CLIMATE CHANGE VULNERABILITY ASSESSMENT AND MITIGATION PLAN

For

VENTURA COUNTY WATERWORKS DISTRICT NO. 16

PIRU WASTEWATER TREATMENT PLANT
PIRU, CALIFORNIA

Prepared by

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for submission to

California Regional Water Quality Control Board
Los Angeles Region

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1.0 INTRODUCTION

1.1 Background

Ventura County Waterworks District No. 16 (District) provides domestic and some commercial wastewater collection, treatment, and disposal services for the town of Piru in an unincorporated area of Ventura County. The Piru Wastewater Treatment Plant (PWTP or Plant) is located at 2815 East Telegraph Road in Piru, California.

Formed on May 8, 1972, the District encompasses 300 acres, including the Piru community, and provides sanitation services to over 400 customers. Up until March 2010, the District owned and managed a secondary wastewater treatment plant with a design capacity of 0.26 MGD (Million Gallons per Day). This was operated and maintained by Ventura Regional Sanitation District. In 2010 at the same site, the District constructed the PWTP with a design capacity of 0.5 MGD. The PWTP is operated and maintained by the District.

1.1.1 PWTP Treatment Process

The PWTP has a tertiary treatment capacity of an average daily dry weather flow of 500,000 gpd. Tertiary treatment at the Piru Treatment Plant consists of treating the secondary treated effluent to reduce the levels of chlorides and TDS present for meeting the discharge requirements. The secondary treated effluent from the clarifiers flows via gravity to the equalization basin.

From the equalization basin, the secondary treated effluent is then pumped via the tertiary pump station to the tertiary treatment system. Tertiary treatment reduces the levels of chlorides and TDS through a desalination treatment known as electrochemical nano diffusion (END). END is a water treatment technology that combines elements of electrochemical cells, ion exchange membranes, and electrodialysis reversal (EDR) treatment. Prior to entering the END for desalination, the secondary treated effluent undergoes pre-treatment consisting of disinfection and filtration to reduce potential bio-loading of the END system.

As shown in Figure 1-1, the PWTP consists of an influent pump station, two vertical bar screens, two extended oxidation ditches, and two secondary clarifiers. In addition, an ozone disinfection unit, two multimedia filters, an END desalination unit, and two evaporation tanks for brine disposal will be constructed.

Waste activated sludge from the secondary treatment is sent to two onsite aerobic digesters for digestion. Residual sludge from the digesters is dewatered by a belt press. Dewatered sludge is hauled off offsite to Toland Road Landfill, an authorized waste management Plant.

Brine that is produced by the END desalination treatment is discharged into nearby evaporation tanks. The tanks consist of above ground galvanized steel tanks fitted with multiple non-woven membrane polyethylene liners and a leak detection system. Each tank has a rated storage capacity of 156,000 gallons. Each pond contains an operational volume of 70,000 gallons, which accounts for the 6 inches of minimum level and 2 feet of freeboard required.

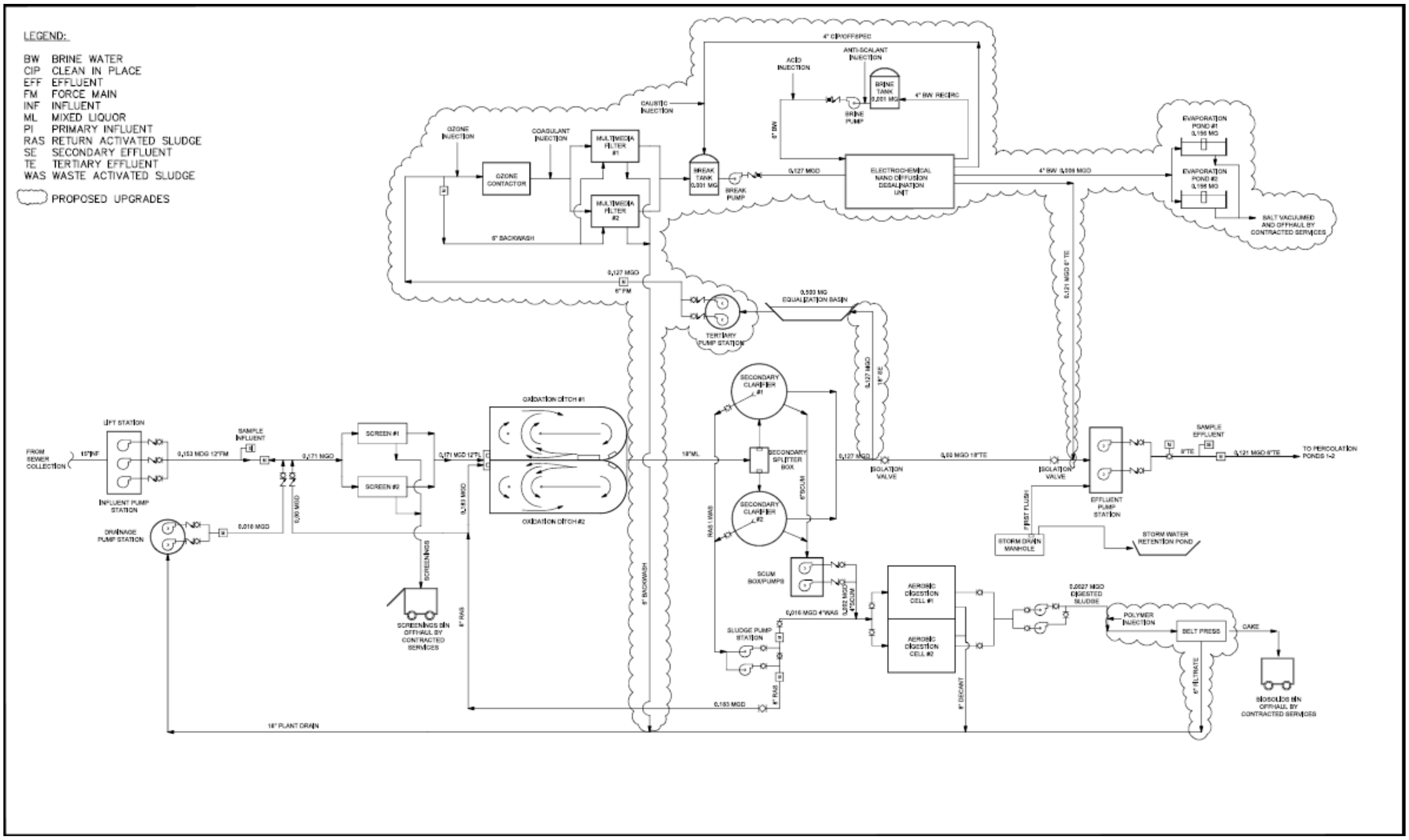
Level-detecting instrumentation is mounted to each tank and wired to the local Programmable Local Controller (PLC) which communicates to the Supervisory Control and Data Acquisition (SCADA) system. In the event an instrument detects a high level, an alarm is transmitted to notify the Operators to assess the system. In the event an instrument detects a high-high level, the Desalination Treatment system is automatically commanded to shut down.

For operation, there is a weather station for monitoring local weather conditions. The blowers are equipped with controls to ramp their speed (capacities) up and down based on production, target brine concentration, and weather conditions. During an Operator's weekly routine maintenance reviews, each pond is inspected to verify production efficacy, brine composition, level, and the system's integrity, particularly the liner assembly and its leak detection system.

1.1.2 PWTP Planned Treatment Process Changes

Currently, in the construction phase, the Piru Wastewater Treatment Plant will be upgraded to include tertiary treatment facilities for the effluent and the addition of a solids dewatering belt filter press system. The project is being funded by a grant from Proposition 84, funding from the American Rescue Plan Act (ARPA), and available District funds.

Figure 1-1: Piru Wastewater Treatment Plant Schematic



The State Water Board adopted the Water Quality Control Policy for Recycled Water (Recycled Water Policy) in 2018 and encourages the increased use of recycled water in California: 714,000 acre-feet per year (AFY) in 2015 to 1.5 million AFY by 2020 and to 2.5 million AFY by 2030.

The Recycled Water Policy categorizes recycled water use as agricultural irrigation, landscape irrigation, golf course irrigation, commercial application, industrial application, geothermal energy production, non-potable uses, groundwater recharge, seawater intrusion barrier, reservoir water augmentation, raw water augmentation, and potable uses.

The PWTP will be upgraded to a tertiary-level treatment system with ozone disinfection. When the District pursues offsite landscape irrigation and agricultural use, the District will be required to submit a Title 22 engineering report to the Department of Drinking Water for approval prior to the implementation of the recycled water applications. The requirements of Order R4-2023-0292 promote the need to develop and use recycled water.

1.1.3 PWTP Surface Water Discharge

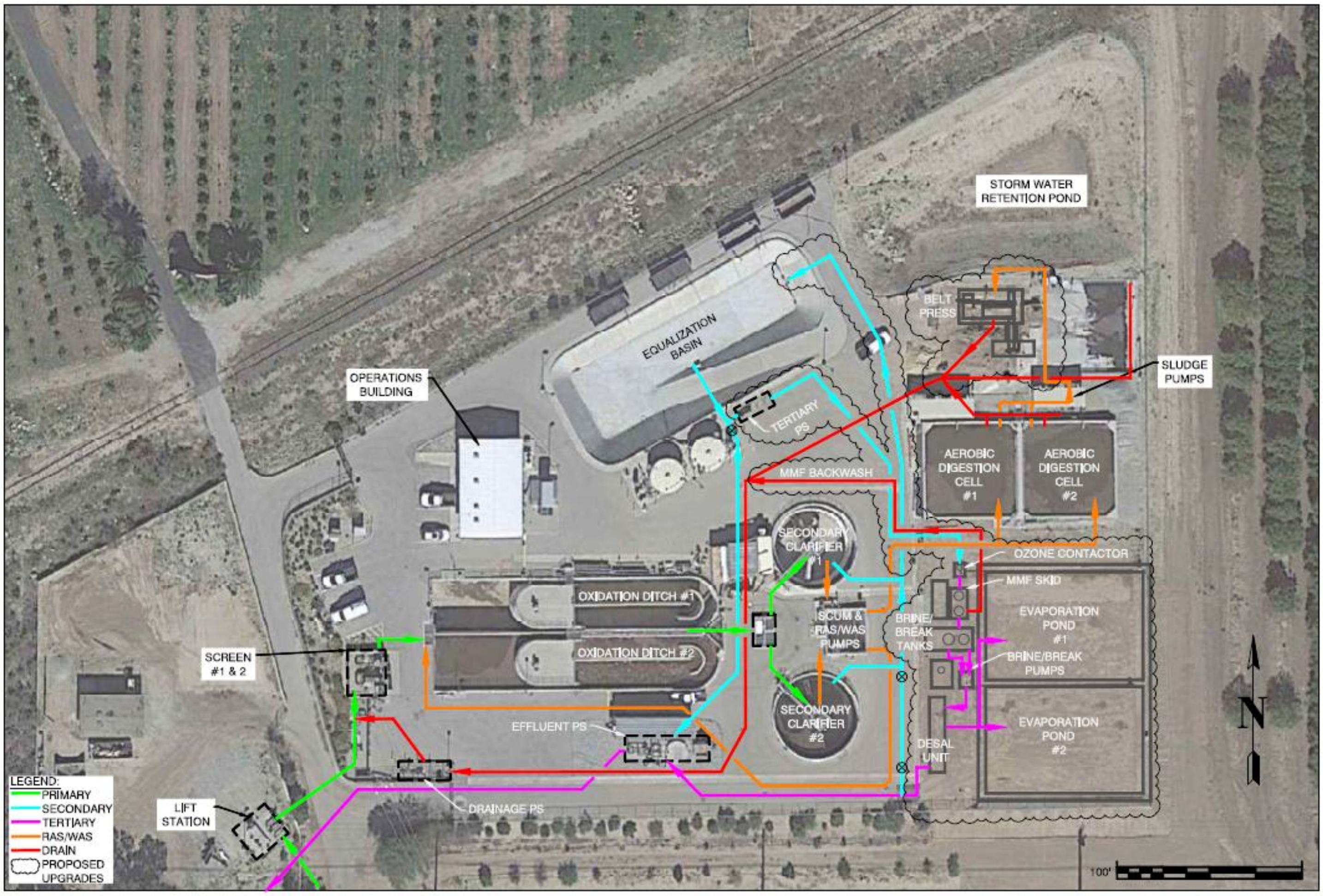
The District is not discharging wastewater from PWTP to surface water.

1.1.4 PWTP Groundwater Discharge

With the upgrade to the PWTP, including ozone disinfection and belt press dewatering processes, the disinfected, tertiary-treated wastewater will be discharged to the subsurface through two existing percolation ponds.

Once completed, the District anticipates that the upgrade of the PWTP and the END/EDR system will provide an effluent that complies with all requirements in Title 22 of the California Code of Regulations (CCR) and all the effluent limitations set forth in Order R4-2023-0292.

Figure 1-2: Piru Wastewater Treatment Plant Aerial View



1.1.5 PWTP Reclaimed Water Uses

The PWTP will be upgraded to a tertiary-level treatment system with ozone disinfection. When the District pursues offsite landscape irrigation and agricultural use, a Title 22 engineering report will be provided to the Department of Drinking Water for approval prior to the implementation of the recycled water applications.

2.0 PURPOSE

2.1 Climate Action Plan

Human activities over the past century have resulted in releases of large quantities of carbon dioxide and other greenhouse gases into the atmosphere, leading to the onset of significant changes in the earth's climate that will have substantial impacts on water resources, including water quality.

More specifically, the various predicted alterations to temperatures and precipitation could significantly affect water supplies in our region, as drought periods become more severe and snowpack levels decrease, leading to depleted groundwater levels and decreasing amounts of imported water available to the region.

In addition to water quantity, predicted changes to weather patterns and sea level could also drastically alter hydrological and ecosystem processes in the region. Such impacts could manifest in multiple ways, such as decreases in stream flow, reductions in, and changes to, aquatic habitats, increases in surface water temperature, increases in pollutant levels, sedimentation, and algal growth, and changes in salinity levels and acidification in coastal areas.

These impacts could affect many beneficial uses of our waters, including those protecting ecological habitats, recreational uses and commercial practices. Because preserving water quality is essential to protect both human populations and natural ecosystems, and to ensure their prosperity into the future, it is imperative to assess these impacts, and to develop strategies to adapt to the upcoming changes and mitigate their effects on water quality and on the beneficial uses of our waters.

The Climate Change Vulnerability Assessment and Mitigation Plan (Climate Change Plan), herein, was prepared pursuant to the requirements in the General Requirements Section E.11 of Order R4-2023-0292 Waste Discharge Requirements issued to the PWTP by the Los Angeles Regional Water Quality Control Board (LARWQCB).

Under General Requirements Section E.11 of Order R4-2023-0292, the District is required to consider the impacts of climate change as they affect the operation of the PWTP due to flooding, wildfire, or other climate-related changes. Furthermore, the District is required to develop a Climate Change Plan to assess and manage climate change-related effects that may impact PWTP's operation, water supplies, its collection system, and water quality, including any projected changes to the influent water temperature and pollutant concentrations, and beneficial uses.

Also, as part of the Climate Change Plan, District is required to identify new or increased threats to the sewer system resulting from climate change that may impact desired levels of service in the next 50 years. To that end, District is required to project upgrades to existing assets or new infrastructure projects, and associated costs, necessary to meet desired levels of service.

Furthermore, because climate change research indicates that the overarching driver of climate change is increased atmospheric carbon dioxide from human activity, the increased carbon dioxide emissions were evaluated. The emissions could trigger changes to climatic patterns, which increase the intensity of sea level rise and coastal storm surges, lead to more erratic rainfall and local weather patterns, trigger a gradual warming of freshwater and ocean temperatures, and trigger changes to ocean water chemistry. As such, the Climate Change Plan also identified steps being taken or planned to address greenhouse gas emissions attributable to the wastewater treatment at PWTP, as well as solids handling and effluent discharge processes at PWTP.

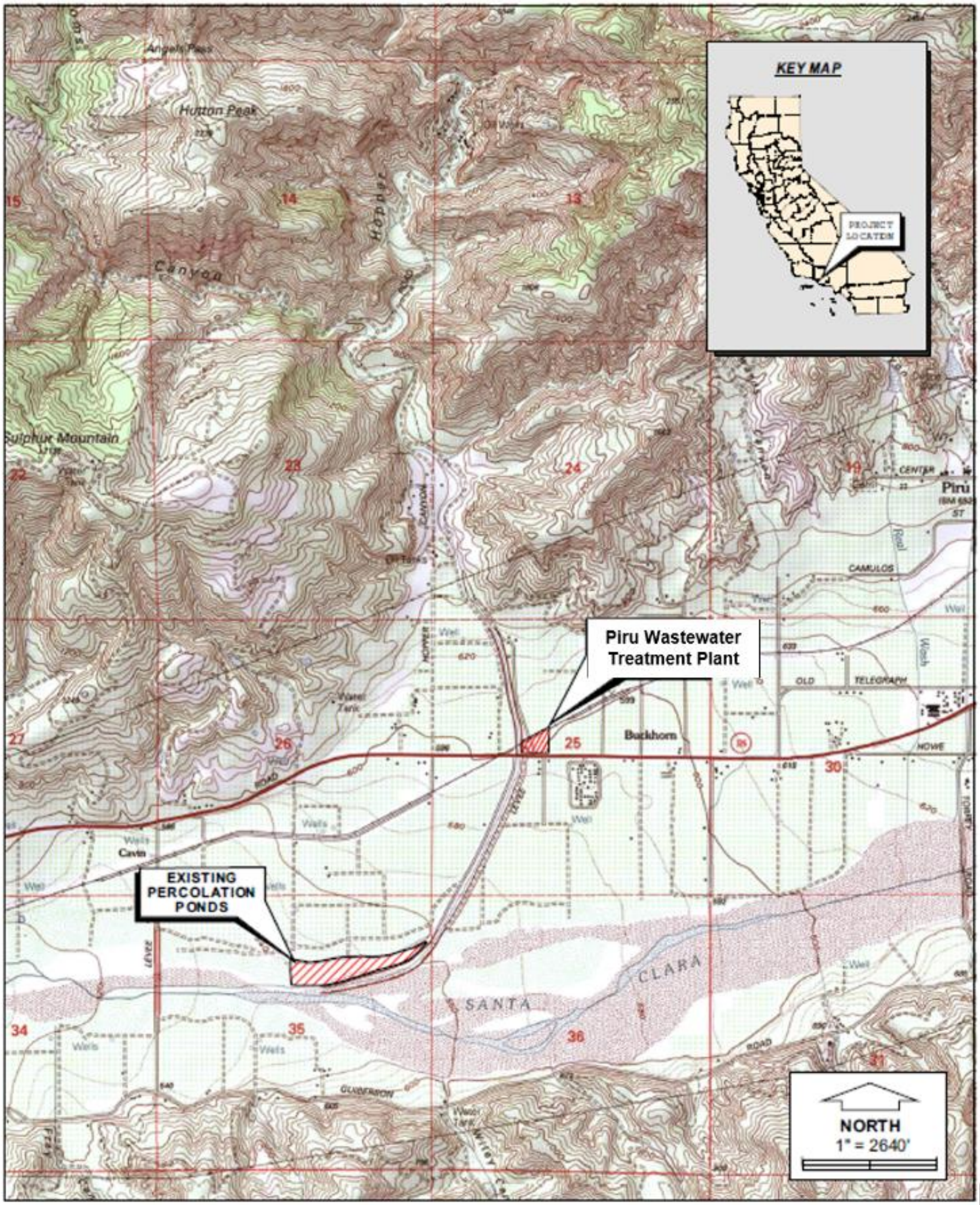
There are potential impacts from hazards that are related to climate change, but they are outside the control of the District. For example, risks to the regional electrical grid are beyond the control of District, nonetheless, District is planning to install a 262.7-kilowatt (kW) PV System at the PWTP to provide for partial independence from the grid as well as to protect ratepayers from potential annual rate increases by Southern California Edison (SCE) and the Clean Power Alliance (CPA).

The project, to be implemented through Agreements with Veolia, will increase on-site renewable energy production and cut operating costs. Total savings over the 30-year period is estimated to be $3.1 million. The $1,354,815 project will be financed by a $812,889 low-interest loan from the California Energy Commission and a 40% direct payment tax credit of $541,926 from the 2022 Inflation Reduction Act.

2.2 Piru Wastewater Treatment Plant Location

PWTP is located at 2815 East Telegraph Road, Piru, California, as presented in Figure 2-1 showing the Plant location and surrounding area.

Figure 2-1: Location of the Piru Wastewater Treatment Plant



2.3 Report Organization

The report is organized as follows:

- Section 1.0 - Introduction: Presents the location and background information on the Piru Wastewater Treatment Plant.
- Section 2.0 – Purpose: Explains the climate change vulnerability assessment and mitigation plan in general and as it relates to the Piru Wastewater Treatment Plant.
- Section 3.0 - Historical Vulnerability Analysis: Presents the historical trends and a vulnerability analysis of their impacts on the Piru Wastewater Treatment Plant.
- Section 4.0 – Future Vulnerability Analysis: Presents the predicted impacts with a focus on precipitation and temperature as well as possible riverine flooding in the areas surrounding Piru.
- Section 5.0 – Impacts to Piru Wastewater Treatment Plant: Presents impacts specific to the Piru Wastewater Treatment Plant.
- Section 6.0 – Summary: Presents a compilation of all the findings from the future vulnerability analysis of the Piru Wastewater Treatment Plant.
- Section 7.0 – References: Presents a list of all the sources of information used in preparing the climate change vulnerability assessment and mitigation plan.

3.0 HISTORICAL VULNERABILITY ANALYSIS

Like much of the Greater Los Angeles Area, Piru has a Subtropical-Mediterranean climate and receives just enough annual precipitation to avoid a semi-arid climate classification.

3.1 Climate Trends

Historical data was analyzed to explain existing vulnerabilities related to climate-driven hazards. Table 3.1 provides a summary of the findings of this analysis of the historical trends associated with each hydrometeorological parameter analyzed. Table 3.1 is followed by a discussion of the details of the methodology followed for identifying findings and the data and information used for that purpose.

While assessing climate change impacts on precipitation, temperature, riverine flooding, and wildfire in the region surrounding the PWTP, leading data sources for the area were considered. Coastal flooding from sea rise was not addressed due to the distance separating the PWTP from the Pacific Ocean coast.

Table 3.1: Summary of Historical Trends and Impacts to Piru Wastewater Treatment Plant

Hydrometeorological Parameters	Historical Trends and Impacts to Piru Wastewater Treatment Plant
Precipitation	The climatic conditions prevailing in Piru are characterized by a warm and moderate temperature. The rain in the area falls mostly in the winter, with relatively little rain in the summer. according to statistical data. The precipitation level on a yearly basis amount to 15.7 inches. The month with the lowest amount of rainfall is August, recording a mere 0.0 inch in its entirety. This denotes an exceptionally dry period within that particular time frame. In February, the precipitation reaches its peak, with an average of 3.7 inches.
Temperature	The mean temperature prevailing in the area is recorded as 62.2 °F (16.8 °C). The month that experiences the highest temperatures throughout the year is the month of August, where an average temperature of 75.5 °F (24.2 °C) prevails. At 50.4 °F (10.2 °C) on average, December is the coldest month of the year.
Sea-level rise	Not addressed due to the distance separating the PWTP from the Pacific Ocean coast.
Riverine Flooding	The Santa Clara River, designated as a flood way, is located south of the Piru Wastewater Treatment Plant. The Plant has not been impacted by flood water since the ground underneath it was raised.
Wildfire and post-fire debris flow	The PWTP is located away from the very high fire hazard severity zone designated by the California Department of Forestry and Fire Protection. Likewise, the post-fire debris flow follows the Santa Alara River to the south of the Plant with minimal impact to the PWTP.
Landslide	The vicinity around the Plant does not have a historical susceptibility to landslides. However, the PWTP sewer shed could be impacted by a landslide which could cause a discharge of untreated sewer water into the environment.
Water Quality	The PWTP has been in compliance with the effluent limits imposed by the Los Angeles Water Quality Control Board.
Water Temperatures	Wastewater temperatures are aligned with seasonal temperature fluctuations. The current LARWQCB-issued permit does not contain a limit for temperature.

Table 3.2 provides the list of the historical hydrometeorological data analyzed including how it was used, the spatial and temporal resolution, and source for each dataset. Observed data was collected from stations closest to the PWTP for all applicable parameters that were available. Modeling was used for parameters where observed data was lacking.

Table 3.2: Summary of Hydrometeorological Data Sources

Data	Used in Analysis	Spatial and Temporal Analysis	Source
Historical Precipitation And Temperature Data	Used for identifying trends for historical precipitation and minimum and maximum temperatures near PWTP	Annual (1921 to 2020) and monthly (1981 to 2010) point data	Parameter-elevation Regressions on Independent Slopes Model dataset (PRISM Climate Group, 2024)
Historical Sea- Level Rise Data	Not Applicable	Not Applicable	Not Applicable
Riverine flooding	Used for identifying trends in historical occurrences and vulnerabilities to riverine flooding near PWTP	Flood maps show areas with highest risk of flooding	Federal Emergency Management Agency (https://www.fema.gov/flood-maps/national-flood-hazard-layer) (FEMA, 2024)
Wildfire and post-fire debris flow	Used for identifying trends in historical occurrences and vulnerabilities of PWTP to wildfire and post-fire debris flow	Fire Hazard Severity Zones (FHSZ) classify a wildland zone as Moderate, High, or Very High fire hazard updated in September 2023 Likelihood of debris flow for Woolsey Fire started on Nov. 8, 2018, in Los Angeles and Ventura Counties, CA	California Department of Forestry and Fire Protection (https://osfm.fire.ca.gov/) (CalFire, 2024) and United States Geological Survey (https://landslides.usgs.gov/hazards/postfire_debrisflow/detail.php?objectid=239) (USGS, 2024)
Landslide	Used for identifying trends in historical occurrences and vulnerabilities of PWTP to landslides	U.S. Landslide Inventory updated in March 2022	United States Geological Survey (https://www.usgs.gov/tools/us-landslide-inventory) (Belair et al., 2022)

3.1.1 Precipitation and Temperature

Historical precipitation and temperature data were downloaded from the Parameter-elevation Regressions on Independent Slopes Model (PRISM) data source developed by Oregon State University. PRISM is a widely used climate data source developed by applying modeling techniques and quality control measures to climate observations gathered from a wide range of monitoring networks (PRISM Climate Group, 2024). Historical annual and monthly data were compiled to provide a summary of trends in recent decades, as presented below.

Figure 3-1 illustrates historical total annual precipitation trends from 1896 to 2023, along with an 11-year rolling average starting in 1906. Precipitation in this region exhibits significant variability, ranging from less than five inches in some years to intense rainfall above 40 inches per year in some years. Recent decades have seen more frequent occurrences of both very low (below 3 inches) and very high (above 30 inches) rainfall, resulting in increased variability.

Notably, the most recent decade experienced similar variations as historical ones. In general, extended periods of low rainfall do not directly impact the Plant but they do increase the risk of wildfires.

Figure 3-1: Annual Total Precipitation from 1896 to 2023

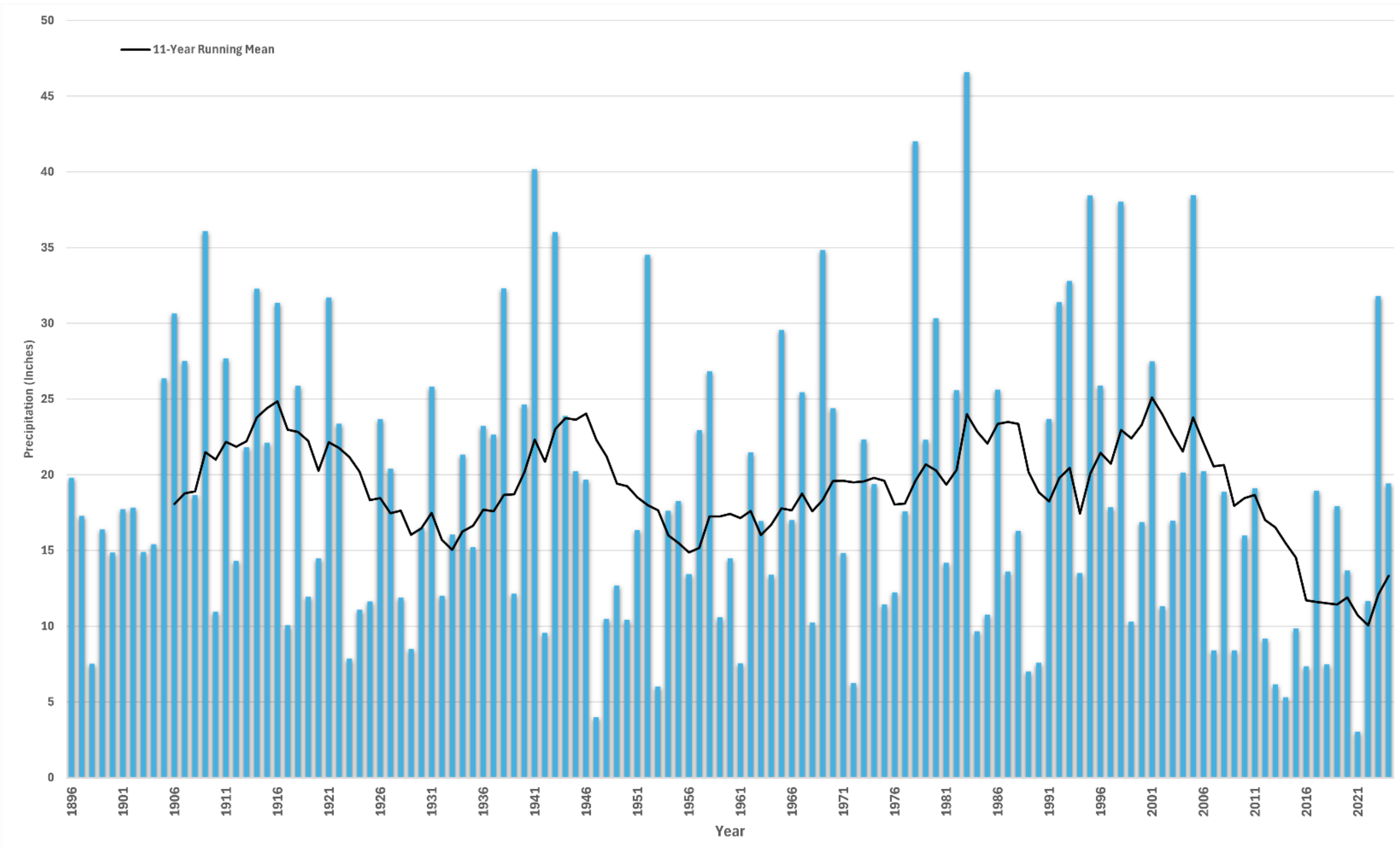


Figure 3-2 illustrates the monthly average precipitation spanning from 2009 to 2024. Peak rainfall occurs between December and March, with January receiving the highest amounts. During this period, the occurrence of flooding is most likely. Conversely, the summer months (June through September) witness sparse precipitation, typically totaling less than one-quarter of an inch on average. These dry conditions elevate the likelihood of wildfires, which are particularly prevalent during the summer season. Overall, the region has experienced an approximate mean annual rainfall of 19.3 inches since 1896 (PRISM Climate Group, 2024).

Figure 3-2: Monthly Average Precipitation from 2009 to 2004

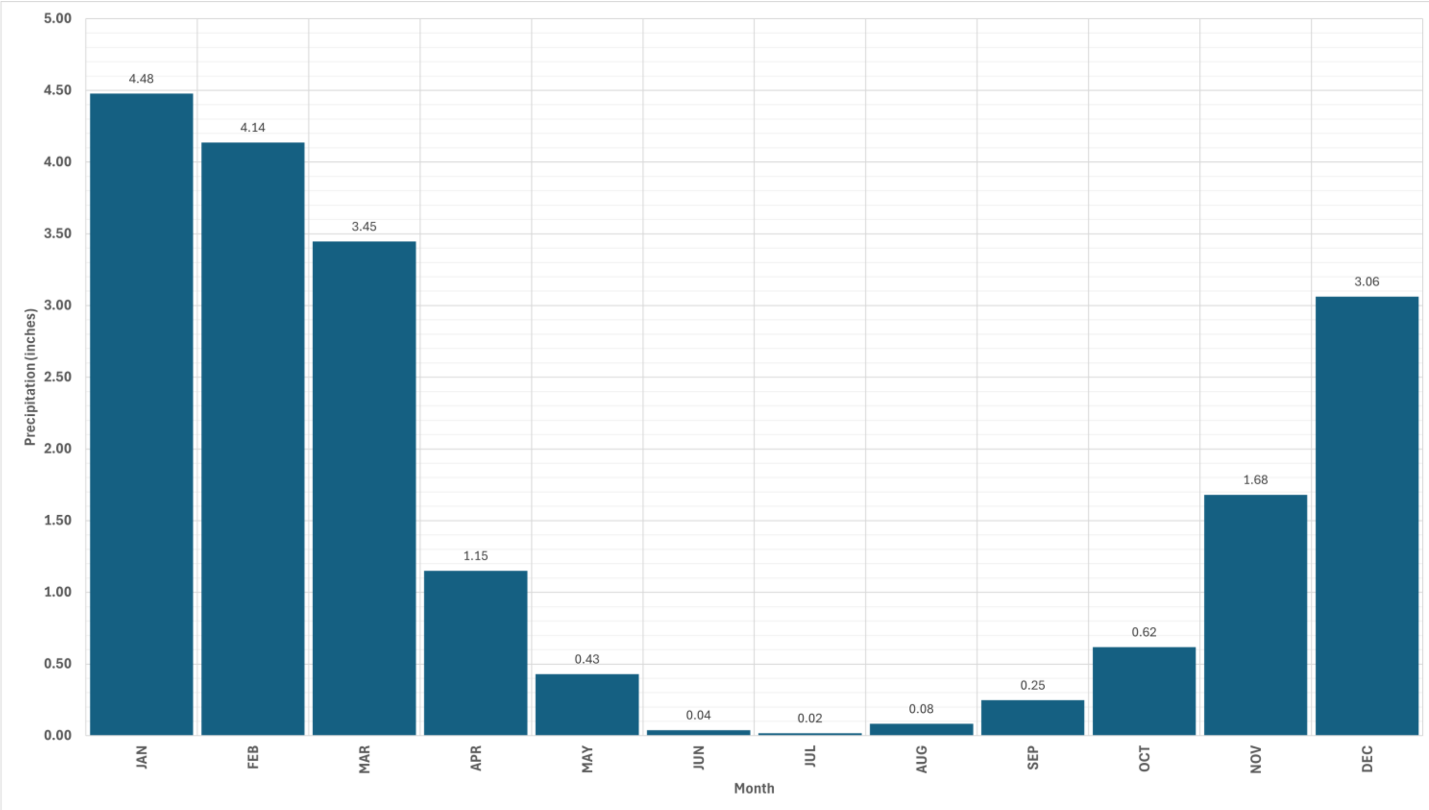


Figure 3-3 and Figure 3-4 display the annual average maximum daily temperature and the annual average minimum daily temperatures from 1896 to 2023, respectively. Both figures include an 11-year rolling average starting in 1906. Throughout this period, temperatures have remained moderate.

The annual average maximum temperature typically fluctuates between 76°F and 77°F. There is an increasing trend in both temperatures over time. The annual average maximum temperature shows a slight increasing trend, increasing from approximately 75°F in the early decades to approximately 78°F in recent decades The annual average minimum temperature shows a slight increasing trend, rising from approximately 50°F in the early decades to approximately 51°F in recent decades.

While temperatures have steadily increased, they are expected to remain moderate. Higher temperatures indirectly impact the Piru Wastewater Treatment Plant by increasing the likelihood of other hazard occurrences such as wildfires. Climate change continues to drive an increase in temperature.

Figure 3-3: Annual Average Maximum Temperature from 1896 to 2023

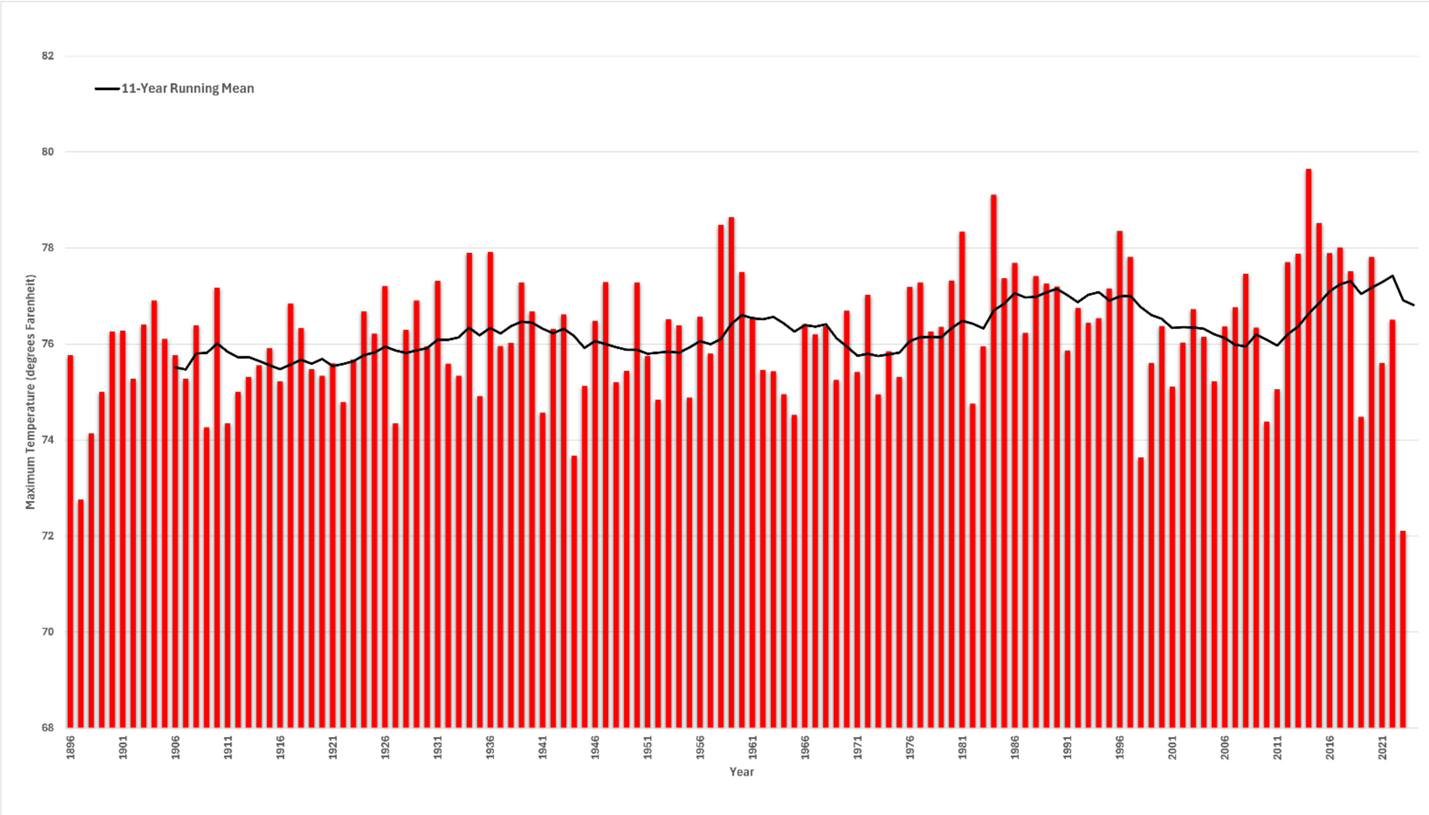
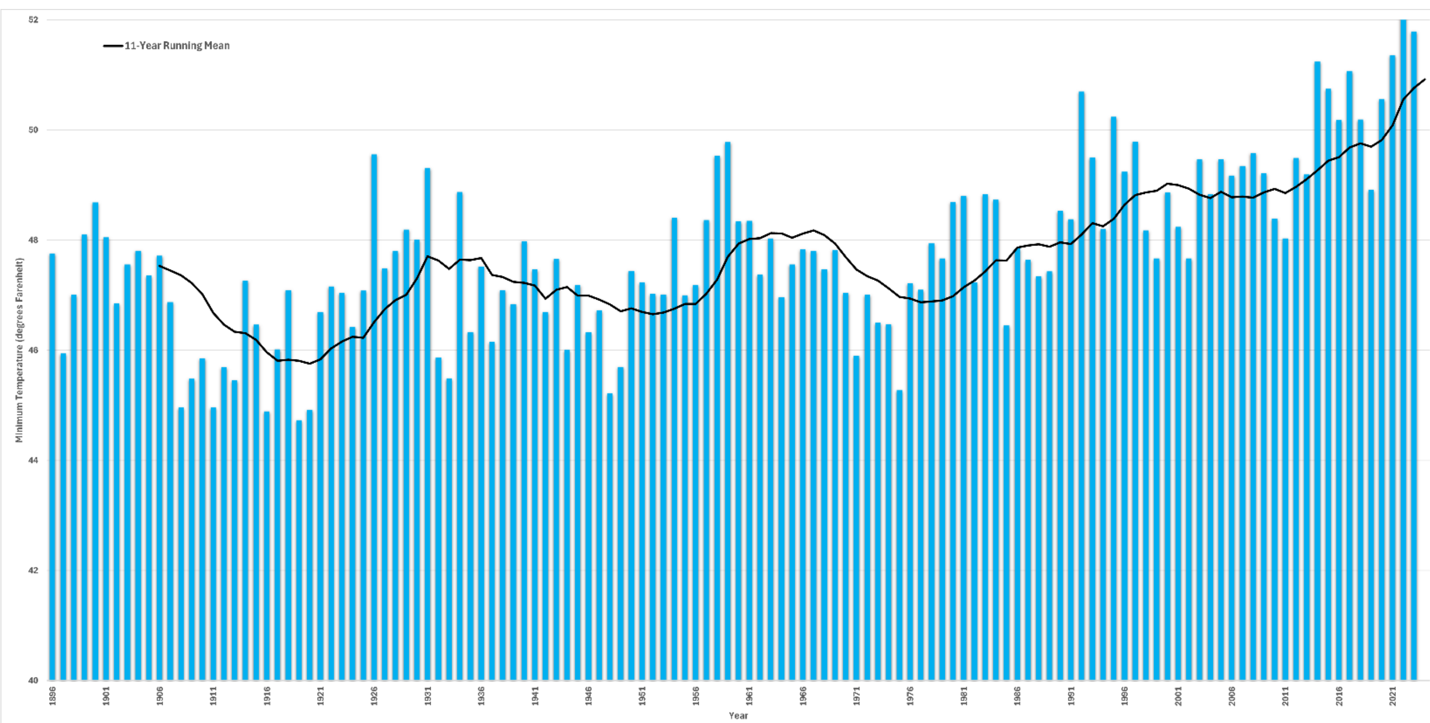


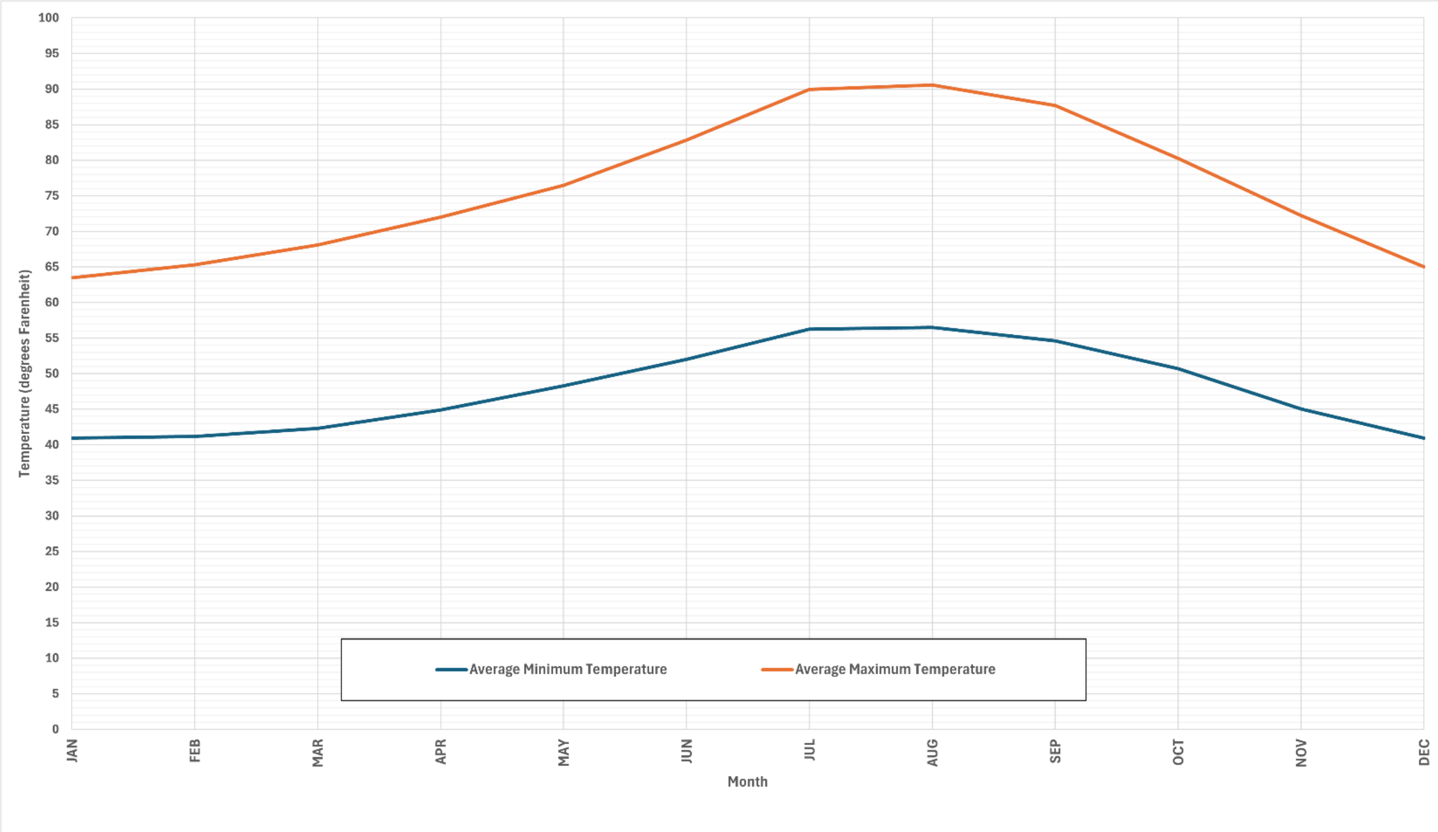
Figure 3-4: Annual Average Minimum Temperature from 1896 to 2023



Monthly average maximum and minimum temperatures between 2006 to 2024 are presented below (Figure 3-5). These values show low temperature values of approximately 41°F to 42°F during early winter months and a peak of 90°F to 92°F in the summer months. (PRISM Climate Group, 2024). The average minimum temperature varies between 42°F in the winter to 57°F in the summer, and the average maximum temperature varies between 64°F in the winter to 92°F in the summer.

The temperatures are generally highest during summer months, which coincides with the driest period of the year. As with dry conditions, warmer temperatures can increase the likelihood of the occurrence of wildfire which is most prevalent in the summer months.

Figure 3-5: Monthly Average Maximum and Minimum Temperature from 2006 to 2024

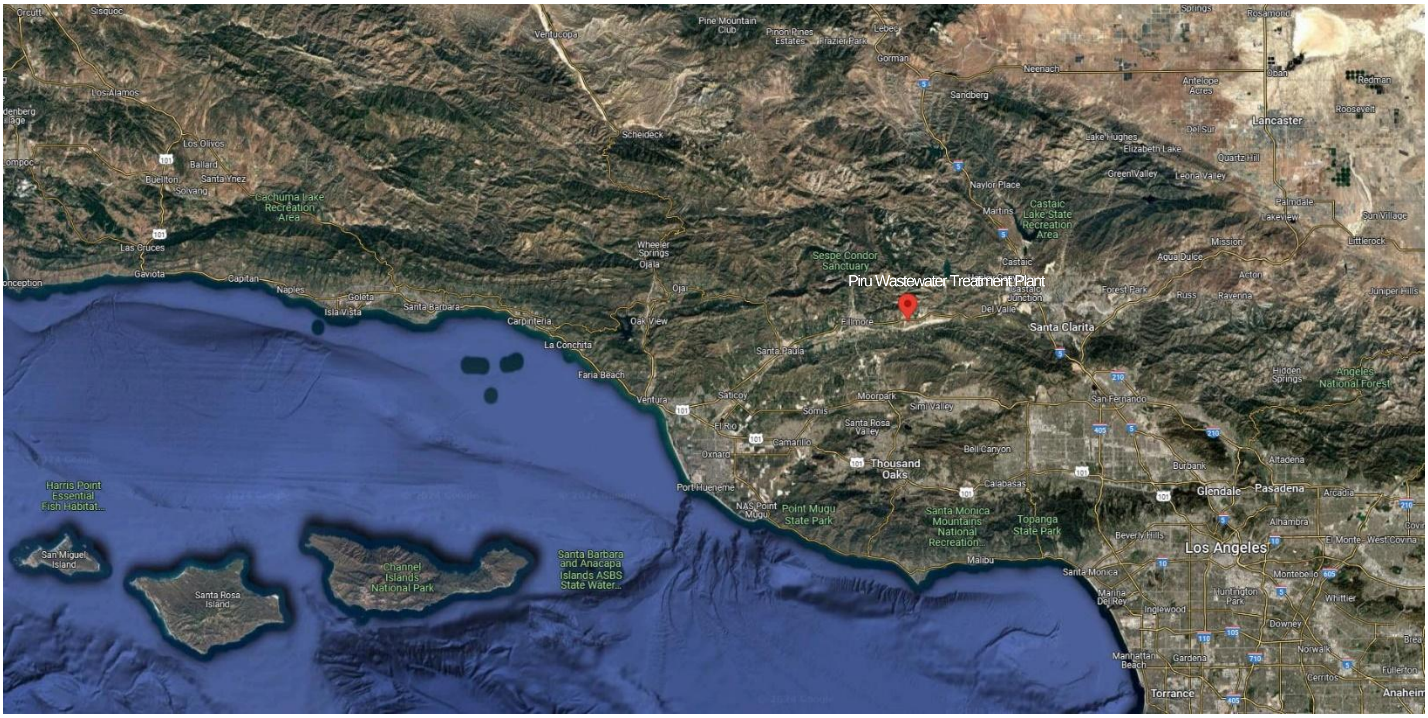


3.1.2 Sea Level Rise

Global and regional sea levels have been increasing over the past century and are expected to continue to increase throughout this century. However, because of geographical distance and topography, PWTP is not vulnerable to the impact from sea rise and therefore, sea level rise and the associated risk have been excluded from this Climate Change Vulnerability Assessment and Mitigation Plan.

With a distance of 26 miles from the Pacific Ocean coast, the Plant is far from coastal areas as shown in Figure 3-6, making it less likely to be directly affected by rising sea levels, which primarily impact coastal regions. Furthermore, with an elevation of 456 ft above sea level, the Plant is situated on higher ground, and therefore, it is less vulnerable to flooding from rising sea levels.

Figure 3-6: Distance Between Piru Wastewater Treatment Plant and Pacific Ocean



3.1.3 Riverine Flooding

Riverine flooding can occur during and after heavy rainfall events when stream and river flows exceed the capacity of their natural or constructed channels, overtopping the banks and spilling out into adjacent low-lying, dry land. This is the most common type of flooding for locations distant from coastal areas and located on higher ground. Localized flooding due to intense rainfall, inadequate drainage, or even nearby construction projects may increase risks due to flooding.

The Santa Clara River is somewhat unique in that it is the largest natural river system in southern California remaining in a relatively undeveloped state. Its headwaters are located on the north side of the San Gabriel Mountains near the unincorporated community of Acton in Los Angeles County. The Santa Clara is a braided stream that flows westerly for approximately 84 miles winding through Ventura County to its outlet into the Pacific Ocean on the south boundary of the City of San Buenaventura. Major tributaries include Castaic Creek and San Francisquito Creek in Los Angeles County, and the Sespe, Piru and Santa Paula Creeks in Ventura County.

Approximately 60 percent of the watershed is located within Ventura County. About 90 percent of the watershed is located in mountainous terrain, with the remainder consisting of the relatively flat floodplain areas of the Oxnard Plain, Santa Clarita Valley, Castaic Valley, the Santa Clara River Valley. The floors of some notable larger canyons including the upper Soledad, lower Sand, Mint, Bouquet, Placerita, San Francisquito, Piru, Santa Paula, and Sespe Canyons also contribute runoff to the main branch of the Santa Clara River (VCWPD, 2003).

Ventura County Flood Zone 2 boundaries incorporate all five of the Supervisorial Districts of Ventura County, however the bulk of Zone 2 is within Supervisor District 3.

The climate of the Santa Clara River watershed is characterized by long, dry periods and a relatively short wet period during winter of each year. Cool moist ocean winds have a moderating effect on the climate near the coast. Frosts are rare in the coastal region and common in the inland valleys and mountains. The types of storms that may occur in the basin are general winter storms, with an occasional thunderstorm or tropical cyclones blowing in from the expansive Pacific Ocean.

Approximately 75 percent of the annual precipitation occurs in the months between December through March. The mean seasonal precipitation varies from about eight inches on the valley floors near the eastern boundary of the basin (in western

Los Angeles County), to over 40 inches in the highest mountains in the basin (northeast portion of Ventura County). Seasonal rainfall average is approximately 14 inches as recorded near the coast at the river estuary outlet into the Pacific Ocean.

Current riverine and coastal flood vulnerabilities of the PWTP were assessed by collecting flood hazard data from the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program (NFIP). Figure 3-7 graphically shows the estimated flooded area due to a 100-year and 500-year storm event (i.e., storm event likely to occur once in every 100 and 500 years, respectively) in Piru according to the FEMA NFIP data.

Figure 3-8 shows this same map, zoomed to show the area surrounding the PWTP to show areas vulnerable to flooding from the 1% annual chance flood (100-year floodplain) and 0.2% annual chance flood (500-year floodplain) prepared by FEMA's NFIP.

In addition, a desktop review of historical reports of coastal flooding was conducted. History has shown that, in Piru and neighboring cities, it is often the unexpected quantity of rain or its lack that stands out.

The rains of 1884 were deeply embedded in the memories of those who were living in the Santa Clara Valley at the time. Piru had not yet been founded but Santa Paula was a growing city and Ventura was well established. The rains began with small typical showers in October and November of 1883 allowing the withered grasses of summer to grow and turn the hills green. On January 24th of 1884 it began to rain and continued for 34 hours measuring 15 inches. From January 31 to February 8, it rained every night measuring 20 inches.

The Santa Clara River was flooding from bank to bank. Nearly all the bridges in Southern California were swept away. According to the newspapers, Santa Paula received 40 inches and Ojai received 70 inches of rain in just 60 days. Newspapers of the time called it the greatest rainfall ever recorded in the valley.

In more modern times, and more specifically, in 1914, shortly after construction of the bridges across the Sespe and Santa Clara, torrential rain caused them to wash out leaving neighboring Fillmore isolated. In 1938 the north approach to the Bardsdale Bridge was washed out.

In 1969 once again brought excess rain and flooding to the area with three major storms from January through March. The vulnerable approaches to the Sespe auto bridge and the railroad bridge failed. Landslides were common. Los Serenos was flooded for the first time and Pole Creek flooded east of Mountain View as far as Main St.

Los Serenos took a hit again in 1978 when after several months of rainstorms, a violent rainstorm sent the Sespe rampaging through the neighborhood when debris formed a dam under the Sespe Auto Bridge. One of the local residents, a heavy equipment operator, took it upon himself to blow the bridge to release the backed-up water. After the community rose up in anger because of the damage, the U.S. Corp of Engineers finally agreed to build the levee which still stands today.

Most recently, in 2005, heavy rain caused the Santa Clara River to run full, from bank to bank. The Sheriff's office closed the Bardsdale Bridge in midafternoon when the river threatened to wash out the south approach. The river broke through south of the equestrian center, flowed over Hwy23 and back out to the river. As often happened in these wet years there were storms from January through March creating a situation ripe for disaster when the final heavy storms hit.

Figure 3-7: Surrounding Area Hydrology Map

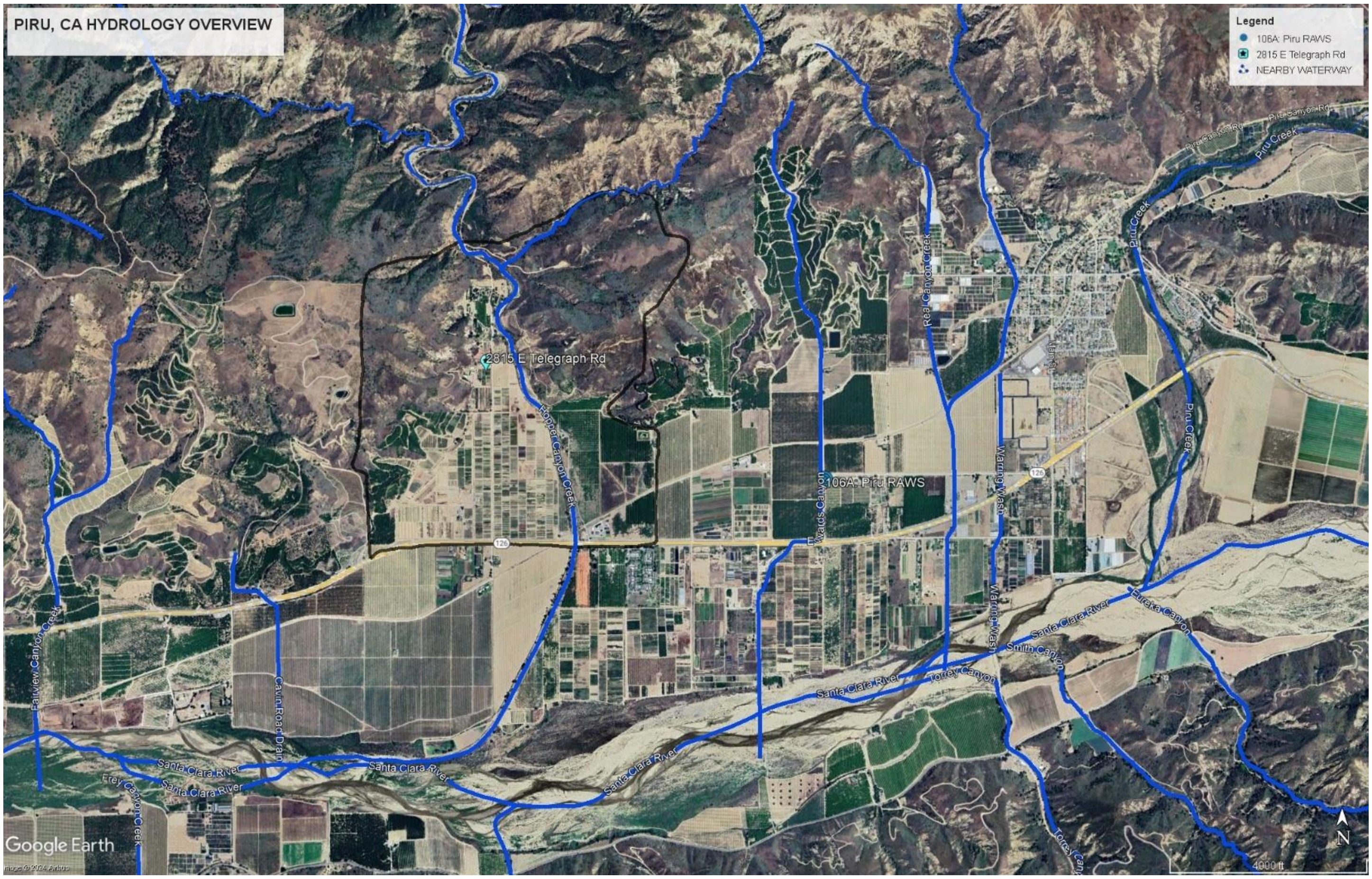
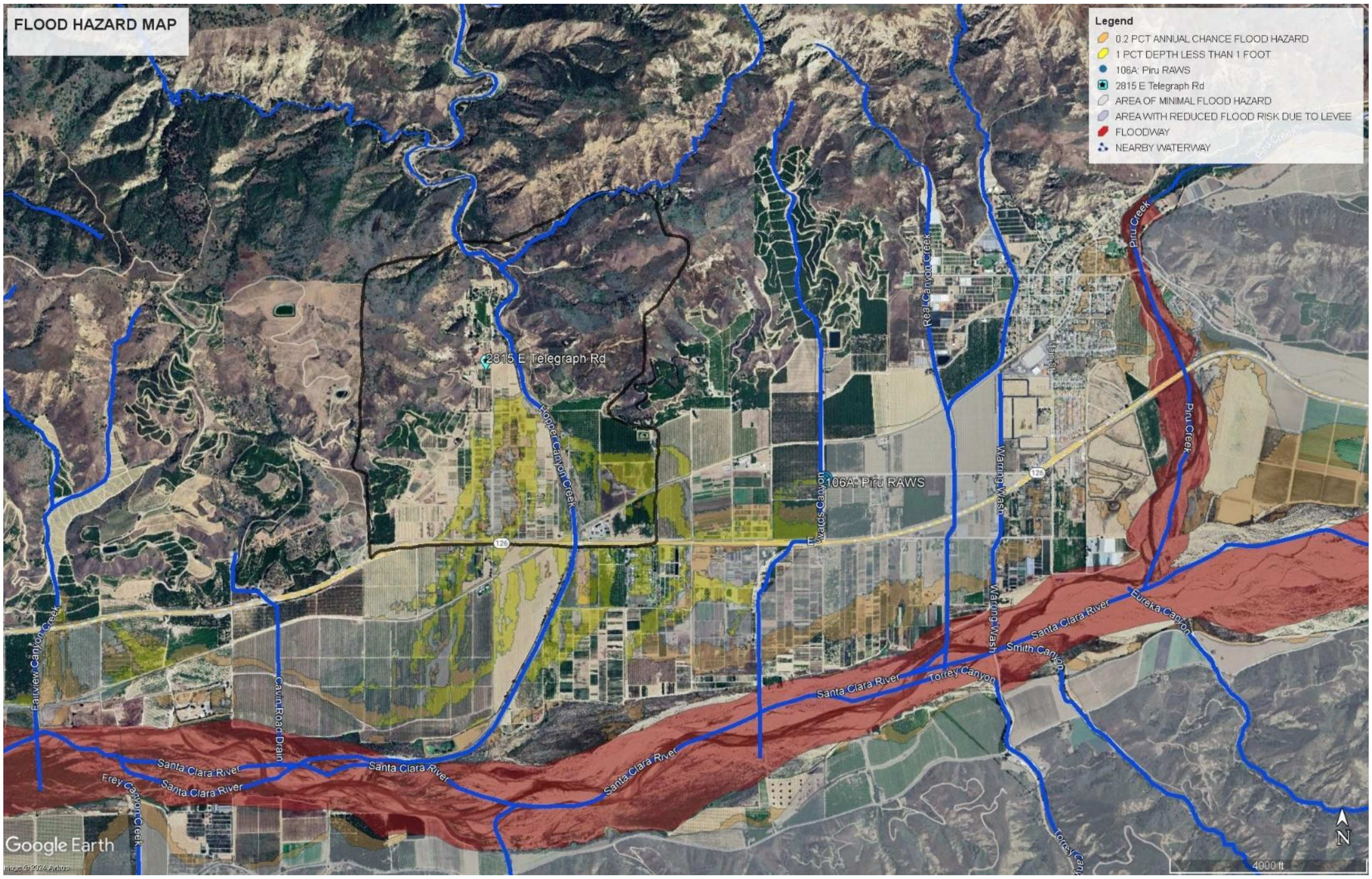


Figure 3-8: Flood Map Showing Areas Vulnerable to Flooding from the 1% Annual Chance Flood and 0.2% Annual Chance Flood



3.1.4 Wildfire and Post-Fire Debris Flow

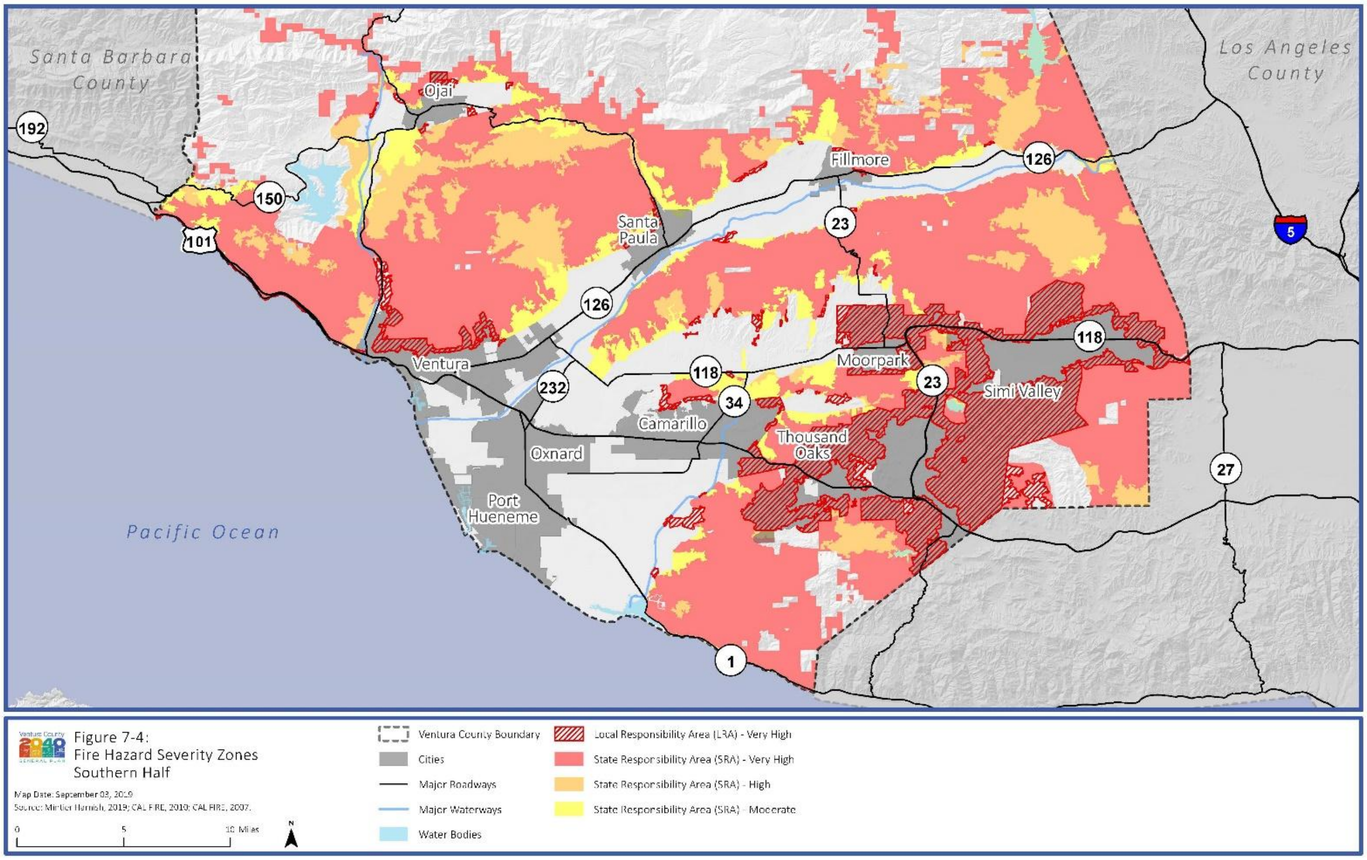
Portions of Ventura County are at very high risk for wildfire with high concentrations on the northern coast leading inland between Santa Paula and Ojai. Additional high fire Hazard Severity Zones, as designated by the California Department of Forestry and Fire Protection (CAL FIRE), occur along the southern coast and continue inland toward Simi Valley.

Figure 3-9 shows areas of Ventura County, including the City of Piru, of significant fire hazards based on fuels, terrain, weather, and other relevant factors.

The map distinguishes these Fire Hazard Severity Zones based on local or State responsibility. Local responsibility areas generally include cities, cultivated agriculture lands, and portions of the desert. Local responsibility area fire protection is typically provided by city fire departments, fire protection districts, counties, and by Cal FIRE under contract to the local government.

State responsibility area is a legal term defining the area where the state has financial responsibility for wildfire protection. Incorporated cities and federal ownership are not included. The prevention and suppression of fires in all areas that are not state responsibility areas are primarily the responsibility of federal or local agencies.

Figure 3-9: Areas of Ventura County of Significant Fire Hazards



Given rising temperatures combined with changes in precipitation patterns, the County of Ventura may continue to experience an increase in wildfire frequency and intensity as fuel loads become drier and more flammable. Furthermore, fires can cause acute damage to soil structure and moisture retention thus increasing susceptibility to erosion or landslides.

Although, as shown in Figure 3-10, the area near the PWTP is prone to wildfires. These zones are typically designated as very high due to the dry climatic conditions, vegetation cover that is susceptible to ignition and rapid-fire spread, nearby steep slopes causing rapid uphill speed of the fire, and a history of repeated fire incidents. However, the PWTP is not within the very high-risk area.

After wildfires, the landscape and natural environment undergo significant changes, which can lead to concerns about landslides and debris flows. The potential of post-fire debris flow in the vicinity of the PWTP and its surroundings is shown in Figure 3-11.

The map presents the likely results of debris flow based on factors in various geospatial data, including basin morphometry, burn severity, soil properties, and rainfall characteristics. These predictions are made at both the drainage basin scale and the individual stream segment scale.

The assessment was conducted under the assumption of a plausible scenario of a storm of comparable strength to those typically encountered approximately every five years in the western United States and that occurs one to three months after a fire.

Figure 3-10: Fire Hazard in Surrounding Areas

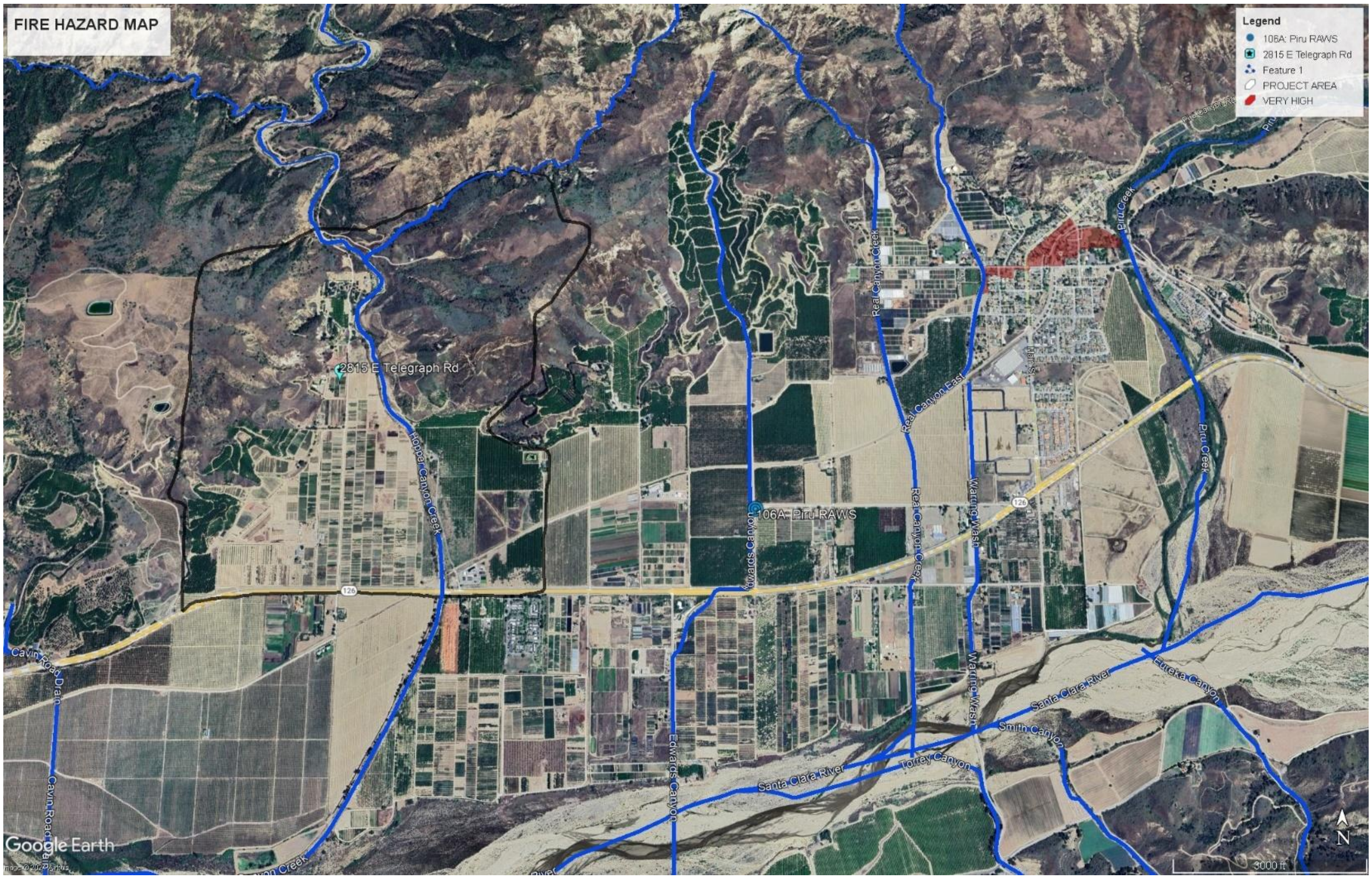


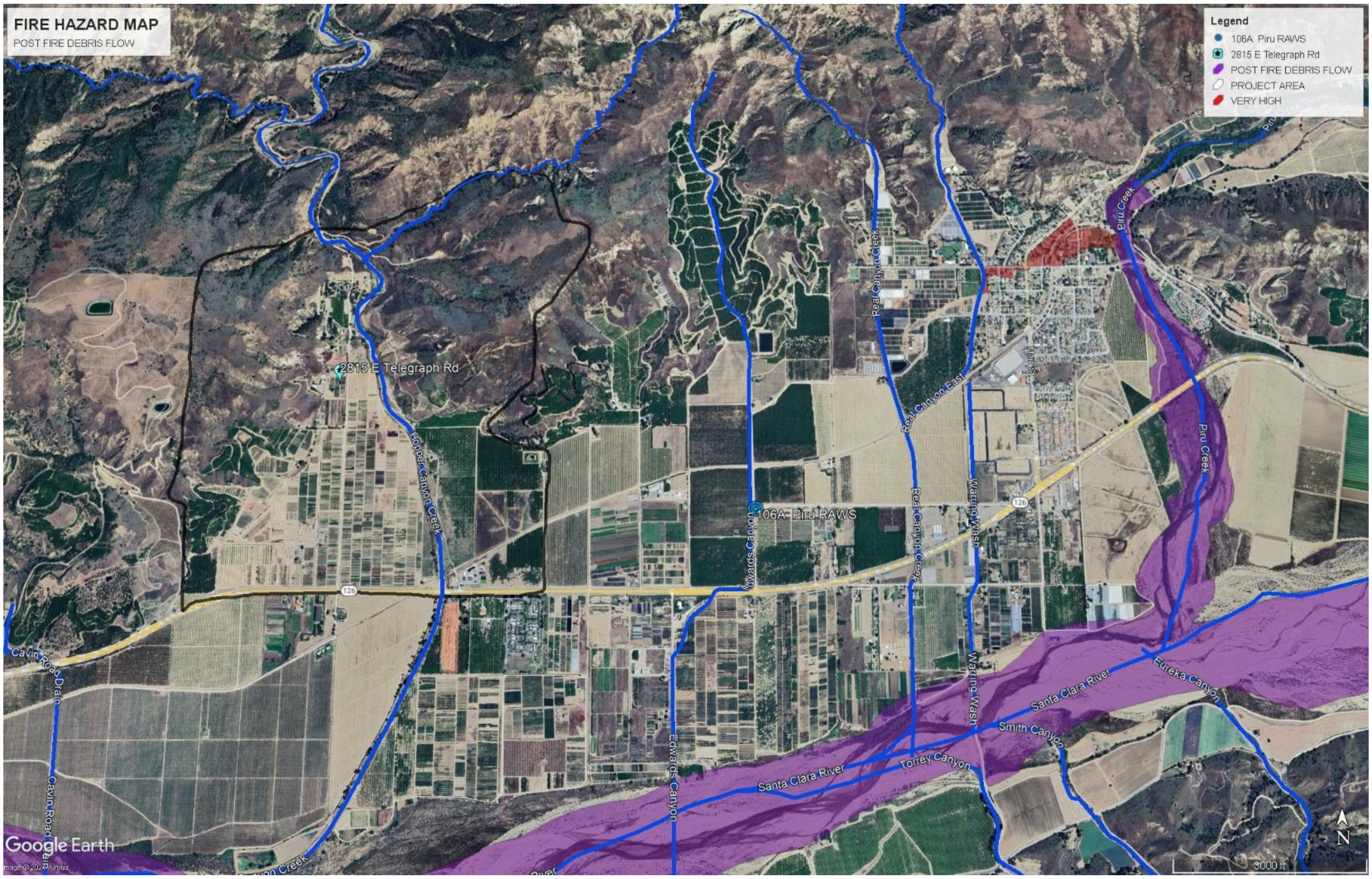
Figure 3-11 shows that post-fire debris flow is highly possible along the Santa Clara river. Also, post-fire debris flow likelihood is high in tributaries near the sewer gravity pipes, manholes, and sewer force main that cross the pipes.

These models serve as valuable tools for understanding the vulnerabilities associated with post-fire debris flows in specific areas. However, the models do not predict downstream impacts, potential debris-flow runout paths, or the areal extent of debris-flow or flood inundation.

Other factors that contribute to post-fire debris flows include:

- Steep slopes
- Heavy rainfall
- Weak or loose rock and soil
- Earthquakes
- Changes in surface or sub-surface runoff patterns
- Improper construction and grading

Figure 3-11: Post Fire Debris in Surrounding Areas



3.1.5 Landslides

A landslide is the movement downslope of a mass of rock, debris, earth, or soil. It occurs when gravitational and other types of shear stresses within a slope exceed the shear strength of the materials that form the slope. Landslides can be triggered by factors such as rain, earthquakes, and volcanic activity.

Figure 3-12 shows the landslide inventory in the vicinity of the PWTP. More specifically, the figure shows the confidence levels of historical occurrences of landslides in the vicinity of the PWTP and surrounding area, as inventoried by the United States Geological Survey (USGS).

The map indicates that the hills north and north-west of the PWTP are prone to landslides, although it does not appear that the PWTP was ever directly impacted by landslides previously. These conditions are expected to persist, but the precise magnitude of potential mass movement during a landslide remains uncertain.

Consequently, accurately determining the likelihood of a landslide impacting the PWTP remains challenging. Currently, information on anticipated climate change impacts to landslides is limited and the analysis utilizes the historic landslide inventory.

Figure 3-12: Landslide Inventory for PWTP

3.1.5.1 Erosion-Caused SSO

A sanitary sewer overflow (SSO) was discovered on December 3rd, 2024. The SSO was attributed, most likely, to an erosion that caused pipe breakage of a line that delivered effluent to percolation ponds located further down from the Plant.

The spill was discovered by a farmer of the lemon orchard next to the ponds. The spilled water flowed down into an agricultural irrigation dish through some bamboo and ultimately reached a dry creek which is a tributary of the Santa Clara River.

The creek was dry and contained the entire volume of spilled water. The spill, with an estimated volume of 44,000 gallons turned into mud in the irrigation ditch.

The breakage occurred at a clamp connecting two sections of effluent pipe. The cause for the breakage was attributed to normal rain erosion. The clamp was not totally secured and could have been displaced by a local earthquake that happened prior to the rain event.

Figure 3-13: Separated Sections of Effluent Piping

Figure 3-14: Muddied Creek as a Result of Spill

3.1.5.2 SSMP Overflow Emergency Response Plan

The District's Public Works Agency's (PWA's) Operations crews followed the intent of both the existing 2009 Sanitary Sewer Management Plan (SSMP) and DRAFT 2023 SSMP, including making required notifications, following the PWA Water and Sanitation Emergency Procedures Manual, responding accordingly with appropriate remedial measures to the SSO, posting public warnings, sampling water quality and making required regulatory reporting.

3.1.5.3 Final Corrective Actions

Reconstruction of the damaged sections of the pipes was performed soon after discovery. Both sections of the pipes were inspected, and a new clamp was installed. In addition, the sections of the pipe were secured in place to prevent the reoccurrence of the same incident.

4.0 FUTURE VULNERABILITY ANALYSIS

This section characterizes the anticipated vulnerabilities and challenges that the PWTP may face as it relates to climate change impacts to hydrometeorological hazards. An assessment of both short- and long-term vulnerabilities of the Plant and operations is provided. The analysis was conducted for 2035-2064 for the short-term impacts assessment, and 2070-2099 for the long-term assessment. The historical reference period for climate change analysis is 1961-1990.

4.1 Climate Change Impacts

Simulated climate change projection data was analyzed to illustrate plausible future, short-term and long-term vulnerabilities related to hydrometeorological hazards to the PWTP. Table 4.1 provides a summary of the findings of this analysis on the projected trends associated with each hydrometeorological parameter that was analyzed. The table is followed by a detailed discussion of the findings, how they were derived, and the data utilized to evaluate them.

While assessing climate change impacts on precipitation, temperature, riverine flooding, and wildfire in the PWTP surrounding area, leading data sources for the region were considered.

Table 4.1: Summary of Projected Hydrometeorological Impacts to PWTP

Hydrometeorological Parameters	Climate Change Trends and Impacts to Piru Wastewater Treatment Plant
Precipitation	Both droughts and floods are expected to become more frequent as precipitation is expected to occur in fewer, more intense storms due to climate change. Although Piru and surrounding areas are likely to experience only a slight increase in overall annual precipitation levels from climate change, the region is expected to see an increase in the number of extreme precipitation events, as well as droughts that last longer and are more intense. As a result, floods are expected to occur more often, and climate change may expand the parts of Piru that are considered flood prone. The increase in frequency and severity of droughts will likely strain both habitats and water supplies in Piru.
Temperature	Warmer temperatures are projected to cause an increase in extreme heat events. The number of extreme heat days is expected to rise in Piru and surrounding areas, in addition to an increase in the average daily high temperatures. Energy delivery infrastructure and services may be damaged by very high temperatures, constraining their ability to meet community needs.
Sea-level rise	Not assessed because it is not necessary since the PWTP is 26 miles from the Pacific Ocean coast and at an elevation of 456 feet above sea level..
Riverine Flooding	Santa Clara River runs south of Piru and also south of the PWTP. The PWTP is constructed on raised ground which protects it from potential riverine flooding.
Wildfire and post-fire debris flow	The combination of complex terrain, Mediterranean climate, and productive natural plant communities next to developed areas has created conditions for extensive wildfires in the surrounding areas. Fire conditions arise from a combination of factors and changing conditions have created an extended fire season that lasts for most or all of the year. Fast and hot burning wildfires can destroy vegetation cover, leading to flooding and debris flows when precipitation does return.
Landslide	Historically, rain-induced landslides have occurred in the mountains to the north of Piru, most recently after heavy rain events in the winter of 2003 and 2017. Climate change is likely to change precipitation patterns, increasing the frequency and intensity of heavy precipitation events, which can increase the risk of slope failures. These types of landslides or debris flows are most common on steep slopes made up of loose or fractured material. Landslides and mudslides can move fast enough to damage or destroy pipes and other structures in their path.
Water Quality	The PWTP has maintained compliance with the Order issued by the Los Angeles Water Quality Control Board. In addition to the Plant, the District maintains the sewer system throughout Piru, which encompasses 300 acres, including the Piru community, and provides sanitation services to over 400 customers.

Table 4.2 provides an overview of the projected hydrometeorological data analyzed including how it was used, the spatial and temporal resolution, and source for each dataset. Observed data was collected from stations closest to the PWTP for parameters that were available. For parameters where observed data was lacking near the PWTP, data was obtained from highly reputable models.

Table 4.2: Summary of Climate Projection Data Sources

Data	Used in Analysis	Spatial and Temporal Analysis	Source
Precipitation and Temperature Projections	Used for analyzing projected changes to precipitation and temperature to assess the potential impact on the Plant location and its operation.	Daily data at 1/16-degree (approximately 6 kilometer) Spatial resolution from 1950 to 2099	CMIP5 Downscaled Climate Model Simulations, per Cal-Adapt Local Climate Change Snapshot (https://cal-adapt.org/tools/local-climate-change-snapshot/)
Sea- Level Rise Projections	Not Applicable	Not Applicable	Not Applicable
Runoff	Used for analyzing total runoff and flood	Daily data from 1950 to 2099	Variable Infiltration Capacity (VIC) (Cal-Adapt located at https://cal-adapt.org/data/download/)
Wildfire	Used for analyzing wildfire decadal probabilities	1/16-degree (~6 kilometer) resolution from 1952 to 2099	Cal-Adapt (https://cal-adapt.org/tools/wildfire/)

4.1.1 Precipitation and Temperature

This section presents climate change projection estimates related to precipitation and temperature. Changes in precipitation are characterized and discussed as projected changes in annual precipitation depths, maximum one-day precipitation depths, 25- and 100-year return period event depths, and maximum length of dry spells. Changes in temperature are characterized and discussed as annual average maximum and minimum daily temperatures, number of extreme heat days, and number of warm nights.

4.1.2 Representative Concentration Pathways

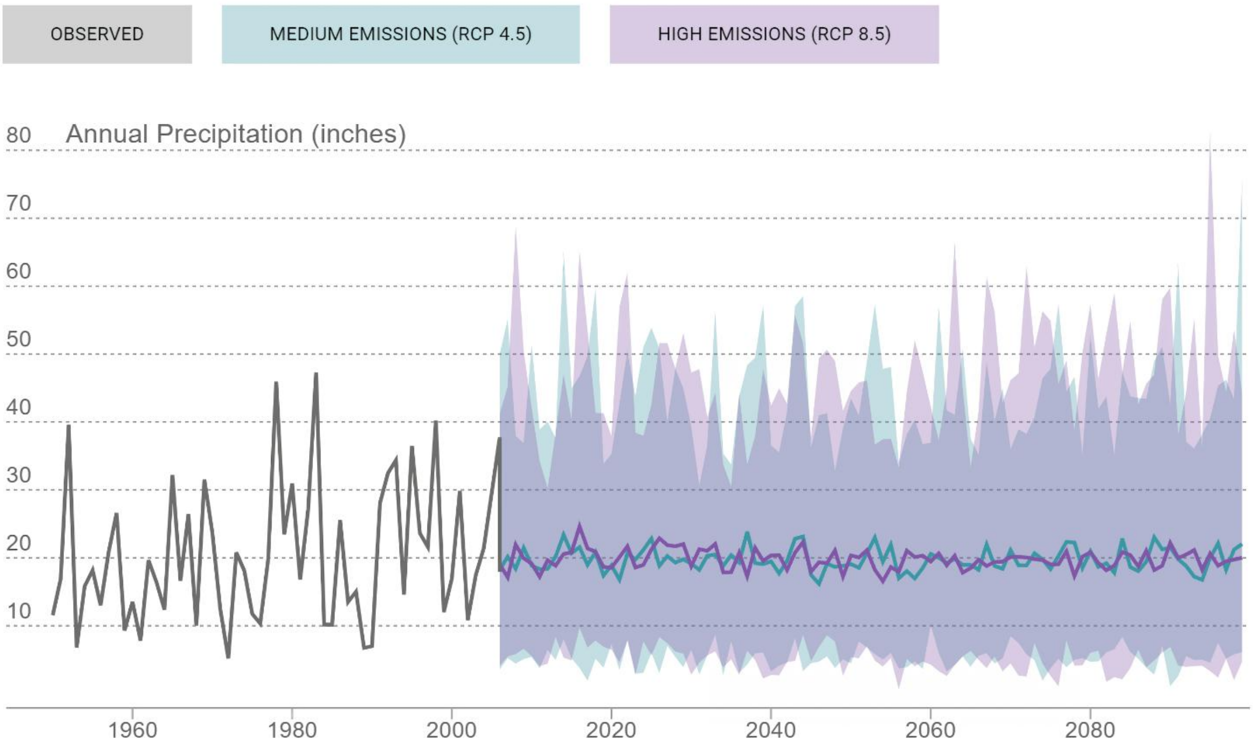
Representative Concentration Pathways (RCP) are climate change scenarios to project future greenhouse gas concentrations. These pathways (or trajectories) describe future greenhouse gas concentrations (not emissions) and have been formally adopted by the Intergovernmental Panel on Climate Change (IPCC). The pathways describe different climate change scenarios, all of which were considered possible depending on the amount of greenhouse gases (GHG) emitted in the years to come. The four RCPs – originally RCP2.6, RCP4.5, RCP6, and RCP8.5 – are labelled after the expected changes in radiative forcing from the year 1750 to the year 2100 (2.6, 4.5, 6, and 8.5 W/m^2, respectively). The IPCC Fifth Assessment Report (AR5) began to use these four pathways for climate modeling and research in 2014. The higher values mean higher greenhouse gas emissions and therefore higher global surface temperatures and more pronounced effects of climate change. The lower RCP values, on the other hand, are more desirable for humans but would require more stringent climate change mitigation efforts to achieve them.

All projections are provided for both a medium greenhouse gas emissions scenario (RCP 4.5) and a high greenhouse gas emissions scenario (RCP 8.5). Projected changes in annual precipitation at the PWTP's location are projected to continue to remain highly variable under both RCP 4.5 and RCP 8.5. Figure 4-1 displays the future trends for both emissions scenarios.

Long-term trends indicate a minimal decrease of less than half an inch, but notably, the projections show that it is possible that the range in rainfall could become as high as 19.6 inches in the short-term and 20 inches in the long-term while only up to approximately 20.1 inches has been observed historically.

Table 4.3 summarizes precipitation data and shows that future projections of the long-term trend of annual precipitation on average remain almost identical to baseline conditions.

Figure 4-1: Projected Change in Annual Precipitation



Note: Solid line shows the average and shaded area shows the range of the data derived from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5.

Table 4.3: Summary of Precipitation Data and Future Trends

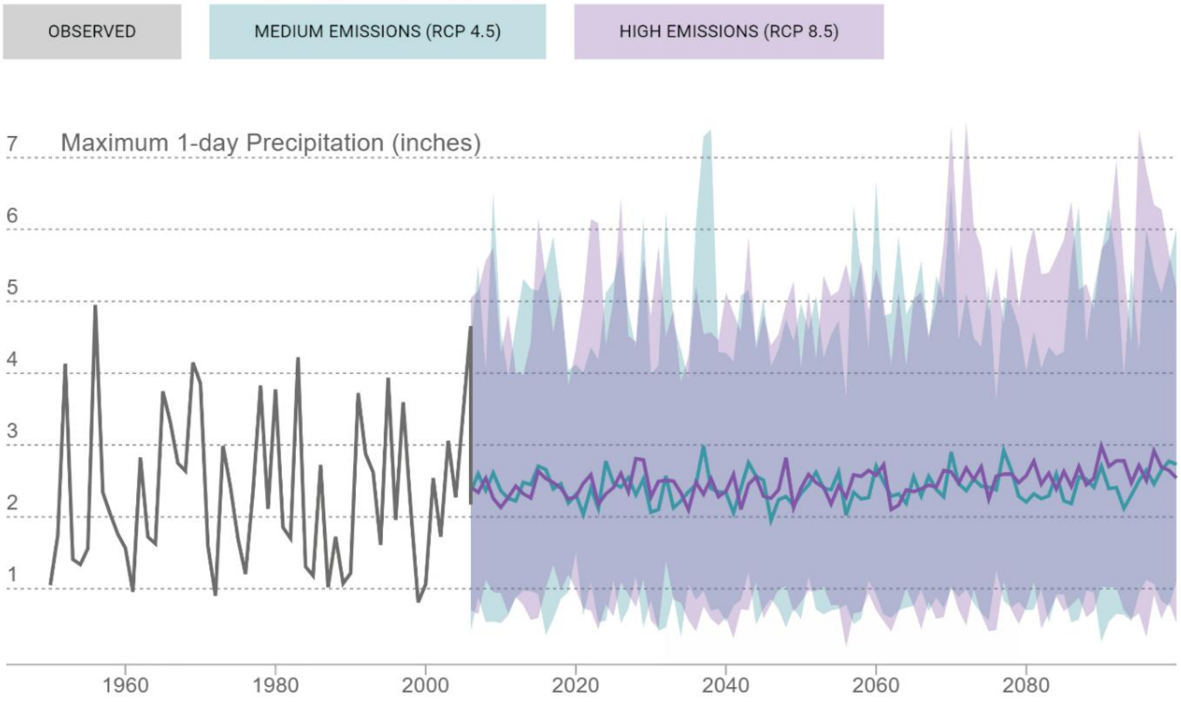
Observed (1961-1990) 30yr Average: 19.2 inches

		30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	20.1 inches	17.5 - 22.0 inches
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	-0.5 inches	19.6 inches	15.1 - 26.1 inches
HIGH EMISSIONS (RCP 8.5)	-0.6 inches	19.5 inches	15.0 - 26.4 inches
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	-0.1 inches	20.0 inches	15.4 - 24.4 inches
HIGH EMISSIONS (RCP 8.5)	-0.4 inches	19.7 inches	12.6 - 29.6 inches

Note: Projected change in annual precipitation during short-term (2035-2064) and long-term (2070-2099) with respect to historic period (1961-1990). Data derived 32 climate model projections from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5. Mid-century refers to short-term (2035-2064) and end- century (2070-2099) refers to long-term impacts.

Figure 4-2 shows a very gradual increase in the projected maximum values for maximum 1-day precipitation at the PWTP's location. Maximum 1-day precipitation appears to increase slightly under future climate conditions for both RCP 4.5 and RCP 8.5. Table 4.4 shows, for the 30-year averages and range for the short-term increase, a slightly larger increase under the high emissions scenario. Compared to the baseline, maximum 1-day precipitation averages are projected to increase between 0.088 to 0.113 inch in the short-term and 0.169 to 0.315 inch in the long-term depending on emissions.

Figure 4-2: Projected Change in Maximum 1-Day Precipitation



Note: Solid line shows the average and shaded area shows the range of the data derived from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5.

Table 4.4: Summary of 1-Day Precipitation Data and Future Trends

Observed (1961-1990) 30yr Average: 2.281 inches

		30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	2.292 inches	2.056 - 2.601 inches
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+0.088 inches	2.380 inches	2.044 - 2.864 inches
HIGH EMISSIONS (RCP 8.5)	+0.113 inches	2.405 inches	1.847 - 2.875 inches
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+0.169 inches	2.461 inches	2.012 - 2.789 inches
HIGH EMISSIONS (RCP 8.5)	+0.315 inches	2.607 inches	2.129 - 3.274 inches

Note: Projected change in maximum 1-day precipitation during short-term (2035-2064) and long-term (2070-2099) with respect to historic period (1961-1990). Data derived 32 climate model projections from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5. Mid-century refers to short-term (2035-2064) and end-century (2070-2099) refers to long-term impacts.

In addition, the projected change in maximum 1-day precipitation for the 25- and 100-year return periods are shown in Figure 4-3 and Figure 4-4, respectively. The percent change is shown for the short-term and long-term aggregating results for both RCP 4.5 and 8.5 emission scenario projections. The 25-year return period daily maximum rainfall is projected to increase by 25.65 percent (%) in the short-term and 24.13% in the long-term, according to the median projection.

Figure 4-3: Projected Change in Short Term Return Precipitation Period

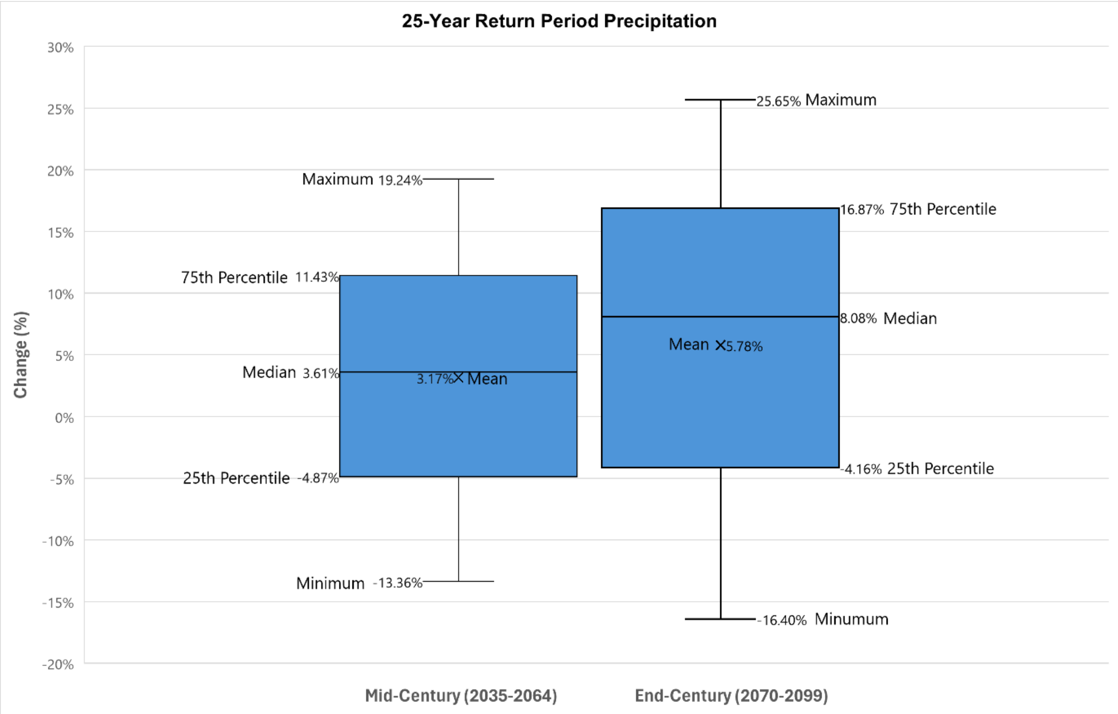
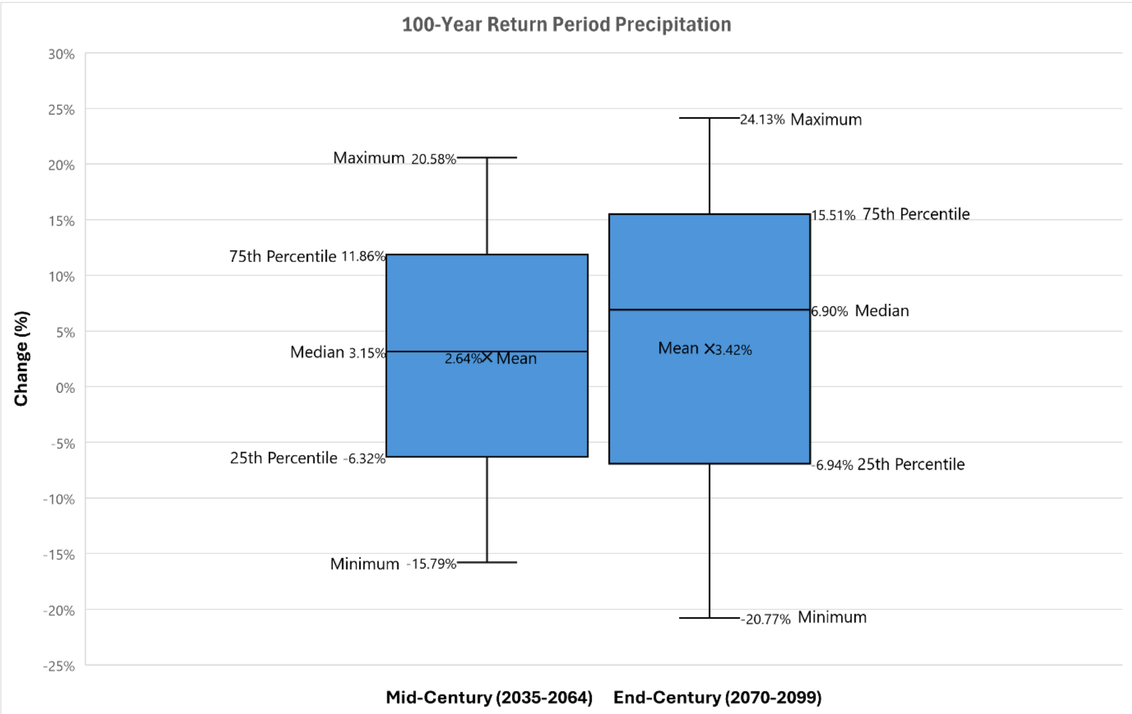


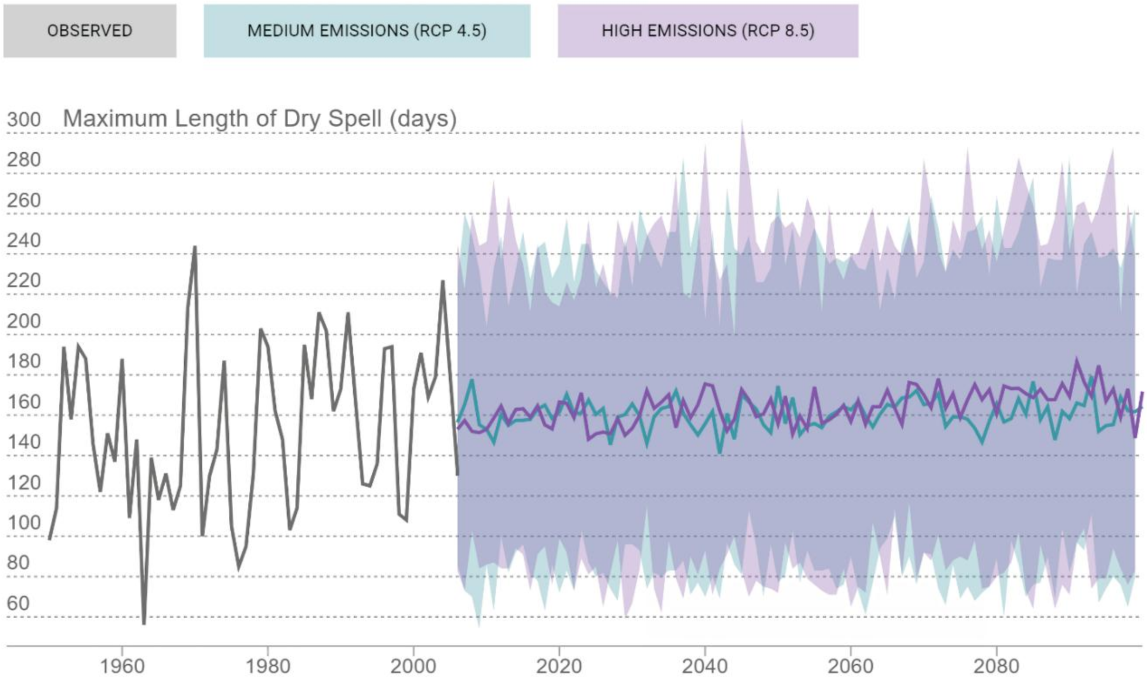
Figure 4-4: Projected Change in Long Term Return Precipitation Period



Note: Projected change in 100-year return period Precipitation during short-term (2035-2064) and long-term (2070-2099) with respect to historic period (1961-1990). Data derived 20 climate model projections from 10 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5.

Historically, the average maximum length of a dry spell at this location is about 180 days. As the effects of climate change worsen, the duration of this occurrence is projected to increase slightly under both the medium (RCP 4.5) and high (RCP 8.5) emissions scenarios. Figure 4-5 provides an overview of these projected trends and Table 4.5 displays a quantitative description of these changes. In the short-term, the medium and high emissions scenario projects an average increase in maximum dry spell duration of 11 days, while the long-term high emissions scenario projects an increase of 18 days.

Figure 4-5: Projected Change in Maximum Length of Dry Spell



Note: Solid line shows the average and shaded area shows the range of the data derived from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5.

Table 4.5: Summary of Projected Change in Maximum Length of Dry Spell

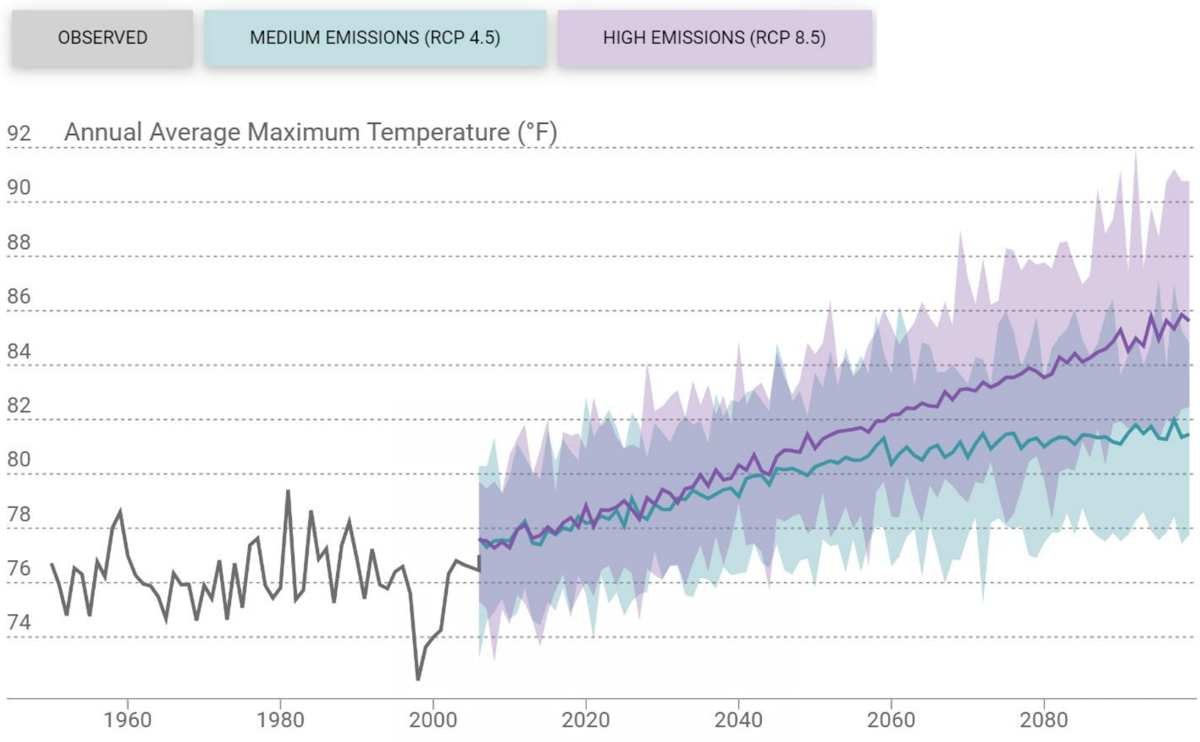
Observed (1961-1990) 30yr Average: 147 days

		30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	152 days	138 - 174 days
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+7 days	159 days	140 - 178 days
HIGH EMISSIONS (RCP 8.5)	+11 days	163 days	140 - 190 days
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+9 days	161 days	138 - 181 days
HIGH EMISSIONS (RCP 8.5)	+18 days	170 days	128 - 202 days

Note: Projected change in maximum length of dry spell during short-term (2035-2064) and long-term (2070-2099) with respect to historic period (1961-1990). Data derived 32 climate model projections from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5. Mid-century refers to short-term (2035-2064) and end-century (2070-2099) refers to long-term impacts.

Annual average maximum temperatures are expected to increase under both the medium and high emissions scenarios because of climate change. RCP 4.5 and RCP 8.5 are roughly consistent through the short-term. Figure 4-6 highlights this increase over time. Table 4.6, presenting the medium and high emissions scenarios, predicts an average maximum temperature increase of 5.2°F in the short term. The high emissions scenarios project an average maximum temperature increase of 8.4°F in the long term.

Figure 4-6: Projected Change in Annual Average Maximum Daily Temperature



Note: Solid line shows the average and shaded area shows the range of the data derived from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5.

Table 4.6: Summary of Annual Average Maximum Daily Temperature and Future Trends

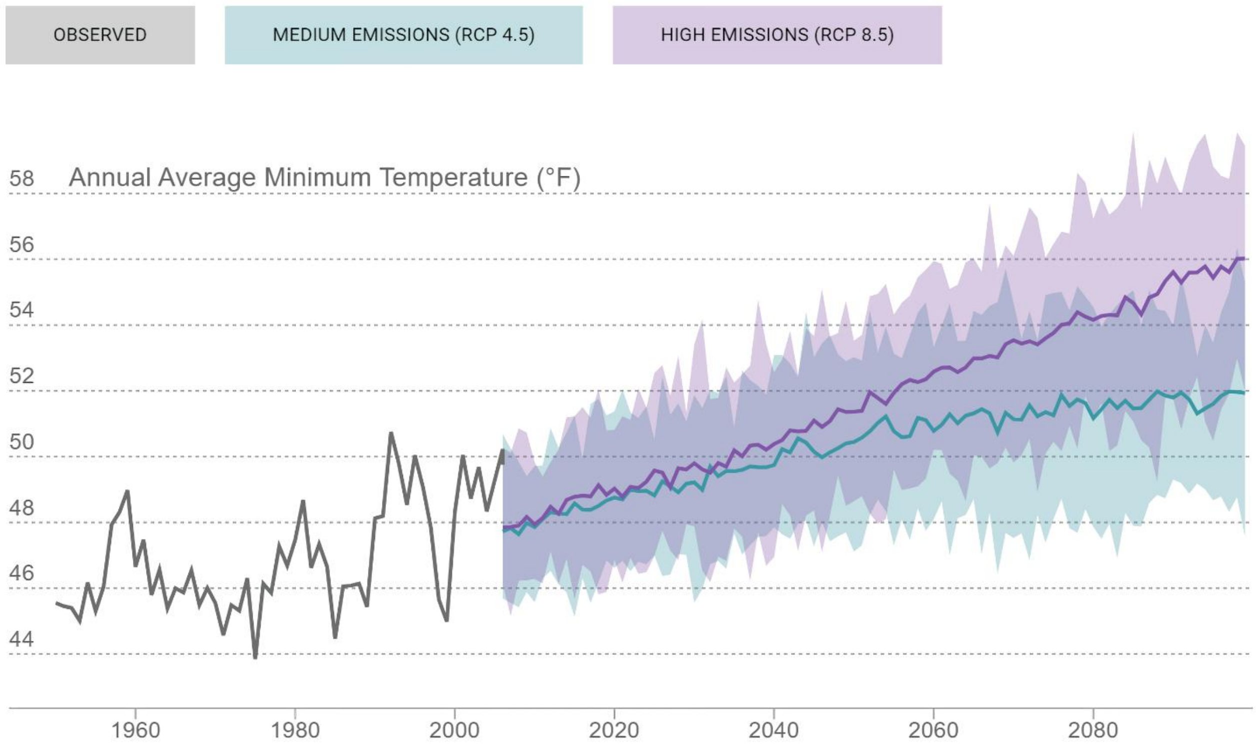
Observed (1961-1990) 30yr Average: 76.3 °F

		30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	75.9 °F	75.5 - 76.3 °F
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+4.3 °F	80.2 °F	77.8 - 82.6 °F
HIGH EMISSIONS (RCP 8.5)	+5.2 °F	81.1 °F	78.7 - 83.0 °F
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+5.4 °F	81.3 °F	79.2 - 84.2 °F
HIGH EMISSIONS (RCP 8.5)	+8.4 °F	84.3 °F	81.6 - 87.9 °F

Note: Projected change in annual average maximum daily temperature during Near Future (2035-2064) and Late Future (2070-2099) with respect to historic period (1961-1990). Data derived 32 climate model projections from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5. Mid-century refers to short-term (2035-2064) and end-century (2070-2099) refers to long-term impacts.

Similarly to the changes presented for annual average maximum temperature, annual average minimum temperatures are projected to increase in the same manner. Figure 4-7 and Table 4.7 present these changes. The medium and high emissions scenarios show an average increase in annual average minimum temperature of 3.8° and 4.7°F in the short-term. The high emissions scenarios project an average maximum temperature increase of 4.9°F and 8.0°F in the long-term.

Figure 4-7: Projected Change in Annual Average Minimum Daily Temperature



Note: Solid line shows the average and shaded area shows the range of the data derived from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5

Table 4.7: Summary of Annual Average Minimum Daily Temperature and Future Trends

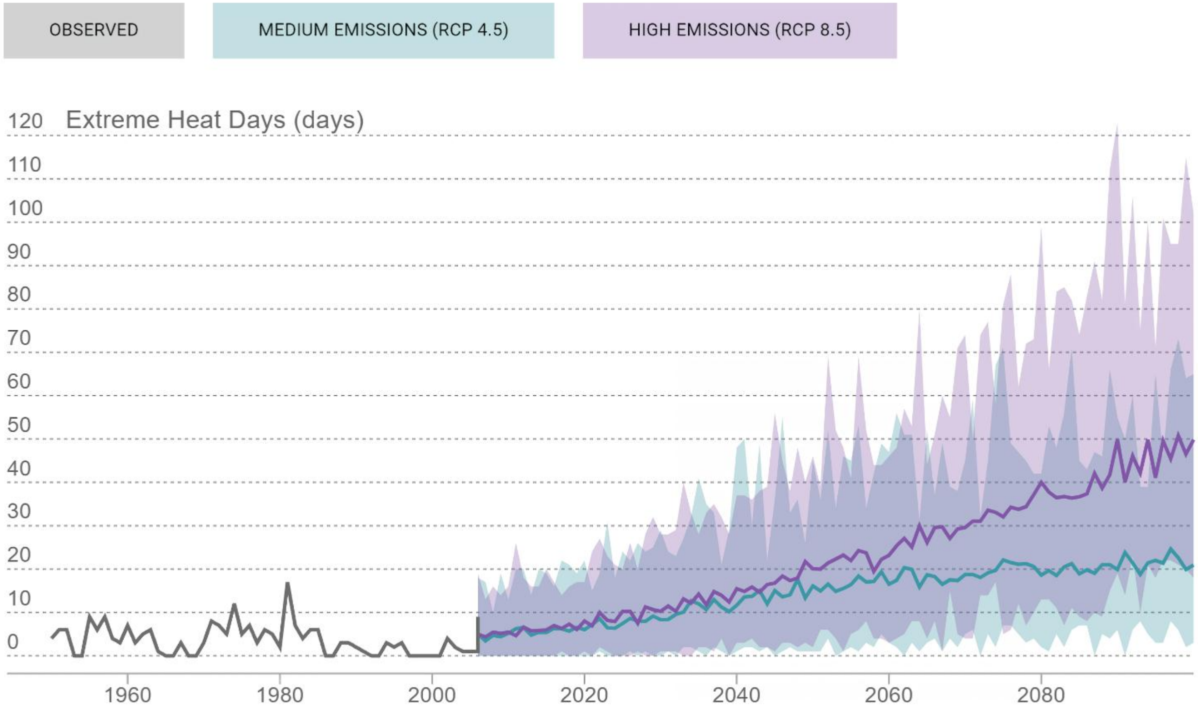
Observed (1961-1990) 30yr Average: 46.2 °F

		30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	46.7 °F	46.5 - 46.9 °F
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+3.8 °F	50.5 °F	48.5 - 52.0 °F
HIGH EMISSIONS (RCP 8.5)	+4.7 °F	51.4 °F	49.4 - 52.7 °F
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+4.9 °F	51.6 °F	49.0 - 53.2 °F
HIGH EMISSIONS (RCP 8.5)	+8.0 °F	54.7 °F	51.6 - 56.9 °F

Note: Projected change in annual average minimum daily temperature during Near Future (2035-2064) and Late Future (2070-2099) with respect to historic period (1961-1990). Data-derived 32 climate model projections from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5. Mid-century refers to short-term (2035-2064) and end-century (2070-2099) refers to long-term impacts.

Given that the annual average maximum temperature is projected to increase under these emissions scenarios, the number of extreme heat days (defined as days with a maximum temperature greater than a threshold of 91°F) are expected to increase as well. Figure 4-8 provides context to these changes. Table 4.8 presents the data in a quantitative format. Historically, approximately 2 extreme heat days per year have been observed. In the short term, this is projected to increase by an average of 13 to 18 additional days under the medium to high emissions scenario. In the long-term, this is projected to increase by an average of 19 to 37 additional days under the medium to high emissions scenario.

Figure 4-8: Projected Change in Number of Extreme Heat Days



Note: Solid line shows the average and shaded area shows the range of the data derived from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5.

Table 4.8: Projected Changes in Number of Extreme Heat Days

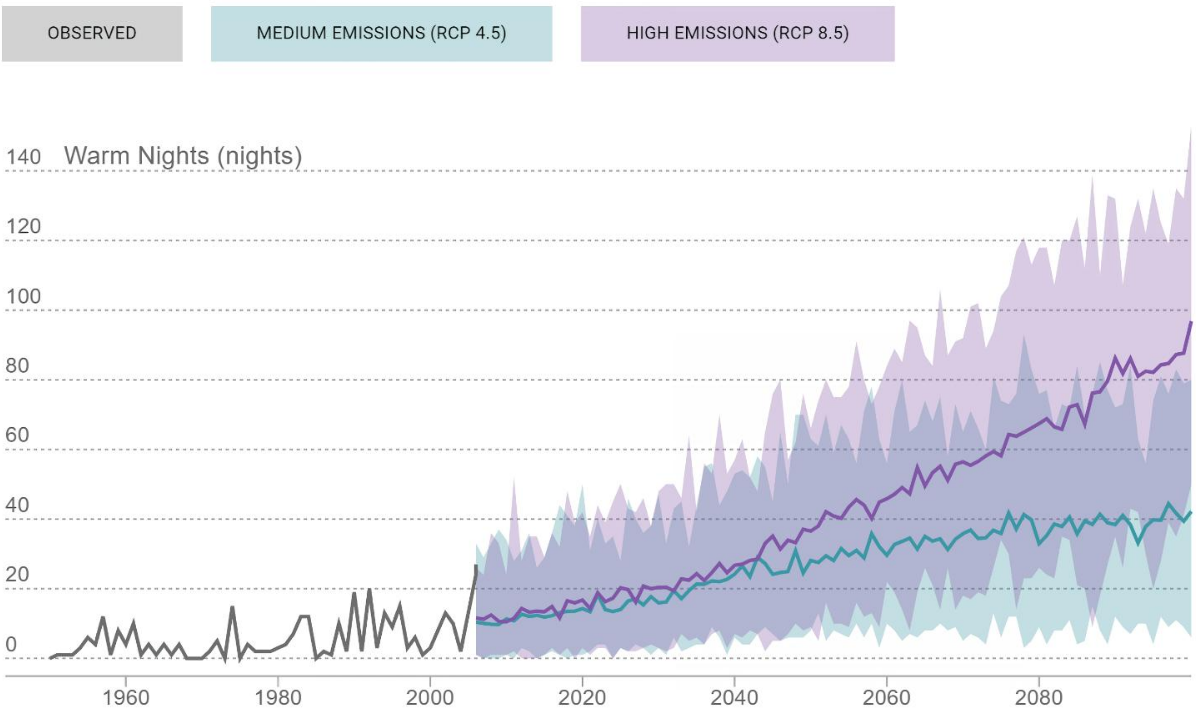
Observed (1961-1990) 30yr Average: 4 days

		30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	2 days	2 - 3 days
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+13 days	15 days	8 - 34 days
HIGH EMISSIONS (RCP 8.5)	+18 days	20 days	11 - 38 days
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+19 days	21 days	11 - 51 days
HIGH EMISSIONS (RCP 8.5)	+37 days	39 days	27 - 82 days

Note: Projected change in extreme heat days during short-term (2035-2064) and long-term (2070-2099) with respect to historic period (1961-1990). Data derived 32 climate model projections from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5. Mid-century refers to short-term (2035-2064) and end-century (2070-2099) refers to long-term impacts.

An increase in the number of warm nights (defined as days with a minimum temperature greater than a threshold of 68.1°F) is expected as well. However, the increases seen here are much more substantial. On average, 6 warm nights have been observed each year historically. Under the impacts of climate change, an increase of 22 to 31 warm nights, on average, is projected in the short-term under the medium and high emissions scenarios and 32 to 66 under the high emissions scenarios. Figure 4-9 and Table 4.9 present these changes.

Figure 4-9: Projected Change in Number of Warm Nights



Note: Solid line shows the average and shaded area shows the range of the data derived from 16 general circulation models under 2 emission scenarios: RCP 4.5 and RCP 8.5.

Table 4.9: Projected Change in Number of Warm Nights

Observed (1961-1990) 30yr Average: 4 nights

		30yr Average	30yr Range
Baseline (1961-1990)			
MODELED HISTORICAL	-	6 nights	2 - 11 nights
Mid-Century (2035-2064)			
MEDIUM EMISSIONS (RCP 4.5)	+22 nights	28 nights	12 - 42 nights
HIGH EMISSIONS (RCP 8.5)	+31 nights	37 nights	20 - 54 nights
End-Century (2070-2099)			
MEDIUM EMISSIONS (RCP 4.5)	+32 nights	38 nights	16 - 56 nights
HIGH EMISSIONS (RCP 8.5)	+66 nights	72 nights	36 - 98 nights

4.1.3 Riverine Flooding

As 1-day maximum precipitation is projected to continue to increase in the future, riverine flooding vulnerabilities are also expected to increase. While projected flood flows in the Santa Clara River were not directly available, its watershed-wide runoff was evaluated as a proxy for understanding potential climate change impacts to riverine flooding. It was evaluated using Variable Infiltration Capacity (VIC) hydrologic model using 20 CMIP5 Localized Constructed Analogs downscaled climate models obtained from CalAdapt.

This VIC simulation was conducted at 1/16th degree spatial resolution by Scripps Institution of Oceanography and obtained from CalAdapt for this report (Pierce et al., 2018). The total runoff from the upstream watershed of the PWTP's location was estimated as the weighted average of the VIC grids over the HUC-12 boundary. Changes in runoff provides another indicator of projected changes in vulnerabilities to flood and drought conditions.

Projected changes in annual average runoff at the PWTP are small under both RCP 4.5 and RCP 8.5. Prolonged, heavy rainfall causes high peak flows of moderate duration and a large volume of runoff, filling the Santa Clara River with water.

When the ground is saturated by previous rainfall, flooding can be more severe. In impervious areas, such as areas covered in asphalt or cement, stormwater cannot absorb into the ground and flows faster over the surface. This can cause more extensive flooding in low lying areas. Flooding susceptibility in Piru is primarily associated with areas adjacent to the Santa Clara River and in the canyons on the hillsides north of the Plant.

3.1.4 Wildfire and Post-Fire Debris Flow

As temperatures and duration of dry days are projected to continue increasing into the future, wildfire vulnerabilities are projected to become further exasperated. Wildfire is of most concern in the areas of Piru and surrounding areas with natural vegetation, such as undeveloped areas and larger lots with expansive un-irrigated vegetation.

A large portion of these areas are covered by grasslands or brush, which are easily ignited, especially in the summer months. Grass and brush fires can be easier to control if they can be reached by fire equipment. However, fast and hot burning wildfires can destroy vegetation cover, leading to flooding and debris flows when precipitation does return.

5.0 IMPACTS TO PWTP

Previous sections detailed the short-term and long-term vulnerabilities related to hydrometeorological hazards that may impact the PWTP. This section evaluates the impacts of the climate induced hazards on the PWTP, including impacts to water quality, permit compliance, receiving waters, and control measures for the identified climate-induced impacts at PWTP. This includes an evaluation of the PWTP-associated sewer shed, lift stations, and treatment system.

5.1 Impacts to Water Quality

Due to adequate capacity within the PWTP and the District's active management of sewer infrastructure throughout the sewer shed, there are no anticipated impacts related to sewer infrastructure or treatment capacity.

As a result of the potential increase in severity of both wet weather and dry weather events, effluent water quality may be impacted. One of the primary methods of water quality impacts evaluated was the potential increase in water quality fluctuations due to changes in inflow and infiltration within the system. Large wet weather events and coastal flooding may cause changes to the influent wastewater quality and strength as a result of high inflows and infiltration.

As temperature continues to increase, along with the potential for more severe droughts, the potential for wildfire impacts will also increase. Water quality may be impacted by an increase in local fire events, which may result in an increase in ash in the wastewater.

Maximum and minimum average air temperatures are projected to increase, which will result in an increase in the average influent wastewater temperature. Warmer wastewater temperatures will generally increase kinetics and result in higher microbial activity in the anoxic and aerobic zones, up to approximately 35 °C (95 °F), which corresponds to the upper limit of typical activated sludge bacteria. Above this threshold, nitrification and denitrification performance may decrease as the bacteria are inhibited. PWTP effluent temperature follows a seasonal pattern, with an approximate range of 55°F – 82°F). The wastewater temperatures are anticipated to remain within typical ranges and any impacts to the treatment system are anticipated to be managed by the wastewater treatment Plant operator.

Wastewater quality and strength may also fluctuate as a result of potential evacuations to the previously identified climate-induced impacts. Additionally, influent wastewater strength is anticipated to increase as the hydraulic loading is reduced due to water conservation measures while the nutrient loading remains stable, resulting in an increase in the concentration of various constituents in the wastewater influent. Potential fluctuations in wastewater quality and strength are anticipated to be managed by the existing wastewater treatment process and wastewater treatment Plant operator. Each process should continue to be monitored as wastewater concentrations fluctuate due to impacts from climate-induced events.

5.2 Impact to Compliance

As identified in previous sections, PWTP may be impacted by short-term and long-term vulnerabilities related to hydrometeorological hazards. These hazards may result in impacts to the treatment system, ultimately impacting the Plant's compliance with Order R4-2023-0292 Waste Discharge Requirements. This section will review the hazards identified in previous sections and their corresponding impacts to potential permit compliance at PWTP, including the collection system, treatment Plant, and discharge locations. Permit compliance will be reviewed against Order R4-2023-0292.

5.3 Impact to Collection System

As discussed in Section 3.1.5.1, an SSO was discovered on December 3rd, 2024, and the cause for the SSO was attributed to land erosion.

5.4 Impact from Power Outage

The County of Ventura Public Works Agency has received approval from the County of Ventura's Board of Supervisors for the installation of a 262.7-kilowatt (kW) photovoltaic (PV) system at PWTP. The project, in addition to providing an alternate source of energy to operate the Plant, will increase on-site renewable energy production, cut operating costs, and protect ratepayers from potential annual rate increases by Southern California Edison (SCE) and the Clean Power Alliance (CPA).

Furthermore, in 2022, the District installed a Tesla Battery Energy Storage System (BESS) using a grant from the California Public Utility Commission (CPUC) Self-Generation Incentive Program (SGIP). In addition to generating renewable solar energy, the proposed PV system will integrate seamlessly with the Tesla BESS, allowing PWTP to leverage the lowest cost of electricity through off-peak time-of-use pricing and be less dependent on the grid.

5.5 Impact on Influent Flow

PWTP may experience both high flow events and low flow events as a result of climate change related impacts. Of these two hydraulic extremes, sustained peak flow events provide greater challenge to PWTP and present a more significant risk. Peak flow events may be caused by large storm events, inundation, or riverine flooding.

A project, currently in the construction phase, consists of upgrading PWTP to include tertiary treatment facilities for the effluent and the addition of a solids dewatering belt filter press system. The project is being funded by a grant from Proposition 84, funding from the American Rescue Plan Act (ARPA), and available District funds.

6.0 SUMMARY

A summary of the main risks, likelihood of the potential risk, consequence of the potential risk, and mitigation strategies for the various climate change-related impacts are presented in Table 6.1 for the PWTP. As a result of the climate induced impacts evaluated, the risk of power outages (short-term and long-term), peak flow events, soil erosion/landslides and wildfires appear to be the most significant risks to PWTP. Control measures for these main risks are also provided.

Each risk for each major climate change impact was evaluated for likelihood of risk and consequence of risk using a Low, Medium, or High rating. The ratings were established based on the review of the PWTP emergency procedures, contingency plans, alarm/notification systems, training, backup power, and equipment and is based on discussions with District staff regarding the control measures for climate induced impacts.

As a result of the analysis of the short term and long-term vulnerability assessment, PWTP staff has become more aware of impacts of climate change as they affect the operation of the treatment system due to flooding, wildfire, or other climate-related changes. As identified in Order No. R4- 2023-0292 and as a result of the prescribed waste discharge requirements, the climate change-related effects as well as their impacts were analyzed.

The analysis included impacts to the wastewater treatment plant's operation, water supplies, the collection system, and water quality, including any projected changes to the influent water temperature and pollutant concentrations, and beneficial uses.

Also, new or increased threats to the sewer system resulting from climate change that may impact desired levels of service in the next 50 years were analyzed. The steps being taken or planned to address greenhouse gas emissions attributable to wastewater treatment plants, solids handling, and effluent discharge processes were also addressed.

The overarching driver of climate change is the increased atmospheric carbon dioxide from human activity. Furthermore, the increased carbon dioxide emissions trigger changes to climatic patterns, which lead to more erratic rainfall and local weather patterns, and, as discussed, trigger landslides and impacts PWTP's sewer shed.

Table 6.1: Summary of Impacts and Mitigation Strategies

Climate Change Impact	Risk	Likelihood of Risk	Consequence of Risk	Mitigation Strategies
Precipitation	SSO	Medium	Medium	Although the Plant is constructed on raised ground and the likelihood of flooding at the Plant is very low, the associated sewer shed may be impacted by increased levels of precipitation. The areas surrounding Piru are expected to see an increase in the number of extreme precipitation events, as well as droughts that last longer due to climate change. As a result, floods are expected to occur more often in the areas surrounding Piru. Increased precipitation may result in an increased chance of a storm-related SSO. PWTP will continue to monitor SSO frequency and ensure the SSMP is updated frequently and is fully implemented.

Climate Change Impact	Risk	Likelihood of Risk	Consequence of Risk	Mitigation Strategies
Precipitation	Spills	High	High	Climate change is likely to change precipitation patterns, increasing the frequency and intensity of heavy precipitation events, which can increase the risk of slope failures. Landslides and mudslides can move fast enough to damage or destroy pipes and other structures in their path. PWTP will continue to ensure that influent flow monitoring is adequate, maintained and tested per manufacturer's recommendations. POTW will also consider adding redundancy to its monitoring program.
Precipitation	Peak flow exceeding PWTP capacity	Medium	Medium	PWTP may experience both high flow events and low flow events as a result of impact related to climate change. Of these two hydraulic extremes, sustained peak flow events provide greater challenge to PWTP and present a more significant risk. Peak flow events may be caused by large storm events, inundation, or riverine flooding. Increases in baseline flow from inflow and infiltration may compound peak flow events, resulting in greater potential peak flows that exceed the treatment system's rated capacity. PWTP will continue to monitor the influent hydraulic flows and Plant capacity and implement control measures to equalize the influent flow. POTW will also consider adding redundancy to its monitoring program.
Temperature	Power outage	Low	Medium	Warmer temperatures are projected to cause an increase in extreme heat events. The number of extreme heat days is expected to rise in Piru, in addition to an increase in the average daily high temperatures. Energy delivery infrastructure and services may be damaged by very high temperatures, constraining the utilities' ability to meet the energy need of its customers. In addition to the planned 262.7-kilowatt (kW) PV System at PWTP, the District will assess the possibility of expanding the PV System to maximize on-site renewable energy production and achieve PWTP's full energy independence.

Climate Change Impact	Risk	Likelihood of Risk	Consequence of Risk	Mitigation Strategies
Temperature	Risk to staff	Medium	High	Excessive heat in the workplace can cause many adverse health effects, including heat stroke and even death, if not treated properly. Workers in outdoor and indoor work settings without adequate climate controls are at risk of hazardous heat exposure. The District complies with California's Heat Illness Prevention Standard which requires employers to provide training, water, shade, and planning. A temperature of 80°F triggers the requirements. The District's heat illness prevention program is an ongoing system that plans for and ensures workplace heat safety.
Sea-level Rise and Coastal Erosion	None	Not Present	Not Present	Global and regional sea levels have been increasing over the past century and are expected to continue to increase throughout this century. However, because of geographical distance and topography, PWTP is not vulnerable to the impact from sea rise and therefore, sea level rise and the associated risk have been excluded from this Climate Change Vulnerability Assessment and Mitigation Plan. With a distance of 26 miles from the Pacific Ocean coast, the Plant is far from coastal areas as shown in Figure 3-6, making it less likely to be directly affected by rising sea levels, which primarily impact coastal regions. Furthermore, with an elevation of 456 ft above sea level, the Plant is situated at an elevation considerably higher than sea level, and therefore, it is less vulnerable to flooding from rising sea levels.
Riverine Flooding	SSO	High	High	Current riverine flooding vulnerabilities of the PWTP were assessed by collecting flood hazard data from the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program (NFIP). In addition, a desktop review of historical reports of riverine flooding was conducted. Occurrences of riverine flooding were reported in . However, the livelihood of riverine flooding causing SSOs in the future is high. PWTP will continue to monitor SSO frequency and ensure that the SSMP is updated frequently and fully implemented.

Climate Change Impact	Risk	Likelihood of Risk	Consequence of Risk	Mitigation Strategies
Riverine Flooding	Peak flow exceeding PWTP capacity	High	Medium	Current riverine flooding vulnerabilities of the PWTP were assessed by collecting flood hazard data from the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program (NFIP). In addition, a desktop review of historical reports of riverine flooding was conducted. In addition, historical reports contained records of sever riverine flooding in the Santa Clara valley starting as early as 1884, and in more modern times, in 1914, 1938, 1969, 1978 and as recently as 2005. Therefore, the livelihood of riverine flooding causing the PWTP to exceed its maximum influent flow is high. The fact that PWTP is built on raised ground, intentionally to safeguard it from floods reduces the likelihood of flooding considerably. However, the sewer shed remains vulnerable to damage from potential flooding. PWTP to continue to monitor the influent hydraulic flows and Plant capacity and implement control measures including using flow equalization as much as possible.
Riverine Flooding	Power outage	Low	Medium	Riverine flooding may increase the likelihood of power outages. In addition to the planned 262.7-kilowatt (kW) PV System at PWTP, the District will assess the possibility of expanding the PV System to maximize on-site renewable energy production and PWTP's full energy independence from the grid.
Wildfire	Wildfire impacts Plant and offices	Low	Medium	The area near Piru is prone to wildfires and is designated as very high risk due to the dry climatic conditions, vegetation cover that is susceptible to ignition and rapid-fire spread, nearby steep slopes causing rapid uphill speed of the fire, and a history of repeated fire incidents. However, the Plant is not within the very high-risk area The District has created a defensible space as a buffer between the Plant and surrounding areas. It can slow or stop the spread of wildfire and help minimize destruction to the Plant. Furthermore, vegetation has been reduced or removed within a prescribed distance from the PWTP and associated offices to reduce fire intensity.

Climate Change Impact	Risk	Likelihood of Risk	Consequence of Risk	Mitigation Strategies
Post-Fire Debris Flow	Wildfire impacts facilities	High	Medium	Post-fire debris flow is highly possible along the Santa Clara River. Also, post-fire debris flow likelihood is high in tributaries near the sewer gravity pipes, manholes, and sewer force main that cross the pipes. PWTP staff can’t stop or change the path of debris flow. However, they may be able to protect the sewer shed from floodwaters or mud by use of sandbags or by building channels or deflection walls to try to direct the flow around manholes.
Landslide	Broken pipes	High	High	The hills north and north-west of PWTP are prone to landslides, although PWTP does not appear to have been directly impacted by landslides previously, but the PWTP-associated sewer shed has. These conditions are expected to persist, but the precise magnitude of potential mass movement during a landslide remains uncertain. Consequently, accurately determining the likelihood of a landslide impacting PWTP and its sewer shed remains challenging. Currently, information on anticipated climate change impacts to landslides is limited and the analysis utilizes the historic landslide inventory. PWTP will continue to ensure that influent flow monitoring is adequate, maintained and tested per manufacturer’s recommendations.
Water Quality	Limited supply of recycled water	Low	Low	PWTP has maintained compliance with the Order issued by the Los Angeles Water Quality Control Board. In addition to the Plant, the District maintains the sewer system throughout Piru, which consists of sewer pump stations, force mains, standard and trunk manholes, and gravity sewer pipes. The PWTP serves as the only wastewater treatment plant for Piru. No significant impacts are anticipated.

Climate Change Impact	Risk	Likelihood of Risk	Consequence of Risk	Mitigation Strategies
Water Temperature	Fluctuation in PWTP's influent and effluent water temperature	Low	Low	Maximum and minimum average air temperatures are projected to increase, which will result in an increase in the average influent wastewater temperature. Warmer wastewater temperatures will generally increase kinetics and result in higher microbial activity in the anoxic and aerobic zones, up to approximately 35 °C (95 °F), which corresponds to the upper limit of typical activated sludge bacteria. No significant impacts are anticipated.

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