Annex F Paradise Irrigation District

F.1 Introduction

This Annex details the hazard mitigation planning elements specific to Paradise Irrigation District (PID or District), a previously participating jurisdiction to the 2014 Butte County Local Hazard Mitigation Plan (LHMP) Update. This Annex is not intended to be a standalone document, but appends to and supplements the information contained in the Base Plan document. As such, all sections of the Base Plan, including the planning process and other procedural requirements apply to and were met by the PID. This Annex provides additional information specific to the District, with a focus on providing additional details on the risk assessment and mitigation strategy for the PID.

F.2 Planning Process

As described above, the PID followed the planning process detailed in Chapter 3 of the Base Plan. In addition to providing representation on the Butte County Hazard Mitigation Planning Committee (HMPC), the District formulated their own internal planning team to support the broader planning process requirements. Internal planning participants, their positions, and how they participated in the planning process are shown in Table F-1. Additional details on plan participation and District representatives are included in Appendix A.

Table F-1 PID Planning Team

Name	Position/Title	How Participated
Kevin Phillips	District Manager	Planning and implementation. Provided data and reviewed drafts
Jim Ladrini	Distribution Superintendent	Planning and implementation
Bill Taylor	Water Treatment Superintendent	Planning and implementation

Coordination with other community planning efforts is paramount to the successful implementation of this LHMP. This section provides information on how the District integrated the previously approved 2014 Plan into existing planning mechanisms and programs. Specifically, the PID incorporated into or implemented the 2014 LHMP through other plans and programs shown in Table F-2.

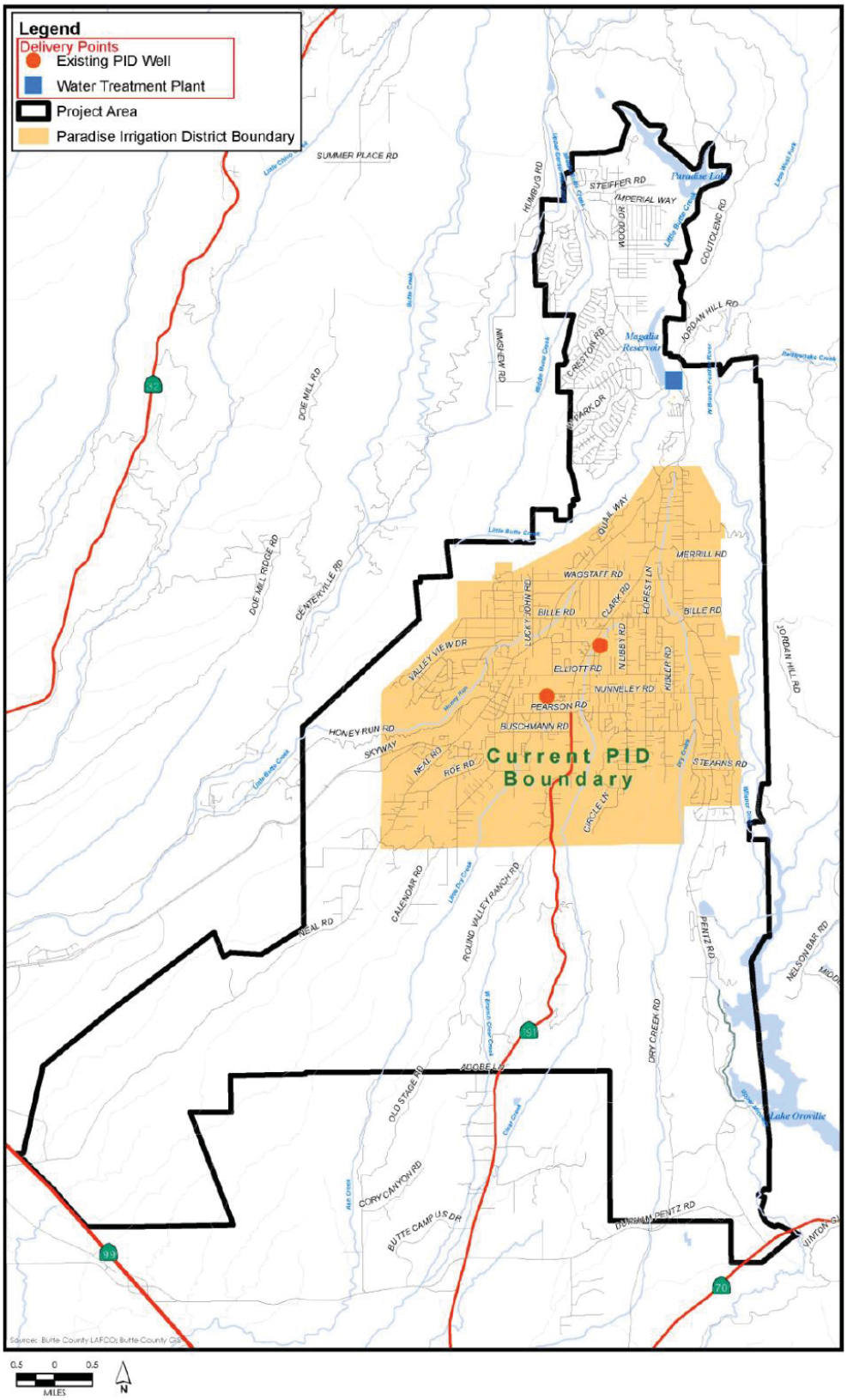
Table F-2 2014 LHMP Incorporation

Planning Mechanism 2014 LHMP Was Incorporated/Implemented In.	Details: How was it incorporated?
Public Agency Capital Improvement Plan	The District replaced approximately 5 miles of pipe within the District
Drought Planning through the District's strategic Business Plan, Capital Improvement Plan and Urban Water Management Plan	The District replaced leaking pipelines and designed a replacement of the B-Reservoir to increase storage.

F.3 District Profile

The community profile for the PID is detailed in the following sections. Figure F-1 displays a map and the location of the District within Butte County.

Figure F-1 Paradise Irrigation District Boundaries



Source: PID 2015 Urban Water Management Plan

F.3.1. Overview and Background

The Paradise Irrigation District was formed in 1916. The District purchased water rights from Pacific Gas and Electric for $14,000. The idea was that water would turn Paradise into the "Fruit Capital of California." Once the District was formed there was much work to be done in order to bring water to the average citizen who had hopes of prospering as a California grower. In February of 1917 Paradise citizens voted 224 to 24 to tax themselves $350,000 for a bond issue that would finance the building of pipelines and Magalia Dam. The assessed land value at that time was $348,000. The optimistic outlook of Ridge residents soon became gloomy as the declaration of war against Germany came in April of 1917. Prices on everything went up, and steel was not available. Early settlers of this area had some very rough years and several residents lost their land due to unpaid tax assessments during the years of World War I, World War II, and the Depression. In 1956, the Paradise Dam was built for just under $1 million dollars.

Remedial works were completed on Magalia Dam in 1964. The work consisted of stabilizing the existing dam by adding fill material to flatten the downstream slope of the western section below the county road. Approximately 13,000 cubic yards of earth were utilized in the reconstruction. Also 3,200 cubic yards of crushed drain and transition rock were placed on the bottom 3 to 8 feet of the embankment. The Bechtel Corporation served as engineer for the District and District personnel and equipment were used whenever possible. Paradise Dam was raised an additional 24.5 feet in 1976 increasing the available storage to 11,497 acre-feet. A water filtration plant was added to the District's water system in 1986 due to the increased turbidity within the reservoirs during the winter months. In January of 1995 the new treatment plant was completed and placed in service. The new filtration plant has the capacity to treat 22.8 million gallons per day.

F.4 Hazard Identification

PID's planning team identified the hazards that affect the District and summarized their location, extent, frequency of occurrence, potential magnitude, and significance specific to the District (see Table F-3).

Table F-3 Paradise Irrigation District – Hazard Identification Assessment

Hazard	Geographic Extent	Likelihood of Future Occurrences	Magnitude/ Severity	Significance	Climate Change Influence
Climate Change	Extensive	Likely	Limited	Low	–
Dam Failure	Extensive	Unlikely	Catastrophic	High	Medium
Drought & Water shortage	Extensive	Likely	Catastrophic	High	High
Earthquake	Extensive	Unlikely	Catastrophic	High	Low
Floods: 100/200/500 year	Limited	Occasional	Limited	Low	Medium
Floods: Localized Stormwater	Extensive	Likely	Catastrophic	Medium	Medium
Hazardous Materials Transportation	Limited	Unlikely	Negligible	Low	Low
Invasive Species: Aquatic	Limited	Occasional	Negligible	Low	Low
Invasive Species: Pests/Plants	Limited	Unlikely	Negligible	Low	Low
Landslide, Mudslide, and Debris Flow	Occasional	Unlikely	Catastrophic	Low	Medium
Levee Failure	Limited	Unlikely	Negligible	Low	Medium
Severe Weather: Extreme Heat	Extensive	Occasional	Negligible	Low	High
Severe Weather: Freeze and Winter Storm	Extensive	Occasional	Negligible	Medium	Medium
Severe Weather: Heavy Rain and Storms (Hail, Lightning)	Occasional	Likely	Catastrophic	Medium	Medium
Severe Weather: Wind and Tornado	Limited	Unlikely	Negligible	Low	Low
Stream Bank Erosion	Occasional	Occasional	Negligible	Low	Low
Volcano	Limited	Unlikely	Negligible	Low	Low
Wildfire	Extensive	Likely	Catastrophic	High	High

Geographic Extent
Limited: Less than 10% of planning area
Significant: 10-50% of planning area
Extensive: 50-100% of planning area

Likelihood of Future Occurrences
Highly Likely: Near 100% chance of occurrence in next year, or happens every year.
Likely: Between 10 and 100% chance of occurrence in next year, or has a recurrence interval of 10 years or less.
Occasional: Between 1 and 10% chance of occurrence in the next year, or has a recurrence interval of 11 to 100 years.
Unlikely: Less than 1% chance of occurrence in next 100 years, or has a recurrence interval of greater than every 100 years.

Magnitude/Severity
Catastrophic—More than 50 percent of property severely damaged; shutdown of facilities for more than 30 days; and/or multiple deaths
Critical—25-50 percent of property severely damaged; shutdown of facilities for at least two weeks; and/or injuries and/or illnesses result in permanent disability
Limited—10-25 percent of property severely damaged; shutdown of facilities for more than a week; and/or injuries/illnesses treatable do not result in permanent disability
Negligible—Less than 10 percent of property severely damaged, shutdown of facilities and services for less than 24 hours; and/or injuries/illnesses treatable with first aid

Significance
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

Climate Change Influence
Low: minimal potential impact
Medium: moderate potential impact
High: widespread potential impact

F.5 Hazard Profile and Vulnerability Assessment

The intent of this section is to profile PID's hazards and assess the District's vulnerability separate from that of the Planning Area as a whole, which has already been assessed in Sections 4.2 Hazard Profiles and 4.3 Vulnerability Assessment in the Base Plan. The hazard profiles in the Base Plan discuss overall impacts to the Planning Area and describes the hazard problem description, hazard extent, magnitude/severity, previous occurrences of hazard events and the likelihood of future occurrences. Hazard profile information specific to the District is included in this Annex. This vulnerability assessment analyzes the property and other assets at risk to hazards ranked of medium or high significance specific to the District. For more information about how hazards affect the County as a whole, see Chapter 4 Risk Assessment in the Base Plan.

F.5.1. Hazard Profiles

Each hazard vulnerability assessment in Section F.5.3, includes a hazard profile/problem description as to how each medium or high significant hazard affects the District and includes information on past hazard occurrences. The intent of this section is to provide jurisdictional specific information on hazards and further describe how the hazards and risks differ across the Planning Area.

F.5.2. Vulnerability Assessment and Assets at Risk

This section identifies PID's total assets at risk, including values at risk, populations at risk, critical facilities and infrastructure, natural resources, and historic and cultural resources. Growth and development trends are also presented for the District. This data is not hazard specific but is representative of total assets at risk within the District.

Assets at Risk and Critical Facilities

This section considers the PID's assets at risk, with a focus on key District assets such as critical facilities, infrastructure, and other District assets and their values. With respect to District assets, the majority of these assets are considered critical facilities as defined for this Plan. Critical facilities are defined for this Plan as:

> ***Any facility, including without limitation, a structure, infrastructure, property, equipment or service, that if adversely affected during a hazard event may result in severe consequences to public health and safety or interrupt essential services and operations for the community at any time before, during and after the hazard event.***

Table F-4 lists critical facilities and other District assets identified by the PID planning team as important to protect in the event of a disaster. PID's physical assets, valued at over $71 million, consist of the buildings and infrastructure to support PID's operations.

Table F-4 Paradise Irrigation District Critical Facilities, Infrastructure, and Other District Assets

Name of Asset	Facility Type	Replacement Value	Which Hazards Pose Risk
PID Treatment Plant	Water Treatment Plant	$14,000,000	Earthquake and dam failure
PID Pumping Station	Treated Water Delivery Pumps	$400,000	Earthquake, dam failure, wildfire
42-inch Transmission Pipeline	Above Ground Pipeline and Creek Crossing	$90,000	Earthquake and dam failure
Paradise Dam	Dam	$100,000,000	Earthquake and dam failure
Magalia Dam	Dam	$30,000,000	Earthquake and dam failure
Diversion Dam	Raw Water Supply	$3,000,000	Earthquake and dam failure
Water District Storage Tanks	Treated Water Delivery	$24,000,000	Earthquake and Wildfire
Total		**$171,490,000**	

Source: PID

Natural Resources

PID has a variety of natural resources of value to the District. These natural resources parallels that of the Town of Paradise as a whole. Information can be found in Section D.5.2 of the Town of Paradise Annex.

Historic and Cultural Resources

PID has a variety of historic and cultural resources of value to the District. These historic and cultural resources parallels that of the Town of Paradise as a whole. Information can be found in Section D.5.2 of the Town of Paradise Annex.

Growth and Development Trends

General growth in the District parallels that of the Town of Paradise as a whole. Information can be found in Section D.5.2 of the Town of Paradise Annex.

Development since 2014

No District facilities have been constructed since 2014.

Future Development

The District has no control over future development in areas the District provides water in. Future development in these areas parallels that of the Town of Paradise. Due to the Camp Fire, future development in Paradise is currently unclear. More general information on growth and development in

Butte County as a whole can be found in "Growth and Development Trends" in Section 4.3.1 Butte County Vulnerability and Assets at Risk of the Base Plan.

The District Planning Team noted that the District is in the process of investigating the opportunity to expand its service area to the west of the District boundaries. The expansion could include an intertie with Cal Water Chico to support the Vina Subbasin groundwater users.

F.5.3. Vulnerability to Specific Hazards

This section provides the hazard profile discussion and vulnerability assessment for those hazards identified above in Table F-3 as high or medium significance hazards. Impacts of past events and vulnerability of the District to specific hazards are further discussed below (see Section 4.1 Hazard Identification in the Base Plan for more detailed information about these hazards and their impacts on the Butte County Planning Area).

An estimate of the vulnerability of the PID to each identified priority hazard, in addition to the estimate of risk of future occurrence, is provided in each of the hazard-specific sections that follow. Vulnerability is measured in general, qualitative terms and is a summary of the potential impact based on past occurrences, spatial extent, and damage and casualty potential. It is categorized into the following classifications:

- **Extremely Low**—The occurrence and potential cost of damage to life and property is very minimal to nonexistent.
- **Low**—Minimal potential impact. The occurrence and potential cost of damage to life and property is minimal.
- **Medium**—Moderate potential impact. This ranking carries a moderate threat level to the general population and/or built environment. Here the potential damage is more isolated and less costly than a more widespread disaster.
- **High**—Widespread potential impact. This ranking carries a high threat to the general population and/or built environment. The potential for damage is widespread. Hazards in this category may have occurred in the past.
- **Extremely High**—Very widespread with catastrophic impact.

Dam Failure

Likelihood of Future Occurrence–Unlikely
Vulnerability–High

Hazard Profile and Problem Description

Dams are manmade structures built for a variety of uses including flood protection, power generation, agriculture, water supply, and recreation. When dams are constructed for flood protection, they are usually engineered to withstand a flood with a computed risk of occurrence. For example, a dam may be designed to contain a flood at a location on a stream that has a certain probability of occurring in any one year. If prolonged periods of rainfall and flooding occur that exceed the design requirements, that structure may be overtopped or fail. Overtopping is the primary cause of earthen dam failure in the United States.

Location and Extent

Paradise Irrigation District maintains two dams north of the Town of Paradise that impound stormwater flows in reservoirs used to provide drinking water to the community. The Skyway two lane road located on top of the dam is the primary access route into the Pines community (>10,000 residents). The upstream Paradise Reservoir is the main storage facility with a storage capacity of approximately 11,500 acre-feet. Magalia Reservoir was originally constructed with a storage capacity of 2,570 acre-feet.

Due to their location and proximity to the Town of Paradise, the Paradise dam is an extremely High classification and the Magalia is classified as a high hazard dam. There has been no history of failure of either of these two dams. Dam failure would affect mainly those living in the canyon and would likely have a limited effect on the Town of Paradise. Both of these dams had available inundation maps from Cal OES. District boundaries and dam inundation areas can be seen on Figure F-2, Figure F-3, and Figure F-4.

Figure F-2 Paradise Irrigation District – Extremely High Hazard Dam Inundation Areas

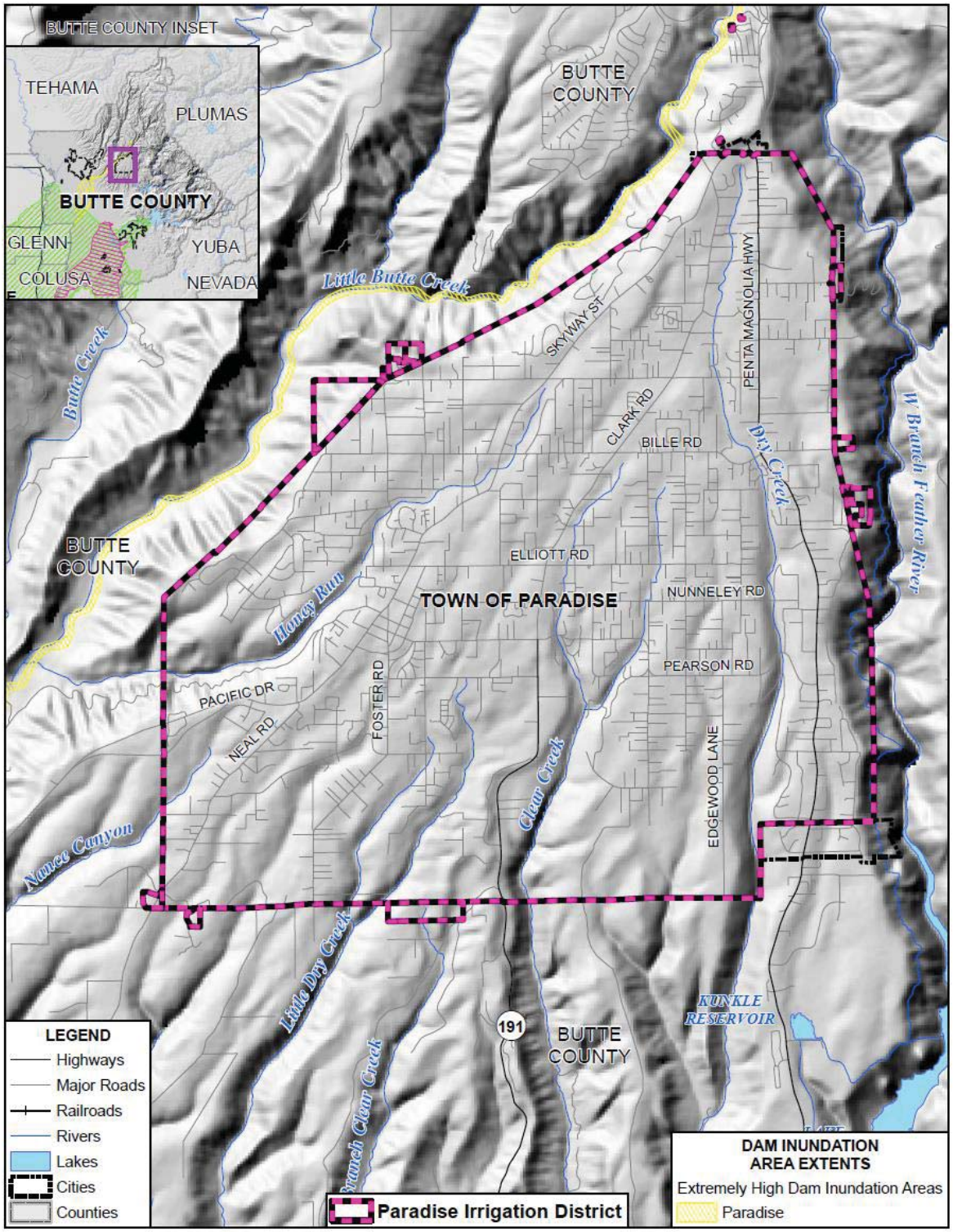


Figure F-3 Paradise Irrigation District – High Hazard Dam Inundation Areas

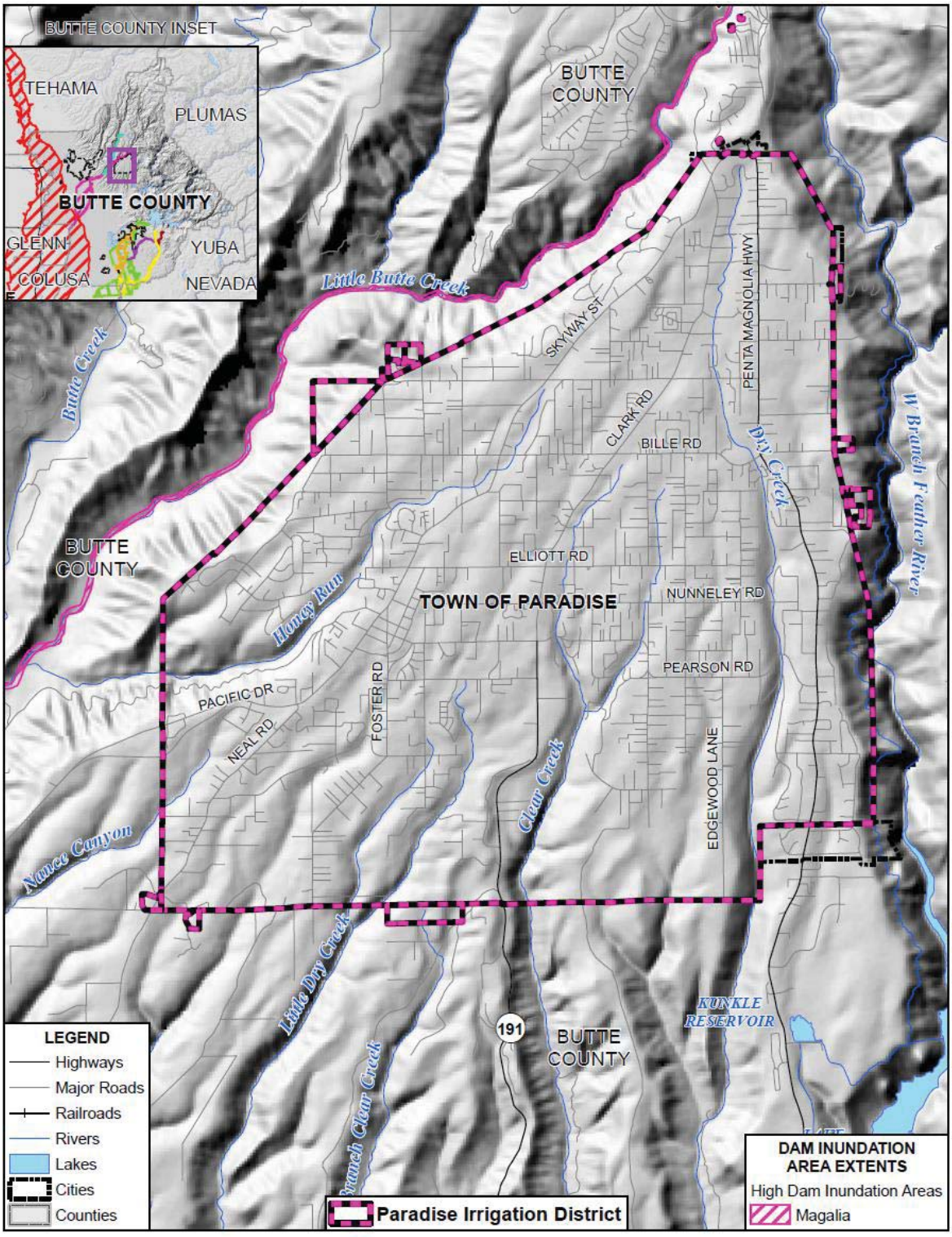
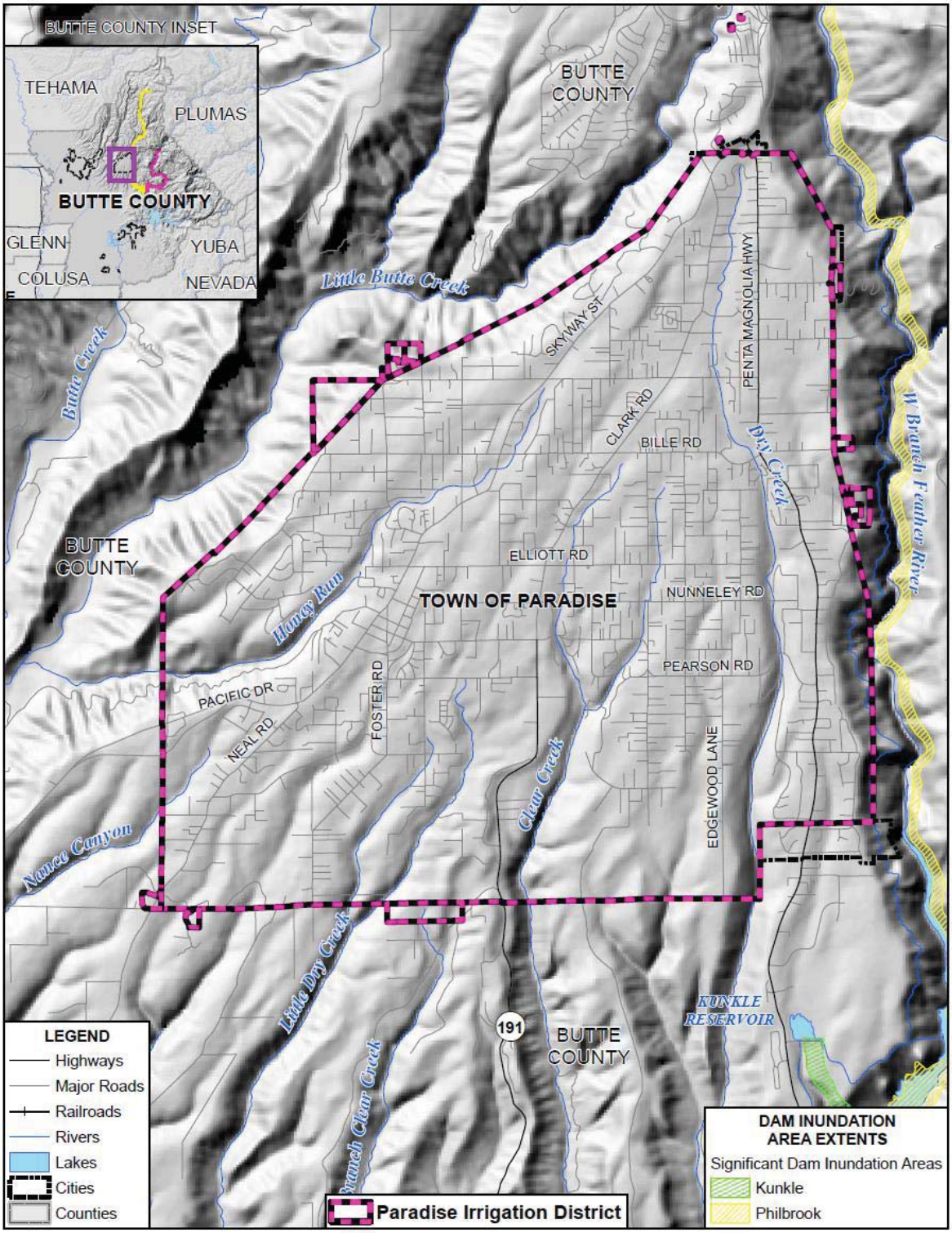


Figure F-4 Paradise Irrigation District – Significant Hazard Dam Inundation Areas



There is no scale with which to measure dam failure, just the hazard classification system for each dam. While a dam may fill slowly with runoff from winter storms, a dam break can have a very quick speed of onset. The duration of dam failure can vary depending on the nature of the dam break or failure.

Past Occurrences

The District Planning Team noted no past occurrences of dam failure that have affected the District.

Vulnerability and Impacts to Dam Failure

Dam failure flooding can occur as the result of partial or complete collapse of an impoundment. Dam failures often result from prolonged rainfall and flooding. The primary danger associated with dam failure is the high velocity flooding of those properties downstream of the dam.

A dam failure can range from a small, uncontrolled release to a catastrophic failure. Vulnerability to dam failures is generally confined to the areas subject to inundation downstream of the facility. Secondary losses would include loss of the multi-use functions of the facility and associated revenues that accompany those functions. Dam failure flooding would vary by community depending on which dam fails and the nature and extent of the dam failure and associated flooding.

Magalia Dam has been identified by the Division of Safety of Dams (DSOD) as at risk to failure in the event of significant seismic activity. In the event of such failure, floodwater would cause significant damages in the Little Butte Creek and Butte Creek Canyons and the town of Durham and exceed the capacity of the downstream Butte Creek levees. The Town of Paradise would be affected since the water treatment plant and the 42-inch supply line that provides drinking water for the residents in the community could be severely damaged since it is located at the downstream toe of the dam. The primary access road to the Pines Community would be eliminated and impact >10,000 residents. Reconstruction of the damaged facilities would be difficult, cause a significant water outage, take many months to restore, and the repair costs would be very high.

In a 1992 study of Magalia Dam it was concluded that the upstream slope of the dam was found to have inadequate stability under seismic loading conditions. In 1997 in response to this concern, the DSOD required the water storage in the reservoir to be decreased to 800 acre-feet. If stabilized, the capacity of Magalia Reservoir could be restored to 2,570 acre-feet. The change in water level elevation from 2,225 feet when full, was lowered to the current restricted operating level of 2,199 feet, or a reduction of 26 change feet. Each year the DSD conducts a dam inspection and the District prepares a “Surveillance Report”, with assistance from the URS Corporation.

In 2004, the PID constructed a diversion structure above Magalia Reservoir and a raw water pipeline to the water treatment plant. This improvement will supply untreated water to the treatment plant during any reconstruction of Magalia Dam, or the widening of Skyway across Magalia Dam. The PID is working on extending its water rights permits, which must be secured before further work is contemplated on Magalia Dam.

The applications for extending the District’s Water Rights were filed on time. The District hired a consultant to complete the CEQA process for the water rights renewal and Sphere of Influence expansion.

The District is in the process of completing an EIR for the water rights extension and sphere of influence expansion. The field work is completed, and the document is being developed.

The County did preliminary engineering on a project to widen the Skyway's two lanes to four lanes across Magalia Dam. The PID's preferred alternative for the widening project involves stabilizing the dam that would restore the design water level of 2,225 feet behind Magalia Dam, or 2,570 acre-feet.

Dam failure flooding presents a threat to life and property, including buildings, their contents, and their use. Large flood events can affect crops and livestock as well as lifeline utilities (e.g., water, sewerage, and power), transportation, jobs, tourism, the environment, and the local and regional economies.

Impacts to the PID from dam failure include damage to property and critical facilities. Other impacts include the costs to PID to rebuild any owned dam that failed. The District would also face the loss of water revenue if the reservoirs were drained.

Assets at Risk

Based on the dam failure inundation maps for the Magalia and Paradise Dams, the following District facilities would be at risk:

- PID Water Treatment Plant
- 42-inch Water Supply Transmission Pipeline
- The Skyway two-lane road on top of Magalia Dam

The following communities and the environment would be at risk:

- Town of Durham - 12 to 15 miles downstream with a population greater than 1000
- Little Butte Creek - Riparian environment
- Little Butte Canyon - 5 to 7 miles downstream with a population less than 1000
- Pines Community - adjacent to Magalia Dam with a population of greater than 10,000

Future Development

The District takes multiple factors into account, including dam inundation areas, when siting new projects. The District has potential projects to mitigate dam inundation for District property, as well as downstream facilities:

- Hazard assessment study
- Dam replacement

Drought & Water Shortage

Likelihood of Future Occurrence–Likely
Vulnerability–High

Hazard Profile and Problem Description

Drought is a gradual phenomenon. Although droughts are sometimes characterized as emergencies, they differ from typical emergency events. Most natural disasters, such as floods or wildfires, occur relatively rapidly and afford little time for preparing for disaster response. Droughts occur slowly, over a multi-year period, and it is often not obvious or easy to quantify when a drought begins and ends. Water districts normally require at least a 10-year planning horizon to implement a multiagency improvement project to mitigate the effects of a drought and water supply shortage.

Location and Extent

As discussed in the Base Plan, drought and water shortage are regional phenomenon. The whole of the County, as well as the whole of the PID, is at risk. Drought has a slow speed of onset and a variable duration. Drought can last for a short period of time, which does not usually affect water shortages. Should a drought last for a long period of time, water shortage becomes a larger issue.

Past Occurrences

Since drought is a regional phenomenon, past occurrences of drought for Paradise are similar to those for the County. Those past occurrences can be found in Section 4.2.8 of the Base Plan.

The District did note that PID's primary water supply system is reliant upon water captured and stored from Little Butte Creek. Little Butte Creek is a minor stream in the Sacramento Valley drainage that rises in the northwestern foothills of the Sierra Nevada and lies wholly within Butte County. Elevations range from 2,150 feet at the base of Magalia Dam to 3,850 feet at the uppermost elevation in the watershed. Flow in the catchment area is seasonal and responds to and follows the pattern of precipitation. Data for the runoff in the catchment area is from 1907 to 2004. The average annual runoff for the past 97 years has been approximately 15,750 acre-feet. The water year 1935-36 (estimated runoff 15,960 acre-feet) was used to represent the average year. The lowest estimated runoff was in the 1923-24 water year at 1,763 acre-feet. Average runoff far exceeds the District's current and projected needs of 7,000 to 8,000 acre-feet of water demand each year, although the District is vulnerable to potential water shortages during extended dry periods. The District's firm yield is 7,300 acre-feet plus 350 acre-feet from a well (groundwater).

Firm yield is defined as the amount of water that could be annually utilized from the Little Butte Creek system during a critical drought period. PID stores water from Little Butte Creek in two reservoirs located on the drainage. Magalia Reservoir originally had a storage capacity of 2,574 AF, but in 1997 the reservoir was drawn down to comply with safety requirements of DSOD. After drawdown, Magalia Reservoir has a storage capacity of 800 AF. Paradise Reservoir has a storage capacity of 11,497 AF. The total storage capacity of both reservoirs is 12,293 AF. The District has approximately 6,000 acre-feet of additional water rights that are not being utilized due to a lack of storage.

The District drilled a well in 1996. The output from the well is estimated to be 350 acre-feet per year but is operated annually at only 30 acre-feet per year to keep the well operational. The primary purpose of the well is to augment the District's water supply during times of drought or emergency. Ground water supply in the District's area is not expected to provide a significant source of water.

Vulnerability and Impacts to Drought and Water Shortage

Based on historical information, the occurrence of drought in California, including the District, is cyclical, driven by weather patterns. Drought has occurred in the past and will occur in the future. Periods of actual drought with adverse impacts can vary in duration, and the period between droughts is often extended. Although an area may be under an extended dry period, determining when it becomes a drought is based on impacts to individual water users. The vulnerability of the PID to drought is District-wide, but impacts may vary and include reduction in water supply and an increase in dry fuels. The increased dry fuels result in an increased fire danger. Areas of Paradise are in the foothill interface and become more susceptible to wildfire as drought conditions increase. Residents of these areas are often times dependent upon ground water (water wells), as these water wells begin to fail the ability of the residents to water landscaping decreases, fire fuel loads increase.

The most significant qualitative impacts associated with drought in the planning area are those related to water intensive activities such as wildfire protection, municipal usage, commerce, tourism, and recreation. Voluntary conservation measures are typically implemented during extended droughts. A reduction of electric power generation and water quality deterioration are also potential problems. Drought conditions can also cause soil to compact and not absorb water well, potentially making an area more susceptible to flooding.

Assets at Risk

The drought and water shortage impacts are thoroughly evaluated in the Paradise Irrigation District's 2015 Urban Water Management Plan, including a Water Shortage Contingency Plan and a Catastrophic Supply Interruption Plan. The District's 2012 updated Water System Emergency Response plan includes an Emergency Action Plan (EAP) for dam failure as well as EAPs for other natural disaster and man-made malevolent events.

Future Development

Future development of District facilities is unlikely to be affected by drought during the process of siting the project. The District has potential projects to mitigate drought's affects to District customers:

- Hydraulic Modeling of the water distribution
- Distribution system and water treatment plant upgrades
- Increase storage of the B-Reservoir
- Upsizing of Customer service-lines with backflow assemblies

Earthquake and Liquefaction

Likelihood of Future Occurrence–Unlikely
Vulnerability–High

Hazard Profile and Problem Description

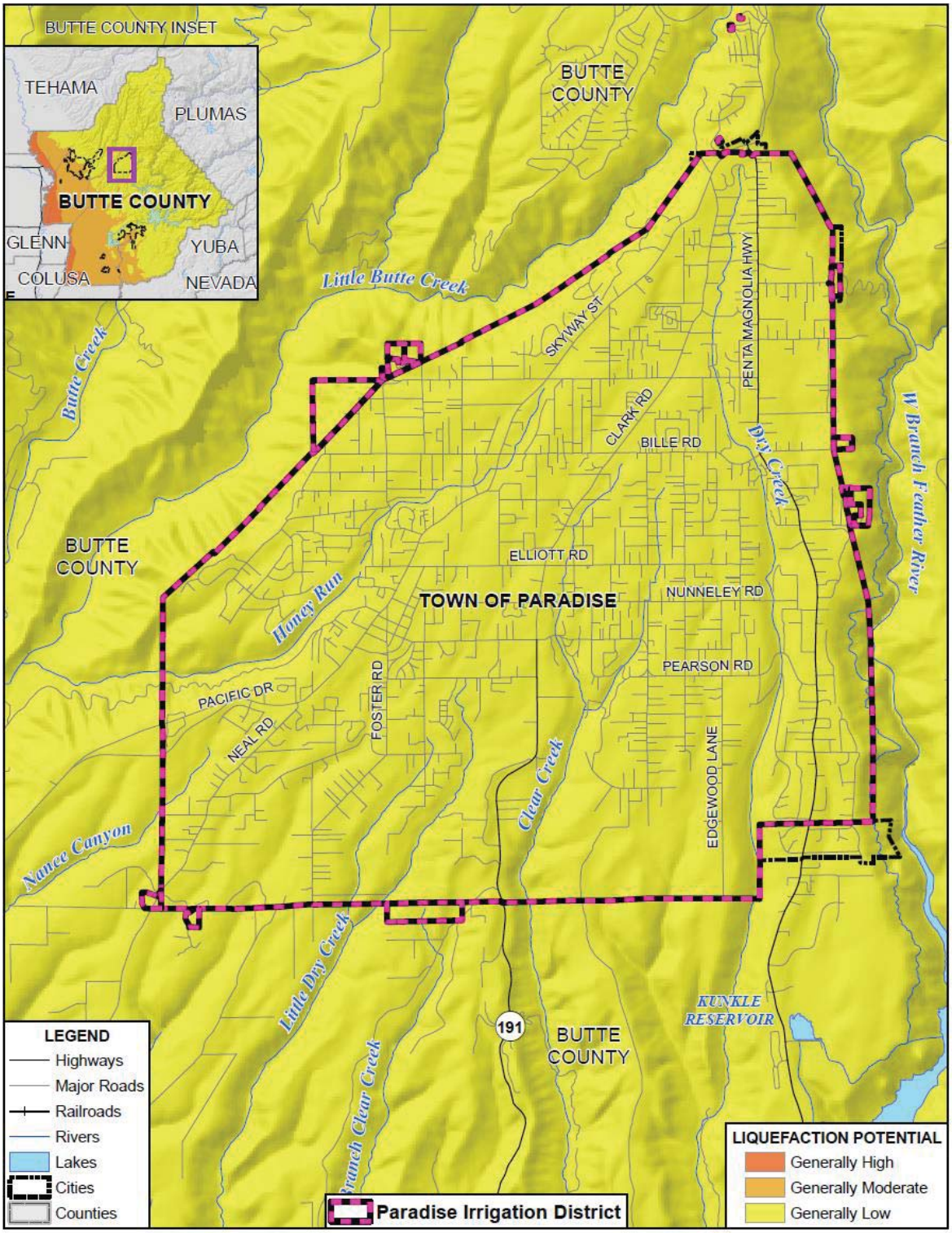
The State of California has identified five areas of critical seismic concern including surface ruptures, ground shaking, ground failure, tsunamis, and seiches. Each of these is caused by earthquake activity

thereby creating hazards for life and property, which has the potential anywhere in California. The District is not at risk for tsunamis or seiches due to its inland location and the absence of nearby large bodies of water. The only known active fault in Butte County is the Cleveland Hills fault, the site of the August 1975 Oroville earthquake. This earthquake had a Richter magnitude of 5.7. Due to the proximity of the District to the Cleveland Hills Fault, the District is at risk to an earthquake occurring on this fault. These earthquakes can cause liquefaction within the District. Liquefaction is a process whereby soil is temporarily transformed to a fluid formed during intense and prolonged ground shaking. In a 1992 study of Magalia Dam it was concluded that the upstream slope of the dam was found to have inadequate stability under seismic loading conditions. In 1997 the water level in the reservoir was lowered, due to seismic stability concerns. There is concern that the Magalia dam could fail under stress from seismic shaking.

Location and Extent

Since earthquakes are regional events, the whole of the District is at risk to earthquake. Hazus earthquake analysis for the region is shown in Section 4.3.6 of the Base Plan. PID and the surrounding area is located in a region of relatively low risk of earthquake occurrence. Additionally, the District is potentially at risk to liquefaction from earthquake shaking; the District falls within an area of generally low liquefaction potential A map of liquefaction potential and District locations is shown on Figure F-5.

Figure F-5 Paradise Irrigation District – Liquefaction Areas



The amount of energy released during an earthquake is usually expressed as a magnitude and is measured directly from the earthquake as recorded on seismographs. An earthquake's magnitude is expressed in whole numbers and decimals (e.g., 6.8). Seismologists have developed several magnitude scales, as discussed in Section 4.2.10 of the Base Plan. Earthquake and liquefaction both have a short onset period, and the duration of shaking and liquefaction is short as well.

Past Occurrences

As shown in the Base Plan, only the 1975 5.7 magnitude Oroville earthquake that resulted in a federal disaster declaration has occurred in the County. The District was not affected by this earthquake. The HMPC noted no other past occurrences of earthquakes or liquefaction that affected the District in any meaningful way.

Vulnerability and Impacts to Earthquake

Earthquake vulnerability and impacts are primarily based on population and the built environment. Urban areas in high seismic hazard zones are the most vulnerable, while uninhabited areas are less vulnerable. The primary impacts of concern are life safety, property damage., and impacts to critical facilities and infrastructure, including the road system.

Ground shaking is the primary earthquake hazard. Many factors affect the survivability of structures and systems from earthquake-caused ground motions. These factors include proximity to the fault, direction of rupture, epicentral location and depth, magnitude, local geologic and soils conditions, types and quality of construction, building configurations and heights, and comparable factors that relate to utility, transportation, and other network systems.

The California DSOD is concerned that if the epicenter of an earthquake of significant magnitude were to occur nearby a dam, the likelihood of a structural failure is high. Local dams vulnerable to earthquake damage are hydraulic-filled embankment dams built with sluicing materials from an adjacent area and depositing the slurry into the embankment, such as the Magalia and De Salba Dams.

While not considered an active fault like the Cleveland Hills fault discussed above, there are a number of faults within Butte County and a large number of relatively nearby faults that could be considered potentially active, based on criteria developed by the California Mining and Geology Board. Following is a description of the active faults near the Magalia Dam. These faults are detailed below and include the following:

- Magalia Fault. The Magalia Fault is located near the northern end of the Foothill Fault System, a system of northwest trending east dipping normal fault formed along the margin of the Great Valley and the Sierra Nevada provinces. The DSOD, based on Fault Activity Guidelines in 2001 reclassified the Magalia Fault as conditionally active. The Paradise Irrigation District commissioned a study by Holdrege & Kull, dated January 2007 to evaluate the Magalia Fault.
- Foothills Shear Zone. The Foothills shear zone extends into southern Butte County. A possible magnitude 7.0 earthquake in this zone would result in intensities as high as IX in Butte County

In 2007, The District hired a consultant to determine the status of the Magalia Fault. The consultant's opinion was that the fault is inactive, but the DSOD would not accept the finding without additional studies. Below is information from the 2007 Fault Evaluation Report prepared by Holdrege and Kull.

Seismic studies were performed in 1973 and updated in 1992 by Harlan Tait Associates (HTA) to evaluate the potential for the hydraulic fill within the dam to liquefy under earthquake loading. The later HTA study concluded that the upstream slope was potentially unstable during seismic events and the Division of Safety of Dams (DOSD) required that the dam be strengthened or the water level behind the dam be lowered. DOSD performed their own evaluation of the dam and concluded that the reservoir be lowered to 35 feet below the crest of the dam. In 1994, Dames & Moore (D&M) performed an independent study for PID to further evaluate a safe reservoir level. D&M's study indicated that the reservoir would be safe if the water level was further reduced an additional 5 feet; lowering the reservoir to 40 feet below the crest of the dam. The DOSD accepted the findings and stipulated that the reservoir elevation be restricted to elevation 2,200 feet, above mean sea level (MSL).

A Feasibility Study was performed in 2002 by URS Corporation (URS) to further evaluate the restricted reservoir level as previously imposed by DSOD. The purpose of that study was to determine if it was possible to revise the restricted storage capacity of the reservoir. The scope of the study included review of the extensive amount of field and laboratory tests that were performed during previous investigations and additional static and dynamic analyses using current software and correction procedures for penetration resistance N1 (60)cs. URS concluded that the water elevation of the reservoir could be safely raised an additional 13 feet to elevation 2,213 feet, above MSL. The URS evaluation was based on an assumed magnitude 6.5 earthquake occurring on the Chico Monocline Fault with an 84th percentile peak ground acceleration (PGA) value of 0.34g.

However, based on the Fault Activity Guidelines established by DSOD in 2001, the Magalia Fault was reclassified as conditionally active in a DSOD memorandum dated July 1, 2002. Because the Magalia Fault was reclassified to be conditionally active, DSOD recommended that the 50th percentile PGA of 0.61g for the Magalia Fault be used to update previous static and dynamic analyses related to the Magalia Reservoir. The reservoir elevation is currently restricted to 2,199 feet above mean seal level.

Impacts to the District included damage to facilities and distribution lines. Dams owned by the District could also be impacted. Other impacts include damage to structures; critical infrastructure and facilities, and loss of life and injury to people in downstream dam areas.

Assets at Risk

Aging water distribution systems comprised of steel pipe requires ongoing replacement that is vulnerable to earthquake damage due to corrosion issues. The District identified 60 miles of pipe that should be replaced. District personnel installed 29,821 feet of mainline in the last five years. In addition to that, grant funding helped with the installation of 12,000 feet of mainline installed by a contractor. While the total fell short of the 5-year goal to complete the replacement of 75,000 feet, a deferral of mainline installation was realized with the freezing of three full-time positions and a dispute with the union over temporary worker status. Pipe replacement avoids unnecessary water losses that deplete water storage supply, reduce water to

the Bay-Delta and increase operations costs. The high cost for unplanned pipeline repairs that damage public and private property can be avoided by replacing the steel pipes before they become problematic.

The water treatment plant and 42-inch transmission water line are highly vulnerable to severe damage and critical loss of water supply due to dam failure due to earthquake shaking. The following District facilities would be at risk due to an earthquake:

- PID Water Treatment Plant
- 42-inch Water Supply Transmission Pipeline
- Water Distribution Storage Tanks
- Magalia Dam

Future Development

The District will build any new development to current California Building Code, which includes construction standards designed to mitigate hazards. In addition, the District has a potential project to mitigate the hazards of earthquake to the District and its customers:

- Replacement of B-Reservoir with steel tanks

Floods: Localized Stormwater

Likelihood of Future Occurrence–Likely
Vulnerability–Medium

Hazard Profile and Problem Description

Localized flooding and other issues caused by severe weather events, primarily heavy rains and severe storms, are an annual occurrence in the District. Normally storm floodwaters are kept within defined limits by a variety of storm drainage and flood control measures. Occasionally, extended heavy rains result in floodwaters that overwhelm the drainage system. Primary concerns include impacts to infrastructure that provides a means of ingress and egress throughout the community.

Location and Extent

The Town of Paradise and areas of the District are subject to localized flooding. The extent of localized flooding is usually measured in volume, velocity, and depths of flooding. Expected flood depths in the District vary by location. Flood durations in the District tend to be short to medium term, or until either the storm drainage system can catch up or flood waters move downstream. Localized flooding in the District tends to have a shorter speed of onset, especially when antecedent rainfall has soaked the ground and reduced its capacity to absorb additional moisture.

Past Occurrences

The District Planning Team noted that localized flooding has not affected District facilities in the past. It can cause issues with District personnel traveling to and from work, as well as to and from District facilities.

Vulnerability and Impacts to Localized Flood

Localized flooding occurs throughout the District primarily during the winter and spring months during periods of heavy rains. Localized flooding can cause road closures, pavement deterioration, washouts, landslides/mudslides, debris areas, and downed trees. The amount and type of damage or flooding that occurs varies from year to year and storm to storm, depending on the quantity of runoff. Heavy rains may produce ponding around storm drains and in low lying areas, but these events are short in duration and do not typically cause property damage.

The drainage patterns of the Paradise area and the District reflect the uniqueness of its location on a gently sloping ridge surface. The Paradise area is dominated by a somewhat continuous overland runoff flow which is organized into local rills or depressions as the runoff is collected. The Paradise area is divided into fairly distinct drainage basins.

The drainage systems often coincide with groundwater seeps and springs which serve to increase the moisture availability beyond the intermittent flows directly related to storm runoff. Consequently, the drainage depressions and their downslope channels are often thickly vegetated.

As these areas are developed, the undergrowth and grass cover are often removed and channels are randomly excavated to suit the individual owner's or developer's interest. Often when this takes place, either through lack of knowledge, lack of funds or indifference, the resulting channel is inadequate in capacity and poses a real possibility of promoting damage. While the soils and subsoils of the Paradise area do not markedly aggravate the runoff situation, they also do not prove to be highly permeable. This often results in localized flooding which can be exacerbated by such land use activities as grading operations, vegetation clearance, inattention to storm runoff from construction sites during the peak winter rainfall period, large-scale paving and the lack of a collection system for storm waters. Storm runoff arrives at the principal drainage channels through overland flow for most of the Paradise area. Very few collector systems have been constructed and the primary form of collection has been through roadside ditches.

Impacts to the District from localized flood include possible damage to facilities and infrastructure. Localized flooding can also affect transportation routes that District personnel must take to get to District facilities.

Assets at Risk

The PID treatment plant and the 42-inch above ground pipeline are vulnerable to flooding from the overtopping of the spillway for Magalia Dam. The spillway currently flows toward the treatment plant below the dam.

Future Development

Future development is unlikely to be affected by localized flooding. The District has noted potential projects to mitigate localized flood for the District and its customers:

- Hazard assessment study
- Dam replacement

Severe Weather: Freeze and Winter Storm

Likelihood of Future Occurrence–Occasional
Vulnerability–Medium

Hazard Profile and Problem Description

According to the National Weather Service (NWS) and the Western Regional Climate Center (WRCC), extreme cold often accompanies a winter storm or is left in its wake. Winter snowstorms in the District can include freezing temperatures, snow, and ice. Prolonged exposure to cold can cause frostbite or hypothermia and can be life-threatening. Infants and the elderly are most susceptible. Pipes may freeze and burst in homes or buildings that are poorly insulated or without heat. Freezing temperatures can cause significant damage to the agricultural industry.

Location and Extent

Freeze and winter storms are regional issues, meaning the entire District is at risk to freeze and winter storms. While there is no scale (i.e. Richter, Enhanced Fujita) to measure the effects of freeze, temperature data from the County from the WRCC indicates that there are 21.8 days that fall below 32°F in western Butte County, with no days falling below 0°F. Freeze has a slow onset and can be generally be predicted in advance for the County. Freeze events can last for hours (in a cold overnight), or for days to weeks at a time. Snowfall is generally measured in snow fall and snow depths. It is rare for snow to fall, and even rarer that snow accumulates in the District. Snowfall has an onset that is similar to freeze in the District.

Past Occurrences

While the District Planning Team noted that while freeze and winter storms are annual events, there have been no events that have damages District facilities.

Vulnerability and Impacts to Severe Weather: Freeze and Winter Storms

The District experiences temperatures below 32 degrees and occasional snowfall during the winter months. The temperature moves to the teens in rather extreme situations. Occasionally, winter storms with freezing weather, snow and ice can affect the District. Winter storms can include snow and ice, and are occasionally accompanied by high winds, which can cause downed trees and power lines, power outages, broken pipes, accidents, and road closures. District facilities can be affected by loss of electricity.

Assets at Risk

The following District facilities would be at risk due to a severe weather:

- PID Water Treatment Plant
- PID Pumping Station

Future Development

The District builds all facilities to current California Building Code, and takes freeze and winter storm into account when siting facilities. Potential projects to mitigate freeze and winter storms for the District and its customers are:

- Hazard assessment study
- Upgrading backup generators throughout the District
- Running a redundant pipeline from the treatment plant to the junction box at the beginning of distribution system.

Severe Weather: Heavy Rain and Storms (Hail, Lightning)

Likelihood of Future Occurrence–Likely
Vulnerability–Medium

Hazard Profile and Problem Description

Storms in the District occur annually and are generally characterized by heavy rain often accompanied by strong winds and sometimes lightning and hail. Approximately 10 percent of the thunderstorms that occur each year in the United States are classified as severe. A thunderstorm is classified as severe when it contains one or more of the following phenomena: hail that is three-quarters of an inch or greater, winds in excess of 50 knots (57.5 mph), or a tornado. Heavy precipitation in the District falls mainly in the fall, winter, and spring months.

Location and Extent

Heavy rain events occur on a regional basis. Rains and storms can occur in any location of the District. All portions of the District are at risk to heavy rains. Most of the severe rains occur during the winter months. There is no scale by which heavy rains and severe storms are measured. Magnitude of storms is measured often in rainfall and damages. The speed of onset of heavy rains can be short, but accurate weather prediction mechanisms often let the public know of upcoming events. Duration of severe storms in California, Butte County, and the District is often short, ranging from minutes to hours. In some cases, rains can continue for days at a time. Information on precipitation extremes can be found in Section 4.2.4 of the Base Plan.

Past Occurrences

While the District Planning Team noted that while heavy rain and storms are annual events, there have been no events that have damages District facilities.

Vulnerability and Impacts to Heavy Rain and Storms

According to historical hazard data, severe weather is an annual occurrence in the District. Damage and disaster declarations related to severe weather have occurred and will continue to occur in the future. Heavy rain and severe storms are the most frequent type of severe weather occurrences in the District. Wind and lightning often accompany these storms and have caused damage in the past. Hail is rare.

Actual damage associated with the primary effects of severe weather have been limited. It is the secondary hazards caused by weather, such as flooding, that have had the greatest impact on the District. Impacts to District assets, critical facilities (such as utilities), and the transportation system can occur. Life safety issues can occur but are less of a concern during heavy rains and storms. The risk and vulnerability associated with these secondary hazards are discussed in the localized flood section of this Annex.

Assets at Risk

The water treatment plan and the above ground 42-inch transmission waterline are at critical risk due to this hazard.

Future Development

The District builds all facilities to current California Building Code, and takes heavy rain and storms into account when siting facilities. Potential projects to mitigate heavy rain and storms for the District and its customers are:

- Hazard assessment study
- Upgrading backup generators throughout the District
- Running a redundant pipeline from the treatment plant to the junction box at the beginning of distribution system.

Wildfire

Likelihood of Future Occurrence–Likely
Vulnerability–Extremely High

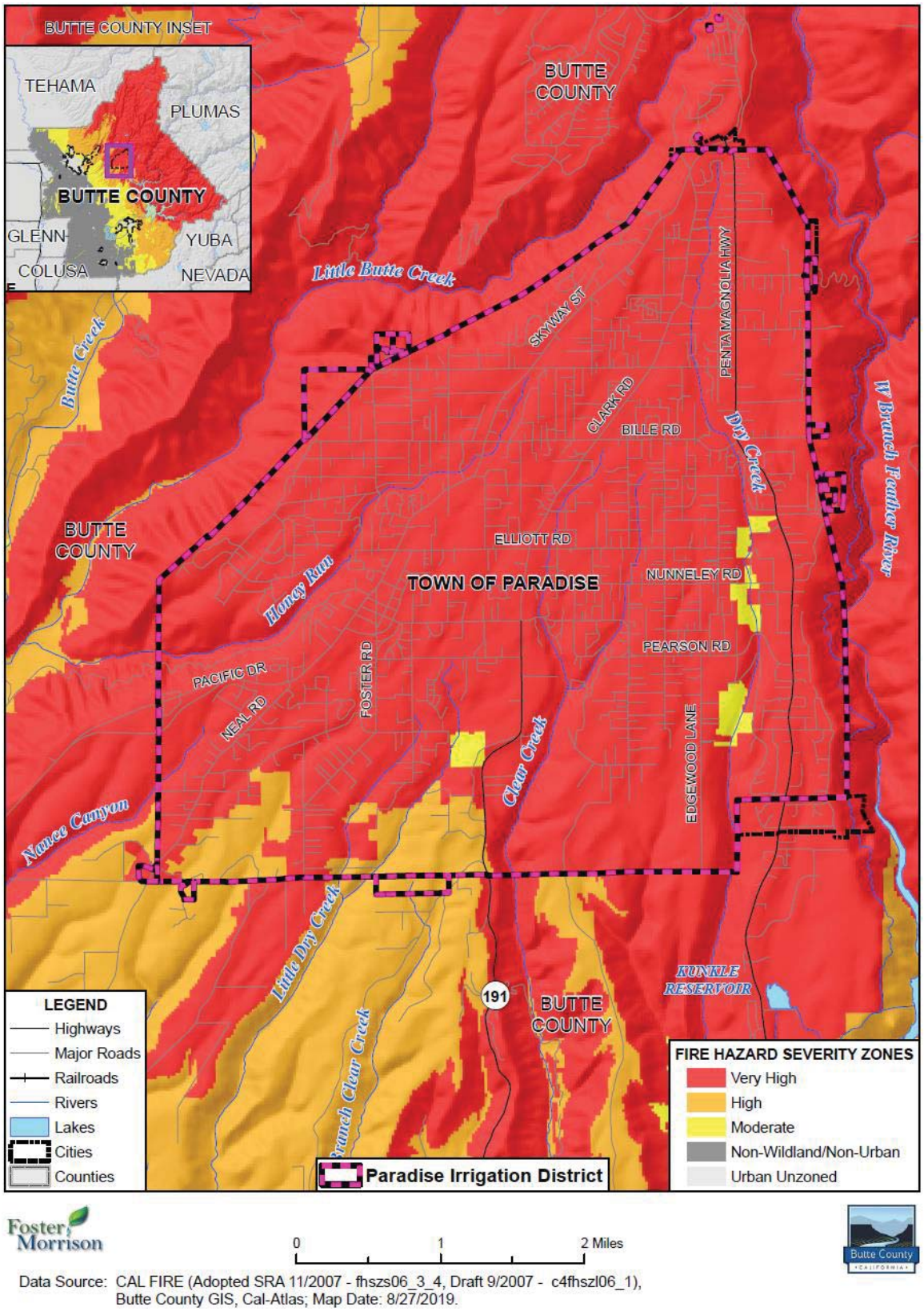
Hazard Profile and Problem Description

Wildland fire is an ongoing concern for the PID. Generally, the fire season extends from early spring through late fall of each year during the hotter, dryer months. Fire conditions arise from a combination of high temperatures, low moisture content in the air and fuel, accumulation of vegetation, and high winds. Throughout California, communities are increasingly concerned about wildfire safety as increased development in the foothills and mountain areas and subsequent fire suppression practices have affected the natural cycle of the ecosystem. While the fire season was considered to be predominantly May through October, it has now become a year around concern. Complicating wildfire issues is the threat of PG&E shutdowns during red flag days. This affects the District's ability to treat water and pump water to the upper zones of the District.

Location and Extent

The whole of the District lies in a Moderate to Very High Fire Hazard Severity Zone. Wildfires tend to be measured in structure damages, injuries, and loss of life as well as on acres burned. Fires can have a quick speed of onset, especially during periods of drought. Fires can burn for a short period of time or may have durations lasting for a week or more. Fire Hazard Severity Zones in the District can be seen on Figure F-6.

Figure F-6 Paradise Irrigation District – Fire Hazard Severity Zones



Data Source: CAL FIRE (Adopted SRA 11/2007 - fhszs06_3_4, Draft 9/2007 - c4fhszl06_1), Butte County GIS, Cal-Atlas; Map Date: 8/27/2019.

Past Occurrences

2008 Ophir Fire- Lightning from storms, particularly during dry summer months is a potential natural ignition source for wildfire. An example of this would be the June 2008 fires. A large fire surrounded the Town of Paradise. No damages were done to the District facilities, but a fire of this nature underscores the risk of wildfire to the District (see discussion of Camp Fire below). The 2008 fires showed that further education in the community is needed to stop the use of yard sprinklers during evacuations. The water is not beneficial and takes water away from firefighting efforts.

2018 Camp Fire – During the Camp Fire, toxic chemicals (especially volatile organic compounds, VOCs, such as benzene) contaminated the Paradise Irrigation District (PID) distribution system. The distribution system is comprised of 172 miles (almost a million feet) of water mains and 10,480 service laterals. A significant number of the 10,480 individual service laterals and/or meters melted and the system partially drained. Following the Camp Fire, the distribution system was re-pressurized, leaks were repaired, and initial water quality testing began. It was discovered in the 2017 Tubbs Fire in Santa Rosa, that VOC contamination may be an issue in areas impacted by wildfire, especially coupled with depressurization of the water distribution system. The initial water quality testing discovered VOC contamination in multiple samples. Immediately, a "do not drink" advisory was initiated by PID. The full extent of the contamination is not yet known, but the system needs to be confirmed to be clear of contaminants and determined safe for use in distributing drinking water. A Water System Recovery Plan has been developed to accomplish this task.

Vulnerability and Impacts to Wildfire

Risk and vulnerability to the Butte County Planning Area and the District from wildfire is of significant concern, with some areas of the planning area being at greater risk than others. High fuel loads in the planning area, along with geographical and topographical features, create the potential for both natural and human-caused fires that can result in loss of life and property. These factors, combined with natural weather conditions common to the area, including periods of drought, high temperatures, low relative humidity, and periodic winds, can result in frequent and sometimes catastrophic fires. During the May to November fire season, the dry vegetation and hot and sometimes windy weather, combined with continued growth in the WUI areas, results in an increase in the number of ignitions. Any fire, once ignited, has the potential to quickly become a large, out-of-control fire. As development continues throughout the Planning Area, especially in these interface areas, the risk and vulnerability to wildfires will likely increase.

PID is not immune to numerous types of grass, brush, and wildland fires and any one of them may accelerate into a large WUI wildfire. As evidenced by the Camp Fire, such a situation could lead to evacuation of large portions of the population and the potential for significant loss of property, structures and rangeland. The natural fuels available in or near the District vary greatly in the rate and intensity of burning. Fires in heavy brush and stands of trees burn with great intensity but more slowly than in dry grass and leaves. Dense fuels will propagate fire better than sparse fuels.

Compounding the problem is the lack of ingress and egress roads in Paradise and around the District. Due to the sheer volume of people that can be affected at one time by a wildland fire, a number of potential traffic flow problems exist. These are complicated by the existence of only one north route out of town;

only four south routes out of town, two of which could easily be affected by a single fire; and only three through east-west streets. The plan concludes that any fire in the Magalia area would have a major impact on the roads in Paradise because access is via a two-lane road.

Wildfires in or near the PID service area in the Town of Paradise provide a significant impact to the District's ability to deliver water. The 2008 fires showed that further education in the community is needed to stop the use of yard sprinklers during evacuations. The water is not beneficial and takes water away from firefighting efforts.

The PID service area is located directly adjacent to the communities of Paradise and Magalia in the WUI.

Wildfires can cause short-term and long-term disruption to the County, the Town of Paradise and the PID, as evidenced by the Camp Fire in Paradise and the resultant loss of housing stock and population in Paradise. Fires can have devastating effects on watersheds through loss of vegetation and soil erosion, which may impact the County by changing runoff patterns, increasing sedimentation, reducing natural and reservoir water storage capacity, and degrading water quality. Fires may result in casualties and can destroy buildings and infrastructure.

Although the physical damages and casualties arising from wildland-urban interface fires may be severe, it is important to recognize that they also cause significant economic impacts by resulting in a loss of function of buildings, infrastructure, and tax base. In some cases, the economic impact of this loss of services may be comparable to the economic impact of physical damages or, in some cases, even greater. Economic impacts of loss of transportation and utility services may include traffic delays/detours from road and bridge closures and loss of electric power, potable water, and wastewater services. Fires can also cause major damage to power plants and power lines needed to distribute electricity to operate facilities.

Assets at Risk

The following District facilities would be at risk due to wildfire:

- PID Water Treatment Plant
- PID Pumping Station
- Magalia Dam
- Paradise Dam
- Distribution Water Storage Tank

Future Development

Wildfire risk will be taken into account when siting new District facilities. The District has sought to undertake projects that will reduce the risk of wildfire to the District and its customers. These projects include:

- Hazard assessment study
- Upgrading backup generators throughout the District
- Running a redundant pipeline from the treatment plant to the junction box at the beginning of distribution system.
- Upgrading B-Reservoir with steel tanks

- Upgrading all service-lines in the District to support fire sprinklers and plumbed with a backflow device.
- Upgrading the treatment plant and distribution system to allow maximum flow throughout the District.

F.6 Capability Assessment

Capabilities are the programs and policies currently in place to reduce hazard impacts or that could be used to implement hazard mitigation activities. This capabilities assessment is divided into five sections: regulatory mitigation capabilities, administrative and technical mitigation capabilities, fiscal mitigation capabilities, mitigation education, outreach, and partnerships, and other mitigation efforts.

F.6.1. Regulatory Mitigation Capabilities

Table F-5 lists regulatory mitigation capabilities, including planning and land management tools, typically used by local jurisdictions to implement hazard mitigation activities and indicates those that are in place in the District.

Table F-5 Paradise Irrigation District – Regulatory Mitigation Capabilities

Plans	Y/N Year	Does the plan/program address hazards? Does the plan identify projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?
Comprehensive/Master Plan	N/A	
Capital Improvements Plan	Y 2017	
Economic Development Plan	N/A	
Local Emergency Operations Plan	Y 2018	
Continuity of Operations Plan	N/A	
Transportation Plan	N/A	
Stormwater Management Plan/Program	N/A	
Engineering Studies for Streams	N/A	
Community Wildfire Protection Plan	N/A	
Other special plans (e.g., brownfields redevelopment, disaster recovery, coastal zone management, climate change adaptation)	N/A	
Building Code, Permitting, and Inspections	**Y/N**	**Are codes adequately enforced?**
Building Code	N/A	
Building Code Effectiveness Grading Schedule (BCEGS) Score	N/A	
Fire department ISO rating:	N/A	
Site plan review requirements	N/A	

Land Use Planning and Ordinances	
Zoning ordinance	N/A
Subdivision ordinance	N/A
Floodplain ordinance	N/A
Natural hazard specific ordinance (stormwater, steep slope, wildfire)	N/A
Flood insurance rate maps	N/A
Elevation Certificates	N/A
Acquisition of land for open space and public recreation uses	N/A
Erosion or sediment control program	N/A
Other	
How can these capabilities be expanded and improved to reduce risk?	
The District will continue to seek to expand capabilities to mitigate hazards, especially in light of the 2018 Camp Fire.	

Source: PID

Paradise Irrigation District Urban Water Management Plan (2015)

The purpose of the Paradise Irrigation District's (PID) Urban Water Management Plan (UWMP) is to inform the public and state agencies of the PID water supply availability, exposure to droughts, conservation efforts, and plans for future supply. In this plan PID shows the current supply calculations, what impacts a customer can expect during drought periods and the impacts to water supply into the future.

Urban Water Management Plans are prepared by California's urban water suppliers to support their long-term resource planning and ensure adequate water supplies are available to meet existing and future water demands. PID has been completing Urban Water Management Plans since 1986, required every five years.

State law requires water agencies to reduce the amount of water each person uses per day (Per Capita Daily Consumption, which is measured in gallons per capita per day) by 20 percent by the year 2020. PID completed calculations, which are provided in the UWMP establishing our base per capita per day (pcpd) that our 20% will be measured from. PID has made significant reductions in water uses in the last few years through pipeline replacement, leak detection, water conservation measures and public response to the statewide drought. It will be important for PID and its customers to remain diligent in their efforts to conserve and continue to use water wisely.

Water Shortage Contingency Plan (2012)

As the water purveyor, the District must provide the minimum health and safety water needs of the community at all times. The water shortage response is designed to provide a minimum of 50% of normal supply during a severe or extended water shortage. The rationing program triggering levels shown below were established to ensure this goal is met. Although an actual shortage may occur at any time during the year, the District will use the Yield Analysis Model during the critical months of January through March to determine potential restrictions.

In Stage I shortages, customers may adjust either interior or outdoor water use (or both), in order to meet the voluntary water reduction goal.

Under Stage II and Stage III mandatory rationing programs, the District has determined that a reduction of 20% (Stage II) and 30% (Stage III) will be required. That amount of water is sufficient for essential interior water with no habit or plumbing fixture changes.

Under Stage IV mandatory rationing, which is likely to be declared only as the result of a prolonged water shortage or as a result of a disaster, the health and safety allotment is reduced to 50% of average use. This allotment still provides enough water for essential interior water use plus a minimal amount of outside use.

Catastrophic Supply Interruption Plan

Interruptions in the District's water supply could be caused by events such as drought, fire, earthquake, flood, reservoir contamination and major power outages.

Determine What Constitutes a Proclamation of a Water Shortage

Interruptions in the District's water supply could be caused by events such as drought, fire, earthquake, flood, reservoir contamination and major power outages.

A proclamation of water shortage can be declared by following the steps outlined in this Water Shortage Contingency Plan. An immediate proclamation will be made by the District Manager and reviewed by the Board of Directors in an emergency meeting as soon as it can be coordinated. The various stages of this plan are dependent on the severity and nature of the catastrophe and its effect on the total water supply of the District. The following is an example of events and remedies that might likely affect the District's water supply and therefore require implementation of water rationing.

- Fire- In the event of a major fire, the District's water treatment and distribution storage tanks will be operated at maximum capacity.
- Earthquake- In the event of a major earthquake where significant portions of the distribution system or treatment facilities are damaged District crews or contractors will work on isolating and re-routing water supplies. In the event that the District's raw water reservoirs are damaged beyond use, the District would activate the intertie agreement with Del Oro Water Company. An intertie with the DOWC has a maximum capacity of 1,000 gallons per minute (GPM) or 4.4 AF/day.
- Flood- Due to the terrain of the District, the possibility of flooding is quite remote.
- Reservoir Contamination- If contamination of the District's raw water supply occurs, the District would implement rationing, activate the intertie agreement and begin pumping from the "D" Tank well site.
- Major Power Outages- The District is able to operate, at full capacity, the raw water pump station and water treatment plant during power outages using a 500 KVA, diesel generator. External plumbing provisions have also been provided at the District's booster pump station to allow for portable pump hook-up.

F.6.2. Administrative/Technical Mitigation Capabilities

Table F-6 identifies the District staff/roles responsible for activities related to mitigation and loss prevention in the District.

Table F-6 Paradise Irrigation District – Administrative and Technical Mitigation Capabilities

Administration	Y/N	Describe capability Is coordination effective?
Planning Commission	N/A	
Mitigation Planning Committee	N/A	
Maintenance programs to reduce risk (e.g., tree trimming, clearing drainage systems)	N/A	
Mutual aid agreements	N/A	
Other		
Staff	**Y/N FT/PT**	**Is staffing adequate to enforce regulations? Is staff trained on hazards and mitigation? Is coordination between agencies and staff effective?**
Chief Building Official	N/A	
Floodplain Administrator	N/A	
Emergency Manager	N/A	
Community Planner	N/A	
Civil Engineer	N/A	
GIS Coordinator	N/A	
Other		
Technical		
Warning systems/services (Reverse 911, outdoor warning signals)	N/A	
Hazard data and information	N/A	
Grant writing	N/A	
Hazus analysis	N/A	
Other		
How can these capabilities be expanded and improved to reduce risk?		
Many of these areas the District does not have existing capabilities. The District works with the County and the Town of Paradise on mitigation projects, and will continue to seek to expand that activity.		

Source: PID

F.6.3. Fiscal Mitigation Capabilities

Table F-7 identifies financial tools or resources that the District could potentially use to help fund mitigation activities.

Table F-7 Paradise Irrigation District – Fiscal Mitigation Capabilities

Funding Resource	Access/ Eligibility (Y/N)	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?
Capital improvements project funding	N	
Authority to levy taxes for specific purposes	Y	
Fees for water, sewer, gas, or electric services	N	
Impact fees for new development	Y	
Storm water utility fee	N	
Incur debt through general obligation bonds and/or special tax bonds	N	
Incur debt through private activities	Y	
Community Development Block Grant	Y	
Other federal funding programs	N	
State funding programs		
Other		
How can these capabilities be expanded and improved to reduce risk?		
The District will continue to pursue outside funding for mitigation related work, especially in light of the 2018 Camp Fire.		

Source: PID

F.6.4. Mitigation Education, Outreach, and Partnerships

Table F-8 identifies education and outreach programs and methods already in place that could be/or are used to implement mitigation activities and communicate hazard-related information. More information can be found below the table.

Table F-8 Paradise Irrigation District – Mitigation Education, Outreach, and Partnerships

Program/Organization	Yes/No	Describe program/organization and how relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?
Local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.	N	
Ongoing public education or information program (e.g., responsible water use, fire safety, household preparedness, environmental education)	Y	
Natural disaster or safety related school programs	N	
StormReady certification	N	
Firewise Communities certification	N	

Program/Organization	Yes/No	Describe program/organization and how relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?
Public-private partnership initiatives addressing disaster-related issues	N	
Other		
How can these capabilities be expanded and improved to reduce risk?		
The District will continue to pursue for mitigation related outreach and partnerships with the County and Town of Paradise, especially in light of the 2018 Camp Fire.		

Source: PID

Continuous work on fuels reduction in the PID watershed is ongoing with assistance by Butte Fire Safe Council. In 2012, the Butte County Fire Safe Council and Paradise Irrigation District successfully partnered on three grant applications which were awarded to improve watershed and forest health in Magalia on Paradise Irrigation District Lands (PID).

The three grant projects will reduce wildfire threat by thinning small overstocked trees and brush. These projects link to four existing shaded fuel break/forest health projects. Partners have included US Forest Service Plumas National Forest, Bureau of Land Management and Cal-Fire.

The neighboring water provider, Del Oro Water Company has a limited supply of water available and none available at this time for transfer. The District does have an agreement in place with them that would provide a small amount of water available to the District in an emergency from their Paradise Pines District. The Paradise Pines District is solely served by groundwater that is limited.

F.6.5. Other Mitigation Efforts

Water Education is provided for annually to fourth grade students in Paradise. The Creekside 6 Elementary School partners with the District to provide an annual watershed education event at the Paradise Lake.

F.7 Mitigation Strategy

F.7.1. Mitigation Goals and Objectives

PID adopts the hazard mitigation goals and objectives developed by the HMPC and described in Chapter 5 Mitigation Strategy.

F.7.2. Mitigation Actions

The planning team for the District identified and prioritized the following mitigation actions based on the risk assessment. Background information and information on how each action will be implemented and administered, such as ideas for implementation, responsible office, potential funding, estimated cost, and timeline are also included. The following hazards were considered a priority for purposes of mitigation action planning:

- Dam Failure
- Drought and Water Shortage
- Earthquake and Liquefaction
- Floods: Localized Stormwater
- Severe Weather: Freeze and Winter Storm
- Severe Weather: Heavy Rain and Storms (Hail, Lightning, Wind)
- Wildfire

It should be noted that many of the projects submitted by each jurisdiction in Table 5-4 in the Base Plan benefit all jurisdictions whether or not they are the lead agency. Further, many of these mitigation efforts are collaborative efforts among multiple local, state, and federal agencies. In addition, the countywide public outreach action, as well as many of the emergency services actions, apply to all hazards regardless of hazard priority. Collectively, this multi-jurisdictional mitigation strategy includes only those actions and projects which reflect the actual priorities and capacity of each jurisdiction to implement over the next 5-years covered by this plan.

Mitigation Actions

Action 1. Hydraulic Modeling Pipe Replacement Program

Hazards Addressed: Drought & Water Supply; Earthquake; Wildfire

Goals Addressed: 1, 2, 3, 4, 5, 7, 9

Issue/Background: 60 miles of aging steel pipe are leaking water and are vulnerable to earthquake damage due to corrosion issues. The District's primary effort at demand management is pipeline replacement. In 2003 the District began replacing 8.4 miles of pipelines with a grant from the California Department of Water resources, and also 2.3 miles with in-house resources. The District's goal is to replace 2 miles per year with in-house resources; however, this will take 30 years to complete the program. The recent pipe replacement fell short of the District's goal due to a reduction of in-house resources that include the following: 1. freezing three full-time positions, 2. a dispute with the union over temporary worker status, and 3. the workforce has been diverted to remodel the Administration building and construct major portions of the Corporation Yard replacement project.

To optimally plan transmission and distributions system improvements; such as maintaining flows and pressures during disaster events; a hydraulic model of the system is needed. The hydraulic model allows planners and designers to simulate multiple scenarios of water demands and pipeline configurations inexpensively. Additionally; the model can be used to estimate prepare emergency operations plans for use during disasters. The mitigation goal is to provide PID a tool to model the hydraulic performance of their transmission and distribution systems during normal and extreme events (such as a large wildland fire).

Water Treatment Plant upgrade: To effectively fight both structure and wildland fires; the system flows must meet minimum flow; pressure; and duration requirements. During fire flow events; the flow restrictions in portions of the distribution system contribute to low pressures; increasing the likelihood of system contamination. Keeping pressures up throughout the entire system better protects public health.

Water Treatment Plant upgrades in accordance with the hydrology study will mitigate future losses protecting lives, property and public health.

Other Alternatives: None

Existing Planning Mechanism(s) through which Action Will Be Implemented: Public Agency Capital Improvement program long-term planning and annual budgeting.

Responsible Office: Paradise Irrigation District

Priority (H, M, L): High

Cost Estimate: $60,000,000: 60 miles @ $1,000,000 per mile of PVC pipe, with diameter varying from 8-inch to 12-inch (includes engineering).

Benefits (Losses Avoided): Avoidance of unnecessary water losses that deplete water storage supply, increase operations costs and provides additional water to the Bay-Delta. The higher cost for unplanned pipeline repairs that damage public and private property can be avoided by replacing the steel pipes before they become problematic. Avoid loss of revenue due to the loss of unsold treated water.

To optimally plan transmission and distributions system improvements; such as maintaining flows and pressures during disaster events; a hydraulic model of the system is needed. The hydraulic model allows planners and designers to simulate multiple scenarios of water demands and pipeline configurations inexpensively. Additionally; the model can be used to estimate prepare emergency operations plans for use during disasters. The mitigation goal is to provide PID a tool to model the hydraulic performance of their transmission and distribution systems during normal and extreme events (such as a large wildland fire).

Water Treatment Plant upgrade: To effectively fight both structure or wildland fires; the system flows must meet minimum flow; pressure; and duration requirements. During fire flow events; the flow restrictions in portions of the distribution system contribute to low pressures; increasing the likelihood of system contamination. Keeping pressures up throughout the entire system better protects public health. Water Treatment Plant upgrades in accordance with the hydrology study will mitigate future losses protecting lives, property and public health.

Wildfire threat within the Town ranges from moderate to very high. The Paradise Irrigation District lists Wildfires on the LHMP Hazard Identification and Vulnerability Assessment. This project aligns with the Butte County LHMP Goals and Objectives #1 by minimizing the risk and vulnerability of the community to hazards and reduce damages and protect lives, property, and public health. Also Goal 2 to provide protection to critical facilities, infrastructure, and services from hazard impacts.

Potential Funding: Pay-as-you-go utilizing funding from water rates. State Revolving Fund Loans or EPA grants.

Timeline: To be determined based on the availability of outside funding. Currently an initial replacement goal is 2 miles of pipeline per year. An increased replacement rate schedule will be implemented should outside funding sources become available.

Action 2. Drought Water Supply

Hazards Addressed: Drought and Water Supply

Goals Addressed: 1, 2, 3, 4, 5, 7, 9

Issue/Background: The District has experienced periods of drought historically as described in the 2010 Urban Water Management Plan (UWMP). The analysis in the UWMP determined that on average the District can expect ongoing drought conditions to occur and would require cutbacks in one year in ten on average. The District has been in negotiations for many years with PG&E and the Del Oro Water Company for a drought supply project that would mitigate the District's water supply from drought.

Other Alternatives: Implement additional conservation measures not deemed to be cost effective. Adding additional groundwater sources to meet future supply needs is not feasible due to an inadequate supply in the area.

Existing Planning Mechanism(s) through which Action Will Be Implemented: Drought has been addressed in the District's updated Strategic Business Plan, Capital Improvement Plan, Budget, and the Urban Water Management Plan.

Responsible Office: Paradise Irrigation District

Priority (H, M, L): High

Cost Estimate: $5,000,000

Benefits (Losses Avoided): Up to $832,500 annual revenue will be lost in a drought situation due to a reduction in water sales to normally used by the District customers, including their current water conservation efforts. This does not include the long-term impact from the customers demand reduction after loss of outside landscaping.

Potential Funding: Apply for State Revolving Fund Loans; EPA Grants; Water Rates; and borrow funds for the remainder of the appropriations needed.

Timeline: No schedule determined yet, pending completion of negotiations with PG&E and the Del Oro Water District, and the extension of water right permits.

Action 3. Magalia Dam Replacement

Hazards Addressed: Drought & Water Supply; Earthquake; Dam Failure; Flooding, Localized Flooding, Heavy Rain and Storms

Goals Addressed: 1, 2, 3, 4, 7, 9

Issue/Background: Paradise Irrigation District (PID) is responsible for the operation of the Magalia Dam. Geotechnical deficiencies in Magalia Dam are limiting the operational storage volumes within the reservoir. Portions of the dam embankment were constructed hydraulically in 1917 and, due to the dam being over

100 years old (typical dam lifespan is 50 years), do not meet current dam safety standards. Studies performed in 1972, 1992, 1994, and 2002 found that those hydraulic fill materials within the dam embankment could liquefy during a seismic event. To mitigate risk of failure and subsequent flood during an earthquake, the water surface of the reservoir, originally designed to be at elevation 2225.8 starting in 1996, was limited to elevation 2,200 and that elevation was further lowered to 2,199 feet in 2002, which is 26.8 feet below the original design water surface elevation and spillway and 41 feet below the dam crest. This restriction has reduced the maximum storage capacity from 2,800 acre-feet to 796 acre-feet.

It is not unusual to find that foundation and/or embankment soils for dams have susceptibility to liquefaction. Lopez, Anderson, Almaden, Calero and other dams were assessed as having a potential for failure due to liquefaction and improved to reduce those risks. Typically, mitigations for liquefaction of dam embankment soils consist of ground modifications to increase the density (consistency) of embankment soils, reduce the pore water pressures of those soils, and/or decrease deformation that might occur to embankment soils during a seismic event. Those mitigations can include mass grading (retrofit or buttress), compaction grouting, deep soil mixing, driven piles, stone columns, or combinations thereof.

Additionally, the pipe supports for the outlet pipe which connects Magalia Reservoir to the PID WTP through a tunnel in the Magalia Dam have been suspected by DSOD inspectors as being deficient. These supports have to be improved and seismically stable in order to prevent failure in an earthquake, which could cause significant flooding on its own, and also could undermine the dam from within, causing more catastrophic dam failure and significantly more flooding.

Wildfire threat within the Town ranges from moderate to very high. The Paradise Irrigation District lists Wildfires on the LHMP Hazard Identification and Vulnerability Assessment. This project aligns with the Butte County LHMP Goals and Objectives #1 by minimizing the risk and vulnerability of the community to hazards and reduce damages and protect lives, property, and public health. Also Goal 2 to provide protection to critical facilities, infrastructure, and services from hazard impacts.

Other Alternatives: Develop regional intertie alternatives; however, this does not mitigate the extensive damage to public and private property and loss of life that may be realized by a dam failure.

Existing Planning Mechanism(s) through which Action Will Be Implemented: Public Agency Capital Improvement program long-term planning and annual budgeting.

Responsible Office: Paradise Irrigation District;

Priority (H, M, L): High

Cost Estimate: $30,000,000

Benefits (Losses Avoided): Avoid potential loss of life (greater than 1,000 people) within 12 miles of the dam failure. Avoid major damage the District's water treatment plant and 42-inch water transmission pipeline for the Town of Paradise. Avoid loss of the sole access to the Pines community (10,000 people) by widening the existing 2-lane road to 4-lanes to improve emergency access.

Potential Funding: Federal Transportation funding; Apply for State Revolving Fund Loans; EPA Grants; Water Rates; and borrow funds for the remainder of the appropriations needed.

Timeline: To be determined based on the availability of funding.

Action 4. Install Bladder Dam in the Paradise Lake Spillway

Hazards Addressed: Drought and Water Supply

Goals Addressed: 1, 2, 3, 4, 7, 9

Issue/Background: To increase supply to help mitigate drought the District investigated this mitigation action and determined it was feasible to install a 3-foot high bladder dam within the spillway channel at Paradise Lake. The bladder dam would provide approximately 750 acre-feet of additional storage. The feasibility was discussed with the DSD; per the DSD the chimney drain inside the dam would be raised an equivalent amount.

Other Alternatives: Intertie projects with PG&E, and the Del Oro Water District. The cost for an intertie alternative is estimated at 5 times the cost for this mitigation action.

Existing Planning Mechanism(s) through which Action Will Be Implemented: Environmental work necessary for this project would be partially duplicated with the District's efforts to extend the existing water rights permits. The Board of Directors deferred this project pending the completion of the permit extensions.

Responsible Office: Paradise Irrigation District

Priority (H, M, L): High

Cost Estimate: $1,500,000

Benefits (Losses Avoided): Up to $832,500 annual revenue will be lost in a drought situation due to a reduction in water sales normally used by the District customers, including their current water conservation efforts. This does not include the long-term impact from the customer demand reduction after loss of outside landscaping.

Potential Funding: State Revolving Fund Loans; EPA Grants; Water Rates

Timeline: Schedule to be determined pending the completion of the water rights permit extensions.

Action 5. Service Line Replacement

Hazards Addressed: Wildfire; Earthquake, Winter Storm

Goals Addressed: 1, 2, 3, 4, 5, 7,9

Issue/Background: Paradise Irrigation District (PID) is responsible for providing potable and fire service water to their customers. Potable use is a fraction of the water demand compared to fire flows. To effectively fight both structure and wildland fires, the system flows must meet minimum flow, pressure, and duration requirements. Flow and pressure are a function of pipe sizes and connectivity (a looped system typically is more reliable and has less pressure losses). During fire flow events, the flow restrictions in portions of the distribution system contribute to low pressures, increasing the likelihood of system contamination. Keeping pressures up throughout the entire system better protects public health.

The area is highly susceptible to wildland fires (as demonstrated in Camp Fire, November 2018) that can cause substantial loss to life and property. Additionally, the rural nature of the area increases the response time of firefighting equipment, thereby increasing the magnitude of a fire when adequate resources arrive – thereby needing greater quantities of water.

In the aftermath of the Camp Fire; many customers will begin the process of rebuilding and will be installing fire sprinkler systems; now required by the 2016 California Residential Building Code for all construction within the Wildland-Urban Interface. Paradise Irrigation District must be able to provide the appropriate amount of flow and pressure at the service connection to support this change in code allowing residents to rebuild and increasing the tax base.

Adequate water flow and pressure reduces the likelihood of loss of life, minimizes property damage, and protects public health.

Other Alternatives: The alternative would be to add a supplementary second line adjacent to the original line, in order to increase overall flow to the structure. This would result in needing to add an additional service lateral connection to the main, as well as connecting it to the connection at the meter. It would also result in a wider trench and additional displacement of soil. This would be inefficient and unnecessarily complicated.

Existing Planning Mechanism(s) through which Action Will Be Implemented: The Butte County Transportation Division must determine the optimal way to improve the Skyway road crossing the dam before the design of the dam can proceed.

Responsible Office: Paradise Irrigation District; Butte County Transportation Division

Priority (H, M, L): High

Cost Estimate: $65,000,000

Benefits (Losses Avoided): Avoid potential loss of life (greater than 1,000 people) within the town of Paradise. Avoid major damage the District's water distribution system.

Potential Funding: Pay-as-you-go utilizing funding from water rates. State Revolving Fund Loans or EPA grants.

Timeline: To be determined based on the availability of funding.

Action 6. B-Reservoir Replacement

Hazards Addressed: Wildfire; Earthquake

Goals Addressed: 1, 2, 3, 4, 5, 7, 9

Issue/Background: The Paradise Irrigation District provides potable water to the Town of Paradise with 10,507 connections, serving a population of 26,800. The distribution system includes 7 distribution zones (Zones A through G), one water treatment plant, and five storage reservoirs ranging in size from just under 1 million gallons to 2 million gallons capacity. All of the reservoirs are steel tank reservoirs, with the exception of Reservoir B, which is an earth embankment lined reservoir with a flexible membrane cover. Reservoir B was designed to store 3 million gallons (MG) of potable water, however, storage capacity is limited to 2 MG due to hydraulic considerations. Treated, potable water is transferred from the PID water treatment plant (WTP) via a 12,500 42-inch gravity water transmission main to Zone B and Reservoir B.

Reservoir A is supplied potable water from Zone B via pump stations.

Reservoir B is a 3 MG earth embankment reservoir lined with reinforced polypropylene and with a floating high-density polyethylene (HDPE) cover. The reservoir was constructed in 1984 and the cover and line were replaced in 2005. Floating cover reservoirs are subject to many issues related to the integrity of the cover---tears, contamination, and failures of other systems that all pose a threat of drinking water contamination. The cover is also subject to vandalism by trespassers and wildlife; it gathers rainwater, and the sump pump installed to drain the rainwater constantly requires maintenance. Maintenance must also be scheduled regularly to remove debris; as debris accumulates, it attracts vectors (e.g. mosquitos) and leads to decay and detritus sitting on the cover of the drinking water reservoir. As the only reservoir that directly feeds Zone B (21% of customers) and Zone A (12% of customers), it is a critical point in the distribution system that does not have any redundancy, and the WTP pumping conditions make it reliant on Reservoir B to deliver water through the transmission main, impacting other zones and residents in the event of Reservoir B failing. See Reservoirs' Schematic under Tab 15, which shows Reservoir B feeds the entire District distribution system by gravity and Zone A through Pump Station A.

Total storage capacity for each zone must include sufficient fire storage. Paradise is in a wildland interface area and, in support of wildland firefighting, PID provides water storage for use in fighting wildfires should they enter the service area. fire storage volume is intended to be available in all zones, at all times (including during peak demand). Prior to the Camp Fire of 2018, the largest fire in recent history in Paradise was the Camp Fire of 2008. On July 8, 2008 the fire increased in sized by 17,000 acres in one day (source: CalFire, "2008 June Fire Siege," pg. 61 and noted on page 18 in the PID Reservoir B Replacement Conceptual Design Report, August 2017), destroying 50 homes only one month after the Humboldt Fire had destroyed 20 homes in Paradise and approximately 75 homes in the Chico area. Reservoir storage levels for reservoirs A, B, C, and D and plant flow data were analyzed for the week of the 2008 Camp Fire to determine system demand during the fire. The calculated hourly system demand and the resulting daily system demand during the week of the 2008 Camp Fire show the 24-hour firefighting period of July 8, 2008 at noon to July 9, 2008 showed a 4 MG increase in system demand.

This 4.0 MG increase is attributed to firefighting efforts within Paradise using fire hydrant flow data. In order to determine needed fire storage requirements, the following firefighting conditions and associated storage requirements were considered:

1. Actual Usage during the 2008 Camp Fire.

2. A "Model" wildfire which requires two hydrants be run at 1,000 gallons per minute (gpm) for 24 hours.

3. A single commercial structure fire which requires 3,000 gpm for 3 hours.

4. A single residential fire which requires 1,500 gpm of firefighting flow for 2 hours.

Based on the regulatory minimum water storage requirements and the fire storage calculation using the above parameters, the total current available storage and minimum water storage requirements by zone was tabulated. According to the Conceptual Design Report prepared by Water Works Engineering in 2017, there is a total storage deficiency in Zone B and a usable storage deficiency in both Zone A and Zone B. Further analysis using operating data and reservoir levels for the peak week of June 30 - July 2013 were examined. This data shows similar deficiencies during peak periods during a drought year, with only 0.66 MG of usable water in Reservoir B, falling 2.2 MG short of the target amount of 2.88 MG.

According to a news article published by Bay Area News Group December 2, 2018 (See Tab 15), since 1999 13 large wildfires have burned in the 153,000 acre footprint of the recent 2018 Camp Fire, including the Bloomer (1999), Bucks (1999), Doe Mill (1999), Concow (2000), Highway 70 (2001), Poe (2001), Skyway (2002 & 2006), Honey (2007), BTU Lightning Complex (2008), Camp Fire (2008), Humboldt (2008), Ninety Nine (2016), and Saddle (2016). Not all of these were declared national disasters, but they all exceeded 300 acres.

The proposed project is to construct an additional 2.5 MG above ground, steel tank reservoir to support fire flow storage requirements and storage needs during drought years. This project also supports water quality protection by eliminating the risks associated with the flexible membrane cover.

Other Alternatives: The construction of new water reservoir tanks is commonly constructed of either prestressed concrete or welded steel. This alternative would be to use prestressed concrete tank. Advantages include:

1. Prestressed concrete tanks do not require coatings, and therefore do not require the maintenance of re-coating.

2. Concrete tanks can be created to be narrower and taller than steel tanks, if needed, however, this site does not require narrower tanks and the tank height is limited by the WTP hydraulics.

3. The tank can be partially buried.

Negatives for this alternative include:

1. Prestressed concrete tanks take longer to construct than steel tanks.

2. Prestressed concrete tanks must be NSF-61 compliant concrete, since the concrete is in contact with drinking water. NSF-61 compliant concrete is not commonly available and the rural location would likely demand a premium price.

3. Prestressed concrete tanks require more significant subgrade earthwork preparation than steel tanks, and are more sensitive to differential settlement conditions. This adds time and expense to construction.

Existing Planning Mechanism(s) through which Action Will Be Implemented: The District has plans to implement this project.

Responsible Office: Paradise Irrigation District;

Priority (H, M, L): High

Cost Estimate: $15,000,000

Benefits (Losses Avoided): Avoid potential loss of life (greater than 1,000 people) within the town of Paradise. Avoid major damage the District's water distribution system.

Potential Funding: Pay-as-you-go utilizing funding from water rates. State Revolving Fund Loans or EPA grants.

Timeline: To be determined based on the availability of funding.

Action 7. A-Zone Pipeline and Generator

Hazards Addressed: Drought and Water Supply

Goals Addressed: 1, 2, 3, 4, 5 7, 9

Issue/Background: The Paradise Irrigation District (PID) provides drinking water to the community of Paradise located in Butte County, California. The PID has multiple potential risks from flooding, earthquakes, severe weather, fire, and power outages. As a result, the PID has evaluated its infrastructure for potential hazards and identified priority capital improvements necessary to mitigate such risks to the community's water supply. The priority infrastructure identified for this project are: 1) Re-align the 42" Raw Water Supply Pipeline, 2) Alternate, emergency treated water transmission pipeline and A Zone Pump Station, and 3) the Water Treatment Plant Back-up Power Supply.

The Raw Water Supply Pipeline currently crosses the Little Butte Creek supported by three (3) concrete pillars. These concrete pillars are at least as old as the pipeline, which was put into service in 1955. Prior to the pipeline, a wooden flume was in its place and it is possible that these concrete supports were used to support this flume prior to 1955. This critical facility is at risk of damage by either earthquake or flood due to the condition of the un-reinforced concrete support piers, the age and the condition of the raw water pipe, and the fact it crosses a creek that is subject to rapid increases in water volumes makes this facility highly vulnerable to seismic and or flooding events. Furthermore, this pipeline crosses the creek downstream from the Magalia Dam, which has been evaluated and characterized by the California Division of Safety of Dams

(DSOD) as the "worst dam" in the state of California. The concern is damage may occur to either the unreinforced concrete supports and/or to the pipeline should another flood event and/or earthquake occur in the future. The current configuration and condition of the pipe and the concrete supports puts the raw water pipeline at risk for a total loss. If this pipeline were to be damaged, the entire Town of Paradise population would be without water until the pipeline could be repaired or an alternate temporary line be installed. Depending on the circumstances of the disaster, this effort may be hindered due to rushing water through the creek and the overtopping of the Magalia Dam as was experienced in 1997, further increasing the likelihood and duration of a water outage to the entire population. Had this pipeline failed in 1997, it is unclear what recourse the District would have had given the flood conditions.

A 16" transmission pipeline from the water treatment plant to the "A" zone section of the District's service area is needed to provide an alternative supply of water to the District's service area. Currently, only one transmission 42" pipeline from the water treatment plant provides all of the Town's treated water via Zone "B". In the event that this pipeline fails, there is no alternative pipeline to deliver the water resulting in a District-wide outage. Furthermore, water service to the District's "A" pressure zone is currently pumped from "B" zone by Pump Station Number 2. If this pump station, or its ancillary facilities, fail all customers will experience a water outage. This pipeline will also allow the District to distribute water more efficiently to the "A" zone portion of the District and improve fire flow to this area of the District. Located in the foothills, the Town of Paradise has a high fire risk (see CalFire map of the Town of Paradise). Additionally, the District's only transmission line is predominantly located along a steep embankment and would be difficult to access in the event of a landslide. Damage to the pipeline itself from fire is not likely, but to the pumping facility, storage tank, or landslide following a fire are potential risks (see 42-inch Transmission Pipeline Location Map).

The Town of Paradise experiences frequent power outages resulting from storms, high winds, and forest trees, without outages averaging six per year and durations of up to 4 – 6 hours. The Water Treatment Plant is also at risk for flooding, due to its location near the Little Butte Creek and Magalia Reservoir. During periods of power outages, the District issues a community order to reduce water use and if the outage persists, a boil water notice would be required, and the District could run out of water if the plant were without power for 24 hours during the warmer months.

Other Alternatives: Construct a water treatment plant and pumping station from Oroville Lake to serve water to the entire Paradise Irrigation Customer base.

Existing Planning Mechanism(s) through which Action Will Be Implemented: Pay-as-you-go utilizing funding from water rates. State Revolving Fund Loans or EPA grants.

Responsible Office: Paradise Irrigation District

Priority (H, M, L): High

Cost Estimate: $11,500,000

Benefits (Losses Avoided): In order to reduce and potentially eliminate the risk to the raw water line, the District will abandon the current pipeline crossing and install a new, 36" raw water pipe aligned along the roadway so it does not cross the creek, which will alleviate any potential damage to the pipeline itself and/or

from the concrete supports being damaged by a future flood or seismic activity. By eliminating the creek crossing at this lower point downstream of the Magalia Dam, the threat of damage due to flooding will be greatly reduced if not eliminated. See the attached photos of the existing and new alignments, and the site plan.

The installation of the alternate 16" transmission pipeline and pump station will allow the District to continue to distribute water throughout this District in the event that the transmission main pipeline or the pumping and/or tank suffers a failure. This is an essential activity, because if only the pump station fails, at a minimum 10% of the District (Zone A) will not receive water; and if the main pipeline is damaged, all of the District will suffer a water outage once the storage tanks drain. This pipeline is also important for fire flow, because if the is power outage that affects pumping capabilities while there is a fire, pressure for fire flow will diminish.

The new, emergency generator will be at least a 1600 kW, diesel generator with an enclosure. This generator will provide 100% of the power needed to operate the water treatment plant and also be of sufficient capacity to provide emergency power into the future to allow for future expansion for the useful life of the generator (19 years). Given the age and the strain on the existing generator, there is potential for it to fail when needed most. Power outages occur, on average, six times per year; and often for extended periods of time (e.g. more than 4 hours). The current generator has also been "grandfathered" for use and only for emergency and maintenance purposes due to its inability to meet current air quality standards---use is limited to 90 hours/year. The new generator will meet current environmental standards.

Potential Funding: State Revolving Fund Loans; EPA Grants; Water Rates

Timeline: To be determined based on the availability of funding.

Action 8. Water Shed Fuel Reduction

Hazards Addressed: Wildfire, Drought, Severe Weather, Extreme Heat, Severe Weather: Wind

Goals Addressed: 1, 2, 3, 4, 5, 7, 9

Issue/Background: Paradise Irrigation District has 389 acres within the project area, located around the Magalia Reservoir and Little Butte Creek. The property has multiple vegetation types including: Mixed Conifer, Fir/Cedar/Oak, Grey Pine/Live Oak, and Serpentine. The current stocking level for the property is approx. 385 trees per acre, with about 270 (~70%) being 10" DBH or less. About 108 trees per acre are

10" DBH or larger. There are approx. 8 snags per acre under 10" DBH and 5 snags per acre 10" DBH and larger, which is a slightly less average than the rest of the Magalia plan area. Therefore, throughout PIDs land it is estimated that there are currently 1,945 10" DBH and larger standing dead trees. There are also less diseased trees per acre on PIDs land than the project areas average, with close to 80 trees being diseased. The expected conifer mortality is about 1 tree 10" DBH or larger per two acres. This means that about 195 conifers 10" DBH and larger may die in per year. Paradise Irrigation District has 59 acres of Hazard Zone in the project, where vulnerable trees are within 150 feet of houses and infrastructure, posing a health and safety risk. This means roughly 295 10" DBH and larger dead trees are located in the hazard areas of their property. There are also approx. 12 diseased trees in the PID Hazard Zone. Expected conifer mortality of

trees 10” DBH and larger in this zone is about 31 trees per year. There is an average of 6.4 tons per acre of dead, downed woody debris located throughout PIDs land holdings.

Project Description: Fuel reduction treatments should remove trees and snags below 10" DBH until the canopy cover reaches 70%. Smaller diameter trees that are in a suppressed or intermediate crown position (the tree is being overtopped by taller, more mature trees and doesn’t receive direct sunlight throughout the majority of its crown) should be targeted first. Leave trees should be pruned up to 12-16 feet or until 1/3 the live crown has been removed for smaller trees. With the stand aging it is vital to make sure there are trees available to regenerate the overstory once mature trees start dying.

Other Alternatives: Prescribed burns were also considered as an additional treatment method, particularly for Starthistle.

Existing Planning Mechanism(s) through which Action Will Be Implemented: Magalia Forest Management Plan and CEQA.

Responsible Office/Partners: Paradise Irrigation District and Butte County Fire Safe Council

Cost Estimate: $5,000,000

Benefits (Losses Avoided): Over $50 million estimated valuation of structures within a 2-mile radius of the project area and water quality issues for the customers of Paradise Irrigation District.

Potential Funding: Paradise Irrigation District in-kind labor, volunteer labor, and the use of CA Conservation Corps and/or Alliance for Work Force Development crews as local match.

Timeline: 36 months implementation period

Project Priority: High

Action 9. Backup Portable Generators

Hazards Addressed: Flooding and Localized Flooding, Earthquake, Wildfire, Dam Failure, Severe Weather, Power Outages

Goals Addressed: 1, 2, 3, 4, 5, 7, 9

Issue/Background: Backup generation is the main way in which the District maintains continued function of its critical facilities. Currently the District has only one portable generator that can be used in case of power outage. It is housed at the District office. In the instance of a widespread and prolonged power outage there is a risk that additional power generation would be needed at facilities that do not have backup generation or current backup generation fails. Additional generators would mitigate some of the risk of a prolonged outage.

Project Description: Purchase additional portable backup generators.

Other Alternatives: Install permanent backup generation at the District main office and other critical facilities without permanent backup power generation.

Existing Planning Mechanism(s) through which Action Will Be Implemented: Unknown

Responsible Office/Partners: Paradise Irrigation District

Cost Estimate: $500,000

Benefits (Losses Avoided): The District would not experience a depressurization of distribution system, lose the ability to treat water for the Town of Paradise, and the loss of communication between the treatment plant and distribution system tanks

Potential Funding: General funds

Timeline: When funding is available.

Project Priority: High

Action 10. Earthquake Vulnerability Assessment on Water Distribution Infrastructure

Hazards Addressed: Earthquake and Liquefaction

Goals Addressed: 1, 2, 3, 4, 5, 7, 9

Issue/Background: California has high susceptibility to earthquake events. Evaluate Agency infrastructure located in fault line and seismically active areas

Project Description: Overlay fault line and seismic activity maps with our infrastructure maps to evaluate a predictability curve. Potentially a project that could be completed by a U.C. or Cal State Engineering program.

Other Alternatives: N/A

Existing Planning Mechanisms through which Action will be implemented:

Responsible Office: Paradise Irrigation District

Priority (H, M, L): Low

Cost Estimate: Approximately $500,000 Potential Funding: Split between the agency and a FEMA Hazard Mitigation Grant

Benefits (avoided Losses): Understand vulnerable areas and ensure our system is capable of withstanding significant seismic/earthquake events

Schedule: When funding is available.