the first time in history. Fluoridation of the domestic water supply expanded rapidly between 1950 and 1953. San Francisco and Antioch added fluoride to their water supplies in 1952, the first cities in California to do so.

Popular opposition to fluoridation gained traction in 1953. Some 60 cities nationwide reversed themselves over the next decade, halting fluoridation programs that they had earlier begun. In California, 36 communities held referendums on the matter, and in 25 cases voters rejected beginning or continuing fluoridation. Opponents voiced a variety of concerns. Some objected in principle to the idea of forced medication or challenged the addition of any chemical to a natural water supply, echoing earlier complaints about the use of chlorine in water treatment. Others noted that sodium fluoride in large doses functioned as a rat poison and worried about the potential of accidentally providing a toxic dose to humans. In the context of the Cold War, some feared that saboteurs might use fluoridation as cover for introducing harmful substances into the water supply, while figures on the fringe insisted that fluoridation was a communist plot to weaken Americans.

Nationally, the supporters of fluoridation prevailed in the long run, backed by the unwavering support of public health officials and the clear and measurable dental health improvements in towns that embraced fluoridation. The introduction of fluoridated toothpastes in the early 1970s lessened tensions around the issue and proponents benefited from the greater calm. By 1980, half of the national population consumed water enhanced with fluoride. California, however, lagged the national trend. In a much-watched campaign, Los Angeles voters strongly rejected fluoridation in 1974. As late as 1992, less than 16 percent of the state's population received fluoridated water, the fourth lowest percentage in the nation. That figure has since increased as a result of legislation in 1995, but California still ranks below the national average.

Water treatment plants inject fluoride as one of the final steps of treatment following filtration to avoid any loss that could occur in reaction with other chemicals. For groundwater systems, injection is either at individual well pumps or in a common line leading to a storage reservoir. No specific type of injection equipment is standard across all plants. Small systems commonly use a solution tank and metering pump with a line to the watermain. Larger plants may use dry or solution feeders, depending upon what commercial form of fluoride is most economical for their purposes. The fluoride feed system is frequently automated, with flow meters used to regulate and adjust the feed rate.

Political Organization

Prior to 1949, the California Department of Public Health had been the chief agency responsible for regulating water pollution and it issued permits for all new sewage disposal sites in the state based upon the recommendations of its Bureau of Sanitary Engineering. The permitting process had originated as a means of providing technical engineering review of proposed treatment plants, and it was thus fundamentally oriented towards regulating the means of pollution abatement rather than the end results. The department did not establish general guidelines for the quantity and quality of sewage discharge, but undertook a site-by-site review to ensure that plants operated as designed and did not endanger the public health or cause a nuisance. By the end of World War II, this system was widely understood to be inadequate and in need of replacement.

The California Legislature in 1949 passed the Dickey Water Pollution Act to overhaul the regulation of water quality. The act created a State Water Pollution Control Board and nine regional boards with authority over water pollution and nuisances. The State Board served as a review authority for appeals of regional board decisions, formulated state-wide policy, and directed a research and construction financing program, but it was to defer to the authority of the regional boards for prescribing and enforcing discharge requirements. The regional boards were established in the nine major drainages (hydrologic basins) of the state and each was composed of five individuals appointed by the governor. The boards were to represent the various regional water interests with the five board members drawn one each from the ranks of irrigated agriculture, industry, water supply organizations, municipal government, and country government. In theory, the conflicting interests of the board members would be so balanced as to prevent requirements from being overly stringent or lax.

The Dickey Act repealed the earlier permitting system through the Department of Public Health and replaced it with a method that set overall standards of water quality, but did not specify what means were to be used to meet those ends. Municipalities no longer had to submit their treatment plant designs for technical review by the state so long as they could met the water quality standards. The act defined pollution as “an impairment of the quality of the waters of the State by sewage or industrial waste to a degree which does not create an actual hazard to public health but which does adversely and unreasonably affect such waters for domestic, industrial, agricultural, navigational, recreational, or other beneficial uses.” The pollution control boards thus had jurisdiction over the economic aspects of waste discharge. The definition excluded substances that created an actual hazard to public health through the spread of disease or introduction of a toxic poison, and these remained the jurisdiction of local and state health officials who could order an immediate abatement of such conditions.

In 1969 the state legislature passed the Porter-Cologne Water Quality Control Act that substantially revised the Dickey Act. Described at the time as "the toughest water quality act in the nation," Porter-Cologne added strong enforcement tools, created an enhanced role for public participation, and for the first time recognized aesthetic enjoyment as a legitimate value meriting protection.314The act retained the nine regional boards and the state board under a new name as the State Water Resources Control Board. The regional boards were expanded to nine members with additional representation from water quality experts and private associations concerned with recreation, fish, and wildlife. The act strengthened the state's regulatory role by explicitly redefining the discharge of waste as a privilege that could be revoked, rather than as a right that might enjoy protection as a beneficial use. The definition of pollution was also rewritten so that it applied to any unreasonable impact to beneficial uses, without the requirement that it be an adverse effect, thus allowing for strict standards to protect future uses without having to show present harm. This broadened authority was necessary for protecting a body of water like Lake Tahoe, where the highest standards of treatment were needed to safeguard unique aesthetic values.

The federal government had been slow to engage with water quality issues, historically treating the matter as a concern for local or state government, but this began to change in the postwar era. Through the first half of the twentieth century, Congress repeatedly debated establishing federal water quality standards, but none of the more than 100 introduced bills was ever passed and enacted into law. The US Public Health Service standards for water used in interstate travel, established in 1914, remained the only federal involvement in water quality issues. Then in 1948, Congress passed the Water Pollution Control Act, the first major federal involvement in water quality regulation. The act was limited in scope—it applied only to interstate waters and required consent of the participating states—but it established a precedent for a federal role in pollution disputes.

Debate over the proper federal role in water issues continued through the 1950s and 1960s, coinciding with the emergence of environmentalism as a major political concern. The 1948 act had been regarded as an experiment and it had a sunset provision following a five-year trial period. After extensive negotiations, Congress extended the act in 1953 for another three-year period and then finally made it permanent in 1956, though with major amendments in 1961 and 1965. Federal involvement deepened every step along the way. Federal jurisdiction was extended from interstate waters to all navigable waters in 1961, encompassing every significant waterway in the country. In 1965, a new bureaucracy, the Federal Water Pollution Control Administration (FWPCA), was created to coordinate the federal role. The administration was placed under the Department of Interior in 1966, highlighting the environmental role of water regulation and downgrading the former importance of USPHS. Federal financial assistance also increased regularly, reversing the slump in spending that had come with the end of the New Deal programs and curtailment of emergency wartime funding. Most grant assistance was doled out in modest sums to standalone projects, so that small cities, towns, and institutions were the primary beneficiaries, rather than more comprehensive, regional treatment programs.

In 1972, Congress radically amended the Federal Water Pollution Control Act, creating the modern environmental law commonly known as the Clean Water Act. The act established the federal government's EPA as the leading actor in setting and enforcing water quality standards, with the states in a supporting role. Partially modeled on California's Porter-Cologne Act, the Clean Water

Act asserted a wide range of uses that merited protection including wildlife conservation and recreation, the so-called "fishable-swimmable" goal. The declared objective of the act was "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." This meant rendering the waters safe for wildlife and recreation by 1983 and fully eliminating toxic discharges by 1985. To accomplish this goal, the act focused on individual dischargers rather than establishing general water quality standards that were measured in-stream. Every municipal or industrial point-source emitter of waste was required to obtain a federal permit from the EPA that placed specific limits on the discharged effluent.

A distinctive characteristic of the Clean Water Act was its reliance on technology-based standards. In what was termed "technology-forcing," dischargers were obligated to adopt particular levels of technology regardless of their quantities of discharge or the existing levels of pollution in the absorbing body of water. For municipal treatment plants, this meant adopting secondary treatment methods prior to July 1977 (extendable to 1988). Higher levels of treatment could be required if the permitting agency (EPA or the state) determined secondary treatment to be inadequate. Approximately 86% of municipal plants nationwide met the 1988 deadline and others were placed under court-ordered schedules requiring compliance as soon as possible. The federal law allowed plants that discharged to seawater to apply for waivers from secondary treatment if they could show that natural conditions allowed for waste dilution without unreasonable risk to fish, shellfish, wildlife, or recreational use. California, however, enacted stricter standards in 1974 that prohibited discharge to bays or estuaries unless enhancement of the receiving waters was proven.

Industrial dischargers were required to adopt "best practical technology" (BPT) by July 1977 and upgradable to the "best available technology" (BAT) that was economically available by 1989. In practice, BPT standards were used to control discharges of conventional pollutants that included biodegradable organic substances. BAT controls applied principally to toxic or persistent pollutants. The EPA had authority to define BPT and BAT standards and states had responsibility for enforcing the requirements. To aid compliance with the standards, federal grants were made available for up to 85 percent of construction costs for projects involving innovative technology, versus a maximum of 75 percent for more conventional treatments. These measures spurred innovation in the wastewater treatment industry and led to a fundamental redesign of many industrial processes to decrease the amount of water used, recapture waste byproducts for reuse, and reduce the effluent discharge.

The Clean Water Act addressed only surface waters and did not directly apply to groundwater that provided the drinking water supply for many communities. Investigative reporting in the early 1970s upended assumptions about the safety of municipal water supplies by exposing the existence of potential carcinogens in the tap water of New Orleans and Pittsburgh and lead contamination in Boston. In response, Congress passed the Safe Drinking Water Act of 1974 to coordinate local, state, and federal agencies in protecting drinking water supplies. The program built on the USPHS model of regulating contamination levels in drinking water, but it vastly expanded the scope of the law. While the USPHS regulations had applied to approximately 700 supply systems that provided water for interstate carriers, the Safe Drinking Water Act applied to approximately 40,000 community systems. Under direction of the EPA, the National Academy of Science conducted studies to determine the maximum contaminant levels (MCLs) that were fully protective of human health for biological, chemical, radiological, and physical contaminants. To protect groundwater

aquifers, the act established a permit system regulating underground injections of wastewater, gases, brines, and other potential contaminates.

Under the terms of the Safe Drinking Water Act, states assumed primary responsibility for monitoring public drinking water supply systems and enforcing compliance. States could establish their own MCL standards, so long as they were at least as stringent as federal criteria. The California legislature passed the California Safe Drinking Water Act in 1976. California initially defined a public water system as one having five or more service connections, in comparison to the 15 or more specified in federal law, though the legislature later amended the state code to match the federal definition. The Sanitary Engineering Section of the Department of Health (successor to the Bureau of Sanitary Engineering) regulated an initial 1,084 large water systems, defined as those with 200 service connections or more. Local health departments retained responsibility for the 8,887 smaller systems in the state. The State Water Resources Control Board assumed primary responsibility for the regulation of drinking water in 1994 and has continued to expand and refine the list of substances regulated by MCL criteria through regular updates to the Safe Drinking Water Plan.

Technology

The wastewater treatment technologies developed in the early twentieth century—sedimentation basins, sludge digestors, trickling filters, activated sludge tanks, and the like—remain the primary tools in use today. A sanitary engineer transplanted from the 1930s would immediately recognize and comprehend the purpose and functioning of nearly every major piece of equipment found at a plant constructed in the twenty-first century, although there have been notable improvements to facilities, systems, and processes.

Automation

Automation came late to wastewater and drinking water treatment systems in comparison to such similar industrial processes as oil refining and chemical manufacturing. Basic mechanical automation had been a part of water and sewer systems since the nineteenth century in such forms as floats used for triggering well pumps or automatic flushing tanks used for clearing sewer laterals. Electrically powered systems were employed as early as the late 1920s when the Sanitary District of Chicago installed electric eye monitors in sedimentation tanks to regulate sludge levels. However, treatment plants remained overwhelmingly under manual control into the postwar decades, with operators physically opening and closing valves and gates and taking laboratory measurements of turbidity and pH levels.

Tightening municipal budgets in the 1970s prompted increased adoption of automation to economize on labor, real estate, chemical, and energy costs. The design of prewar plants had followed generally conservative standards and intentionally built-in excess capacity to handle unexpectedly high flows. This added to land acquisition and construction costs and permitted a more loosely controlled operation. Automation promised to maximize efficiency by continually adjusting flow rates, temperatures, pH levels, and other variables to remain within set parameters. This allowed adding treatment capacity to existing facilities, rather than building new plants, and offered savings on chemical, energy, and labor inputs. As an additional benefit, automation held the potential to increase the reliability of the treatment process, necessitating fewer shutdowns and enhancing the quality of the final effluent or water supply.

Treatment plant instrumentation performed two chief tasks: monitoring conditions and automating processes. The first was much more widely practiced than the second. The principal sensors used in the 1970s measured hydraulic flow rates and levels. Of secondary importance were analytical instruments for measuring temperature, pressure, pH levels, turbidity, and chlorine concentrations. These more advanced sensors were not always economical to use as the difficult conditions inherent in sewage treatment generated heavy wear and tear. Air, liquid, and sludge pumps were the principal controllers to be automated. Used in conjunction with autonomous sensors, these could adjust flowrates through the plant and maintain consistent processing rates. Chlorination injections and sludge digester temperature controls were also automated successfully and produced savings in chemical and energy inputs.

By the mid-1970s, every wastewater treatment plant other than the smallest systems had a centralized control room that displayed information gathered from remote sensors, showing the operational status of the plant at a glance (Figure 62). By allowing a single worker to monitor plant operations, control rooms produced labor savings and were the one form of automation almost universally justifiable on economic grounds. A standard control room had display panels and consoles with indicators, recorders, alarms, and automatic and manual controls. The graphic panels frequently were organized into a sequence that followed the plant layout, though as plants increased in complexity this became less feasible. Computers were common at most new plants constructed in the late 1970s, though these primarily served to display and record data, rather than to directly control the treatment process.

Still, automation proceeded more slowly than treatment plant operators and equipment manufacturers expected or desired. When the EPA sponsored a nationwide study of automation in 1976, they found few processes operating by automated control loops and a generally low level of technological adoption. Even where automated systems existed, operators had switched many off to allow for manual override. Experts initially thought that technological limits were the problem and that solutions would emerge as sensors improved, but the biological complexity of sewage treatment proved a larger obstacle. A plant never operated at complete equilibrium, but experienced constant variation as bacterial populations adjusted to diurnal and seasonal changes in inputs and ambient conditions. The underlying biology was only incompletely understood, and even sophisticated models were approximations at best. The objective of plant operations also changed with circumstance. What worked best during ordinary conditions was different from what was required during a storm or following an industrial chemical discharge. The challenge of integrating all these variables presented real limits for automated systems and left most plant operations under human control.

Desalination

Desalination is not a modern concept. Oceangoing vessels have supplemented their fresh water supplies by distilling seawater since at least the early seventeenth century, and humans have understood the principles of desalination for many centuries before then. Distillation methods continued to advance, with small seawater-purification machines becoming ubiquitous among naval ships by the Second World War, but large-scale land-based desalination remained in its infancy into the mid-twentieth century.

In 1952, Congress passed the Saline Water Act, which Secretary of the Interior Oscar Chapman had promoted as a necessary response to an ongoing drought in the Southwest that had begun in 1949. The act initially allocated only $2 million over five years, but with the drought only worsening during that period, Congress increased funding fourfold and created the Office of Saline Water in 1958. They tasked the new office with constructing five demonstration desalination plants in different regions. Coastal regions would desalinate seawater while inland regions would desalinate brackish groundwater. Walter L. Badger Associates designed the first nation's first desalination plant in Freeport, Texas, and construction was completed in 1961. The U.S. Department of the Interior's Office of Saline Water operated the plant, supplying half of its production to Dow Chemical and the other half to the City of Freeport. As a result of the Freeport plants success, support for desalination continued growing over the subsequent decade until the energy crisis of the 1970s made desalination appear less cost-effective.

California's first desalination plant was constructed in Coalinga in 1965. Located in the San Joaquin Valley, the city's water supply came mostly from groundwater, which was growing increasingly brackish. The Freeport plant had purified salt water through distillation, but subsequent research had shown reverse osmosis to be more efficient for treating brackish groundwater. The technology passed the water through semipermeable membranes whose openings were of such a size and shape to permit only water molecules through them, thereby holding back salt and other impurities. Coalinga became home to the first Office of Saline Water demonstration plant that used reverse osmosis in 1965. Though experiments with reverse osmosis had already occurred elsewhere in the United States, two UCLA graduate students developed a new membrane that produced freshwater from saltwater ten times faster than the existing membranes. The Coalinga plant functioned as a test site for the viability of the new membrane, and as such, it was small, supplying only 5,000 gallons per day. Their new membrane was successful, and though only a few additional plants were built in California, they all adopted reverse osmosis. Orange County Water District, for instance, integrated reverse osmosis into its Water Factory 21 completed in 1975. A Santa Barbara plant completed in 1991 had a capacity of 6.7 mgd and was the largest built to date in California. However, the plant was decommissioned after Santa Barbara received a connection to the State Water Project and could more easily import surface water than treat groundwater.

2.4.2 Coalinga Wastewater Treatment Plant Operations

The following is excerpted from the City of Coalinga's Preliminary Engineering Report (AM Consulting Engineers 2023:6-7):

> The City of Coalinga imports its water through the federal Central Valley Project (CVP) supervised by the U.S. Bureau of Reclamation (USBR). Due to the poor groundwater quality in the area, the City does not pump groundwater to supplement the water supply due to its poor quality and high concentrations of sulfates, total dissolved solids (TDS), and sodium. On October 28, 1968, the City entered a 40-year contract with the US Bureau of Reclamation for up to 10,000 acre-feet (ac-ft) of CVP water on an annual basis. This contract expired on December 31, 2008. On January 22, 2021, a long-term contract was signed between the City and the USBR (Contract No. 14-06-200-4173A-IR1-P) that established new rates and extended the City's right to pump up to 10,000 AF of water per year.

Raw water for the City flows from the Sacramento-San Joaquin Delta to the south into either the Delta-Mendota Canal or the CVP California Aqueduct, which discharges in the O'Neil Forebay. From the O'Neil Forebay, water continues to flow south into the California Aqueduct to the point of origination of the Coalinga Canal, approximately 15 miles northeast of the City where Highway 145 crosses over the California Aqueduct. After leaving the California Aqueduct, water is carried in the Coalinga Canal approximately 12 miles south to the City of Coalinga WTP intake. A raw water pump station then lifts the water from the Coalinga Canal to the City's conventional surface WTP.

Surface water from the Coalinga Canal is treated at the City's Water Treatment Plant, which is located approximately 7 miles outside of city limits. The City's surface WTP originally came online in April 1972 with an average daily flow capacity of 8 million gallons per day (MGD) and maximum daily flow capacity of 12 MGD. In anticipation of the increased demands resulting from the construction of the Pleasant Valley State Prison, the capacity of the WTP was increased to receive an average daily flow of 12 MGD and a maximum daily flow of 16 MGD. The Plant provides conventional surface water treatment, with processes that include chemical pretreatment, chlorine disinfection, corrosion control, filtration, flocculation, and sedimentation. As a secondary disinfection, chlorination is used to maintain chlorine residual in the distribution system while reducing further production of disinfection byproducts. Treated water is pumped by a filtered-water pump station into a 27-inch diameter pipeline in Palmer Avenue.

Treated water is pumped by a filtered-water pump station into a 27-inch diameter pipeline on Palmer Avenue. Approximately two miles west of the WTP, the flow tees at Calaveras Avenue. Water flowing west continues for another mile and a half to the Palmer Avenue Reservoir. Water going to the Pleasant Valley State Prison travels south in the 12-inch Calaveras Avenue pipeline to the Calaveras Avenue Reservoir. After flowing through the Calaveras Reservoir, it continues south along Calaveras Avenue another 3.5 miles to Jayne Avenue and then east to the prison. Water can potentially travel from the Calaveras Reservoir westerly into the City; however, this seldom occurs due to the hydraulic conditions. Water leaving the Palmer Reservoir flows through approximately eight miles of 24 and 27-inch transmission mains to the Derrick Avenue Reservoir. Water travels primarily from the Derrick Avenue Reservoir through 18, 24, and 30-inch transmission mains into the City's water distribution system. The distribution system consists of a network of water mains ranging in size from 4 to 14 inches in diameter. The system can supply peak hour needs without excessive losses and can deliver fire flows to main lines.

The City's existing storage reservoirs all consist of steel tanks resting on reinforced concrete ring wall foundations. The following is a description of each of the City's treated water storage reservoirs:

- Palmer Avenue Reservoir – This reservoir is located on the south side of Palmer Avenue and has a capacity of 2.8 MG. This reservoir receives pumped treated water from the WTP.

- Calaveras Avenue Reservoir – This reservoir is located on the east side of Calaveras Avenue and has a capacity of 5.0 MG. Water flows from the WTP to the Calaveras Reservoir and then to the Pleasant Valley State Prison.
- Derrick Avenue Reservoir – This reservoir is located west of the City, on the east side of Derrick Avenue. This reservoir has a capacity of 7.6 MG. Water from the Palmer Reservoir flows to the Derrick Reservoir and then into the City.
- Oil King Reservoir – This reservoir is located west of Highway 33/198, approximately three miles north of Palmer Avenue. The reservoir has a capacity of 0.5 MG and exclusively serves the City's oil company customers.
- Northwest Reservoir – This reservoir is located east of Derrick Avenue, approximately three miles north of Gale Avenue. This reservoir has a capacity of 0.2 MG. Like the Oil King Reservoir, this reservoir is also used exclusively for the City's oil company customers.

Since the Oil King and Northwest reservoirs' sole function is to provide water to oil companies, they are excluded from the evaluation of the City's available storage. The existing combined storage capacity of the Palmer, Derrick and Calaveras reservoirs is 15.4 million gallons (MG).

2.4.3 Coalinga Wastewater Treatment Plant

The WWTP within the APE is part of a wastewater collection and treatment system for the urbanized areas of the City of Coalinga that includes more than 42 miles of sewer pipelines (6 in. to 24 in. in diameter). As of 2023, the WWTP within the APE serves 3,369 residences and 318 businesses. The WWTP "treats and discharges the municipal wastewater generated by residences and businesses within the City. The treatment process at the City's WWTP consists of screening, primary clarification, and secondary treatment (aerated facultative lagoons followed by stabilization lagoons)" (AM Consulting Engineers 2023:16).

The first step in the treatment process is screening the wastewater that enters the system at the headworks, and the large debris is screened out. Then the wastewater continues through a Parshall flume with an ultrasonic-level transducer that measures and records plant flow data.

According to AM Consulting Engineers (2026):

> Pretreated effluent from the headworks flows through a 24-inch gravity line into a clarifier center feed well. The purpose of the feed well baffle is to disperse the incoming wastewater without disturbing the settled sludge in the bottom of the clarifier. As wastewater flows through the clarifier, heavy solids settle to the bottom and are removed as primary sludge. The clarified effluent is collected by a peripheral overflow launder protected by a submerged baffle that retains floatable from entering the effluent channel. Floating material is removed by a surface skimmer that pushes the material into a scum beach. From there, the scum is pumped to the digester. Settled solids, primarily inorganic, and some large organic particles constitute the primary settled sludge. This sludge is scraped and pushed into the center sludge hopper by rotating rake arms. Scum is scraped by a rotating skimmer and deposited into a scum box. Eight spray nozzles are mounted along the clarifier walkway to aid in scum removal. Two 6-inch lines carry sludge from the sludge hopper and scum from the scum box to the primary pump station. From the primary pump station, the sludge is pumped to an aerobic digester by

two separate plunger pumps. Both pumps are actuated either manually or automatically from a local control panel at the pump station. The piping is arranged in a way that both pumps are capable of pumping sludge (AM Consulting Engineers 2023:17-18).

According to AM Consulting Engineers (2026):

> Aerated facultative lagoons (AFLs) are the main treatment process responsible for the reduction of the soluble BOD. These lagoons, in conjunction with the downstream stabilization ponds, achieve high removal of organic materials, solids that are not removed in primary treatment, and pathogen bacteria.
>
> The AFLs are equipped with surface aerators to supply the required oxygen for treatment and provide mixing of the surface zone. Eight aerators are installed, four in each lagoon. The aerators are driven by constant-speed electric motors. The aerators are controlled where they can be started and stopped to maintain a minimum dissolved oxygen concentration of 1 mg/L in the top layer of the lagoons.
>
> The AFLs are designed to operate in parallel to better distribute the wastewater. The first aerator in each lagoon is a 20 HP unit while the remaining three are 10 HP. This design provides increased aeration in the zones of high oxygen demand at the beginning of the AFLs and inhibits uneven deposition or mounding of sludge (AM Consulting Engineers 2023:18).

According to AM Consulting Engineers (2026):

> Wastewater effluent from the AFLs flows into an effluent control box and then through three stabilization ponds (SPs) operated in series. The main purpose of these stabilization ponds is to provide secondary treatment or further removal of the remaining BOD and TSS not removed in primary treatment and aerated facultative lagoons. The stabilization ponds also act as seasonal storage facilities for the treated wastewater prior to effluent disposal. The water surface elevation in the first two stabilization ponds is controlled by a downstream weir at the end of the second pond. The water level at the third stabilization pond is controlled by the effluent pumping rate used at a given time to meet irrigation needs (AM Consulting Engineers 2023:18).

According to AM Consulting Engineers (2026):

> Sludge collected at the primary clarifiers is regularly pumped into the aerobic digester. The aerobic digester provides an anoxic environment where the organic matter contained in the sludge is decomposed and transformed into stable material that can be air dried without causing objectionable odors. The aerobic digestion process decomposes the organic matter in water and C02, reducing the strength or volatile suspended solids (VSS) in the sludge collected by the primary clarifier. Aeration in the aerobic digester is provided by two positive displacement blowers that feed coarse bubble diffusers located near the bottom of the digester. The aerators are located at the side to impart turnover and mixing in the digester (AM Consulting Engineers 2023:18).

According to AM Consulting Engineers (2026):

> Digested sludge leaving the aerobic digesters is fed to one of two asphalt-bottom sludge drying beds. These beds provide enough air-sludge surface contact to enhance the evaporation of the water contained in the sludge. The sludge is first allowed to settle at the beds, after which the supernatant is decanted by telescopic valves and returned to the headworks. The remaining sludge is allowed to dry before it is scraped and stockpiled on-site. The sludge is then tested for regulated heavy metals before it is transported off-site by truck to a sludge composting facility for final disposal (AM Consulting Engineers 2023:19).

According to AM Consulting Engineers (2026):

Currently, the City's wastewater effluent is transported to adjacent land and used for irrigation of non-food crops such as cotton, alfalfa, and feed grains. Technically, all of Coalinga's wastewater can be said to be recycled since it is used to irrigate crops and a portion of the irrigation water percolates beyond the crop root zone ultimately to become groundwater. However, since groundwater is not a source of drinking water supply, it cannot be considered as offsetting potable water demand (AM Consulting Engineers 2023:19).

According to AM Consulting Engineers (2026):

> The City's WWTP has undergone two major modifications and additions over the last 40 years. According to WDR Order No. 76-180, the WWTP originally consisted of a primary clarifier followed by three oxidation ponds in series. The final disposal consisted of irrigating land controlled by the City and West Hills Community College for agricultural reclamation. At that time, the WWTP's treatment capacity was 0.6 MGD.
>
> In 1980 the City submitted a Report of Waste Discharge for the expansion of the existing treatment capacity from 0.6 MGD to 0.93 MGD. The modifications consisted of influent screening followed by two aerated facultative lagoons and three stabilization ponds. Final effluent disposal was consistent with previous practices on City-owned land and West Hills College grounds. These modifications and additions were implemented in 1982. WDR Order No. 80-064 was adopted on May 26, 1980.
>
> In 1991, the City submitted a Report of Waste Discharge in support of a change in operation and an increase in quantity of discharge from its municipal WWTP. The treatment capacity was increased from 0.93 MGD to the current 1.34 MGD. The City completed the rehabilitation of the primary clarifier and aerobic digester, which were removed from service during the previous plant modification. Effluent is pumped from one of the stabilization ponds to 30 acres of farmland owned by the Discharger (leased and operated by West Hills Community College District) and 102 acres of farmland owned by West Hills Community College (User) for crop irrigation and percolation disposal. The User grows alfalfa, hay, cotton, pasture, and sugar beets (for research only) with reclaimed wastewater. The Discharger owns an additional 96.7 acres of land in the immediate area, which could be used for reclamation if needed (AM Consulting Engineers 2023:16).

2.4.4 Site Specific History

WWTP APE

According to USGS topographic quadrangles, historical aerials, Google Earth imagery, and Nationwide Environmental Title Research, the WWTP APE has undergone significant development since at least the mid-twentieth century. During 1933–1937, land within the APE was largely undeveloped, with several linear features in its near vicinity including the Southern Pacific Railroad, Siskiyou Avenue, and a San Joaquin Light and Power Corporation transmission line (USGS 1933, 1937). An unnamed road runs through the southern portion of the WWTP APE along the same alignment of present-day Palmer Avenue.

Structures are first visible within the WWTP APE circa 1940-1941 (USGS 1944).[2] The structures appear to be in the same general area as the extant structures associated with the WWTP and retain the label of "Sewage Disposal." The WWTP remained in the same configuration by 1953[3] with a main building, a water tank, and an unnamed access road that reaches the buildings from Jayne Avenue to the south. Topographic maps drawn from aerial photographs confirm that minimal changes occurred within the WWTP APE between 1940 and 1956 (USGS 1956) (Figures 3–4).

The Coalinga Wastewater Treatment Plant site underwent its first major expansion beginning in 1963, with an official dedication in 1964. Constructed for $250,000 (approximately $2.7 million adjusted for inflation), the plant was expanded with federal and matching local funds on land purchased from Standard Oil Company and was constructed by the Charles S. McCandless & Company. The opening of the newly expanded plant was seen as a step forward for Coalinga, where it represented community progress as it would permit the city to double in size as well as allow for industry in the area (*The Fresno Bee* 1964:32). These changes are first apparent in the 1967 historic aerial photograph, where the plant site consisting of the operating building, the primary clarifier, and the digester are visible with some minor supporting structures (USDA 1967) (Figure 5).

The plant developed again between this time and 1979, when improvement plans were prepared by John Carollo Engineers. While the plant site remained unchanged, these plans revealed that the plant had expanded to the east with treatment lagoons and ponds that replaced a body of water likely associated with Coalinga WWTP and Los Gatos Creek. Then, between 1981 and 1994, historic aerial photographs confirm further development of the site with construction of several new buildings and a sludge-drying bed to the northeast. This is supported by the Wastewater Treatment Plant Primary Treatment Rehabilitation drawings created by James M. Montgomery Consulting Engineers, Inc. in 1990 and historic photographs from 1991 depicting the construction of the new buildings and machinery at the plant. Construction of new buildings and modifications completed between 1994 and 2024 continued to change the WWTP's configuration, particularly in the large area to the northwest of the plant site, where between 2018 and 2020 three additional sludge beds were constructed (Figures 6–12).

[2] The USGS 1944 topographic map was first surveyed between 1935 and 1936, and again in 1940 and 1941.
[3] The USGS 1956 topographic map was drawn based on 1953 aerial photographs.

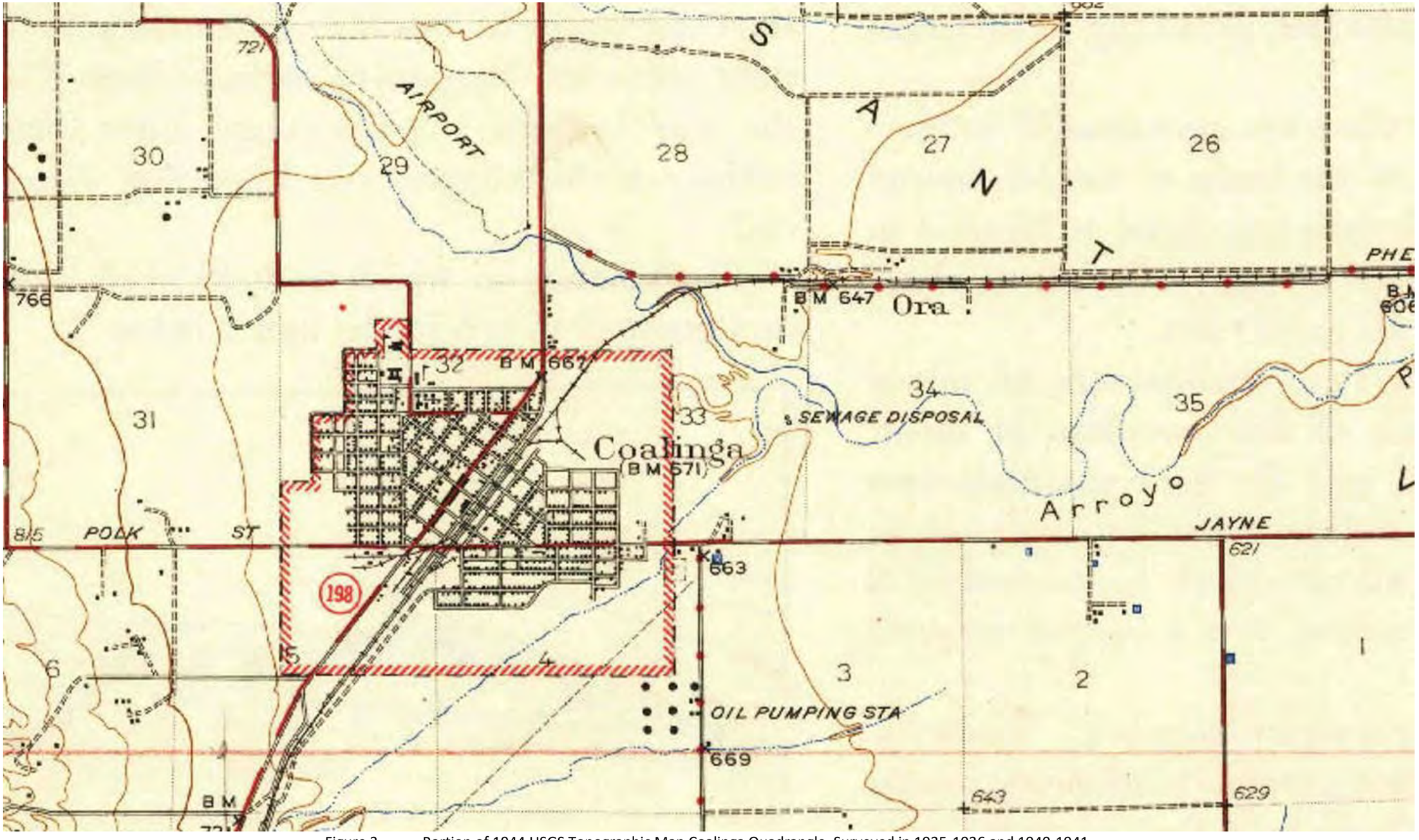


Figure 3. Portion of 1944 USGS Topographic Map Coalinga Quadrangle. Surveyed in 1935-1936 and 1940-1941.



Figure 4. Portion of 1956 USGS Topographic Map Coalinga Quadrangle. Aerial Photographs taken 1953.



Figure 5. 1967 historic aerial photograph of the Coalinga WWTP. Source: USGS 1967.

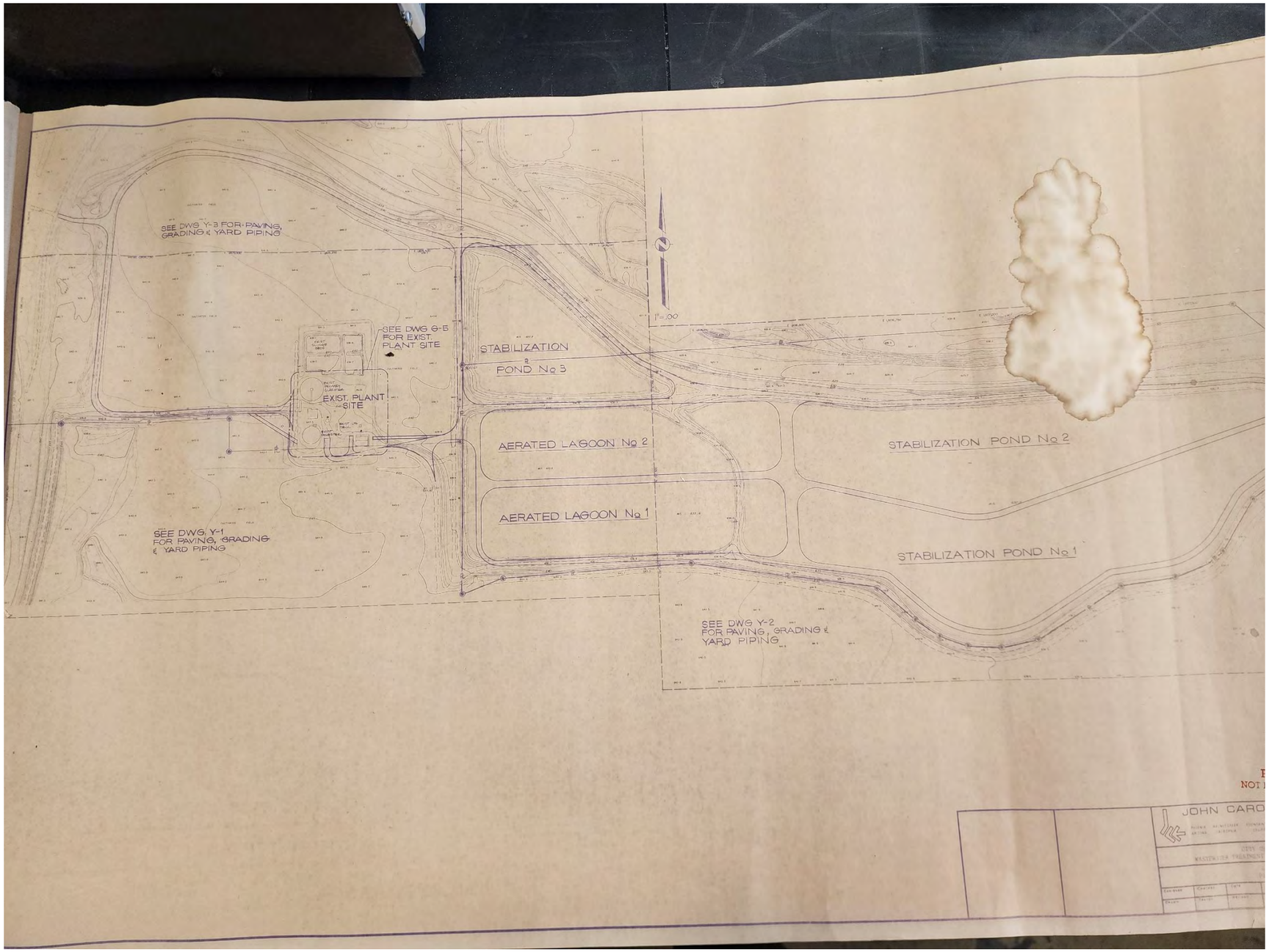


Figure 6. The Coalinga WWTP as depicted in the 1979 drawings by John Carollo Engineers.

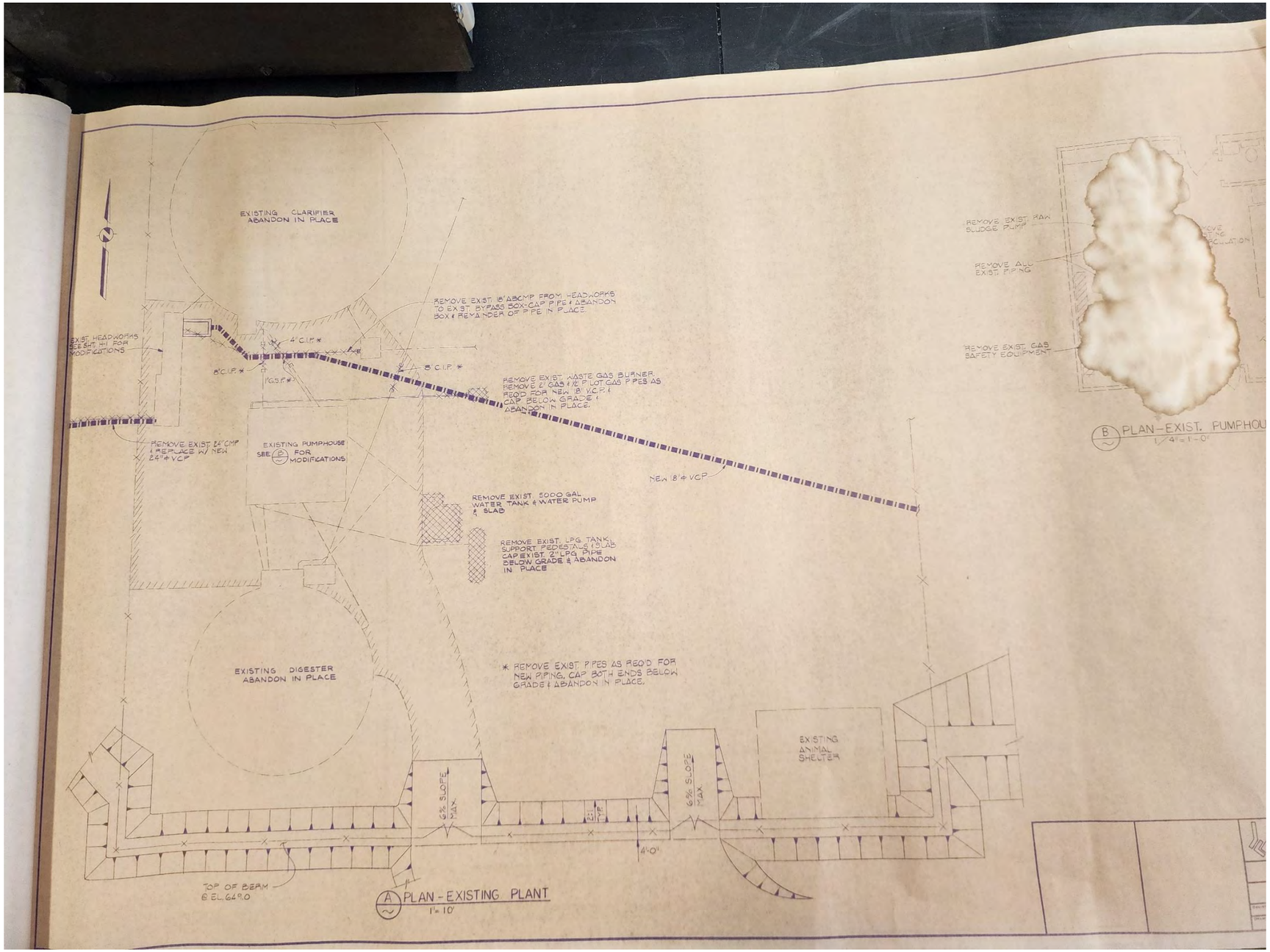


Figure 7. Detail of the plant area of the WWTP as depicted in the 1979 drawings by John Carollo Engineers.

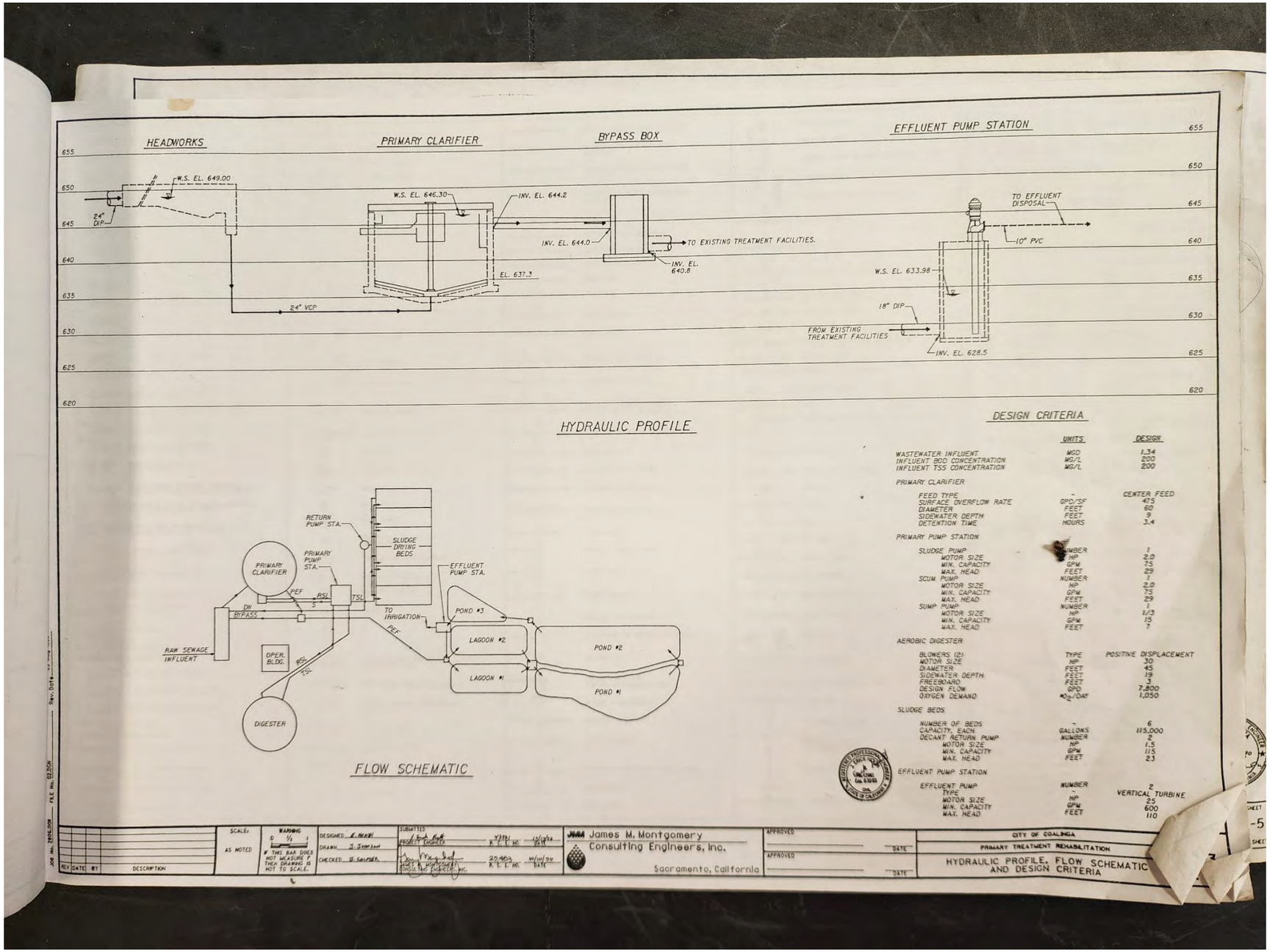


Figure 8. The Coalinga WWTP as depicted in the 1990 drawings by James Montgomery Consulting Engineers.

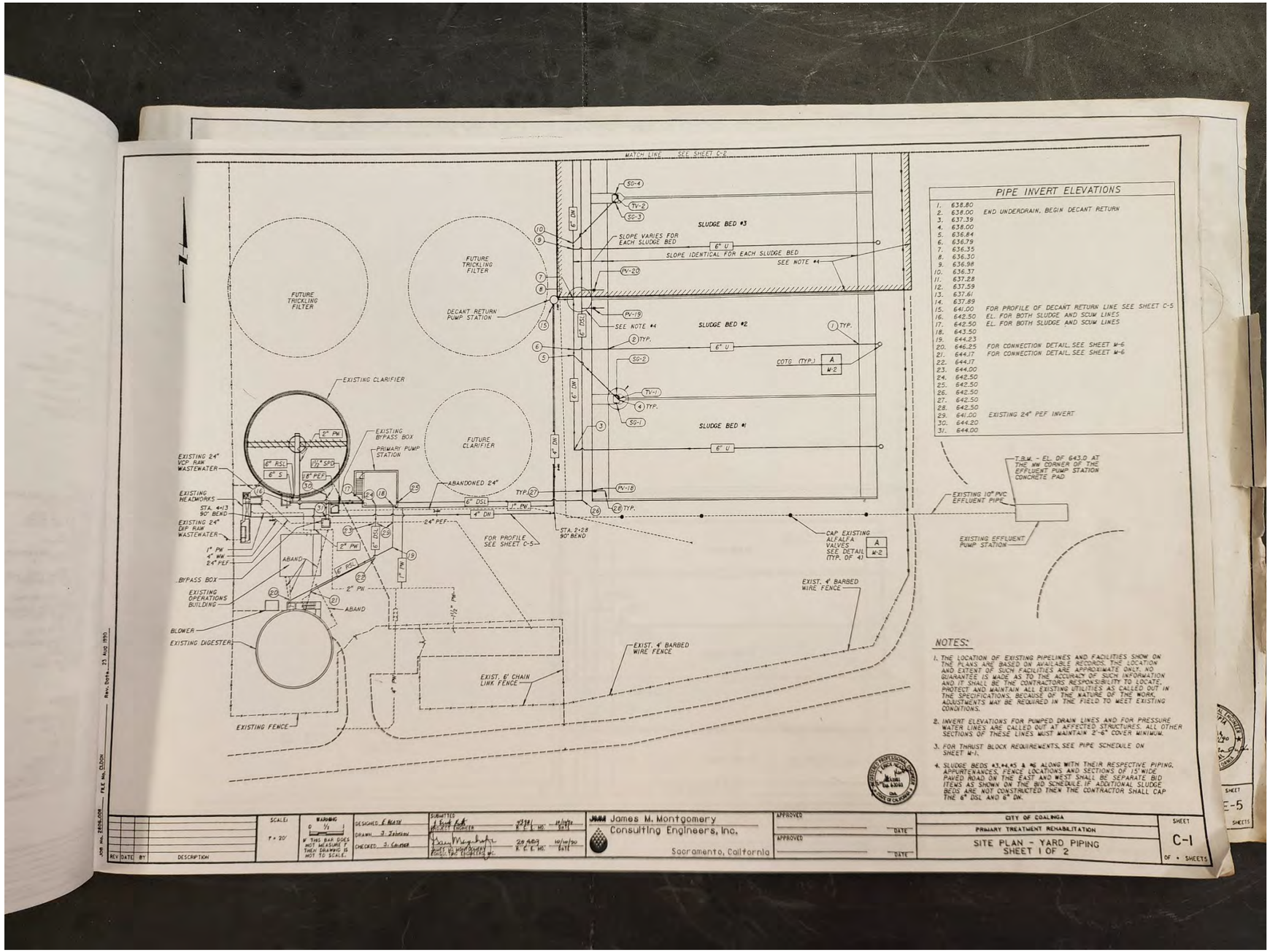


Figure 9. Detail of the WWTP plant area as depicted in the 1990 drawings by James Montgomery Consulting Engineers.



Figure 10. Photograph of the construction occurring at the Coalinga WWTP, dated May 28, 1991. The clarifier is visible in the foreground, and the animal shelter building is visible in the background.



Figure 11. Photograph of the construction occurring at the Coalinga WWTP, dated May 28, 1991. This photograph depicts the materials that were removed for the modernization and expansion of the facility.

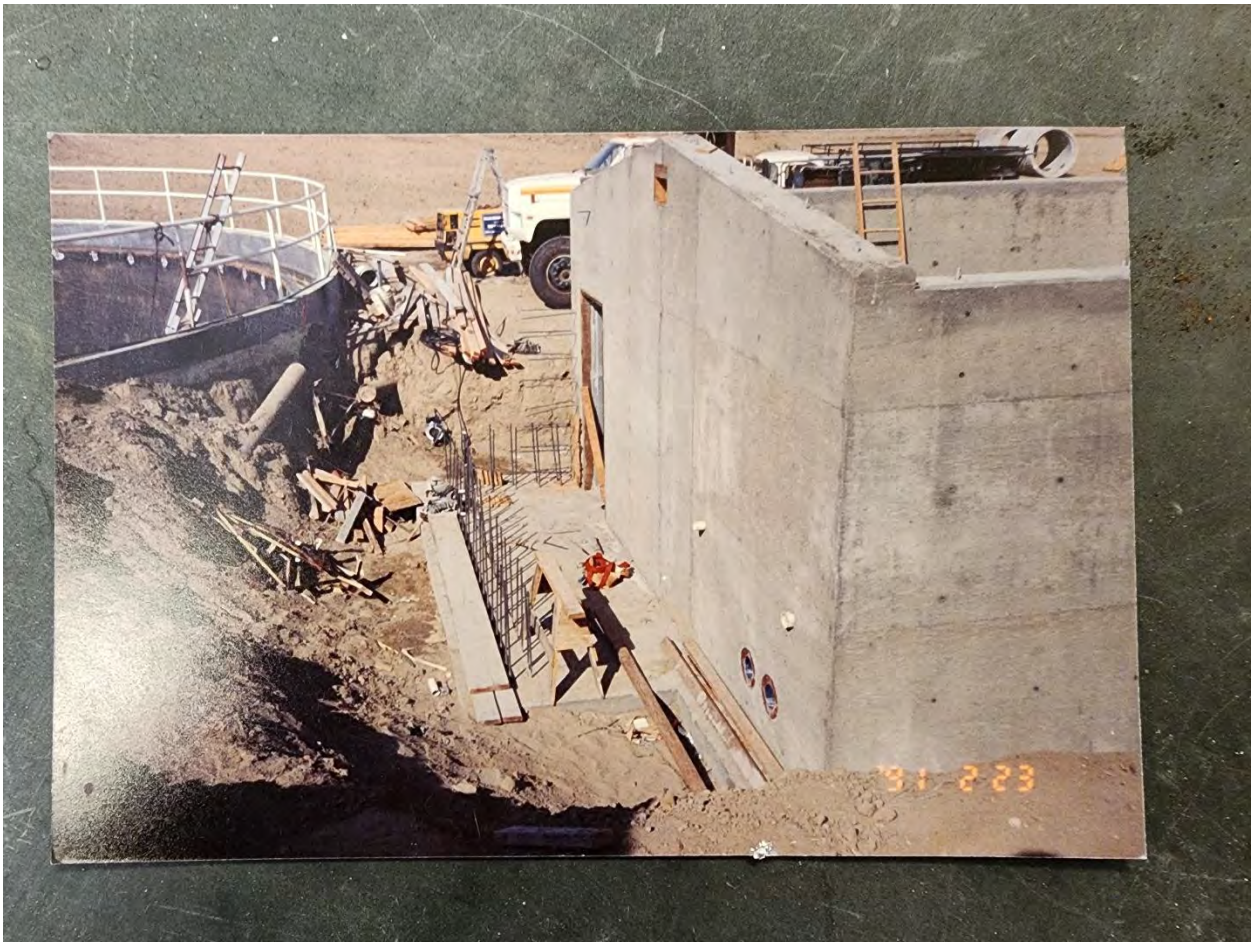


Figure 12. Photograph of the construction occurring at the Coalinga WWTP, dated May 28, 1991. The clarifier structure is depicted, and the primary pump station is visible under construction.

Pipeline APE

Historical topographical maps and aerial imagery that included the Pipeline APE were consulted to identify potential historic-era structures or resources.

According to historical topographic maps, the portions of the APE in the city of Huron and outside of the WWTP have had significant development since at least the mid-twentieth century. The Pipeline APE was largely undeveloped except for the Southern Pacific Railroad northeast-southwest segment that bisected this portion of the APE and Lassen Road that extended north-south through the eastern portion (USGS 1933, 1937). Population growth had spurred incorporation of the City of Coalinga (1951) and by 1956, multiple buildings are depicted adjacent to the Pipeline APE (USGS 1956). Between 1971 to 1981, the Pipeline APE changes very little with an airfield being constructed southeast of the APE along with the realignment of roads east and south of the APE and industrial development in the eastern portion of the city. From 1981 to 2024, aerials confirm that land within the Pipeline APE had not been further developed.

2.5 HISTORIC-ERA ARCHAEOLOGY: REFUSE DEPOSITS

Refuse deposits are a commonly identified site type. Before municipal trash collection and disposal was provided, individual households were responsible for disposing of their own trash. In many rural areas municipal trash collection was never implemented, and individual households remain responsible for disposing of their own trash. In the years before people had automobiles at their disposal, trash was generally disposed of either on the householder's property, preferably at some distance removed from the residence, or on an adjacent vacant piece of land. Often householders dug pits into which they deposited trash until it became too full. Periodically the trash was burned so that it would not attract rodents. The pit was eventually backfilled, and another pit was excavated. Old privy pits were frequently used to dispose of trash before they were backfilled. Trash was also dumped close to the main residence initially before it was moved to a pit for burning or burying. In rural settings, trash pits and trash surface scatters tend to cluster on the edge of the main residential/activity area, at some remove from the house.

Before the automobile, trash was transported in horse-drawn carts to municipal dumps. Farmers could also use carts to remove trash from their property to dump in an adjacent, vacant property, but as the road system was poor and moving trash by horse-drawn cart was a laborious process, rural dwellers did not tend to travel far to dispose of their trash. With the advent of the automobile, however, people experienced greater mobility and disposal of household trash became easier. People could now travel out of town to dump trash on vacant parcels on the outskirts of town, and farmers could also transport their trash more easily to dump outside their property. Improved roads also facilitated trash disposal. Transporting trash for dumping elsewhere required considerably less labor than excavating a pit, transporting the trash to the pit, burning it, and then backfilling it.

Types of Historic Refuse Deposits

Guerrero and Bupp (1996) identify three principal types of trash dumps in the archaeological record: trash dumps associated with a residence; trash dumps associated with an on-site activity, but not a residence; and isolated trash dumps that are not associated with either a residence or on-

site activity. Historic archaeological sites are generally evaluated for their potential to address important regional research issues. Trash deposits associated with a known household have the greatest research potential. Where no historical context can be established for a trash deposit and there is no known association with any household, ethnic group, community or labor group, the lack of a definitive association diminishes its research potential.

Research Questions

These research questions address three main research domains: chronology, subsistence and economy, and structure and integrity of the cultural deposits.

Chronology

- Can the chronological placement of the trash deposit be determined?
- What kinds of chronometric data are available? How well do the different kinds of chronometric data correlate?
- Are there data indicating the presence of multiple dumping episodes at project sites?

Date ranges for individual historic deposits are derived from glass maker's marks, maker's marks on ceramics, technological features of both tin cans and bottles, and chronological markers such as glass color (Clark 1977; Fike 1987, 2002; Fontana and Greenleaf 1962; IMACS 1990; Jones and Sullivan 1985; Kendall 1978, 1979; Kovel and Kovel 1986; Lockhart 2000; Munsey 1972; Rock 1980a-b; Sharley 2002; Simonis 1987; Toulouse 2001). These various kinds of chronological data generally provide a fairly narrow date range for the manufacture of the artifact. To provide a date range for deposition, all of the chronological data from individual artifacts are correlated. The date of deposition is assumed to be sometime after the latest date of manufacture. The time lag between manufacture and discard varies depending on the function of the artifact. For example, an expensive porcelain teapot may be a family heirloom that would remain in the family for decades, while a tin can or milk bottle was likely discarded immediately after use. A date range for the deposit is estimated based on the latest manufacture date and the expected time lag before discard. Where multiple dumping episodes were suspected based on the range of dates of manufacture, an effort is made to differentiate individual dumping episodes and provide an estimated date range for each.

Technology, Subsistence and Settlement Organization

- What is the nature of refuse at historic sites? Is it possible to determine the original activities that resulted in the historic deposit? For trash deposits is it possible to determine the origin of the deposits?

Trash deposits associated with homestead sites tend to be directly associated with the homestead household and therefore can be analyzed for data regarding the date of occupation and abandonment of the homestead, activities that took place within the homestead, household composition and gender, and consumer behavior of the residents. It should be remembered, however, that not all trash present on homestead sites relates to the original homestead occupation. Once sites were abandoned, they were considered vacant, and roadside and opportunistic dumping could take place. It is important that every effort be made to identify post-abandonment trash deposits so that they can be eliminated from analysis of homestead-related activity.

For trash deposits, it is more difficult to make an association with a single household or even group of households. Typically, isolated trash deposits are found on what were vacant lots at the time of deposition. While the trash may have been deposited from a nearby household, this is extremely difficult to establish. Cross-matching of artifacts from adjacent home sites is one method that can be used to associate an isolated trash deposit with a home site. If a portion of an artifact is found on a homesite and another portion found in a nearby dump, this would help to establish the origin of the trash deposit. The association of other trash dumps are difficult to identify and therefore their research potential is poor.

- Is a sufficient range of materials present in the historic deposits to provide data on the consumption patterns of homesteaders and other historic-period residents in the area?

Homesteaders and other settlers in the rural areas of Central Valley in the early decades of the twentieth century faced an uphill struggle in attempting to make a living. These settlers came from a wide catchment area, and surviving in this new environment necessitated adaptation and more than likely frugal living for a number of years.

One important research issue concerns how successful rural farm families defined wealth and spent money compared to middle- and upper-middle-class urban dwellers. Research has indicated that after achieving a basic standard of living that included inexpensive ceramics and a few luxury items, farm families invested in equipment, land, livestock, and outbuildings rather than in status symbols favored by urban dwellers such as fine furniture, table settings and clothes. The difference in household values between successful farm families and middle- and upper-middle-class urban residents is manifested through cross-site comparisons of functional profile and economic indexing data. Profiles of rural assemblages show higher frequencies of hardware, livery items, and equipment and machinery parts than those representing urban sites (Phillips and Van Wormer 1991; Van Wormer 1991; Van Wormer and Schaefer 1991; Van Wormer 1996). In addition, rural site assemblages tend to exhibit reduced ceramic index values (i.e., cheaper ceramic wares), that remain unaffected by fluctuating economic trends, as well as excessive ceramic and bottle manufacture-deposition lag time when compared to urban assemblages from the same period. These patterns indicate that rural households exhibited a different style of consumption from urban residents by spending less money on ceramic tableware and being more conservative about disposing of items only a few years old. Trash deposits from ranch and farmstead sites provide an excellent opportunity to test hypotheses relating to consumption patterns of rural versus urban dwellers. Remote rural dwellers survived in very difficult conditions and the rural consumer pattern may be further accentuated at these sites.

Data requirements for an analysis of consumer patterns include a range of food and drink containers including glass jars, bottles and cans, and a range of domestic tableware, and furnishings. The range of cultural materials can vary from site to site, depending both on the nature of the deposits and the recovery methodology. While controlled collection from a surface scrape provides a representative sample of what is contained in a surface scatter, it can result in large quantities of highly fragmented glass and metal that contributes little to the data analysis. To obtain a representative sample of a wider range of artifact types it is preferable to excavate smaller samples from a number of deposits and to augment those with a larger surface collection.

Structure and Integrity of Cultural Deposits

- Do inclusive chronometric data from the sites permit the identification and definition of temporally and/or spatially discrete historic dumps?
- Are the definitions of discrete components supported by multiple, independent chronological controls and, if so, how similar are their age estimates?
- Is there substantial evidence of occupational "overprinting?" How has this affected the temporal integrity of the refuse deposits?

Later dumping episodes can result in a mixing of historic, submodern, and modern deposits in such a way that differentiation of dumping episodes can be difficult, if not impossible. Since historic trash deposits tend to be largely surface scatters, the sites lack vertical stratigraphy which would help in distinguishing between historic and later deposits. In some cases, the dumping episodes have taken place in different areas of the sites, and it is possible to distinguish between historic and later deposits. However, at many of the sites historic deposits are mixed with submodern and modern dumping. Consequently, chronological control is lacking, and the research potential of the historic deposits is reduced.

3. RECORDS AND SACRED LANDS FILE SEARCHES

3.1 RECORDS SEARCH

To determine whether the Project APE had been previously surveyed for cultural resources, and/or whether any such resources were known to exist within or near to it, staff of the Southern San Joaquin Valley Information Center (SSJVIC) conducted an archival records search on May 29, 2024. The records search was completed to determine: (i) if pre-contact or historic-era cultural resources had previously been recorded within the Project APE; (ii) if the Project APE had been systematically surveyed by archaeologists prior to the initiation of this fieldwork; and/or (iii) whether the area surrounding the proposed Project was known to contain archaeological sites or built environment resources and to thereby be culturally sensitive. Records examined included archaeological site files and maps, the NRHP, Historic Property Data File, California Inventory of Historic Resources, and the California Points of Historic Interest. The records search included the Project APE and a 0.5-mi. buffer.

According to the SSJVIC, six previous studies have been conducted within the Project APE, and 31 previous studies were identified within the 0.5-mi. buffer (Table 4). Based on SSJVIC data, approximately 30 percent of the Project APE has been previously surveyed. Dates for previous studies in the APE range from 1974 to 2021.

The SSJVIC results identified a single previously recorded cultural resource (P-10-003930) within the APE (Table 5). An additional 17 resources were identified within the 0.5-mi. buffer. The results of the SSJVIC records search are available in Confidential Appendix A.

Table 4. Previous Reports within 0.5 mi. of the APE

Report #	Year	Author/Affiliation	Title	APE Relationship
FR-00008	1996	Kus, James S. and Mader, Claudia A.	Negative Archaeological Survey Repot for Proposed Subdivision in Fresno County, California	Outside
FR-00175	1988	Brady, Jon L.	Archaeological Survey Report for Widening of 06-FRE-198 P.M. 16.0/22.4 06253-343310	Outside
FR-00197	1998	Binning, Jeanne Day and Laylander, Don	Road Widening of State Route 33, north of the town of Coalinga	Outside
FR-00198	1996	Nissen, Karen	Negative Archaeological Survey Report for the Warthan Creek Bridge in Coalinga, Fresno County	Outside
FR-00198A	1997	Scott, Gloria	Historical Architectural Survey Report for Warthan Creek Bridge Replacement Project, Fresno County, California	Outside
FR-00198B	1998	Fredericks, Tom	Historical Property Survey Report for Caltrans Proposal to Replace the Warthan Creek Bridge (# 42-0119)	Outside
FR-00251	1998	Binning, Jeanne Day and Laylander, Don	Negative Archaeological Survey Report for the Los Gatos Creek Overflow Bridge Replacement	Outside

Report #	Year	Author/Affiliation	Title	APE Relationship
			Bridge Number 42-0006 and Access Improvement for State Route 33, Coalinga, Fresno County, California	
FR-00251A	1999	Lortie, Frank	Historic Property Survey Report for the Los Gatos Creek Overflow Bridge Replacement Bridge Number 42-0006 and Access Improvement for State Route 33 Coalinga	Outside
FR-00251B	1999	Lortie, Frank	Historic Architectural Survey Report for the Los Gatos Creek Overflow Bridge Replacement Bridge Number 42-0006 and Access Improvement for State Route 33 Coalinga	Outside
FR-00673	1974	Ritchie, Carl W.	An Archaeological Survey of Los Gatos and Warthan Creeks Near Coalinga, California	**Within**
FR-00779	1994	Varner, Dudley M.	An Archaeological Study of Property in the City of Coalinga, In Fresno County, California	Outside
FR-01610	1999	Binning, Jeanne Day and Marine, Mandy	First Supplemental Archaeological Survey Report for the Los Gatos Creek Overflow Bridge Replacement, State Route 33, Coalinga, Fresno County, California	Outside
FR-01869	2001	Nadolski, John A.	Archaeological Investigations for Tower modifications at 34 Cell Tower Sites	Outside
FR-01957	2003	Losee, Carolyn	Cultural Resources Analysis for Cingular Wireless Site No. CC-514-01 "Downtown Coalinga"	Outside
FR-02028	2004	Varner, Dudley M.	A Cultural Resource Study of the Los Gatos Creek Property, Fresno County, California	Outside
FR-02041	2004	Billat, Lorna	Proposed Wireless Telecommunication Service Facility Projects in California (Coalinga/CA-1363A)	Outside
FR-02163	2004	Roper, C. Kristina	A Cultural Resources Survey for the Proposed Warthan Creek Housing Development, Coalinga, Fresno County, California	Outside
FR-02264	2005	Roper, C. Kristina	A Cultural Resources Survey for the 280-Acre Coalinga Parcels, Coalinga, Fresno County, California	Outside
FR-02265	2005	Roper, C. Kristina	A Cultural Resources Survey for the 2,248-Acre Coalinga Parcels, Coalinga, Fresno County, California	**Within**
FR-02267	2005	Roper, C. Kristina	A Cultural Resources Survey of the 296-Acre Old School Farm, Coalinga, Fresno County, California	**Within**
FR-02365	2007	Baloian, Randy and Dalu, Chris	Cultural Resources Inventory for APN 070060-76, 070-060-83, and 070-060-86, North of Coalinga in Fresno County, California	Outside
FR-02374	2007	Nettles, Wendy M. and Baloian, Randy	Cultural Resources Inventory of a 320-acre Parcel Northwest of Coalinga, Fresno County, California	Outside
FR-02400	2010	Brunzell, David	Cultural Resources Assessment and National Register of Historic Places Eligibility Evaluation, Coalinga Library Building, Coalinga, Fresno County, California	**Within**
FR-02652	2014	Greenberg, Gregory	Cultural Resources Survey East Coalinga / CVU4251 1188 Gregory Way Coalinga, Fresno County, California 93210	Outside

Report #	Year	Author/Affiliation	Title	APE Relationship
FR-02671	2014	Dietler, Sara, Gibson, Heather, and Hall, Lee	Cultural and Paleontological Resources Constraints Study for the Coalinga 1 and 2 Reconductoring Project, Fresno County, California	Outside
FR-02720	2015	Peak, Melinda A.	Determination of Eligibility and Effect for the Coalinga Senior Apartments Project, City of Coalinga, Fresno County, California	Outside
FR-02907	2017	Belcourt, Tria Marie, Kelly, Jennifer, and Sifuentes, Sonia	Cultural and Paleontological Assessment: Anderson - Coalinga 1 - 1109 Solar Project CA 17 - 0106 in Ora, Unincorporated Fresno County, California	Outside
FR-03096	2021	Valentin, Sylvere	Archaeological Survey Report for the Coalinga SR 33 2R Rehabilitation Project, Fresno County, California	**Within**
FR-03103	2021	Carr, Paula Juelke	Historic Property Survey Report City of Coalinga Trails Master Plan (TMP)	**Within**
FR-03103A	2021	Laurie, Leroy and Stevens, Nathan	Archaeological Survey Report for the City of Coalinga Trails Master Plan, Segments 3, 4, and 9, City of Coalinga, Fresno County, California	Outside
FR-02652	2014	Greenberg, Gregory	Cultural Resources Survey East Coalinga / CVU4251 1188 Gregory Way Coalinga, Fresno County, California 93210	Outside

Table 5. Previously Recorded Resources

Primary #	Type	Description	NRHP Eligibility Status	APE Relationship
P-10-003930	Historic-era structure	Southern Pacific Railroad	Determined not eligible for NRHP by consensus through Section 106 process. Not evaluated for CRHR or Local Listing	**Within**
P-10-004725	Historic-era building	Wooden Walking Beam Pumping Unit	Determined eligible for NRHP by a consensus through Section 106 process. Listed in the CRHR.	Outside
P-10-004726	Historic-era structure	Coalinga Airport	Determined not eligible for NRHP by consensus through Section 106 process. Not evaluated for CRHR or Local Listing	Outside
P-10-004784	Historic-era building	740 East Polk Street	Determined not eligible for NRHP by consensus through Section 106 process. Not evaluated for CRHR or Local Listing	Outside
P-10-004785	Historic-era building	730 East Polk Street	Determined not eligible for NRHP by consensus through Section 106 process. Not evaluated for CRHR or Local Listing	Outside
P-10-004786	Historic-era building	Southeast Corner East Polk/Thompson Streets	Determined not eligible for NRHP by consensus through Section 106	Outside

Primary #	Type	Description	NRHP Eligibility Status	APE Relationship
			process. Not evaluated for CRHR or Local Listing	
P-10-004787	Historic-era building	712 East Polk Street	Determined not eligible for NRHP by consensus through Section 106 process. Not evaluated for CRHR or Local Listing	Outside
P-10-004788	Historic-era building	Coalinga 4th District Maintenance Yard Bungalow	Determined eligible for NRHP by a consensus through Section 106 process. Listed in the CRHR.	Outside
P-10-004789	Historic-era structure	Coalinga 4th District Maintenance Yard Gateway Arch	Determined eligible for NRHP by a consensus through Section 106 process. Listed in the CRHR.	Outside
P-10-005019	Historic-era building	720 East Polk Street		Outside
P-10-005403	Historic-era building	Coalinga Polk Street School	Determined not eligible for NRHP by consensus through Section 106 process. Not evaluated for CRHR or Local Listing	Outside
P-10-005595	Historic-era building	Old CDF Coalinga Fire Station	Individual property listed in NRHP by the Keeper. Listed in the CRHR	Outside
P-10-005769	Historic-era isolate	Historic-era refuse	Categorically not eligible	Outside
P-10-005771	Historic-era isolate	Historic-era refuse	Categorically not eligible	Outside
P-10-005772	Historic-era isolate	Historic-era refuse	Categorically not eligible	Outside
P-10-005830	Historic-era building	Coalinga Library Building	Recommended not eligible	Outside
P-10-005834	Historic-era site	Refuse scatter	Unknown	Outside
P-10-007414	Historic-era building	779 East Polk Street	Recommended not eligible	Outside

3.2 TRIBAL OUTREACH

As part of the CEQA process, a search of the Native American Heritage Commission (NAHC) Sacred Lands File was completed on May 9, 2024. Based on the NAHC records, the APE is negative for sacred sites or traditional cultural places. Outreach letters were sent on July 23, 2024, to tribal organizations on the NAHC contact list. Follow-up emails were sent on August 30, 2024. On August 12, 2024, Table Mountain Rancheria responded stating the Project was out of their area of interest. No other responses were received as a result of this outreach. NAHC requests, NAHC results, Tribal outreach letters, and Tribal responses can be found in Confidential Appendix B.

4. METHODS AND RESULTS

4.1 FIELD METHODS

The Class III inventory/Phase I survey of the Project APE was conducted from August to September 2024. ASM Associate Archaeologist Robert Azpitarte, BA, conducted the survey with assistance from Assistant Archaeologist Margarita Medina Lemus, BA. Parallel survey transects spaced at maximum intervals of 15 meters (m) apart were employed for pedestrian survey. The Class III inventory/Phase I survey included a review of the Project APE for the presence of built environment features. The field methods employed also included intensive pedestrian examination of the ground surface for evidence of archaeological sites in the form of artifacts, surface features (such as bedrock mortars or historical mining equipment), and archaeological indicators (e.g., organically enriched midden soil or burnt animal bone); the identification and location of any discovered sites, should they be present; tabulation and recording of surface diagnostic artifacts; site sketch mapping; preliminary evaluation of site integrity; and site recording, following the California Office of Historic Preservation (OHP) Instructions for Recording Historic Resources using California Department of Parks and Recreation (DPR) 523 forms. Parallel survey transects spaced at maximum intervals of 15 m. apart were employed for pedestrian survey of the 174.7 ac. Project APE.

4.2 SURVEY RESULTS

4.2.1 Archaeological Results

The proposed Project APE consists of improvements to The Coalinga Wastewater Treatment Plant (WWTP APE), constructed in 1963, and its associated pipelines throughout the city of Coalinga (Pipelines APE). The Project APE outside of the water WWTP consists largely of paved roads (Figure 13 and Figure 14). As such, the vast majority of the APE has been hardscaped over. Within the water treatment facility, the majority of the APE was developed over (Figure 15 and Figure 16). Visibility within the WWTP outside of developed areas was excellent (over 95 percent) due to recent disturbance of the soil (Figure 18). Non-native vegetation inhibited visibility in undeveloped areas. A diffuse refuse scatter (WWTP-SITE-1) was observed on the northwestern edge of the existing aerator ponds in the WWTP APE. This resource is described below. No other archaeological resources were observed within the Project APE.



Figure 13. Project APE overview along Van Ness Street, facing east.



Figure 14. Project APE overview along Cherry Lane, facing west.



Figure 15. WWTP APE infrastructure overview, facing east.



Figure 16. WWTP APE infrastructure overview, facing northwest.



Figure 17. Northwestern WWTP APE overview, facing southwest.

WWTP-SITE-1

The refuse concentration consists of a glass and ceramic scatter located along the northwestern edges of the existing aerator ponds. The scatter measures 1,016 ft. in length and 20 ft. in width and is entirely contained within the sloped pond embankment. Refuse was not identified in other areas of the WWTP. At least 3,000 highly fragmented pieces of assorted glass, including solarized amethyst glass, and dishware fragments were observed. Identified makers marks include Maywood glass (MARK) and Owens-Illinois (MARK)

Evaluation

The AIMS-R evaluation matrix defined in Section 2.5.3 serves as a useful rubric for evaluating historic-era archaeological sites.

Using the AIMS-R evaluation matrix for historic-era sites, the sites can be assessed for NRHP and CRHR eligibility as follows:

1. *Association* – WWTP-SITE-1 is ubiquitous throughout the region and lacks any clear social association. While it may be possible to associate a refuse scatter with an activity type, they lack clear association to any specific individual, and it is often unclear whether they are associated with domestic use or instead resulted from illicit dumping by residents of nearby towns. The only WWTP-SITE-1 is with the structural

WWTP features they are found near. These features themselves have no distinguishable association with any specific individual or group. WWTP-SITE-1 therefore does not have research potential as an individual site due to the lack of a social or functional associative context.

2. *Integrity* – WWTP-SITE-1 includes materials of mixed ages from the early to mid-twentieth century, without an associative context. Although identifiable materials such as bottle bases and ceramic sherds were recorded, many of the artifacts present are very fragmentary and thus lacking in integrity of design, workmanship, or setting.

3. *Materials* – WWTP-SITE-1 has a range in the variety of materials present, but overall the assemblage displays a limited diversity of artifact types that are ubiquitous throughout the region, most of which are mass-produced consumer goods.

4. *Stratigraphy* – Though stratigraphy is possible in historic-era refuse scatters, specifically when a privy is present, WWTP-SITE-1 is a surficial scatter which precludes stratigraphic development.

5. *Rarity* – No rare or unusual features/feature types were identified.

Based on the information above, WWTP-SITE-1 lacks association with important known historical events (Criterion A/CRHR Criterion 1) or individuals (Criterion B/CRHR Criterion 2) and does not represent a distinctive example of structural types or works of master craftsmen (Criterion C/CRHR Criterion 3). In addition, WWTP-SITE-1 lacks research potential beyond its recordation here (NRHP Criterion D/CRHR Criterion 4). Therefore, WWTP-SITE-1 is recommended as not NRHP/CRHR eligible.

Southern Pacific Railroad (P-10-003930)

Research revealed that a segment of the Southern Pacific Railroad (P-10-003930) is located within the Pipeline APE. The Southern Pacific Railroad extended northeast-southwest through the City of Coalinga (reference Confidential Appendix A), between the present streets of Glenn Avenue and Forest Avenue.

Segments of the Southern Pacific Railroad (P-10-003930) have previously been evaluated, and the resource has previously been recommended not eligible for listing in the NRHP or CRHR (Asselin and Baloian 2016; Jones et al. 2018; Schultz and Vanderslice 2007). In addition, the segment of the Southern Pacific Railroad (P-10-003930) that extends through the Pipeline APE has been determined not eligible by consensus through Section 106 process.

An October 2026 survey of the APE revealed no extant features of this resource, and all potentially associated features have been destroyed. The resource is a ruin whereby all the materials of the resource have been removed or deteriorated to the point that it cannot convey physical associations to any identified themes. As such, ASM agrees with the previous evaluations of the resource and no DPR update was completed for this resource.



Figure 18. WWTP-SITE-1 overview, facing north.



Figure 19. WWTP-SITE-1 refuse scatter.

4.2.2 Built Environment Results

Coalinga Wastewater Treatment Plant

Coalinga WWTP is located immediately adjacent to Los Gatos Creek on the north and Warthan Creek on the west and measures 3,100 ft. (east-west) by 920 ft. (north-south).

The WWTP currently consists of four buildings and two primary structures: an operations building, an animal shelter building, a primary pump station building, a shed building, a digester structure, and a primary clarifier structure. It also retains additional secondary resources related to the process of waste treatment, including two aerated lagoons and three stabilization ponds to the east, a sludge bed to the immediate northeast of the plant site, and three sludge beds on the west. Two modern shipping containers, placed in the 2010s, are also within the WWTP APE.

Coalinga Wastewater Treatment Plant Historic District

ASM investigated the potential for a historic district associated with the operations of the Coalinga WWTP. The Coalinga WWTP first appears in a 1944 topographic map of the area labeled as a sewage plant, and 1940 historic aerial photographs show a structure and water basin in the area. By 1951, population growth spurred the incorporation of the City of Coalinga and prompted infrastructure improvements for higher capacity that led to a complete modernization and expansion of what is now the Coalinga WWTP in 1963. This first plant expansion included the Operations Building (Building 1), the Digester and Clarifier tanks (Structures 1 and 2 respectively), and the addition of a large body of water to the east of the plant site that conformed to pre-existing natural topographic configurations from Los Gatos Creek. These buildings and structures were modernized and improved in 1979, when the site was expanded again. This second expansion led to the reconfiguration of the large body of water to the east of the plant site, where three stabilization ponds and two aerated lagoons were added, likely to meet environmental standards. There were few improvements or additions until 1991, when a new primary pump station was constructed (Building 3) and the other buildings and structures were modernized as part of a third expansion, which also included the addition of a sludge-drying bed to the northeast of the plant site.[4]

Based on the statewide historic context of WWTP prepared by JRP (2023) and the local historic context, ASM identified the period of significance (POS) for a potential Coalinga WWTP historic district. Although the presence of the sewage plant was recorded in the area as early as 1940, the contemporary configuration of the site was first constructed in 1963. Research did not reveal any buildings or structures within the plant older than 1963. The second recorded improvements to the site occurred in circa 1979, when some of the buildings and structures within the plant site were modernized to reflect environmental standards, and the area to the east of the plant site was expanded with the construction of additional resources of ponds and lagoons. The third expansion continued modernization of the plant with construction of new buildings and structures in 1991. As such, the potential period of significance of the site as an example of a mid-century wastewater

[4] First plant expansion: 1963; Second plant expansion: 1979; and third plant expansion: 1991.

treatment plant in California begins in 1963, with the construction of the initial buildings and structures that support the incorporated City of Coalinga, and ends in 1979, when it was confirmed via drawings that lagoons and ponds were reconfigured from the existing body of water to the east and expanded the plant's capacity.

According to the JRP (2023) report, wastewater treatment plants are an identified property type. This resource notes that while modern plants "include secondary treatment with trickling filters or activated sludge tanks," older plants "offer only primary treatment, using clarifiers to decrease the quantity of the suspended matter" (JRP 2023: 223). Coalinga WWTP operated under standard conditions and then was modernized to meet contemporary standards during the POS.

ASM then considered the boundary of the potential Coalinga WWTP historic district. To determine the boundary, ASM referenced the 1967 and 1971 historic aerial photographs of the plant site and the contemporary placement of fencing surrounding the plant site. The original plant site from the POS retained a sludge-drying bed directly to the north of the plant site that was removed in the 1991 expansion of the plant. Additionally, during the POS, a lagoon or body of water was extant to the east of the plant site and was likely related to the operations of the Coalinga WWTP. However, this body of water was modified in the c.1979 expansion of the plant. Therefore, the boundaries of the potential historic district that best reflect the extant resources from the POS are the historic boundaries of the plant site (Figures 20 and 21).

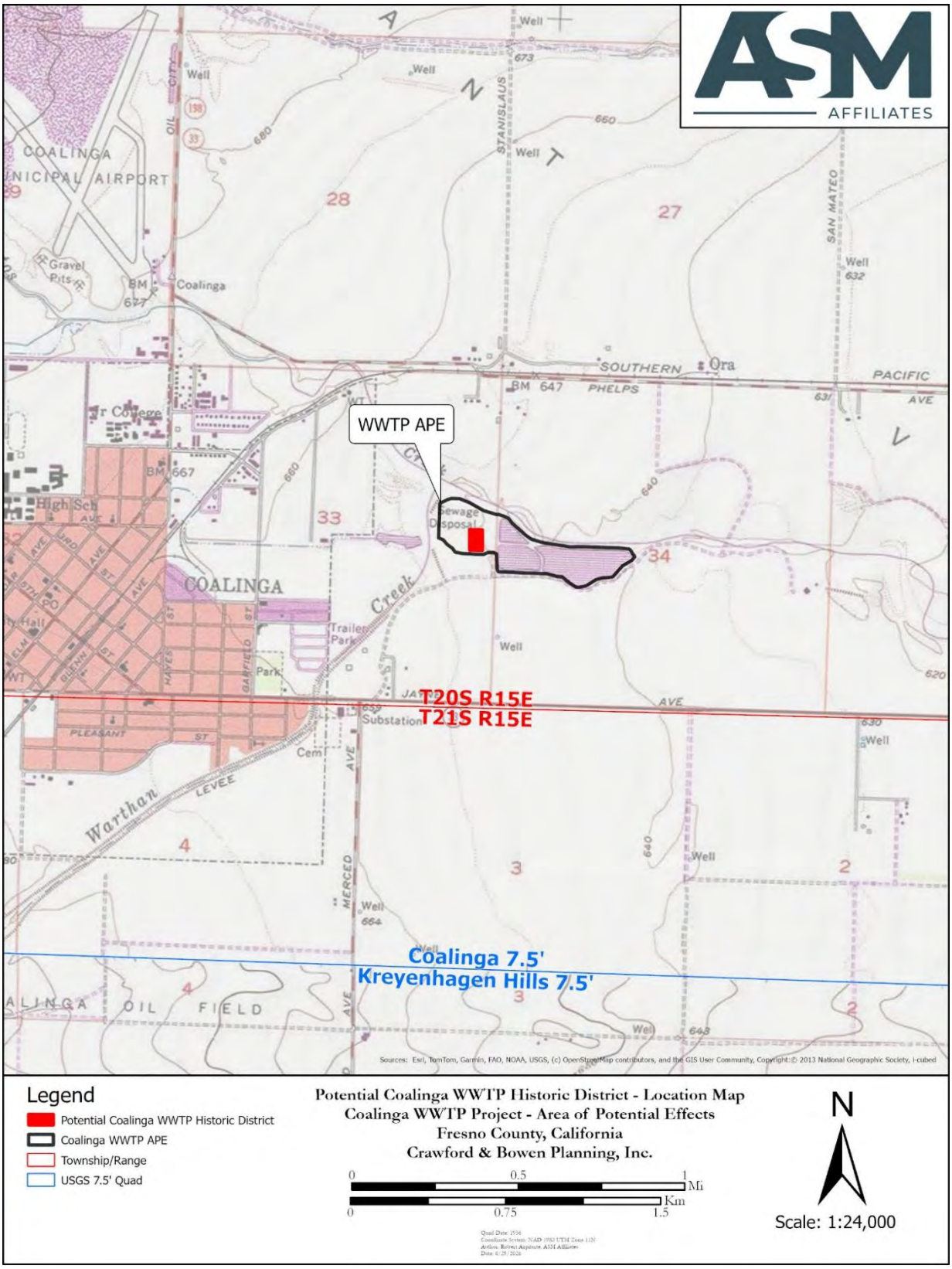


Figure 20. Location Map of Coalinga WWTP APE and potential WWTP historic district boundary



Figure 21. Aerial map that identifies the components of the Coalinga WWTP and the potential WWTP historic district boundary.

Within the boundaries of the potential Coalinga WWTP historic district are several potential contributors. The buildings and structures that could potentially contribute to the potential Coalinga WWTP historic district are the Operations Building (Building 1), the Digester (Structure 1), and the primary clarifier (Structure 2). These buildings and structures were identified as potential contributors as they were constructed within the period of significance and directly contribute to the operations of the Coalinga WWTP.

One other building, the Animal Shelter Building (Building 2), was constructed during the period of significance within the boundary of the potential Coalinga WWTP historic district. However, this building is not a potential contributor as research did not reveal that it directly contributed to the operations of the Coalinga WWTP, and it likely only played a secondary or supporting role to the function of the plant. One other building, the Primary Pump Station (Building 3), was constructed within the boundary of the potential Coalinga WWTP historic district but is not a contributing resource as it was constructed outside of the POS. The various machinery and equipment present within the potential district boundaries, particularly the equipment related to the raw sewage influent located to the southwest of the clarifier, were installed outside of the POS and are therefore non-contributors. An additional building that was likely associated with the Coalinga WWTP was identified, the Shed Building (Building 4), but it is located outside of the potential district boundaries and was constructed outside of the POS and is therefore not considered a contributor. The two aerated lagoons and two stabilization ponds to the east of the plant site, the sludge-drying bed to the northeast of the plant site, and three sludge drying beds to the west of the plant site were all constructed after the POS, and therefore none are considered contributors.

ASM then considered whether the potential Coalinga WWTP historic district is eligible under any NRHP or CRHR considerations. Because wastewater treatment plants are an identified property type as defined by JRP (2023), ASM referenced and followed the evaluation procedures in that report to determine whether the potential historic district retained any historic significance.

ASM first considered whether the potential Coalinga WWTP historic district is eligible under NRHP/CRHR Criterion A/1. The JRP (2023) report notes that a district may be eligible under this criterion if it had "historic importance above and beyond fulfilling its ordinary role," if it "introduced or proved the efficiency of an important new technology…public health measure, environmental treatment standard," if it was "closely associated with the creation of a type of political organization," or finally if it was "the clearly identified focus of important social or political conflicts" (JRP 2023:253). ASM referenced local newspapers and other primary and secondary sources for information regarding the reception of the 1963 modernization and expansion of the Coalinga WWTP. The expansion was popular amid the City of Coalinga and within Fresno County because the improved infrastructure could support greater development within the city and support agricultural growth at a time when the population of the city and county were expanding. Because the impetus of the 1963 modernization was to accommodate for growth, and because the modernization that occurred appears to be standard across California wastewater treatment plants, it does not appear to have retained historic importance beyond its ordinary role and did not introduce any new technology. While the plant was updated in later years to meet environmental standards, these updates appear to be standard, and research did not reveal that the Coalinga WWTP was an important site for the testing or implementation of any new technology.

ASM did not find any reference to political or social conflicts associated with the plant. As such, the Coalinga WWTP appears to be the result of standard mid-century modernization of wastewater treatment plants in California. Therefore, ASM recommends that the potential Coalinga WWTP historic district is not eligible for listing in the NRHP/CRHR under Criterion A/1.

ASM then considered whether the potential Coalinga WWTP historic district is eligible for listing in the NRHP/CRHR under Criterion B/2. Research did not reveal that an individual of historic importance was associated with the Coalinga WWTP. The JRP (2023) report notes that "wastewater systems do not commonly have strong, direct association with single individuals" (JRP 2023:256). This statement applies to the Coalinga WWTP as no specific individual was identified in any announcements related to the plant, nor did research reveal that a specific individual important to the history of the state or nation was directly associated with the Coalinga WWTP. As such, ASM recommends that the potential Coalinga WWTP historic district is not eligible for listing in the NRHP/CRHR under Criterion B/2.

ASM then considered whether the Coalinga WWTP historic district is eligible for listing in the NRHP/CRHR under Criterion C/3. The JRP (2023) report notes that a wastewater treatment plant may be historically significant if it is the "earliest, best preserved, or a rare surviving example of its type," if it "introduced a design innovation," or finally if it "represents a transition between different expressions of the property type" (JRP 2023:256). Because the Coalinga WWTP was completely re-constructed, reconfigured, and modernized in 1963, performs standard operations associated with waste management, and replaced an earlier sewage plant, it is not the earliest, best preserved, nor a rare surviving example of its type. Research did not reveal that the Coalinga WWTP introduced any new design innovations. It appears to have undergone standard mid-century modernization with no reference to unique or new design innovations in relation to the operations and practices of the plant. Based on the historic context of wastewater management in California (JRP 2023), the Coalinga WWTP reflects period appropriate wastewater management practices and does not appear to represent a transition period. The buildings and structures that were constructed within the POS (the operations building, the digester, and the clarifier) represent standard operating practices for the mid-century, and the previous buildings and structures from the earlier decades of the twentieth century that the Coalinga WWTP replaced were removed entirely. Therefore, ASM recommends that the potential Coalinga WWTP historic district is not eligible for listing in the NRHP/CRHR under Criterion C/3.

Finally, the potential Coalinga WWTP historic district includes several buildings and structures that reflect common designs and whose function, use, design, and construction are readily apparent and therefore do not have the potential to provide information about history or prehistory that is not available through historic research. Therefore, ASM recommends that the potential Coalinga WWTP historic district is not eligible for listing in the NRHP/CRHR under Criterion D/4.

In conclusion, the potential Coalinga WWTP historic district does not meet any of the NRHP/CRHR eligibility criteria; therefore, ASM recommends that the potential Coalinga WWTP historic district is not eligible as a historic district associated with the Coalinga WWTP.

Operations Building (Building 1)

The Operations Building was constructed in 1963, which was represented on the USGS (1963) topographic map, and confirmed on the 1967 historic aerial photograph of the area. The 1979 plans labeled the building as both an existing pumphouse and existing utility building and discussed proposed modifications for the building as part of the site expansion. By 1990, this building became known as an operations building.

Before the site expansions that occurred in 1991, this building served as the primary operations building for the site. This is reflected in the plaque that was placed on the building in 1964 when the Coalinga Sewer Plant was dedicated to the City of Coalinga after construction in 1963. This building likely replaced a smaller pump house that once supported the smaller sewer plant before the 1963 expansion. This building continued to provide sole support as the primary building associated with the sewer plant until the plant expanded again in 1991 and more support buildings were constructed. The JRP (2023) report identifies the Operations Building as most closely resembling the Control Building property type element. This building type is described as retaining a "control console that automates plant monitoring and operations," and may include additional support structures such as "vehicle garages, workshops, and storage warehouses" (JRP 2023:230).

An October 2024 survey of the site revealed that the building is one-story and square, features a flat roof, and corrugated metal siding on all façades. The primary façade faces east, and features a covered porch, an entry area composed of two flat, metal doors, and a plaque commemorating the dedication of the building. The extending roof that creates the covered entry area is supported by three equidistant metal beams. The primary entrance doors are on the southern side of the wall, and a row of windows between the top of the entry doors and the roofline provide both light and ventilation into the interior space. Metal screens that appear to have since been added to the windows obscure the materials of the windows in this area. The area under the covered entry area is composed of poured concrete.

The side façade facing north retains the corrugated metal siding and provides additional entrance points into the interior of the building. One entrance point is slightly recessed and features a single flat, metal door. The other entrance point is not recessed; however, it features an extended porch roof covering that provides shade, and double flat, metal doors that appear to have ventilation paneling in the lower half of the door. The side façade facing south also retains the corrugated metal siding but no further architectural details or features beyond the presence of an outdoor lighting fixture and a generator. The rear façade similarly features no architectural details or fixtures beyond the continued use of corrugated metal siding and a utility box that appears to be associated with the nearby equipment (Figures 22–26).

ASM considered whether the Operations Building is individually eligible under any NRHP/CRHR criteria. Because the Operations Building is an identified property type element associated with Waste Treatment Plants as defined by JRP in their 2023 report, ASM referenced and followed the evaluation procedures stipulated in that report in order to determine the historic significance of the building.



Figure 22. Building One, the Operations Building. Primary façade, view toward east.



Figure 23. Building One, the Operations Building. Side and primary façade, view toward southwest.



Figure 24. Building One, the Operations Building. Rear façade, view toward west.



Figure 25. Building One, the Operations Building. Side and primary façade, view toward northeast.



Figure 26. Detail of the plaque on the primary façade of Building One, the Operations Building.

ASM first considered whether the Operations Building is eligible for listing in the NRHP/CRHR under Criterion A/1. The JRP (2023) historic context notes that an individual feature may be eligible under this criterion if it had "historic importance above and beyond fulfilling its ordinary role," if it "introduced or proved the efficiency of an important new technology…public health measure, environmental treatment standard," if it was "closely associated with the creation of a type of political organization" or finally if it was "the clearly identified focus of important social or political conflicts" (JRP 2023:253). Research did not reveal that the Operations Building and its associated role in the wastewater management of the City of Coalinga was associated with the introduction of any new technology, public health measure, or environmental standard. Research additionally did not reveal that the construction and the use of the Operations Building and its associated role in wastewater management was associated with any political organization, nor was it ever a focus of important social or political conflicts. Because eligibility under this Criterion requires that the building must be an important example of a specific trend or theme related to the above described qualifications, the Operations Building does not qualify as historically significant under this criterion. Furthermore, although the building was modernized and was associated with the expansion of the plant, the expansion and modernization did not introduce any new services nor fundamentally change the nature of the municipal water system. Although the Operations Building was constructed as a result of modernization and expansion, the JRP (2023) report notes that "the construction of new, modern infrastructure is a routine function of municipal public

service departments to account for population growth" (JRP 2023:254). This seems to be the case with the construction of the Operations Building in 1963, which replaced an older pump house building. Therefore, ASM does not recommend the Operations Building individually eligible for listing in the NRHP/CRHR under Criterion A/1.

ASM then considered whether the Operations Building is individually significant under NRHP/CRHR Criterion B/2. Research did not reveal that an individual of historic importance was associated with the Operations Building. The JRP (2023) historic context notes that "wastewater systems do not commonly have strong, direct association with single individuals" (JRP 2023:255). This is the case for the Operations Building, and therefore ASM does not recommend the Operations Building is individually eligible for listing in NRHP/CRHR under Criterion B/2.

ASM then considered whether the Operations Building is individually significant under NRHP/CRHR Criterion C/3. The JRP (2023) historic context notes that an individual feature may be historically significant if it is the "earliest, best preserved, or a rare surviving example of its type," if it "introduced a design innovation," or finally if it "represents a transition between different expressions of the property type" element (JRP 2023:256). Because the operations building was constructed in 1963, performs standard operations associated with waste management, and replaced a previous building that likely performed a similar function, it is not the earliest, best preserved, nor a rare surviving example of its type. The building is of utilitarian construction, performs standard operations, and therefore did not introduce any design innovations. Finally, research did not reveal a transition between different expressions of the Operations Building property type element. In comparison to other examples of operations/control buildings in California, the Operations Building associated with this plant retains minimal uses in comparison to others that also retain administration offices and/or laboratory testing spaces, and it did not introduce any new technologies or innovations. Finally, the Operations Building was not associated with a master architect or engineer and is of utilitarian design. Because the JRP (2023) report provides several examples of other Operations/Control buildings that were constructed with the influence of architectural styles such as Spanish Revival style, Neoclassical style, and Art Deco style, the Operations Building retains no significance of design in comparison. The JRP (2023) report notes that property type elements such as Operations Buildings "perform routine functions that remain consistent across treatment eras" and were "constructed using common designs and materials for their era" and are therefore "unlikely to be significant for their engineering" (JRP 2023:258). This appears to be the case for the Operations Building, as research did not reveal any significant feats of engineering associated with the use and operations of the Operation Building. Therefore, ASM does not recommend the Operations Building individually eligible under NRHP/CRHR Criterion C/3.

Finally, the Operations Building is a common property type element that does not have the potential to provide information about history or prehistory that is not available through historic research. Therefore, ASM recommends the property not individually eligible under NRHP/CRHR Criterion D/4.

In conclusion, the Operations Building is recommended not individually eligible under any NRHP/CRHR criteria.

Animal Shelter (Building 2)

The Animal Shelter Building is first visible in the 1967 historic aerial photograph of the area. However, it appears to have historically been a minor support building and was not depicted on any of the USGS topographic maps. It was likely constructed in tandem or in near proximity to the Operations Building and, therefore, received a circa 1963 construction date. The 1979 preliminary plans refer to the building as an animal shelter. Brief research revealed that other cities within Fresno County routinely established animal shelters within the vicinity of sewage plants; however, research could not confirm that to be the case in this instance beyond the notation in the preliminary plans. Additionally, this building was not drawn, noted, nor labeled in the 1990 drawings of the Sewage Plant expansion.

An September 2024 survey of the site revealed that the building is one-story and rectangular, features a shed roof, and has concrete block walls on all sides. The primary façade faces west toward the entrance of the plant, facing a concrete pathway that leads up to a paved driveway/parking area in the vicinity of a tree. The shed roof was constructed to slope down toward the south, the edge of the plant area, and away from the concrete pad along the primary façade. The roof is composed of asphalt shingle. The primary entrance to the building is located along the primary façade and features a centered flat, metal door. Some replacement siding appears to have been installed just below the roof, as the siding materials in this section appear to be a type of metal, wood, or synthetic covering. One side of the building faces north toward a storage container that was placed in the 2010s. This side retains few notable architectural features beyond the continued use of concrete block walls that have since been modified with attached wood plank along the bottom portion of the wall, likely in response to leaks or damage. The extending eaves of the roof are visible along this side and are composed of wood and feature wood rafters. This side additionally faces a poured concrete slab with a drain on the westernmost side.

The rear of the building features no architectural features of note beyond the continued use of concrete-block building materials for the walls and replaced wood siding in the under-eave. The poured concrete extends over to this side of the building as well. The side of the building that faces south toward the chain link fence similarly retains few architectural features beyond one rectangular, centered window that appears to be the only feature that provides natural light and ventilation into the interior of the building (Figures 27–30).



Figure 27. Building Two, the Animal Shelter Building. Rear and side façade, view toward southwest.



Figure 28. Building Two, the Animal Shelter Building. Rear and side façade, view toward northwest.



Figure 29. Building Two, the Animal Shelter Building. View of concrete pad and pathway. View toward east.



Figure 30. Building Two, the Animal Shelter Building. Primary façade, view toward east.

ASM considered whether the Animal Shelter Building is individually eligible for listing in the NRHP or CRHR under any criteria. This building was not an identified property type within the JRP (2023) historic context, and research did not reveal that this building provided direct or indirect support for the operations of the plant. Therefore, it was evaluated under the standard NRHP and CRHR regulatory contexts.

ASM first considered whether the Animal Shelter Building is individually eligible for listing in the NRHP/CRHR under Criterion A/1. ASM considered whether the Animal Shelter Building was associated with a specific event marking an important moment in the history of Coalinga or was associated with a pattern of events that made a significant contribution to the development of Coalinga. Research did not reveal that the Animal Shelter Building was associated with any significant historical events. Its association with the waste management plant appears to be historically minimal as it was not represented in the various drawings and plans of the plant. Research did not reveal that, as an animal shelter, it was notable, such as the first to be constructed in the area, or the first of its type. Therefore, because the Animal Shelter Building did not contribute to the history or development of Coalinga, ASM recommends the Animal Shelter Building is not individually eligible for listing in the NRHP/CRHR under Criterion A/1.

Research did not reveal that the Animal Shelter Building is associated with any historically significant individuals. It is therefore recommended not individually eligible for listing in the NRHP/CRHR under Criterion B/2.

ASM then assessed whether the Animal Shelter Building embodies distinctive characteristics of a type, period, or method of construction, or represents the work of a master. The Animal Shelter Building is primarily utilitarian and, as a result, retains no reference to any specific architectural styles and retains minimal examples of design. Research did not reveal that any type of Animal Shelter Building was identified as particularly important to the history of Coalinga. It also did not reveal that there are elements of construction of the Animal Shelter Building that are unique to Coalinga or utilize local resources. Research additionally did not reveal that a master architect or builder was associated with the construction, design, or development of the building. As such, ASM recommends the Animal Shelter Building is not individually eligible for listing in the NRHP/CRHR under Criterion C/3.

Finally, the Animal Shelter Building is a common property type that does not have the potential to provide information about history or prehistory that is not available through historic research. Therefore, ASM recommends the property is not individually eligible for listing in the NRHP/CRHR under Criterion D/4.

In conclusion, ASM recommends that the Animal Shelter Building is not individually eligible for listing in the NRHP/CRHR under any criteria.

Primary Pump Station (Building 3)

The Primary Pump Station building is first visible on a 1994 historic aerial photograph and is documented in the 1990 Wastewater Treatment Plant Primary Treatment Rehabilitation drawings. This building was constructed in 1991 as a result of the expansion that occurred on the site and replaced the Operations Building as the primary pump building within the plant.

Details from the 1990 Primary Treatment Rehabilitation drawings reveal that the majority of the building is subterranean, with stairs that lead to the lower level (referred to in the drawings as the "pit"). These drawings additionally detail that the building retains a poured concrete foundation, the roof features plywood sheathing and pre-engineered wood roof trusses covered by metal roofing panels, and metal siding along all sides.

An October 2024 survey of the site revealed that little has changed since the 1990 drawings of the building were completed. The Primary Pump Station features a metal, front gabled, roof with vertically oriented corrugated metal siding on all sides. The primary façade faces west and retains a subterranean entrance, the only entrance into the building. Along the primary façade and the rear façade are ventilation panels in the under-gable, also composed of metal. Because this building is largely subterranean, stairs were constructed along the primary facade of the building that provide access from the ground level to the subterranean entrance. These stairs are composed of concrete and feature a metal handrail.

The rear of the building features an additional vent that is covered by metal grating. The side of the building facing south does not have any design features. The side facing north faces a large shipping container that was added after its construction and which now obscures the view of the side of the building (Figures 31–33).



Figure 31. Building Three, the Primary Pump Station. Rear and side façade, view toward northwest.



Figure 32. Building Three, the Primary Pump Station. Primary and side façade, view toward northeast.



Figure 33. Building Three, the Primary Pump Station. Rear façade, view toward west.

Given that this building was likely constructed in 1991, ASM considered whether the Primary Pump Station demonstrates exceptional historical significance for eligibility for listing in the NRHP/CRHR. For the NRHP, ASM applied Criterion Consideration G for properties that are less than 50 years old but demonstrate they possess exceptional significance. Because the Primary Pump Station is an identified property type associated with Waste Treatment Plants as defined by JRP (2023), ASM followed the evaluation procedures in that document to determine the historic significance of the building.

ASM first considered whether the Primary Pump Station meets NRHP/CRHR Criterion A/1. The JRP (2023) historic context notes that an individual feature may be eligible under this criterion if it had "historic importance above and beyond fulfilling its ordinary role," if it "introduced or proved the efficiency of an important new technology…public health measure, environmental treatment standard," if it was "closely associated with the creation of a type of political organization" or finally if it was "the clearly identified focus of important social or political conflicts" (JRP 2023:253). Research did not reveal that the Primary Pump Station and its associated role in the wastewater management of the City of Coalinga was associated with the introduction of any new technology, public health measure, or environmental standard. Research additionally did not reveal that the construction and the use of the Primary Pump Station and its associated role in wastewater management was associated with any political organization, nor was it ever a focus of important social or political conflicts. Because eligibility under this Criterion requires that the building must be an important example of a specific trend or theme related to the qualifications described above, the Primary Pump Station does not qualify as historically significant under this criterion. Furthermore, although the building was associated with the expansion of the plant, the expansion did not introduce any new services nor fundamentally change

the nature of the municipal water system. Although the Primary Pump Station was constructed as a result of expansion, the JRP (2023) report notes that "the construction of new, modern infrastructure is a routine function of municipal public service departments to account for population growth" (JRP 2023:254). This seems to be the case with the construction of the Primary Pump Station in 1991, which replaced the Operations Building as the building primarily associated with the pumping that occurred on the site. Therefore, ASM recommends that the Primary Pump Station is not individually eligible for listing in the NRHP/CRHR under Criterion A/1.

ASM then considered whether the Primary Pump Station meets NRHP/CRHR Criterion B/2. Research did not reveal that an individual of historic importance was associated with the Primary Pump Station. The JRP (2023) historic context notes that individual "wastewater systems do not commonly have strong, direct association with single individuals" (JRP 2023:255). That statement applies to the Primary Pump Station, and, therefore, ASM recommends that the Primary Pump is not individually eligible for listing in the NRHP/CRHR under Criterion B/2.

ASM then considered whether the Primary Pump Station meets NRHP/CRHR Criterion C/3. The JRP (2023) historic context notes that an individual feature may be historically significant if it is the "earliest, best preserved, or a rare surviving example of its type," if it "introduced a design innovation," or finally if it "represents a transition between different expressions of the property type element" (JRP 2023:256). Because the Primary Pump Station was constructed in 1991, performs standard operations associated with waste management, and replaced a previous building that likely performed a similar function, it is not the earliest, best preserved, nor a rare surviving example of its type. The building is of utilitarian construction, performs standard operations, and, therefore, did not introduce any design innovations. Finally, research did not reveal a transition between different expressions of the Primary Pump Station property type. Finally, the Primary Pump Station was not associated with a master architect or engineer and is a utilitarian design. The JRP (2023) historic context notes that property types such as the Primary Pump Station "perform routine functions that remain consistent across treatment eras" and were "constructed using common designs and materials for their era" and are therefore "unlikely to be significant for their engineering" (JRP 2023:258). Research did not reveal any significant feats of engineering associated with the use and operations of the Primary Pump Station. Therefore, ASM recommends that the Primary Pump Station is not individually eligible for listing in the NRHP/CRHR under Criterion C/3.

Finally, the Primary Pump Station is a common property type element that does not have the potential to provide information about history or prehistory that is not available through historic research. Therefore, ASM recommends that the Primary Pump Station is not individually eligible for listing in the NRHP/CRHR under Criterion D/4.

Given that the Primary Pump Station does not meet any NRHP criteria and is not exceptionally important, ASM recommends that the Primary Pump Station is not individually eligible for listing in the NRHP under NRHP Criteria Consideration G. The Primary Pump Station does not meet any CRHR criteria and is not exceptionally important; therefore, ASM recommends that the Primary Pump Station is recommended not individually eligible for listing in the CRHR under any criteria.

Shed Building (Building 4)

The Shed Building was first visible in the 1994 historic aerial photograph of the area, and it was not noted in the 1990 Wastewater Treatment Plant Primary Treatment Rehabilitation drawings. Presently, it appears to act as a large storage unit for the equipment associated with the site and was likely constructed in 1991 as part of the site expansion.

Because this building was not identified in the plans of 1990 Wastewater Treatment Plant drawings, it likely played a supporting role in the function of the site. Due to its open nature and lack of walls, this building likely provided shelter for the equipment associated with the site during its construction and operation.

An September 2024 survey of the site revealed that the building is one story and rectangular, features a front-gabled, metal roof and no walls with the exception of the rear. The rear side façade faces east toward the wastewater treatment plant and is composed of concrete block with the under-gable composed of vertically oriented corrugated metal siding. Along the sides of the building are wooden poles that support the roof. Wood roof trusses support the corrugated metal roof and wood-plank siding along the edge of the roof along all four sides.

The primary façade of the building faces west with a chain-link fence and gate that limits access to the building to this side only. The primary façade features only the chain-link gated entrance and the corrugated metal under-gable, while the rear façade features only the concrete block wall and the corrugated metal under-gable. The rear façade also includes metered equipment with associated pipes/wires attached along the bottom of the wood truss roof (Figures 34–37).

Given that this building was likely constructed in 1991, ASM considered whether the Shed Building demonstrates exceptional historical significance for eligibility for listing in the NRHP/CRHR. For the NRHP, ASM applied Criterion Consideration G. This building was not an identified property type within the JRP (2023) report and research did not reveal direct or indirect support of the operations of the plant. Therefore, it was evaluated under the standard NRHP and CRHR regulatory contexts.

ASM first considered whether the Shed Building is individually eligible for listing in the NRHP/CRHR under Criterion A/1. ASM considered whether the Shed Building was associated with a specific event marking an important moment in the history of Coalinga or was associated with a pattern of events that made a significant contribution to the development of Coalinga. Research did not reveal that the Shed Building was associated with any significant historical events. Its association with the waste management plant appears to be historically minimal as it was not represented in the various drawings and plans of the plant. Research did not reveal that, as a storage shed, it was notable, the first to be constructed in the area, or the first of its type. Therefore, because the Shed Building did not significantly contribute to the history or development of Coalinga, ASM recommends that the Shed Building is not individually eligible for listing in the NRHP/CRHR under Criterion A/1.

Research did not reveal that the Shed Building is associated with any historically significant individuals. It is therefore recommended not individually eligible for listing in the NRHP/CRHR under Criterion B/2.

ASM then assessed whether the Shed Building embodies distinctive characteristics of a type, period, or method of construction, or represents the work of a master. The Shed Building is primarily utilitarian and, as a result, retains no reference to any specific architectural styles and retains minimal design attributes. Research did not reveal that any type of shed building, or similar storage building, was identified as particularly important to the history of Coalinga, nor did it reveal that there are elements of construction of the Shed Building that are unique to Coalinga or utilize local resources. Research additionally did not reveal that a master architect or builder was associated with the construction, design, or development of the building. As such, ASM recommends the Shed Building is not individually eligible for listing in the NRHP/CRHR under Criterion C/3.

Finally, the Shed Building is a common property type element that does not have the potential to provide information about history or prehistory that is not available through historic research. Therefore, ASM recommends the property not individually eligible for listing in the NRHP/CRHR under Criterion D/4.



Figure 34. Building Four, the Shed. View toward south.



Figure 35. Building Four, the Shed. Rear façade, view toward southwest.



Figure 36. Building Four, the Shed. Primary façade, view toward northeast.



Figure 37. Building Four, the Shed. Detail of interior.

Given that the Shed Building does not meet any NRHP criteria and is not exceptionally important, ASM recommends that the Primary Pump Station is not individually eligible for listing in the NRHP under NRHP Criteria Consideration G. The Shed Building does not meet any CRHR criteria and is not exceptionally important; therefore, ASM recommends that the Shed Building is recommended not individually eligible for listing in the CRHR under any criteria.

Digester (Structure 1)

The digester tank is first visible in a 1967 historic aerial photograph and is represented on a USGS topographic map beginning in 1967. This structure was likely constructed as part of the expansion of the site in 1963 and is therefore given a circa 1963 construction date. The 1979 plans labeled the structure as a digester with plans to abandon the structure in place. By the 1990 drawings, this structure was still referred to as a digester.

Within the JRP (2023) report, a digester most closely resembles the sludge digestion property type. This building type is described as part of a "treatment chain [that] continues to process the sludge collected from the clarifiers and filters" and requires a "sealed container" in order to achieve sludge digestion. The context notes that "circular digestion tanks with floating metal lids are common," which the Coalinga Digester reflects (JRP 2023: 229).

The digester is a large concrete tank that presently does not appear to have a top, nor has been filled according to aerial imagery. An September 2024 survey of the site revealed that the majority of the equipment associated with the tank is located on the north side, facing the Operations Building. This includes two pumps with a large pipe connecting the pumps to the interior of the tank, two boxes of staggered heights that are connected to pipes that connect to the inside of the tank as well as the outside, and a set of metal stairs that allow access to the interior of the tank from the top. No further architectural or design details were noted (Figures 38–40).

ASM then considered whether the Digester is individually eligible under any NRHP or CRHR criteria. Because the Digester is an identified property type associated with Waste Treatment Plants as defined by JRP (2023), ASM followed the evaluation procedures in the report to determine the historic significance of the building.



Figure 38. Structure One, Digester Tank. View toward northwest. Building Four visible in background.



Figure 39. Structure One, Digester Tank. View toward southwest.



Figure 40. Structure One, Digester Tank. View toward southeast.

ASM first considered whether the Digester is eligible for listing in the NRHP/CRHR under Criterion A/1. The JRP (2023) report notes that an individual feature may be eligible under this criterion if it had "historic importance above and beyond fulfilling its ordinary role," if it "introduced or proved the efficiency of an important new technology…public health measure, environmental treatment standard," if it was "closely associated with the creation of a type of political organization," or finally if it was "the clearly identified focus of important social or political conflicts" (JRP 2023:253). Research did not reveal that the Digester and its associated role in the wastewater management of the City of Coalinga was associated with the introduction of any new technology, public health measure, or environmental standard. Research additionally did not reveal that the construction and the use of the Digester and its associated role in wastewater management was associated with any political organization, nor was it ever a focus of important social or political conflicts. Because eligibility under this Criterion requires that the building must be an important example of a specific trend or theme related to the qualifications described above, the Digester does not qualify as historically significant under this criterion. Furthermore, although the building was modernized and was associated with the expansion of the plant, the expansion and modernization did not introduce any new services nor fundamentally change the nature of the municipal water system. Although the Digester was constructed as a result of modernization and expansion, the JRP (2023) report notes that "the construction of new, modern infrastructure is a routine function of municipal public service departments to account for population growth" (JRP 2023:254). This seems to be the case with the construction of the Digester in 1963, which was constructed to accommodate the population growth of Coalinga in the mid-century. Therefore, ASM recommends that the Digester is not individually eligible for listing in the NRHP/CRHR under Criterion A/1.

ASM then considered whether the Digester is eligible for listing in the NRHP/CRHR under Criterion B/2. Research did not reveal that an individual of historic importance was associated with the Digester. The JRP (2023) report notes that "wastewater systems do not commonly have strong, direct association with single individuals" (JRP 2023:255). This statement applies to the Digester, and therefore ASM recommends that the Digester is not individually eligible for listing in the NRHP/CRHR under Criterion B/2.

ASM then considered whether the Digester is eligible for listing in the NRHP/CRHR under Criterion C/3. The JRP (2023) notes that an individual feature may be historically significant if it is the "earliest, best preserved, or a rare surviving example of its type," if it "introduced a design innovation," or finally if it "represents a transition between different expressions of the property type element" (JRP 2023:256). Because the Digester was constructed in 1963 and performs standard operations associated with waste management, it is not the earliest, best preserved, nor a rare surviving example of its type. The building is utilitarian, performs standard operations, and therefore does not represent any design innovations. Research did not reveal a transition between different expressions of the Digester property type. Finally, the Digester was not associated with a master architect or engineer. The JRP (2023) report notes that property types such as digesters "perform routine functions that remain consistent across treatment eras" and were "constructed using common designs and materials for their era" and are therefore "unlikely to be significant for their engineering" (JRP 2023:258). This statement applies to the Digester, as research did not reveal any significant feats of engineering associated with the use and operations of the Digester.

Therefore, ASM recommends that the Digester is not individually eligible for listing in the NRHP/CRHR under Criterion C/3.

Finally, the Digester is a common property type element that does not have the potential to provide information about history or prehistory that is not available through historic research. Therefore, ASM recommends the Digester is not individually eligible for listing in the NRHP/CRHR under Criterion D/4.

In conclusion, ASM recommends that the Digester is not individually eligible for listing in the NRHP/CRHR under any criteria.

Primary Clarifier (Structure 2)

The primary clarifier is first visible in a 1967 historic aerial photograph, and it is represented in a USGS topographic map beginning in 1967. This structure was likely constructed as part of the expansion of the site in 1963 and is therefore given a circa 1963 construction date. The 1979 plans labeled the structure a clarifier with a note of plans to abandon the structure in place. According to the 1990 drawings, this structure was still extant and was labeled as a clarifier.

The JRP (2023) report defines a clarifier as a property type that "serves to calm the influent" and "[hold] it without agitation for a period of several hours." Clarifiers are described as "often the largest structures at a treatment plant" where older examples of clarifiers "favored circular form from 20 to 200 feet in diameter" while modern tanks "are more commonly rectangular" (JRP 2023: 225).

An September 2024 survey of the site revealed that the clarifier is largely subterranean, with only small portions of the concrete exterior visible above the ground. During the survey, water was noted at the top of the structure. A metal fence was constructed all around the structure, with a single opening allowing access to the central equipment facing south toward the Operations Building. Poured concrete steps support the walkway, as the ground rises in the southern area of the facility to meet the grading of the site, obscuring portions of the small surrounding concrete exterior. The stairwell leads to a metal catwalk over the clarifier to the center, which retains various equipment associated with the use of the structure. (Figures 41–42).

Additional equipment associated with the clarifier was placed to the southwest of the structure and west of the entrance to the catwalk. This equipment was likely placed during the second expansion of the plant, as it appears for the first time in historic aerial photographs between 1981 and 1994, and was depicted in the 1990 drawings of the plant labeled "headworks."

ASM considered whether the Clarifier is individually eligible for listing in the NRHP/CRHR under any criteria. Because the Clarifier is an identified property type associated with Waste Treatment Plants as defined by JRP (2023), ASM followed the evaluation procedures in that report to determine the historic significance of the building.



Figure 41. Structure Two, Clarifier Tank. View toward southeast.



Figure 42. Structure Two, Clarifier Tank. View toward north. Structure One visible in background.

ASM first considered whether the Clarifier is eligible for listing in the NRHP/CRHR under Criterion A/1. The JRP (2023) report notes that an individual feature may be eligible under this criterion if it had "historic importance above and beyond fulfilling is [sic] ordinary role," if it "introduced or proved the efficiency of an important new technology…public health measure, environmental treatment standard," if it was "closely associated with the creation of a type of political organization," or finally if it was "the clearly identified focus of important social or political conflicts" (JRP 2023:253). Research did not reveal that the Clarifier and its associated role in the wastewater management of the City of Coalinga was associated with the introduction of any new technology, public health measure, or environmental standard. Research did not reveal that the construction and the use of the Clarifier and its associated role in wastewater management was associated with any political organization, nor was it ever a focus of important social or political conflicts. Because eligibility under this Criterion requires that the building be an important example of a specific trend or theme related to the qualifications described above, the Clarifier does not qualify as historically significant under this criterion. Furthermore, although the building was modernized and was associated with the expansion of the plant, the expansion and modernization did not introduce any new services nor fundamentally change the nature of the municipal water system. Although the Clarifier was constructed as a result of modernization and expansion, the historic context notes that "the construction of new, modern infrastructure is a routine function of municipal public service departments to account for population growth" (JRP 2023:254). This statement applies to the Clarifier, which was constructed to accommodate the population growth of Coalinga in the mid-century. Therefore, ASM recommends that the Clarifier is not individually eligible for listing in the NRHP/CRHR under Criterion A/1.

ASM then considered whether the Clarifier is individually eligible for listing in the NRHP/CRHR under Criterion B/2. Research did not reveal that an individual of historic importance was associated with the Clarifier. The JRP (2023) report notes that "wastewater systems do not commonly have strong, direct association with single individuals" (JRP 2023:255). This statement applies to the Clarifier. Therefore, ASM recommends that the Clarifier is not individually eligible for listing in the NRHP/CRHR under Criterion B/2.

ASM then considered whether the Clarifier is individually eligible for listing in the NRHP/CRHR under Criterion C/3. The JRP (2023) report notes that an individual feature may be historically significant if it is the "earliest, best preserved, or a rare surviving example of its type," if it "introduced a design innovation," or finally if it "represents a transition between different expressions of the property type element" (JRP 2023:256). Because the Clarifier was constructed in 1963 and performs standard operations associated with waste management, it is not the earliest, best preserved, nor a rare surviving example of its type. The building is utilitarian, performs standard operations, and therefore does not represent any design innovations. Research did not reveal a transition between different expressions of the Clarifier property type. Finally, the Clarifier was not associated with a master architect or engineer. The JRP (2023) report notes that property types such as Clarifiers "perform routine functions that remain consistent across treatment eras" and were "constructed using common designs and materials for their era" and are therefore "unlikely to be significant for their engineering" (JRP 2023:258). This statement appears to apply to the Clarifier, as research did not reveal any significant feats of engineering associated with the use and operations of the Clarifier. Therefore, ASM recommends that the Clarifier is not individually eligible for listing in the NRHP/CRHR and Criterion C/3.

Finally, the Clarifier is a common property type that does not have the potential to provide information about history or prehistory that is not available through historic research. Therefore, ASM recommends that the Clarifier is not individually eligible for listing in the NRHP/CRHR under Criterion D/4.

In conclusion, ASM recommends that the Clarifier is not individually eligible for listing in the NRHP/CRHR under any criteria.

Aerated Lagoons and Stabilization Ponds

Aerated lagoons and stabilization ponds are necessary components of wastewater treatment and management, and they are first visible as present to the east of the plant site in the 1967 historic aerial photograph (USDA 1967). Constructed abutting Los Gatos Creek, the body of water associated with the Coalinga WWTP in 1967 occupied the entire space to the east of the plant site as a singular body of water (with no islands or separators differentiating the areas). This was likely completed in tandem with the modernization and expansion of the plant site in 1963. The body of water to the east of the plant site remained unaltered until circa 1979 when the Coalinga WWTP expanded again. The 1979 plans of the site reveal an intention to separate the body of water into distinct parts of aerated lagoons and stabilization ponds. While the proposed plans reveal extensive changes that would eventually be reflected, the 1981 historic aerial photograph of the site reveal that the body of water at this point had been separated into three: the largest, easternmost part was the stabilization pond, the large, westernmost part was the aerated lagoon, and to the north was another aerated lagoon. The next available historic aerial photograph of 1994 reveals the aerated lagoons and stabilization ponds in their contemporary iteration of two stabilization ponds on the easternmost area, two aerated lagoons to the west of the ponds, and an additional stabilization pond to the north of the aerated lagoons. This is also reflected in the 1991 drawings of the Coalinga WWTP, which specified the flow of waste between the plant area, the stabilization ponds, and the aerated lagoons.

The aerated lagoons and stabilization ponds are surrounded by unpaved but leveled roads and pathways that provide access throughout the area. Natural rocks are located at the eastern ends of the stabilization ponds. The aerated lagoons and stabilization ponds both appear to have been dug into the earth, and the unpaved and leveled paths between the structures appear to be slightly raised.

While aerated lagoons and stabilization ponds are necessary components in the process of waste management systems, they were not recognized as a distinct property type in the JRP (2023) report. However, because research has revealed the extent to which they directly supported the operations of the plant site, ASM followed the evaluation procedures in the JRP (2023) report to determine the historic significance of the structures. For the NRHP, ASM applied Criterion Consideration G for properties that are less than 50 years old.

ASM first considered whether the aerated lagoon and the stabilization pond structures meet NRHP/CRHR Criterion A/1. The JRP (2023) historic context notes that an individual feature may be eligible under this criterion if it had “historic importance above and beyond fulfilling is [sic] ordinary role,” if it “introduced or proved the efficiency of an important new technology…public

health measure, environmental treatment standard," if it was "closely associated with the creation of a type of political organization," or finally if it was "the clearly identified focus of important social or political conflicts" (JRP 2023:253). Research did not reveal that the aerated lagoons nor the stabilization ponds and their associated role in the wastewater management of the City of Coalinga was associated with the introduction of any new technology, public health measure, or environmental standard. Research additionally did not reveal that the construction and the use of the aerated lagoons and stabilization ponds and their associated role in wastewater management was associated with any political organization, nor was it ever a focus of important social or political conflicts. Because eligibility under this Criterion requires that the structures must be important examples of a specific trend or theme related to the qualifications described above, the aerated lagoons and stabilization ponds do not qualify as historically significant under this criterion. Furthermore, although the structures were associated with the expansion of the plant, the expansion did not introduce any new services nor fundamentally change the nature of the municipal water system. Although the aerated lagoons and stabilization ponds were constructed as a result of expansion, the JRP (2023) report notes that "the construction of new, modern infrastructure is a routine function of municipal public service departments to account for population growth" (JRP 2023:254). This seems to be the case with the construction of the aerated lagoons and stabilization ponds in 1991, which replaced the previous iteration of the body of water that aided in the wastewater management of the site. Therefore, ASM recommends the aerated lagoons and stabilization ponds are not individually eligible for listing in the NRHP/CRHR under Criterion A/1.

ASM then considered whether the aerated lagoons and stabilization ponds meet NRHP/CRHR Criterion B/2. Research did not reveal that an individual of historic importance was associated with the aerated lagoons and stabilization ponds. The JRP (2023) report notes that individual "wastewater systems do not commonly have strong, direct association with single individuals" (JRP 2023:255). That statement applies to the aerated lagoons and stabilization ponds, and, therefore, ASM recommends that the aerated lagoons and stabilization ponds are not individually eligible for listing in the NRHP/CRHR under Criterion B/2.

ASM then considered whether the aerated lagoons and stabilization ponds meet NRHP/CRHR Criterion C/3. The JRP (2023) report notes that an individual feature may be historically significant if it is the "earliest, best preserved, or a rare surviving example of its type," if it "introduced a design innovation," or finally if it "represents a transition between different expressions of the property type element" (JRP 2023:256). Because the aerated lagoons and stabilization ponds were constructed in their present iteration in 1991, perform standard operations associated with wastewater management, and replaced a previous body of water that likely performed a similar function, it is not the earliest, best preserved, nor a rare surviving example of its type. The aerated lagoons and stabilization ponds are utilitarian, perform standard operations, and therefore did not introduce any design innovations. Finally, the aerated lagoons and stabilization ponds were not associated with a master architect or engineer. Research did not reveal any significant feats of engineering associated with the use and operations of the aerated lagoons and stabilization ponds. Therefore, ASM recommends that the Primary Pump Station is not individually eligible for listing in the NRHP/CRHR under Criterion C/3.

Finally, aerated lagoons and stabilization ponds are a common property type that do not have the potential to provide information about history or prehistory that is not available through historic research. Therefore, ASM recommends that the aerated lagoons and stabilization ponds are not individually eligible for listing in the NRHP/CRHR under Criterion D/4.

Given that the aerated lagoons and stabilization ponds do not meet any NRHP criteria and are not exceptionally important, ASM recommends that the aerated lagoons and stabilization ponds are not individually eligible for listing in the NRHP under NRHP Criteria Consideration G. The aerated lagoons and stabilization ponds do not meet any CRHR criteria and are not exceptionally important; therefore, ASM recommends that the aerated lagoons and stabilization ponds are recommended not individually eligible for listing in the CRHR under any criteria.

Sludge-Drying Beds

Sludge-drying beds are necessary components of wastewater management treatment and were part of the Coalinga WWTP plant site likely beginning in 1963 after the Coalinga WWTP expanded for the first time. The first sludge-drying beds were constructed directly to the north of the plant site, are first visible in the 1967 historic aerial photograph, and are noted in the 1979 drawings of the Coalinga WWTP. However, these sludge-drying beds appear to have been abandoned after the site expanded in 1991. Historic aerial photographs from 1994 and onward do not relay the presence of sludge, and contemporary aerial photographs reveal only the old boundaries of the sludge bed with no indication of any active use in any recent period. Further evidence that the sludge-drying beds were abandoned at this time is seen in the construction of new sludge-drying beds to the east and northeast of the plant site and directly adjacent to the old sludge-drying beds around the same time, circa 1991. These sludge-drying beds were expanded to the north in circa 2009, as visible in the differences between the 2009 historic aerial photograph and the 2010 historic aerial photograph. More sludge-drying beds were later constructed beginning in 2018 to the west of the plant site. These sludge-drying beds are longer and are more expansive than the previous sludge-drying beds (circa 1991), and were continuously improved through 2022 with the construction of 10 circular earthen pools at the southern end of the sludge-drying beds.

The JRP (2023) report defines a sludge-drying bed as a property type where the remaining sludge after digestion takes place and is "spread on a bed to dry" where, as it loses water, "comes to resemble thick, cracked mud," and then is either sent to a landfill, an incinerator, or in some contemporary and historic cases sold as fertilizer. Research did not reveal how the Coalinga WWTP disposes of its sludge.

The circa 1991 sludge-drying beds to the east of the plant site are about 250 ft. long by 160 ft. wide all together and are visually divided into thirds by two walls. Within each walled area, historic and contemporary aerial photographs reveal different stages of sludge digestion, indicating that the sludge-drying beds were used systematically as needed rather than simultaneously.

The circa 2018 sludge-drying beds to the west of the plant site are about 575 ft. long and 475 ft. wide all together and are visually divided into thirds by two walls. Within each walled area, aerial photographs generally show the same stage of sludge digestion, indicating that the sludge-drying beds are in operation consistently and simultaneously. At the southern end of the sludge-drying

beds are 10 earthen circular pools that likely assist in the operation and function of the sludge-drying beds.

ASM considered whether the circa 1991 sludge-drying beds or the circa 2018 sludge-drying beds are individually eligible for listing in the NRHP/CRHR under any criteria. For the NRHP, ASM applied Criterion Consideration G for properties that are less than 50 years old. Because sludge-drying beds are an identified property type associated with WWTPs as defined by JRP (2023), ASM followed the evaluation procedures in the report to determine the historic significance of the structures.

ASM first considered whether the circa 1991 or circa 2018 sludge-drying beds meet NRHP/CRHR Criterion A/1. The JRP (2023) report notes that an individual feature may be eligible under this criterion if it had "historic importance above and beyond fulfilling is [sic] ordinary role," if it "introduced or proved the efficiency of an important new technology…public health measure, environmental treatment standard," if it was "closely associated with the creation of a type of political organization," or finally if it was "the clearly identified focus of important social or political conflicts" (JRP 2023: 253). Research did not reveal that the circa 1991 sludge-drying beds nor the circa 2018 sludge-drying beds and their associated role in the wastewater management of the City of Coalinga was associated with the introduction of any new technology, public health measure, or environmental standard. Research additionally did not reveal that the construction and the use of the circa 1991 sludge-drying beds nor the circa 2018 sludge-drying beds and their associated role in wastewater management was associated with any political organization, nor was it ever a focus of important social or political conflicts. Because eligibility under this criterion requires that the structures must be an important example of a specific trend or theme related to the qualifications described above, neither the circa 1991 sludge-drying beds nor the circa 2018 sludge-drying beds qualify as historically significant under this criterion. Furthermore, although the structures were associated with the expansion of the plant in different eras, neither expansion introduced any new services nor fundamentally changed the nature of the municipal water system. Although the circa 1991 sludge-drying beds and the circa 2018 sludge-drying beds were constructed as a result of expansion, the JRP (2023) report notes that "the construction of new, modern infrastructure is a routine function of municipal public service departments to account for population growth" (JRP 2023:254). This seems to be the case with the construction of both sludge-drying beds in circa 1991 and circa 2018, where the circa 1991 sludge drying beds replaced the original 1963 sludge drying beds, and the circa 2018 sludge-drying beds either replaced or greatly expanded the capacity of the sludge drying beds at the Coalinga WWTP. Therefore, ASM recommends that the circa 1991 sludge drying beds and the circa 2018 sludge-drying beds are not individually eligible for listing in the NRHP/CRHR under Criterion A/1.

ASM then considered whether the circa 1991 or the circa 2018 sludge-drying beds meet NRHP/CRHR Criterion B/2. Research did not reveal that an individual of historic importance was associated with Coalinga WWTP sludge-drying beds from any era. The JRP (2023) report notes that individual "wastewater systems do not commonly have strong, direct association with single individuals" (JRP 2023:255). That statement applies to the circa 1991 and circa 2018 sludge-drying beds, and therefore ASM recommends that the sludge-drying beds from both the circa 1991 and circa 2018 era are not individually eligible for listing in the NRHP/CRHR under Criterion B/2.

ASM then considered whether the circa 1991 or the circa 2018 sludge-drying beds meet NRHP/CRHR Criterion C/3. The JRP (2023) report notes that an individual feature may be historically significant if it is the "earliest, best preserved, or a rare surviving example of its type," if it "introduced a design innovation," or finally if it "represents a transition between different expressions of the property type element" (JRP 2023:256). Because the circa 1991 and the circa 2018 sludge-drying beds perform standard operations associated with waste management, and in the case of the circa 1991 sludge-drying beds replaced a previous structure that performed a similar function, it is not the earliest, best preserved, nor a rare surviving example of its type. Finally, the circa 1991 and the circa 2018 sludge-drying beds were not associated with a master architect or engineer. Research did not reveal any significant feats of engineering associated with the use and operations of either the circa 1991 nor the circa 2018 sludge-drying beds. Therefore, ASM recommends that the circa 1991 and the circa 2018 sludge-drying beds are not individually eligible for listing in the NRHP/CRHR under Criterion C/3.

Finally, sludge-drying beds are a common property type element that do not have the potential to provide information about history or prehistory that is not available through historic research. Therefore, ASM recommends that the circa 1991 and circa 2018 sludge-drying beds are not individually eligible for listing in the NRHP/CRHR under Criterion D/4.

Given that the circa 1991 and the circa 2018 sludge-drying beds do not meet any NRHP criteria and are not exceptionally important, ASM recommends that the sludge-drying beds are not individually eligible for listing in the NRHP under NRHP Criteria Consideration G. The sludge-drying beds do not meet any CRHR criteria and are not exceptionally important; therefore, ASM recommends that the circa 1991 and circa 2018 sludge-drying beds are recommended not individually eligible for listing in the CRHR under any criteria.

5. SUMMARY, ASSESSMENT OF EFFECTS, AND RECOMMENDATIONS

5.1 SUMMARY

A Class III inventory/Phase I survey was conducted for the Coalinga Sanitary Sewer Collection System and WWTP Improvements Project, Fresno County, California. A records search was conducted at the SSJVIC. This search indicated that the portions of the Project APE had been previously surveyed, and a single previously recorded cultural resource (P-10-003930) was observed within the Project APE; however, there are no extant features related to the resource within the current Project APE. An NAHC SLF search was conducted for the Project APE and the NAHC responded with negative SLF results. Geoarchaeological review of the project APE indicates that the pipeline portion of the APE is potentially likely to contain buried deposits; however, historic aerial and topographic map review indicates the APE has been heavily disturbed by development as far back as the mid-twentieth century.

A Class III inventory/Phase I survey fieldwork of the Project APE was conducted in August and September 2024, with parallel transects spaced at 15-m intervals. A single refuse scatter was observed along the northwestern edges of the existing aerator ponds. This refuse scatter was recommended not eligible for the NRHP/CRHR. No other archaeological resources of any kind were identified within the Project APE.

ASM considered the potential for a historic district associated the Coalinga WWTP with six primary buildings and structures, and additional ponds, lagoons, and sludge beds associated with the operations of Coalinga WWTP identified within the APE. ASM evaluated Coalinga WWTP for eligibility for listing in the NRHP/CRHR as a potential historic district and evaluated all buildings and structures associated with the WWTP within the APE. ASM recommended that a potential Coalinga WWTP historic district within the APE is not eligible for listing in the NRHP/CRHR under any criteria. ASM also recommended that none of the buildings, structures, lagoons, or ponds associated with the WWTP are individually eligible for listing in the NRHP/CRHR under any criteria.

Pipelines Associated with the Coalinga WWTP in the Pipelines APE

During the September 2024 survey, archeologists identified WWTP-Linear-1 as the only exposed linear feature as the rest of the underground pipelines were inaccessible. ASM was not tasked with evaluation of any pipeline or ditch within the Pipelines APE.

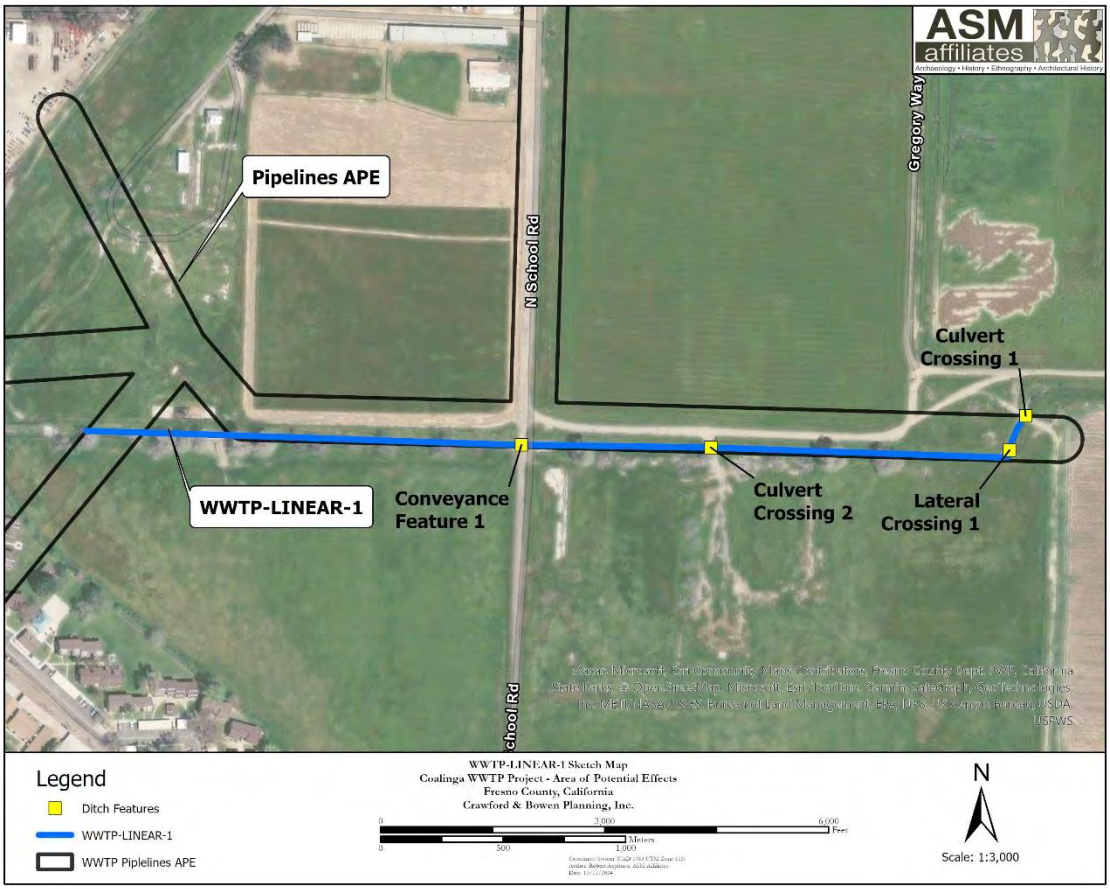


Figure 43. Showing exposed ditch feature within the Pipelines APE.

5.2 ASSESSMENT OF EFFECTS

A single previously recorded historic-era archaeological site and an unrecorded historic-era archaeological site and a historic-era built structure were recorded during the Class III inventory/Phase I survey. All 3 have been evaluated for eligibility to the NRHP/CRHR as a result of this study and previous studies and are recommended not eligible for inclusion in the NRHP/CRHR. As such, none of these resources are considered historic properties under NHPA nor historical resources under CEQA. and there will be no adverse effect or significant impact.

No cultural resources identified within the APE were recommended eligible for inclusion in the NRHP/CRHR under any criteria. Therefore, ASM recommends that there are no adverse effects or significant impacts as a result of the Project.

5.3 RECOMMENDATIONS

Based on the above analyses and findings, the proposed Coalinga Sanitary Sewer Collection System and WWTP Improvements Project will not result in adverse effects to historic properties

or significant impacts to historical resources. ASM recommends a determination of ***no adverse effect*** under Section 106 and ***no significant impact*** under CEQA. It is further recommended that, in the unlikely event that previously unrecorded cultural resources are identified during Project construction, work be halted within a 100-ft. radius of the find and a qualified archaeologist be contacted to evaluate the newly discovered resource.

REFERENCES

Advisory Council on Historic Preservation
n.d. National Register Evaluation Criteria. Electronic document, http://www.achp.gov/nrcriteria.html. Accessed June 18, 2018.

Asselin, Katie, and Randy Baloian
2016 Cultural Resources Inventory for the City of Huron Recycled Wastewater Project, Fresno County. California. Applied Earthworks, Inc., Fresno, California. Prepared for Crawford and Bowen Planning, Inc., Visalia, California.

Bird, Morgan
2021 DPR Site Form for P-10-003930. Available at Department of Parks and Recreation, Sacramento, California

Cook, S. F.
1978 Historical Demography. In *Handbook of North American Indians, Volume 8, California*, R. F. Heizer, editor, pp. 91-98. Washington, D.C., Smithsonian Institute.

Culleton, Brendan J.
2006 Implications of a Freshwater Radiocarbon Reservoir Correction for the Timing of the Late Holocene Settlement of the Elk Hills, Kern County, California. *Journal of Science* 33:1331-1339.

Driver, H.E.
1937 Cultural Element Distributions: VI, Southern Sierra Nevada. *University of California Anthropological Records* 1(2):53-154. Berkeley

Elsasser, A.
1962 *Indians of Sequoia and Kings Canyon National Parks*. Three Rivers: Sequoia Natural History Association.

Fenenga, F.
1952 The Archaeology of the Slick Rock Village, Tulare County, California. *American Antiquity* 17:339-347.

Fenenga, G.
1993 Test Excavations at the Witt Site (CA-KIN-32). In W.J. Wallace and F.A. Riddell, editors, pp. 25-38, *Finding the Evidence: The Quest for Tulare Lake's Archaeological Past*. Contributions to Tulare Lake Archaeology II. Redondo Beach, Tulare Lake Archaeological Research Group.

Fredrickson, D.A. and J. Grossman
1977 A San Dieguito component at Buena Vista Lake, California. *Journal of California and Great Basin Anthropology* 4:173-190.

(The) Fresno Bee
1964 "Coalinga Dedicates Sewer Plant as Key to City Growth." December 21.

Gayton, A.H.
1930 Yokuts-Mono Chiefs and Shamans. *University of California Publications in American Archaeology and Ethnology* 24. Berkeley, 361-420.
1948 Yokuts and Western Mono Ethnography. *University of California Anthropological Records* 10:1–290. Berkeley.

Gifford, E.W. and W.E. Schenck
1926 Archaeology of the Southern San Joaquin Valley. *University of California Publications in American Archaeology and Ethnology* 23(1):1-122.

Glennan, W.S.
1987a Concave-Based Lanceolate Fluted Projectile Points from California. *Prehistory of the Antelope Valley, California: An Overview*, R.W. Robinson, ed., Antelope Valley Archaeological Society, Occasional Papers No.1: 21-24.
1987b Evidence for Paleoeastern Culture Type in the Southwestern Great Basin. P*rehistory of the Antelope Valley, California: An Overview*, R.W. Robinson, ed., Antelope Valley Archaeological Society, Occasional Papers No.1:11-20.

Harp, E.L., and D.K. Keffer
1990 Landslides Triggered by the Earthquake. *United States Geological Survey, Professional Paper*; (USA), Vol. 1487.

Harrington, John Peabody
n.d. Yokuts ethnographic notes. National Anthropological Archives.

Hewes, G.
1941 Archaeological reconnaissance of the central San Joaquin Valley. *American Antiquity* 7:123-133.

Horne, S.P.
1981 *The Inland Chumash: Ethnography, Ethnohistory and Archaeology*. Ph.D. dissertation, UCSB. University Microfilms, Ann Arbor.

Hughes, J.P., W. Won, and R.C. Erickson
1990 Earthquake Damage to the Coalinga Oil Fields. *United States Geological Survey, Professional Paper*; (USA), Vol. 1487.

Jones, Jessica, Mary Baloian, and Annie McCausland
2018 Cultural Resource inventory for the Biota Community Services District Recycled Water improvements Feasibility Study, Fresno County. California. Applied EarthWorks, Inc. Fresno. California. Prepared for Crawford and Bowen Planning. Inc. Visalia, California.

Jones. T.L., G.M. Brown, L.M. Raab, J.L. McVickar, W.G. Spaulding. D.J. Kennett, A. York and P.L. Walker
1999 Demographic Crisis in Western North America during the Medieval Climatic Anomaly. *Current Anthropology* 40:137-170.

JRP Historical Consulting Services
2023 *Drinking Water and Wastewater Treatment Facilities in California: Historic Context and Research Design for National Register Evaluation*. Prepared for State Water Resources Control Board.

King, C., C. Smith and T. King
n.d. Archaeological Report Related to the Interpretation of Archaeological Resources Present at the Vasquez Rocks County Park. Report on file, UCLA AIC.

Kroeber, A.L.
1925 Handbook of the Indians of California. *Bureau of American Ethnology, Bulletin 78*. Washington, D.C.

Latta, F. F.
1977 *Handbook of the Yokuts Indians*. Bear State Books, Santa Cruz.

Meighan, Clement
1985 Personal communication between David Whitley and Clement Meighan.

Meyer, J, D. Craig Young, and Jeffrey S. Rosenthal
2010 *Volume I: A Geoarchaeological Overview and Assessment of Caltrans Districts 6 and 9.* Submitted to California Department of Transportation

Moratto, M.
1984 *California Archaeology*. New York: Academic Press.

Powers, Stephen
1971 The Yokuts Dance for the Dead. In R.F. Heizer and M.A. Whipple, editors, pp. 513-519, *The California Indians: A Source Book* (second edition). Berkeley, University of California Press (original 1877).
1976 *Tribes of California*. Berkeley, University of California Press (original 1877).

Preston, William L.
1981 *Vanishing Landscapes: Land and Life in the Tulare Lake Basin*. Berkeley, University of California Press.

Rosenthal, J. S., White, G. G., & Sutton, M. Q.
2007 The Central Valley: A View From the Catbird's Seat. *California Prehistory: Colonization, Culture, and Complexity*(50):147-164.

Rymer, Michael, and William Ellsworth
1990 The Coalinga, California, Earthquake of May 2, 1983. *United States Geological Survey, Professional Paper*; (USA), Vol. 1487.

Schiffman, R.A. and A.P. Garfinkel
1981 Prehistory of Kern County: An Overview. *Bakersfield College Publications in Archaeology, Number 1*.

Schultz, A . and A. Vanderslice
2007 Site Record for CA-STA-000350H/P-50-00000I, San Pablo & Tulare Railroad. Carey & Co. On file, California Historical Resources Information System, Central California Information Center, California State University. Stanislaus

Siefkin, Nelson
1999 Archaeology of the Redfeldt Mound (CA-KIN-66), Tulare Basin, California. M.A. Thesis, Department of Sociology and Anthropology, California State University, Bakersfield.

Sutton, M.Q.
1988a An Introduction to the Archaeology of the Western Mojave Desert, California. *Archives of California Prehistory, No. 14*. Salinas: Coyote Press.
1988b On the Late Prehistory of the Western Mojave Desert. *Pacific Coast Archaeological Society Quarterly* 24(1):22-29.
2009 People and Language: Defining the Takic Expansion into the Southern California. *Pacific Coast Archaeological Society Quarterly* 40(2, 3): 31-73.

U.S. Department of Agriculture Natural Resources Conservation Service (USDA NRCS)
2019 Web Soil Survey. Electronic document, http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx. Accessed September 2024.

United States Department of Agriculture (USDA)
1940 Historic aerial photograph. Accessed on historicaerials.com June 24, 2026.
1957 Historic aerial photograph. Accessed on historicaerials.com June 24, 2026.
1961 Historic aerial photograph. Accessed on historicaerials.com June 24, 2026.
1967 Historic aerial photograph. Accessed on historicaerials.com June 24, 2026.
1971 Historic aerial photograph. Accessed on historicaerials.com June 24, 2026.
1981 Historic aerial photograph. Accessed on historicaerials.com June 24, 2026.
1994 Historic aerial photograph. Accessed on historicaerials.com June 24, 2026.
2018 Historic aerial photograph. Accessed on historicaerials.com June 24, 2026.

U.S. Geological Survey (USGS)
1944 Topographic map of Coalinga Quadrangle: Fresno County, California. Scale 1:24000.
1956 Topographic map of Coalinga Quadrangle: Fresno County, California Scale 1:24000.
2007 Geologic Map of Coalinga and Guijarral Hills Quadrangles: Fresno County, California. Dibblee Geological Foundation Map DF-302, scale 1:24000.

W&S Consultants
1994 Phase II Test Excavations and Determinations of Significance at CA-LAN-2133, -2233, -2234, -2235, -2236, -2240, -2241 and -2242, Los Angeles County, California. Manuscript on file, CSUF AIC.
1999 Class III Inventory/Limited Archaeological Testing Program for the Manuscript on file, CSUB AIC.
2004 Class II Inventory of the Carrizo Plain National Monument, San Luis Obispo County, California. Report on file, BLM Bakersfield office.
2006 Phase II Test Excavations and Determinations of Significance for the Tejon Mountain Village Project, Kern County, California. Report on file, Tejon Ranch Company.

Wedel, W.
1941 Archaeological Investigations at Buena Vista Lake, Kern County, California. *Bureau of American Ethnology Bulletin* 130.

Whitley, D.S.
1992 Shamanism and Rock Art in Far Western North America. *Cambridge Archaeological Journal* 2(1):89-113.
2000 *The Art of the Shaman: Rock Art of California*. Salt Lake City: University of Utah Press.

Whitley, D.S. and M.P. Beaudry
1991 Chiefs on the Coast: The Development of Complex Society in the Tiquisate Region in Ethnographic Perspective. *The Development of Complex Civilizations in Southeastern Mesoamerica*, W. Fowler, ed., pp. 101-120. Orlando: CRC Press.

Whitley, D.S., G. Gumerman IV, J. Simon and E. Rose
1988 The Late Prehistoric Period in the Coso Range and Environs. *Pacific Coast Archaeological Society Quarterly* 24(1):2-10.

Whitley, D.S., J. Simon and J.H.N. Loubser
2007 The Carrizo Collapse: Art and Politics in the Past. In *A Festschrift Honoring the Contributions of California Archaeologist Jay von Werlhof*, ed RL Kaldenberg, pp. 199-208. Ridgecrest: Maturango Museum Publication 20.

Zimmerman, K.L., C.L. Pruett, and M.Q. Sutton
1989 A Clovis-Like Projectile Point from the Southern Sierra Nevada. *Journal of California and Great Basin Anthropology* 11:89-91.

CONFIDENTIAL APPENDICES