Local Wastewater Treatment and Disposal Alternatives

Technical Memorandum #4

Paradise Sewer Project

November 11, 2020

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1. Introduction

The Town of Paradise (Town) is implementing the Paradise Sewer Project (Project), which involves identifying and implementing a long-term solution for collection, treatment, and reuse/disposal of its wastewater. HDR is under contract to assist the Town with the first two phases of the Project—final selection of a wastewater alternative (Phase 1), and preparation of an Environmental Impact Report (EIR) covering the selected alternative (Phase 2). This technical memorandum (TM) is part of the Phase 1 effort.

The purpose of this TM #4 is to develop and evaluate local wastewater treatment and disposal alternatives for the Town. These alternatives were developed based on design criteria established in TM #2 – Design Criteria for Local Wastewater Treatment Plant. The feasible local wastewater treatment and disposal alternatives were evaluated and compared based on economic and non-economic factors. Local alternative(s) recommended in this TM #4 will be compared to the regional alternative, which involves conveying raw sewage to the City of Chico for treatment and disposal.

This TM is organized as follows:

- Section 1: Introduction
- Section 2: Background
- Section 3: Development of Local Alternatives
- Section 4: Evaluation of Local Alternatives
- Section 5: Recommendation

Supporting information for this TM is provided in the following appendices:

- Appendix A: Environmental Constraints Analysis
- Appendix B: Process Equipment Information
- Appendix C: Recycled Water Criteria
- Appendix D: OMB Circular
- Appendix E: Cost Estimates

2. Background

Prior to the Camp Fire, Paradise was the largest unsewered community in California. A new wastewater management solution is needed to improve the local economy (e.g., encourage opening of new businesses) and to stop degradation of groundwater quality caused by failed or failing septic systems.

The need for a centralized wastewater treatment solution for the Town has been studied in seven prior reports. The most recent study was prepared by Bennett Engineering in June 2017, *Town of Paradise Sewer Project, Alternative Analysis and Feasibility Report: Determining a Preferred Option for Implementation* (2017 Report). Figure 1 presents the proposed sewer service area (SSA) identified in the 2017 Report; the Town has directed that this be the proposed SSA for this effort. A new collection system will be constructed in the proposed SSA to convey wastewater collected in the area to a new local wastewater treatment plant (WWTP) or to the City of Chico Water Pollution Control Plant (WPCP). Based on the 2017 Report, the proposed SSA was defined to represent the area that had the most septic systems that had failed or were projected to fail within the next 5 years. The proposed SSA will serve 1,469 parcels through the Skyway, Clark Road, and Pearson Road corridors. (There are 11,000 total parcels in Paradise.) The 2017 Report analyzed the following five WWTP options:

- Option A: Localized WWTP with Effluent Land Application
- Option B: Localized WWTP with Surface Water Discharge Location
- Option C: Regional Connection to the City of Chico Water Pollution Control Plant
- Option D: Wastewater Treatment with Beneficial Reuse
- Option E: No Project

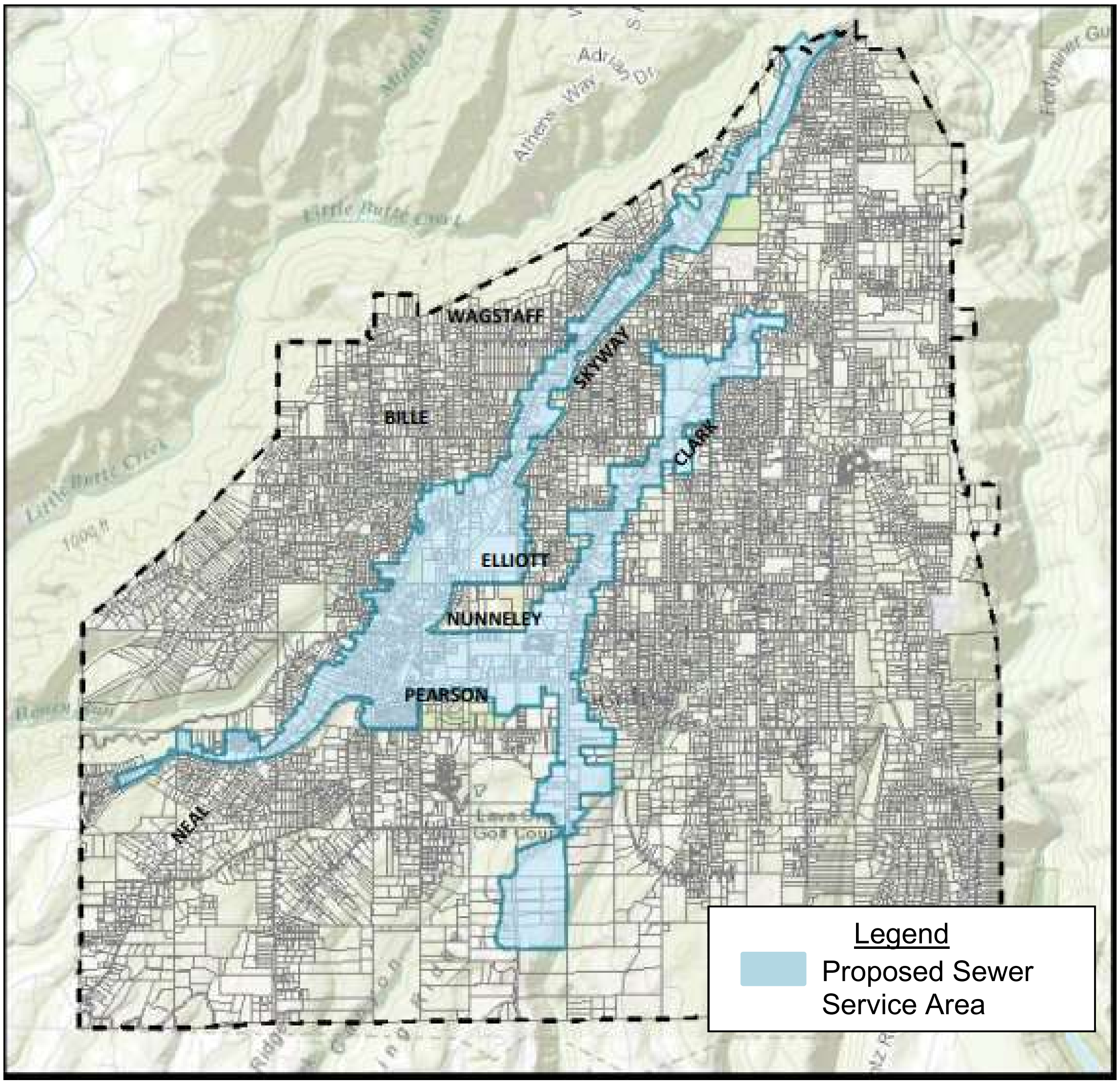

Figure 1. Proposed Town of Paradise Sewer Service Area

The 2017 Report also analyzed two sewer collection system options: a gravity sewer and a septic tank effluent pumping (STEP) system.

For the WWTP, the 2017 Report recommended Option C: Regional Connection to the City of Chico Water Pollution Control Plant. For the collection system, the 2017 Report recommended the STEP system.

Following the devastation caused by the November 2018 Camp Fire, the Town reconsidered the recommendations from the 2017 Report. In May 2019, the Town Council voted to pursue a localized wastewater treatment alternative for the following reasons:

- More funding opportunities became available since the 2017 Report was issued.
- More land became available to locate a local WWTP due to the devastation caused by the Camp Fire.
- The Town would have more control over future decisions related to wastewater management.

The type of collection system was also reconsidered. The 2017 Report recommended a STEP system, but the Town recently determined that a conventional gravity sewer system is the preferred collection system alternative. A gravity sewer was preferred because it eliminated continued use of the septic tanks and installation of new individual pumps that each parcel owner would need to maintain. The collection system was analyzed for this current effort in TM #3 – Evaluation of collection System.

3. Development of Alternatives

The local wastewater effluent disposal alternatives identified in TM #2 and an additional alternative involving discharge to the Miocene Canal are being further developed in this TM. These alternatives are as follows:

- Alternative 1: Local WWTP with Effluent Storage and Land Application
- Alternative 2: Local WWTP with a Surface Water Discharge
- Alternative 3: Local WWTP with Water Recycling within the Town
- Alternative 4: Local WWTP with Discharge to the Miocene Canal

TM #2 provided an overview of regulatory requirements and established design criteria and the basis of design for a new WWTP that will be owned and operated by the Town. The anticipated WWTP discharge requirements are provided in Table 1.

Table 1. Anticipated Discharge Requirements for Local WWTP Alternatives

Disposal Method	Basic Discharge Requirements (monthly average)			Level of Treatment
	BOD, mg/L	TSS, mg/L	Total N, mg/L	
1. Local WWTP with Effluent Storage and Land Application	30	30	10	Disinfected (23 MPN) secondary treatment meeting Total N of 10 mg/L.

Disposal Method	Basic Discharge Requirements (monthly average)			Level of Treatment
	BOD, mg/L	TSS, mg/L	Total N, mg/L	
2. Local WWTP with a Surface Water Discharge	10	10	10	Disinfected (2.2 MPN) tertiary treatment meeting Total N of 10 mg/L. Additional stringent discharge requirements are likely, such as meeting priority pollutant (chemical pollutants the US Environmental Protection Agency regulates) criteria as well as the California Thermal Plan (limits wastewater increasing receiving water temperature).
3. Local WWTP with Water Recycling within the Town	10	10	10	Disinfected (2.2 MPN) tertiary treatment meeting Total N of 10 mg/L.
4. Local WWTP with Discharge to the Miocene Canal	10	10	10	Disinfected (2.2 MPN) tertiary treatment meeting Total N of 10 mg/L. Additional advanced treatment requirements must be met, including, as a minimum, processes to meet indirect potable reuse requirements such as ultrafiltration along with reverse osmosis.

BOD = biochemical oxygen demand; MPN = most probable number; N = nitrogen; TSS = total suspended solids

The recommended influent flows and loads for a proposed new local WWTP and separate septage treatment facility are presented in Table 2.

Table 2. Recommended Design Criteria for Local WWTP and Septage Facilities

Flow Type	Flow to WWTP, mgd		Flow to Septage Treatment, mgd	
Average Dry Weather Flow	0.448		0.026	
Peak Diurnal Flow	0.672		--	
Peak Wet Weather Flow	0.896		--	
Constituent	Annual Average Constituent Load, lbs/day	Maximum Month Constituent Load, lbs/day (1)	Concentration, mg/L	Annual Average Constituent Load, lbs/day (2)
Biochemical Oxygen Demand (BOD)	1,310	1,700	10,000	2,170
Total Suspended Solids (TSS)	1,500	1,950	40,000	8,675
Ammonia as Nitrogen	170	220	NA	NA
Total Kjeldahl Nitrogen (TKN)	NA	NA	700	152

(1) Based on flow of 0.448 mgd and peaking factor of 1.3
(2) Based on flow of 0.026 mgd
NA = not applicable

3.1 Alternative 1: Local WWTP with Effluent Storage and Land Application

Alternative 1 includes a local WWTP with effluent storage and land application. For land application, effluent from the WWTP must meet secondary treatment requirements and a total nitrogen concentration of 10 mg/L to ensure that no degradation of groundwater occurs. A conceptual schematic for secondary treatment is shown in Figure 2. For Alternative 1, treatment by means of a package treatment plant manufactured by Aero-Mod was used. Information on the package secondary treatment process by Aero-Mod is provided in Appendix B, Attachment 1.

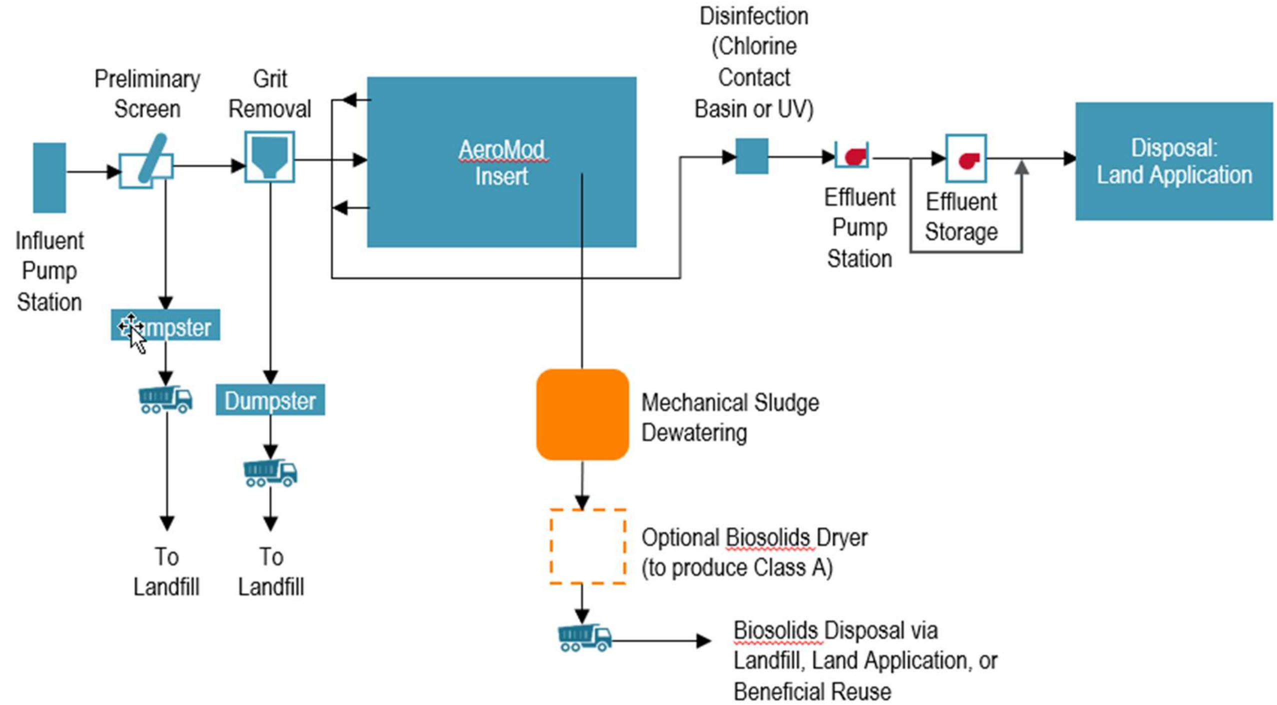

Figure 2. Conceptual Schematic for Secondary Treatment for Alternative 1

To determine the land requirements for effluent storage and disposal, a water balance was prepared. The following assumptions were used to develop the water balance:

- Storage of treated effluent would be required for 151 days per year when application of the effluent is not feasible because of rain or saturated soils. This is based on no irrigation for the months of December through March and for 15 days in April and November.
- The annual average rainfall is 55 inches.
- The 100-year return interval seasonal rainfall is 100 inches as reported by the Western Regional Climate Center for Paradise (046685) for 1957 through 2006.
- Pan evaporation is 67.63 inches annually as reported monthly by the Western Regional Climate Center for Chico Experiment Station for 1906 through 2005.
- Evapotranspiration is 49.9 inches annually as reported monthly in “Butte County Water Inventory and Analysis,” June 2016, Climate and Hydrology Document, Chapter 4, Figure 4.7, Durhan CIMIS (Station 12).

The water balance for the 100-year seasonal rainfall is presented in Table 3.

Table 3. Hydrologic Water Balance at 0.448 mgd Wastewater Flow and Estimated 100-year Precipitation

Parameter	Units	October	November	December	January	February	March	April	May	June	July	August	September
Days/Month		31	30	31	31	28	31	30	31	30	31	31	30
Pond Storage	days	151	151	151	151	151	151	151	151	151	151	151	151
Pond Volume	acre-ft	208	208	208	208	208	208	208	208	208	208	208	208
Pond Volume	MG	68	68	68	68	68	68	68	68	68	68	68	68
Pond Depth	feet	4	4	4	4	4	4	4	4	4	4	4	4
Pond Surface Area	acres	52	52	52	52	52	52	52	52	52	52	52	52
Land Disposal Area	acres	260	260	260	260	260	260	260	260	260	260	260	260
Precipitation	in	5.56	13.11	17.46	19.45	16.03	14.59	7.15	3.31	1.24	0.14	0.47	1.53
Pan Evaporation	in	4.46	2.09	1.3	1.26	2.13	3.82	5.63	8.28	10.11	11.48	9.71	7.36
Pond Evaporation	in	3.57	1.67	1.04	1.01	1.70	3.06	4.50	6.62	8.09	9.18	7.77	5.89
Evapo/Trans.	in	3.50	1.80	1.20	1.20	2.00	3.20	4.80	6.40	7.20	7.30	6.30	5.00
Net Evapotranspiration	in	-2.06	-11.31	-16.26	-18.25	-14.03	-11.39	-2.35	3.09	5.96	7.16	5.83	3.47
Net Evaporation	in	-1.99	-11.44	-16.42	-18.44	-14.33	-11.53	-2.65	3.31	6.85	9.04	7.30	4.36
Average Daily Flow	mgd	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Total Monthly Flow	MG	13.89	13.44	13.888	13.888	12.544	13.89	13.44	13.89	13.44	13.89	13.89	13.44
Monthly Flow	acre-feet	42.62	41.25	42.62	42.62	38.50	42.62	41.25	42.62	41.25	42.62	42.62	41.25
Net Evapotranspiration (land only)	acre-feet	0.00	0.00	0.00	0.00	0.00	0.00	0.00	66.95	129.13	155.13	126.32	75.18
Net Evaporation (ponds only)	acre-feet	-8.62	-49.47	-71.02	-79.77	-61.97	-49.89	-11.44	14.33	29.62	39.12	31.57	18.85
Allowable Crop Irrigation Rate	ac-ft/ac/yr	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
% of Days Land Application Occurs	%	100.00	50.00	0.00	0.00	0.00	0.00	50.00	100.00	100.00	100.00	100.00	100.00
Percolation Volume (land only)	acre-feet	88.33	42.74	0.00	0.00	0.00	0.00	42.74	88.33	85.48	88.33	88.33	85.48
Flow to Storage	acre-feet	-37.09	47.98	113.65	122.39	100.46	92.51	9.95	-126.99	-202.98	-239.96	-203.59	-138.26
Accumulative Flow to Storage [a]	acre-feet	0.00	47.98	161.63	284.02	384.49	477.00	486.95	359.96	156.98	-82.98	-286.57	-424.83

[a] Assumes start of October ponds are empty.

Land requirements for storage and disposal generated from the water balance, and land needed for the WWTP, are noted in Table 4. The areas include the "active" area occupied by operating facilities and additional acreage around the operating facilities to help isolate them from adjacent neighbors (buffer).

Table 4. Land Requirements for Local Alternatives

Description	Active Acres	Total Acres with Buffer
Treatment Plant		
Secondary or Tertiary Treatment	4	5
Tertiary with Advanced Treatment	6	7
Effluent Storage	122	150
Land Application	260	310

Potential locations for the WWTP and land for effluent storage and land application are shown in Figure 3. The WWTP locations were chosen based on the following criteria:

- Relatively close to the Town limits, to minimize conveyance distance.
- Near a facility that is less desirable for development and more suitable for locating a WWTP (e.g., the Neal Road Recycling and Waste Facility).
- Currently available vacant parcels of the size needed for the WWTP and adjacent to Neal Road or Clark Road. Skyway was not included, as an industrial facility such as a WWTP was not considered compatible with the current and future uses of Skyway.

On Figure 3, the potential WWTP locations shown indicate general locations, not specific parcels or land requirements. The potential WWTP locations are generally as follows:

- Neal Road just south of the Town limits
- Neal Road near the Neal Road Recycling and Waste Facility
- Clark Road just south of the Town limits
- Clark Road near the Paradise Airport

The area within which effluent storage and land application could occur is shown in Figure 3. This blue-hatched area was defined based on the following criteria:

- The land topography must be flat enough to allow for piped spray irrigation. As you move south off of the ridge from Paradise, you encounter marginal grazing land that is hilly but could be irrigated (although almost none of it is at this time). This defines the undulating northern boundary of the area shown.

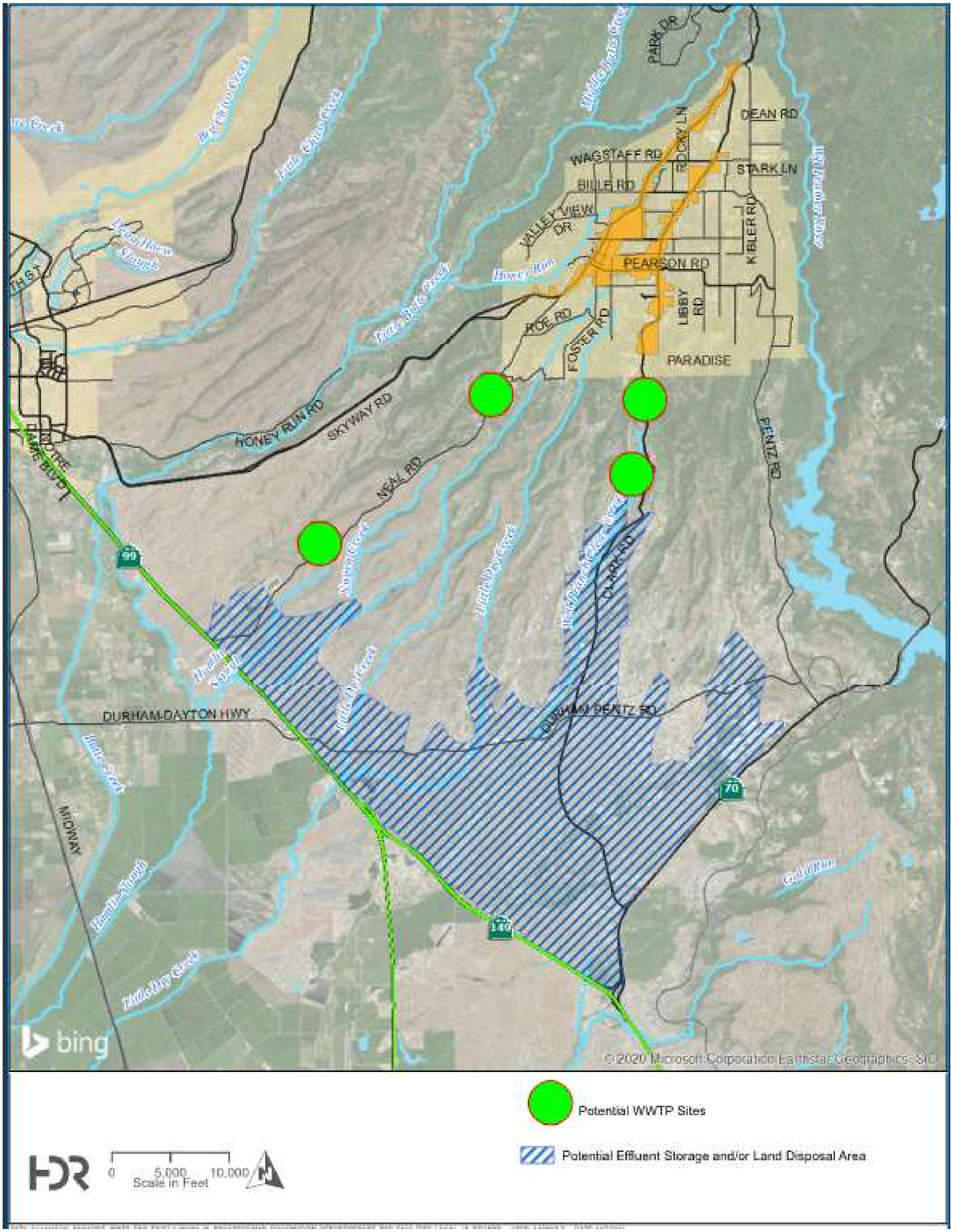

Figure 3. WWTP Sites and Land for Effluent Storage and Land Application for Alternative 1

- As you continue to move south and west, the topography becomes flatter, until land use changes from marginal grazing land to high end agriculture (e.g., rice farming) at roughly Highway 99/149). Based on discussions with the Butte County Farm Bureau, it was determined that this high-end farming area has sufficient low-cost water available. It was also felt that farmers here might have concerns with using recycled water on their higher-end crops. Therefore, these high-end ag areas were not considered good candidates for land application, and Highway 99/149 was considered the western border of the potential land application area.
- Highway 70 was used as the southeast boundary, as topography east of there becomes quite steep again.

The blue-hatched area shown as potential storage and land application area in Figure 3 covers 16,020 acres. The total area needed for a Paradise land application system is 460 acres (150 acres for effluent storage and 310 acres for land application), or 2.9 percent of the 16,020 acres. A significant portion of the 16,020 acres may not be useable, due to environmental habitat restrictions (e.g., vernal pools), landowners unwilling to participate, or other reasons. However, it is felt that it would ultimately be feasible to obtain 460 usable acres within this 16,020-acre area.

Components needed to implement Alternative 1 are as follows:

- Pump station and pipeline from end of collection system to WWTP location
- Land, purchased by the Town, for construction of the WWTP
- Pipeline from WWTP to effluent storage facility
- Land, purchased by the Town, for construction of effluent storage facility
- Pipeline from effluent storage facility to land application area
- Land, either purchased by the Town or used through written agreements developed between the Town and landowners, for land application of treated effluent as irrigation

3.2 Alternative 2: Local WWTP with Surface Water Discharge

Alternative 2 includes a local WWTP, located on Neal Road, with discharge of treated effluent to a local surface water. Surface water discharge to Nugen Creek or Hamlin Slough, both ephemeral streams, was used for this alternative. (An ephemeral stream is a stream that flows only briefly during and following a period of rainfall in the immediate locality.) Figure 4 shows the location of Nugen Creek and Hamlin Slough; an exact location for the discharge into the creek or slough has not been identified at this time.

A surface water discharge would require the WWTP to produce disinfected (most probable number of coliform bacteria of 2.2) tertiary treated effluent meeting a total nitrogen concentration of 10 mg/L. Additional stringent discharge requirements are likely, such as meeting priority pollutant criteria (chemical pollutants the US Environmental Protection Agency regulates) as well as the California Thermal Plan (limits wastewater from increasing receiving water temperature).

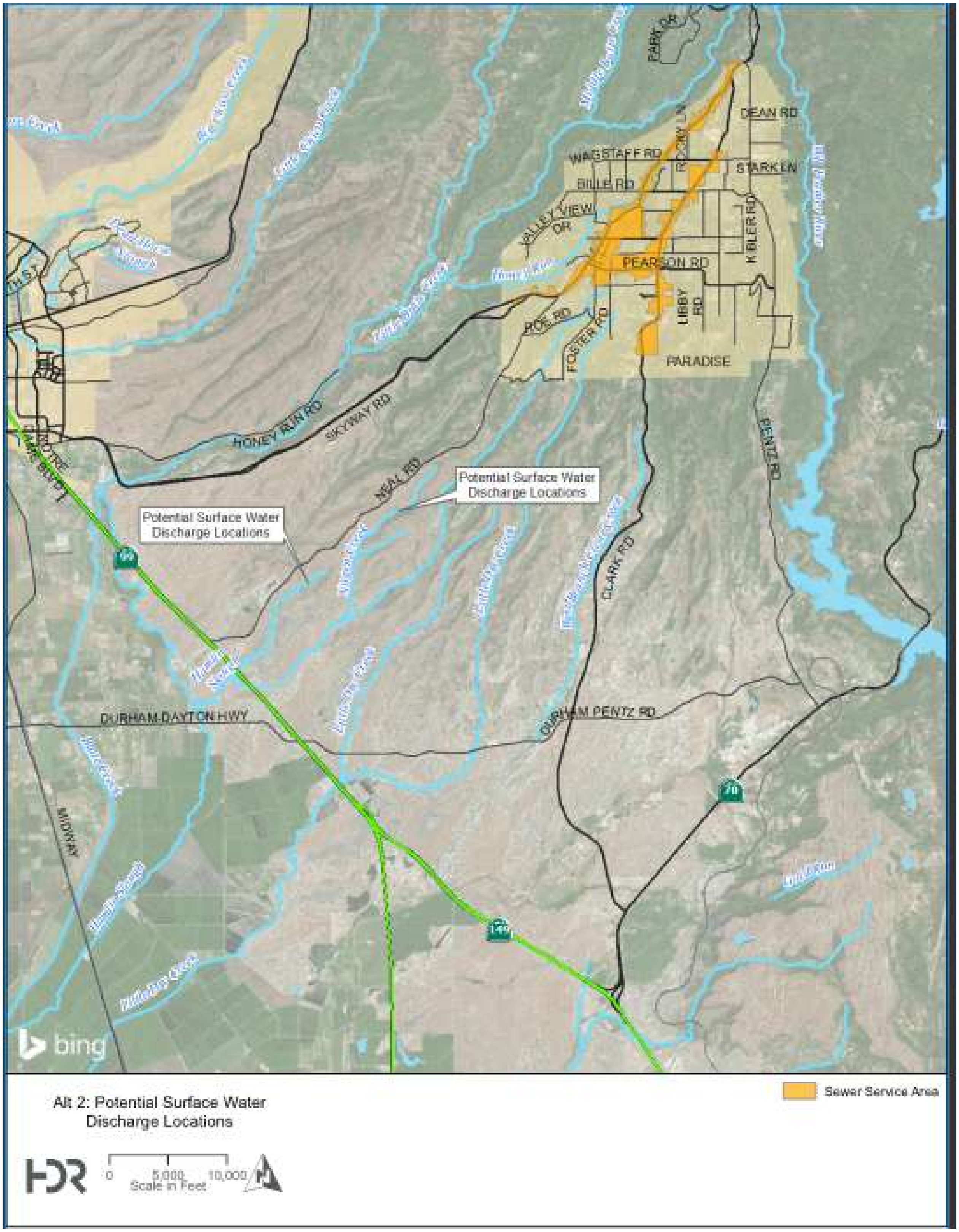

Figure 4. Location of Nugen Creek and Hamlin Slough

A conceptual schematic for tertiary treatment is shown in Figure 5. For Alternative 2, treatment by means of a membrane bioreactor was used. Information on a membrane bioreactor process by Suez is provided in Appendix B, Attachment 2.

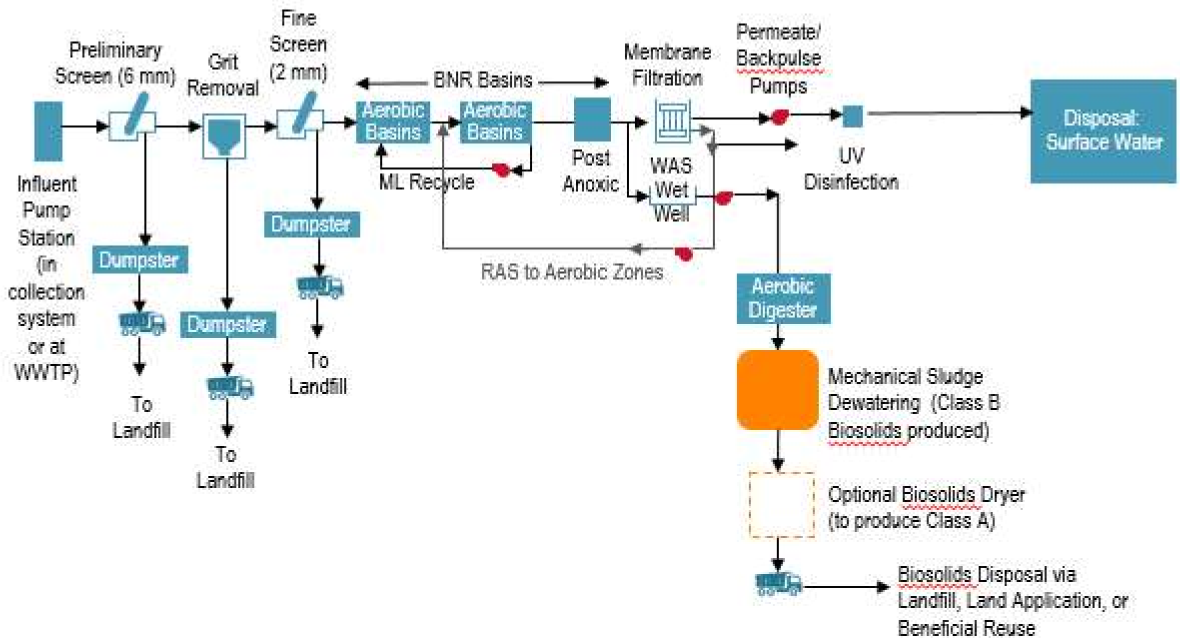

Figure 5. Conceptual Schematic for Tertiary Treatment under Alternative 2

Components needed to implement Alternative 2 are as follows:

- Pump station and pipeline from end of collection system to WWTP location
- Land for WWTP
- Pipeline from WWTP to Nugen Creek or Hamlin Slough outfall
- Outfall structure into Nugen Creek or Hamlin Slough

The Central Valley Regional Water Quality Control Board (Regional Board) staff, in recent meetings and calls, has indicated that it does not support a local surface water discharge and that it will be difficult to permit. If a permit is issued, it is anticipated to be very onerous.

3.3 Alternative 3: Local WWTP with Water Recycling

Alternative 3 includes a local WWTP with beneficial reuse of recycled water within the Town. Currently, there are no designated users for recycled water. As the Town rebuilds following the 2018 Camp Fire, potential users may be identified. To not limit the type of potential users in the future, it is recommended that recycled water meet unrestricted reuse requirements of Title 22, which requires a tertiary treated effluent meeting filtration and disinfection criteria presented in the State Water Resources Control Board Order WQ 2016-0068-DDW, Water Reclamation Requirements for Recycled Water Use.

A summary of uses for recycled water for various levels of treatment is provided in Appendix C. A conceptual schematic for tertiary treatment for unrestricted reuse is shown in Figure 6.

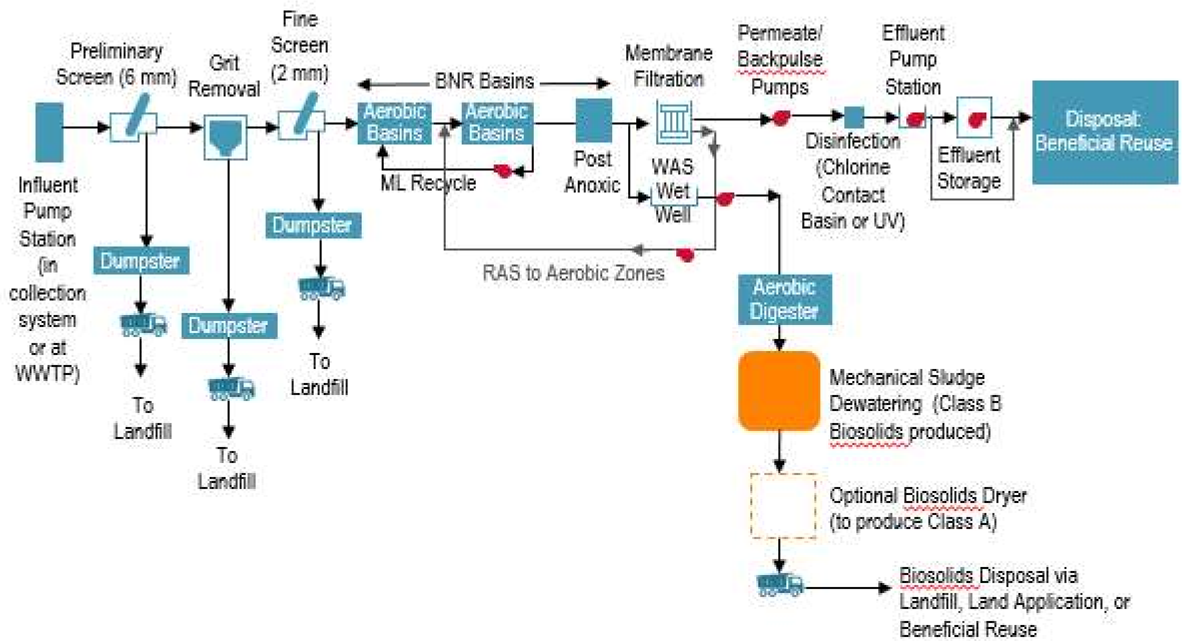

Figure 6. Conceptual Schematic for Tertiary Treatment for Unrestricted Reuse for Alternative 3

3.4 Alternative 4: Local WWTP with Discharge to the Miocene Canal

Alternative 4 includes a local WWTP with discharge to the Miocene Canal. The Miocene Canal begins north of the Town, runs along its eastern edge, and ultimately terminates near the city of Oroville. Just south of the Town, the canal empties into Kunkle Reservoir, and then continues out of Kunkle Reservoir in a pipe and later an open canal. Figure 7 shows the location of the Miocene Canal in the vicinity of the Town.

The Miocene Canal has been owned and operated by Pacific Gas and Electric Company (PG&E) since 1917. Prior to the 2018 Camp Fire, the Miocene Canal ran from a diversion on the West Branch of the Feather River to a small reservoir near Lake Oroville. Flows in the canal were about 50 cubic feet per second (cfs) through most of the year except between August and November, when flows were reduced to 30 cfs. The canal's upper reach runs from the diversion to Kunkle Reservoir and was completely destroyed in the 2018 Camp Fire. The canal’s lower reach runs from Kunkle Reservoir to a small reservoir near Lake Oroville and is still intact. Water in the Miocene Canal is owned by PG&E and is sold to small diverters along the canal; diversions occur at various locations in the middle and lower reaches to irrigate orchards and for other land uses. Irrigation tailwater flows into a number of creeks in the area. In the past, water from the Miocene Canal was also used to supplement municipal supplies in Oroville, California.

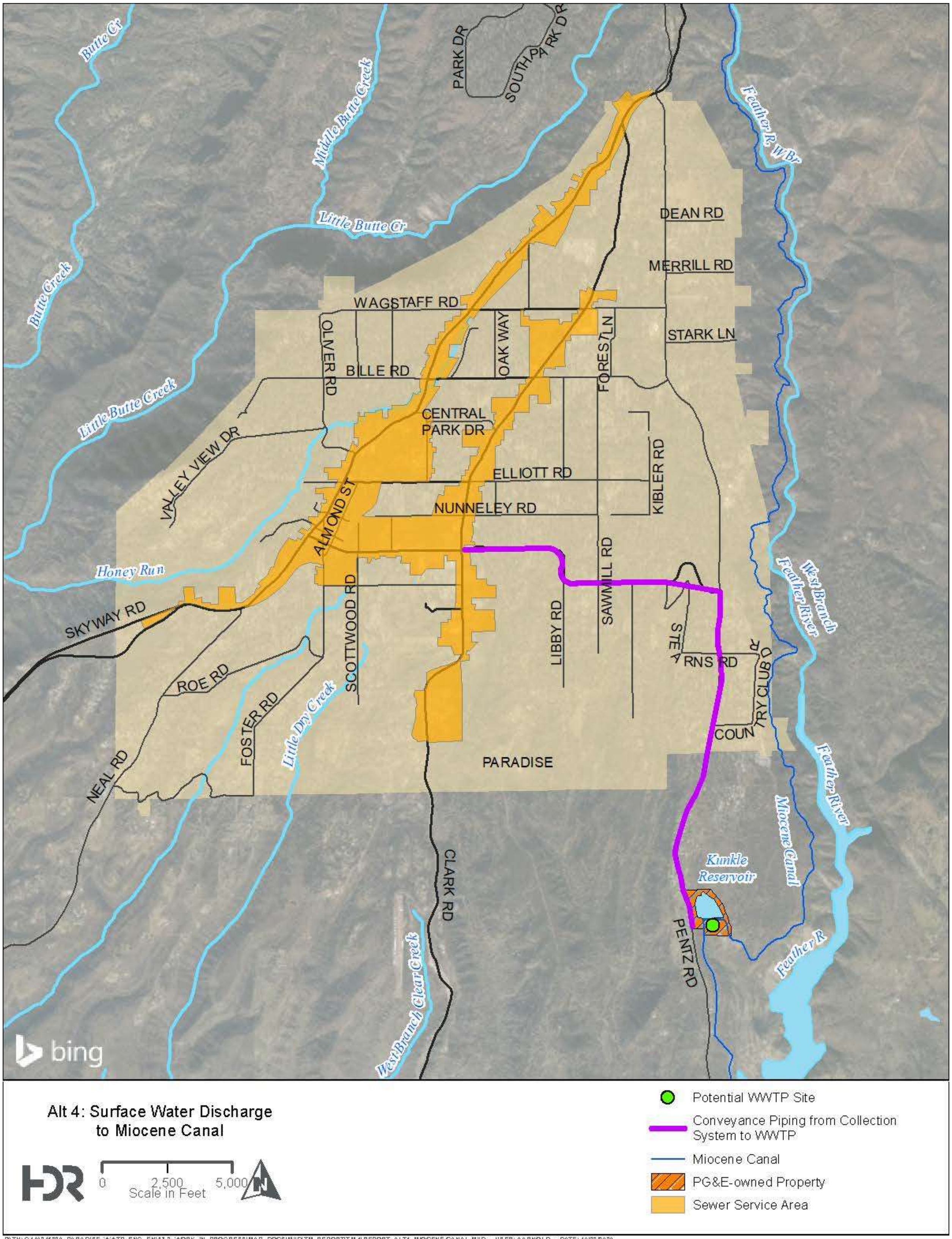

Figure 7. The Miocene Canal Alternative

PG&E estimates that there are about 18 water users along the middle and lower reaches of the Miocene Canal who pay PG&E for canal water under 60- to 70-year-old agreements. The agreements do not obligate PG&E to provide water. Instead, the agreements read that, if and when there is water in the canal, then people can take water out (and pay for it).

The only known feed into or out of the Kunkle Reservoir is the Miocene Canal. As the canal leaves the reservoir, it is in a pipe that serves as a penstock for the downstream Lime Saddle Powerhouse. The reservoir has remained full for the past several years, even after the Camp Fire destroyed the upper reach of the Miocene Canal. The exact source of the water filling Kunkle Reservoir is unknown, but it is believed that there are underground springs of some sort feeding water into the reservoir.

At the lower end of the Miocene Canal is a terminal reservoir, which is owned by the California Water Service Company (CalWater). It has been observed that, while the Miocene Canal has been completely dry for the past two years, the terminal reservoir has remained full, indicating that there is some other source of feed water into the reservoir. The source of this water is unknown.

The 2018 Camp Fire destroyed major portions of the Miocene Canal. Recently, PG&E has agreed to fund efforts to restore access to water for the next 5 years for residents impacted by the loss of the Miocene Canal. PG&E has indicated that it will not be restoring the upper reaches of the Miocene Canal, but as part of the recent settlement, PG&E has proposed to supply the canal with 10 cfs of water for 5 years. PG&E has proposed to pump water from a barge located at the Lake Oroville Marina, just south of the Lime Saddle Recreation Area, to discharge into the Miocene Canal approximately 0.5 miles due west of that location. At the end of the 5 years, PG&E intends to discontinue feeding water into the canal, and will look to a new entity to take over the pumping of the water.

The concept for Alternative 4 is to discharge 0.7 cfs (448,000 gallons per day) of treated wastewater either into Kunkle Reservoir or directly into the Miocene Canal at that location, where it will eventually mix with the 10 cfs of surface water from Lake Oroville that will be pumped by PG&E into the canal. For the development and evaluation of alternatives, the concept of direct discharge into the Miocene Canal was used.

For Alternative 4, the WWTP is envisioned to be located on property currently owned by PG&E, in an area south of Kunkle Reservoir, as shown in Figure 8.

The water conveyed in the Miocene Canal is used for many agricultural and municipal purposes. Because of these uses, it has been assumed that the Regional Board will require the treated effluent to meet indirect potable reuse (IPR) requirements. This means that, following membrane filtration, additional advanced water treatment processes would be necessary.

Figure 8. Land Available at Kunkle Reservoir to Site WWTP for Alternative 4

The advanced water treatment processes used are ultra-filtration (UF), reverse osmosis (RO), advanced oxidation (AOP), and ultraviolet (UV) disinfection. As part of the reverse osmosis process, a brine reject flow would be produced that would require disposal. The amount of brine reject flow would be approximately 20 percent of the total influent flow (448,000 gallons per day), which would equate to 89,600 gallons per day. Brine disposal could be accomplished by using evaporation ponds or trucking it away. Because of the high precipitation and low evaporation rate in the Paradise area, evaporation ponds would not be suitable and that the brine would need to be trucked away. To reduce the amount of brine to be trucked away, an additional process called vibratory, shear-enhanced processing (VSEP) would be needed. With VSEP, the amount of brine that would be trucked would be reduced by 75 percent to 22,400 gallons per day, or about 5 truckloads per day. One facility that has, in the past, taken brine and mixed it into the effluent prior to disposal is a WWTP in Oakland, California. For purposes of this TM, trucking brine to this Oakland WWTP was used.

A conceptual schematic for tertiary treatment followed by advanced water treatment for discharge into the Miocene Canal is shown in Figure 9.

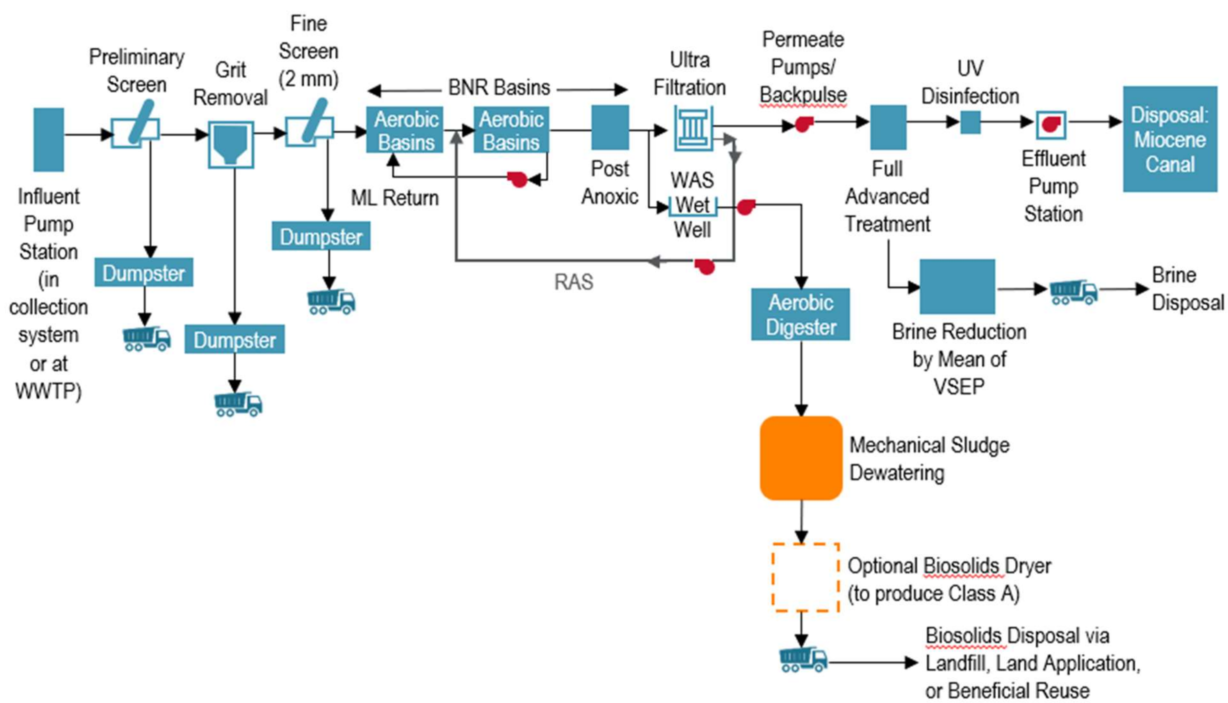

Figure 9. Advanced Treatment Schematic for Alternative 4

Components needed to implement Alternative 4 are as follows:

- Pump station and pipeline from end of collection system to WWTP location
- Land for WWTP at Kunkle Reservoir
- Pipeline from WWTP to Kunkle Reservoir or Miocene Canal
- Outfall structure into Kunkle Reservoir or Miocene Canal

3.5 Biosolids Management

Biosolids are a product of the wastewater treatment process. During wastewater treatment, liquids are separated from the solids. Those solids are then treated physically and chemically to produce a semisolid, nutrient-rich product known as Biosolids.

TM #2 reviewed the regulations regarding the end use and disposal of Biosolids and the classification of Biosolids. The information provided in TM #2 is summarized as follows:

- **End Use/Disposal.** It was noted that in California, smaller wastewater agencies typically dispose of Biosolids onto land or convey it to a landfill for use as alternative daily cover. However, Biosolids management has recently become increasingly challenging and complex, especially for smaller agencies. These challenges are due to California regulations mandating reductions in greenhouse gas emissions as well as emerging contaminants.

- **Classification of Biosolids.** Biosolids are designated as either Class A or Class B based on their treatment methods. Each class has specified treatment requirements for pollutants, pathogen and vector attraction reduction, and general requirements and management practices. Because of concerns over pathogens, odors, and future regulations, there is a distinct shift away from Class B use and toward Class A treatment solutions. To provide flexibility in Biosolids disposal, TM #2 recommended that Biosolids generated from a proposed local WWTP for the Town meet Class A criteria.

Since completion of TM #2, discussions with the City of Chico and Synagro, a Biosolids management firm, have occurred. The City of Chico produces Class B Biosolids and contracts with Synagro for year-round disposal of its Biosolids on land. During these discussions, Synagro indicated that the Town of Paradise could enter into a similar contract. Based on this information, it is now recommended that any local WWTP alternative produce Class B Biosolids and contract with Synagro for disposal.

3.6 Septage Handling

The proposed Project will serve 1,469 parcels out of the approximately 11,000 parcels in the Town. The parcels not served by the proposed Project would remain on septic tanks. It is possible to incorporate septage handling facilities into a local WWTP.

A conceptual schematic for septage handling is shown in Figure 10. The process shown in Figure 10 can be implemented only if a local WWTP is constructed as decant and sludge from the aerobic digester would be conveyed to the WWTP for further treatment.

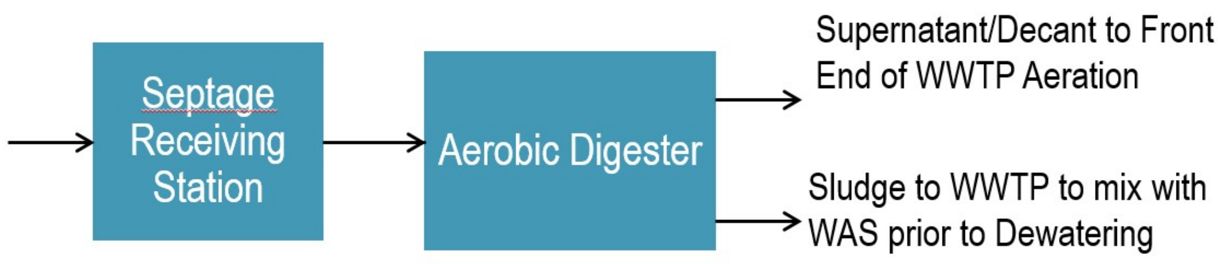

Figure 10. Process Flow Schematic for Septage Treatment

4. Evaluation of Alternatives

In this section, potentially feasible local wastewater and disposal alternatives developed in this TM are first screened based on whether they are deemed feasible or not. The alternatives that passed this screening were then evaluated based on economic and non-economic criteria to determine the highest ranked alternative(s). These local alternatives will be compared to a regional alternative, where raw sewage would be conveyed to the City of Chico for treatment and disposal, in TM #6 – Comparison of Local and Regional Alternatives.

4.1 Screening of Alternatives

The four alternatives were screened as follows:

- Alternative 1: Local WWTP with Effluent Storage and Land Application
    - This alternative was deemed feasible and carried forward. With no surface water discharge, it should be easier to permit with the Regional Board.
- Alternative 2: Local WWTP with a Surface Water Discharge
    - This alternative was deemed not feasible due to lack of support by the Regional Board for issuing a surface water discharge permit, and the potential for a very onerous discharge permit if one was issued.
- Alternative 3: Local WWTP with Water Recycling within the Town
    - This alternative was deemed not feasible at this time due to a lack of recycled water users in the area. It should be noted that the two local alternatives carried forward for consideration contain a sufficient level of treatment such that water recycling could still be implemented in the future, should sufficient recycled water uses develop.

- Alternative 4: Local WWTP with Discharge to the Miocene Canal
  - This alternative was deemed feasible and carried forward. While technically a surface water discharge, the Miocene Canal is an existing, constructed facility with agricultural users, and it was felt the Regional Board could support permitting it.

4.2 Economic Comparison

The construction costs and operations and maintenance (O&M) costs of Alternatives 1 and 4 were then estimated based on the following assumptions:

- Opinions of Probable Construction Costs (cost estimates) were prepared for both alternatives. The estimates are considered to be Class 4, associated with a 1 to 15 percent level of project definition. When needed, the 20-Cities Average version of the Engineering News-Record Construction Cost Index (ENR CCI) was used to update costs.
- Alternative 1 includes the following for treatment and disposal:
  - Tertiary treatment: though secondary treatment is all that is needed to implement Alternative 1, tertiary treatment provides the Town flexibility to implement water recycling in the future.
  - Chlorine disinfection
  - Class B Biosolids produced
  - No land for effluent disposal will be purchased. Instead, agreements would be sought with local farmers to use treated effluent for agricultural irrigation.
- Alternative 4 includes the following for treatment and disposal:
  - Tertiary treatment followed by advanced treatment (ultra-filtration, reverse osmosis, advanced oxidation, and UV disinfection). Construction and O&M costs for advanced treatment processes were developed based on a report titled, “Recycled Water Feasibility Study for Oro Loma Sanitary District,” prepared by RMC Water and Environment with support from HDR Engineering, dated March 2016.
  - Brine produced by the reverse osmosis process will be reduced in quantity by the vibratory shear enhanced processing (VSEP) process with remaining brine trucked to a WWTP in Oakland, California, for disposal. Construction and O&M costs for VSEP treatment of the brine were developed based on a Technical Memorandum titled, “DVI Brine Concentrator System Replacement Project,” for the Deuel Vocational Institution in Tracy, California, prepared by Kjeldsen Sinnock and Neudeck, dated August 2018.
  - Brine hauling at $0.32 per gallon
  - Class B Biosolids produced

- Equipment costs were obtained from equipment manufacturers or their respective representatives.

- Costs for Class B biosolids were obtained from John Pugliaresi of Synagro.

- A 20-Cities Average ENR CCI of 11439 (July 2020) is the basis of the cost estimates.

- Construction costs include a 30% percent contingency for undefined scope items to account for the level of accuracy at this phase of the project and a 10% construction contingency to be held in reserve for changes during construction.

- To calculate a capital cost, the following implementation cost factors were used (numbers are percentages of the construction cost):

○ Project Administration	2
○ Legal and Finance Council	1
○ Planning	3
○ Design	13
○ Environmental Documentation/Permitting	3
○ Right-of-Way Acquisition	3
○ Construction Management	8
○ Engineering Services During Construction	4
○ Environmental Monitoring/Regulatory Compliance	3
○ Environmental Mitigation	6

- The cost of electrical power is assumed at $0.1704/kilowatt-hour.

- Land cost assumptions based on costs for properties shown for sale on the website Estately.com:
    - $40,000/acre for WWTP sites
    - $20,000/acre for effluent storage

- Costs for on-site spray irrigation infrastructure for land disposal were assumed at $5,000/acre.

- Net Present Value: To compare overall costs of the alternatives (i.e., combining construction and O&M costs), a net present value cost analysis was done, using a 20-year planning period. The net present value analysis also requires establishing a discount rate. A real discount rate of 0.3% was used, following the US Department of Agriculture (USDA) Bulletin 1780-2, which in turn refers to the real discount rate in the US Office of Management and Budget's Circular A-94 (see Appendix D).

- Salvage Value: Because the life span of wastewater components exceeds 20 years, salvage values were estimated, based on the life span of the asset and a straight-line depreciation of the value of the asset over the analysis period of 20 years (per USDA Bulletin 1780-2 guidance for analysis of wastewater projects). In determining salvage value, the following was assumed:

- Within the overall WWTP construction cost, equipment is 20 percent of the construction cost and has a 20-year life, with a discount rate of 0.3 percent.
- Within the overall WWTP construction cost, non-equipment is 80 percent of the construction cost and has a 50-year life, with a discount rate of 0.3 percent
- Salvage value of land purchased was assumed to be the estimated purchase price.

The estimated costs for wastewater treatment and disposal for Alternatives 1 and 4 are shown in Table 5. Detailed cost estimates for various combinations of treatment and disposal alternatives are included in Appendix E.

Table 5. Estimated Costs for Local Wastewater Treatment and Disposal Alternatives 1 and 4

Description	Alt 1: Local WWTP with Effluent Storage and Land Application	Alt 4: Local WWTP with Discharge to Miocene Canal
Treatment Method	Tertiary Treatment with Chlorine Contact Tank	Tertiary Treatment (Membrane Bioreactor) with Advanced Treatment (UF/RO/AOP) and UV Disinfection
Classification of Biosolids Produced	Class B	Class B
WASTEWATER TREATMENT PLANT		
Total WWTP Construction Cost with Contingency and Land Purchase	$ 25,096,000	$ 102,801,000
Total WWTP Capital Cost (includes implementation costs)	$ 36,051.000	$ 147,911,000
O&M Cost Net Present Value (20 yrs., 0.3%)	$ 25,228,000	124,257,000
Total Net Present Value (includes salvage value)	$ 49.824,000	$ 225,540,000
EFFLUENT DISPOSAL		
Total Effluent Disposal Construction Cost with Contingency and Land Purchase	$ 24,136,000	$ 6,820,000
Total WWTP Capital Cost (includes implementation costs)	$ 32,949,000	$ 9,822,000
O&M Cost Net Present Value (20 yrs., 0.3%)	$ 3,344,000	$ 2,229,000
Total Net Present Value (includes salvage value)	$ 20,896,000	$ 8,225,000
TREATMENT AND DISPOSAL		
Total WWTP and Effluent Disposal Construction Cost with Contingency and Land Purchase	$ 49,232,000	$ 109,621,000
Total WWTP and Effluent Disposal Capital Cost (includes implementation costs)	$ 69,000,000	$ 157,733,000
O&M Cost Net Present Value (20 yrs., 0.3%)	$ 28,572,000	$ 126,486,000
Total Net Present Value (includes salvage value)	$ 70,720,000	$ 233,765,000

As shown in Table 5, Alternative 1 is less expensive in terms of capital cost, O&M costs, and overall net present value.

The estimated costs to receive and treat septage are shown in Table 6. A detailed cost estimate for the septage receiving and treatment facility is included in Appendix E.

Table 6. Estimated Costs for Septage Receiving and Treatment Facility

Description	Costs
Total Construction Cost	$6,983,000
Total Capital Cost (includes implementation costs)	$10,095,000
O&M Cost Net Present Value (20 yrs., 0.3%)	$3,027,000
Total Net Present Value (includes salvage value)	$9,827,000

Providing a septage receiving station is only feasible if a local WWTP is constructed.

4.3 Non-Economic Comparison

Alternatives 1 and 4 differ in terms of the following non-economic factors:

- Social
- Environmental
- Implementation
- Operations

An initial environmental constraints analysis for the local wastewater treatment and disposal alternatives was conducted. The environmental constraints analysis is provided in Appendix A, and the environmental constraints are summarized in Table A-1.

Table 7 compares the advantages and disadvantages of each treatment and disposal alternative for each non-economic factor.

Table 7. Advantages and Disadvantages of Wastewater Treatment and Disposal Alternatives for Non-Economic Factors

Non-Economic Factor	Alt 1: Local WWTP with Effluent Storage and Land Application		Alt 4: Local WWTP with Discharge to Miocene Canal	
	Advantages	Disadvantages	Advantages	Disadvantages
Social	Effluent may help farmers by improving value of marginal grazing land Town controls growth in its service area	Negotiating agreements with farmers to use treated effluent for irrigation of pastureland may be difficult because of public perception	Effluent provides current ag users along the Miocene Canal a year-round source of water Town controls growth in its service area	Current ag users along the Miocene Canal may not want treated effluent to be mixed with Lake Oroville water supplied to the canal
Environmental	Easier to permit with the Regional Board	Land intensive More mitigation for vernal pools, meadowfoam, and other rare plants on proposed storage and land application acreage	Provides a very high quality treated effluent suitable for indirect potable reuse	More land required for treatment facilities

Non-Economic Factor	Alt 1: Local WWTP with Effluent Storage and Land Application		Alt 4: Local WWTP with Discharge to Miocene Canal	
	Advantages	Disadvantages	Advantages	Disadvantages
Implementation	None identified	Soils south of Paradise and off the ridge are rocky, making land application more difficult Finding 150 acres of land to purchase for effluent storage may be difficult	Land owned by PG&E readily available for siting WWTP	Requires permits to be obtained from both the State Water Resources Control Board and the Regional Board More complex WWTP to construct
Operations	Potentially eliminates the need for farmers to relocate their cattle for grazing during the summer months WWTP facilities less complex and easier to operate	Need to oversee farmers' operations to ensure compliance with permit conditions	None identified	More complex WWTP to operate Very stringent discharge requirements

5. Recommendation

Based on information presented in this TM, it is recommended that both Alternatives 1 and 4 be carried forward and compared against the regional alternative in TM #6 – Comparison of Local and Regional Alternatives, where raw sewage would be conveyed to the Chico WPCP for treatment and disposal.

A

Environmental Constraints Analysis

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Appendix A – Environmental Constraints Analysis – Local WWTP Alternative

A.1 Introduction

The Town of Paradise (Town) is implementing the Paradise Sewer Project (Project), which involves identifying and implementing a long-term solution for collection, treatment, and reuse/disposal of its wastewater. HDR is under contract to assist the Town with the first two phases of the Project—final selection of a wastewater alternative, which includes this environmental constraints analysis as part of the Local Alternatives Screening process (Phase 1), and preparation of an Environmental Impact Report (EIR) covering the selected alternative (Phase 2). This technical memorandum (TM) is part of the Phase 1 effort.

The purpose of this analysis is to identify the environmental constraints of the local collection, treatment, and reuse/disposal of wastewater locations. More specifically, the environmental constraints analysis considers the physical footprint of the proposed activities, along with the existing conditions and land uses of proposed locations, so as to identify those "constraints" or issues that should be considered when selecting the location and developing the preliminary design of the Project. This TM captures individual constraints from a local standpoint and involved the following:

- Preliminary desktop review of proposed and alternative local wastewater treatment plant (WWTP) site locations, collection system, storage and discharge locations, and related infrastructure and construction footprint.
- Historic records search of the local project area.
- Proposed definition of the preliminary area of potential effect (APE) to inform design, and tribal and agency coordination.
- Identification of environmental permits and agency consultations necessary to advance the Project.
- Geospatial cataloguing of all data.

A.2 Local Alternative General Overview

The local alternative includes siting, construction, and operation of the following:

- Collection system
- New WWTP
- Storage reservoir
- Related piping and infrastructure
- Surface water discharge location
- Land application discharge location

With the exception of the collection system, siting of the remaining project components includes an alternatives screening, as summarized in TM #4, Local Wastewater Treatment and Disposal Alternatives, based on the technical and land-based requirements defined in the *Town of Paradise Sewer Project, Alternatives Analysis and Feasibility Report: Determining a Preferred Option for Implementation* (2017 Feasibility Report) and subsequent engineering assessments pertaining to acreage needs (TM #3). This environmental constraints analysis for the local alternative considers the physical footprint of those alternatives, broadly allowing for a conservative estimate of where each project component might be placed. As such, the analysis identifies those constraints of the project area and those of the surrounding area, thus defining the study area, shown in Figure A-1. This further allows for flexibility in the specific footprint as the preliminary design matures.

The collection system, by contrast, was largely defined in the 2017 Feasibility Report and included a sewer service area (SSA) including 1,469 parcels within Paradise's urban core, as shown in Figure A-2. As of April 2020, there were 300 parcels with habitable structures within the SSA.[1] The SSA defined in 2017 will continue to be used as the SSA for the proposed collection system.

This constraints review includes a broad consideration of the footprint of each of these project components to encompass the range of alternatives being considered at this stage of the planning process. Not all of these project components and alternatives will necessarily be carried forward in future planning and review.

[1] The count of existing parcels with habitable structures was obtained from the Chico State Geographical Information Center, which compiled the data supplied by CAL FIRE. CAL FIRE defines a structure as habitable if it is less than 25 percent damaged.

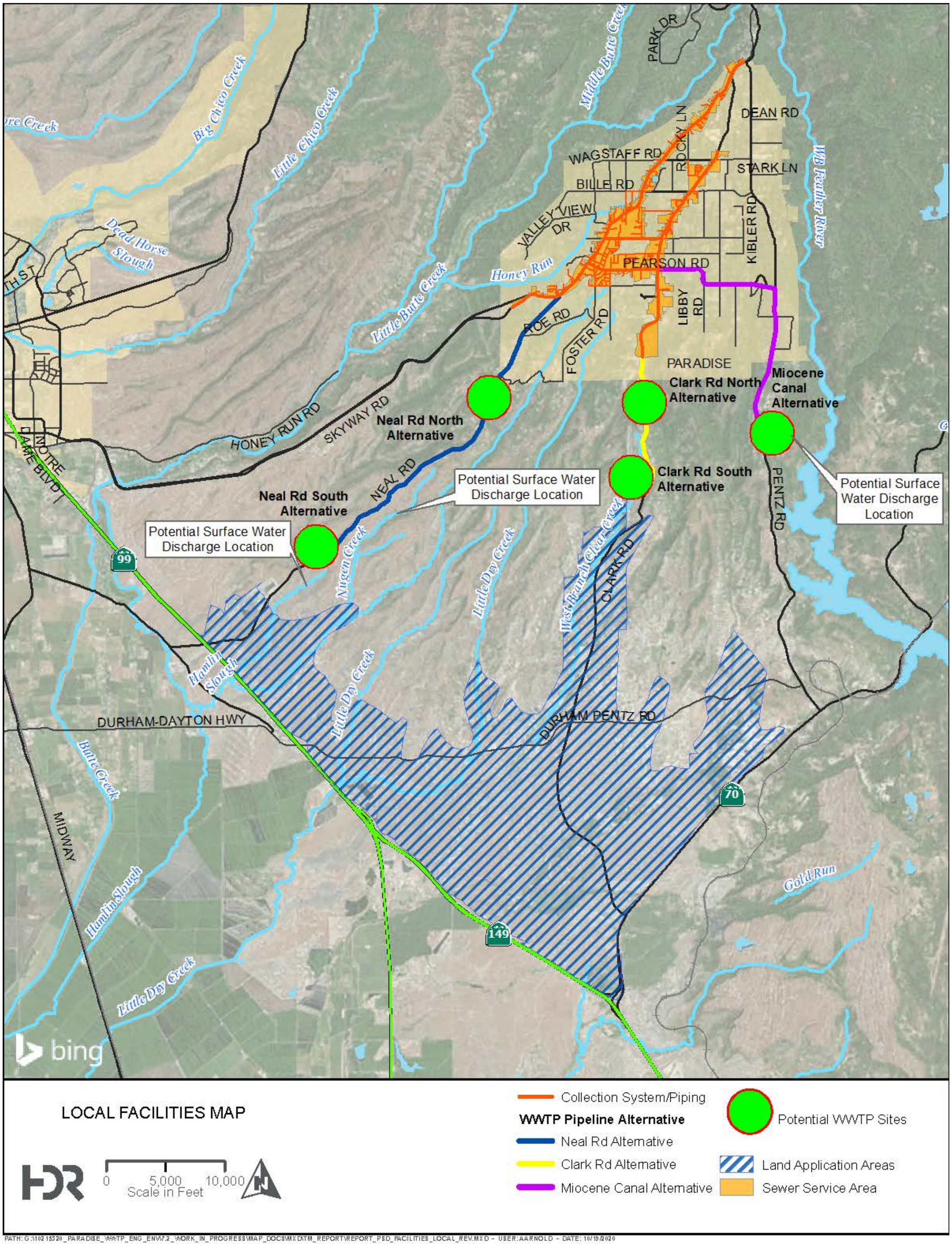

Figure A-1. Study Area

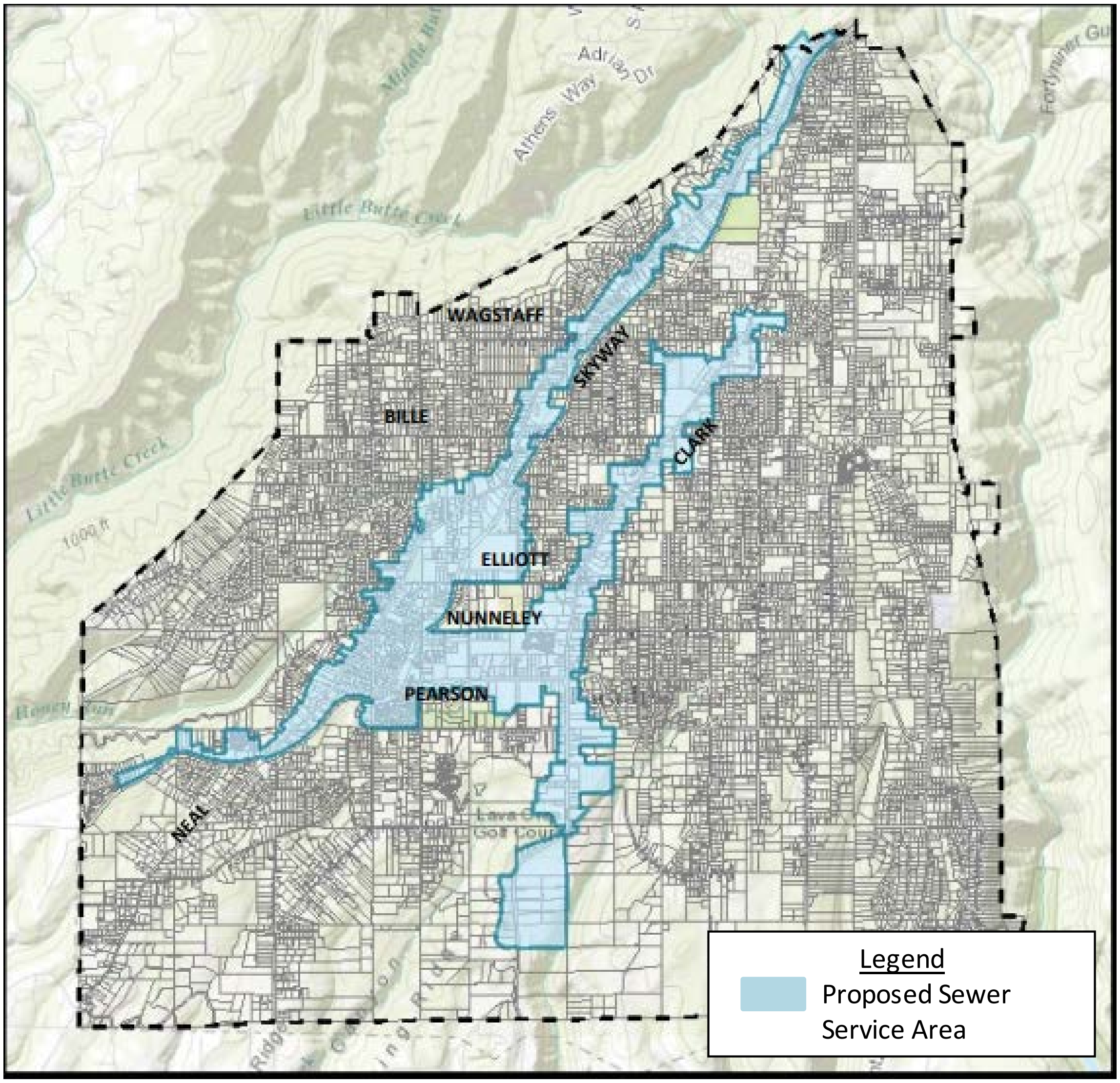

Figure A-2. Proposed Town of Paradise Sewer Service Area

A.3 Limitations of Consideration

Land use constraints discussed in Section A.4.2 are based on current and historic land uses as indicated through review of Google street view imagery and local (Town of Paradise and Butte County) mapping. Recognizing that areas damaged by fire are in a phase of reconstruction or remain vacant, the land use constraints assessment assumes areas would be redeveloped according to local plans and policies. The land use constraints analysis included examining impaired waterbodies as defined by Section 303(d) of the Clean Water Act and administered in California by the State Water Resources Control Board. California's Clean Water Act Section 303(d) and 305(b) Integrated Report is developed in cycles, with each cycle occurring every 2 years. The most recent report, started in 2018, is in progress. The current active report is the 2014 and 2016 Integrated Report. Data used to identify impaired waters in the study area are from 2015.

Biological constraints summarized in Section A.4.3 include waters of the United States and waters of the state. Aerial imagery was analyzed and existing National Wetlands Inventory (NWI) data imported to show the general location of aquatic features in the study area. However, to determine the more precise extent and nature of waters of the United States, waters of the state, and wetlands in the study area, an aquatic resources delineation will need to be conducted as outlined in Section A.4.3.1.

Biological constraints also include special-status species that may be affected by project-related activities, and their associated California Wildlife Habitat Relationships (CWHR) habitat types. Special-status species that have the potential to occur in the study area, along with their general habitat characteristics, were identified using information from the United States Fish and Wildlife Service (USFWS), the California Department of Fish and Wildlife (CDFW), and the California Native Plant Society (CNPS). A biological habitat assessment was not conducted to validate these findings in the field. However, it is recommended that prior to finalizing conceptual design, such an assessment be conducted.

Sensitive cultural and tribal cultural resources constraints are summarized in Section A.4.4 and include preliminary findings of archaeological resources, built-environment resources, informally recorded cultural resources, and one known Indian Tribal Asset (ITA) that may be affected by project-related activities. The review conducted for this effort should not be considered an identification effort sufficient to complying with local, state, or federal laws and it is recommended that prior to finalizing conceptual design, an archaeological resources inventory and tribal cultural resources study be conducted.

A.4 Constraints Analysis

A.4.1 Summary of Constraints

The environmental constraints analysis of the local alternative's proposed collection, treatment, and reuse/disposal of wastewater is based on review of land use and zoning, biological resources, and cultural resources that would affect the constructability of the facilities. More specifically, the environmental constraints analysis considers the physical footprint of the proposed activities, along with the land uses and biological and cultural resources, so as to identify those constraints or issues that should be considered when developing the preliminary design of a project. Table A-1 summarizes the results of the environmental constraints analysis.

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Table A-1. Summary of Environmental Constraints

	Collection System	Local WWTP Site - Kunkle	Local WWTP Site – Clark Road	Local WWTP Site – Neal Road	Pipeline/Infrastructure – Pearson/Pentz Roads	Pipeline/Infrastructure – Clark Road	Pipeline/Infrastructure – Neal Road	Surface Water Discharge – Kunkle Reservoir	Surface Water Discharge – Miocene	Land Discharge
	Sewer pipes buried within existing paved Town streets	10-acre advanced treatment plant on vacant developed parcel next to road	5-acre tertiary treatment plant on vacant developed parcel next to road	5-acre tertiary treatment plant on vacant developed parcel next to road	Pipe buried within existing paved road	Pipe buried within existing paved road with tunneled crossings of two creeks	Pipe buried within existing paved road with tunneled crossings of two creeks	Pipe discharge into existing man-made reservoir	Pipe discharge into existing man-made canal	Water stored in new 122-acre earthen reservoir (total acreage needed is 150 acres with 20% buffer) and discharge to 260 acres of grazing land (total acreage needed is 312 acres with 20% buffer)
Land Use Constraints	None	None	None	None	None	None	None	None	None	None
Impaired Waters Constraints	None	None	None	None	None	None	None	Drains to West Branch Feather River, impaired	Drains to West Branch Feather River, impaired	None
Wetlands/Waters Constraints	Little Butte Creek, Little Dry Creek, Honey Run	Kunkle Reservoir and related drainages	West Branch Clear Creek	Nugen Creek, Hamlin Slough, seasonal wetland complexes	Little Butte Creek, Little Dry Creek, Honey Run	West Branch Clear Creek, seasonal wetland complexes	Nugen Creek, Hamlin Slough, seasonal wetland complexes	Kunkle Reservoir and related drainages	Miocene Canal	West Branch Clear Creek, Little Dry Creek, Hamlin Slough, seasonal wetland complexes
Species Constraints	Anadromous fish, foothill yellow-legged frog (FYLF), California red-legged frog (CRLF), bald and golden eagle, willow flycatcher (WIFL), peregrine falcon (PEFA), California spotted owl (SPOW), fisher	FYLF, CRLF, bald and golden eagle, PEFA	North and South: Anadromous fish, FYLF, bald and golden eagle, PEFA South only: Butte County meadowfoam, California black rail (BLRA)	North and South: Anadromous fish and FYLF North only: bald and golden eagle, PEFA South only: Butte County meadowfoam, vernal pool obligate rare plants, vernal pool crustaceans, valley elderberry longhorn beetle (VELB), giant gartersnake (GGS), tricolored blackbird (TRBL), burrowing owl (BUOW), Swainson's hawk (SWHA), white-tailed kite (WTKI)	Anadromous fish, FYLF, CRLF, bald and golden eagle, WIFL, PEFA, SPOW, fisher	North and South: Anadromous fish, FYLF, bald and golden eagle, PEFA South only: Butte County meadowfoam, BLRA	North and South: Anadromous fish and FYLF North only: bald and golden eagle, PEFA South only: Butte County meadowfoam, vernal pool obligate rare plants, vernal pool crustaceans, VELB, anadromous fish, FYLF, TRBL, BUOW, SWHA, WTKI	CRLF, FYLF	FYLF	Butte County meadowfoam, vernal pool obligate rare plants, vernal pool crustaceans (vernal pool tadpole shrimp critical habitat), VELB, FYLF, GGS, TRBL (known colony), BUOW, SWHA, WTKI, BLRA
Cultural Resources Constraints	Survey coverage: <50% Site sensitivity: • P: moderate/high • H: moderate/high • HBE: low Note: ~50 resources previously recorded	Survey coverage: ~10% Site sensitivity: • P: moderate • H: low/moderate • HBE: low Note: no previously recorded resources identified	Survey coverage: <50% Site sensitivity: • P: moderate/high • H: moderate/high • HBE: low Note: 1 resource previously recorded	Survey coverage: ~10% Site sensitivity: • P: moderate/high • H: low/moderate • HBE: low Note: 1 resource previously recorded along corridor	Survey coverage: ~10% Site sensitivity: • P: moderate • H: moderate • HBE: low Note: ~2 resources previously recorded	Regional constraint: Survey coverage: ~50% Site sensitivity: • P: moderate/high • H: low/moderate • HBE: low Note: ~50 resources previously recorded along corridor	Local/Regional constraint: Survey coverage: ~30% Site sensitivity: • P: moderate/high • H: moderate • HBE: low Note: ~11 resources previously recorded along corridor	Survey coverage: ~10% Site sensitivity: • P: moderate/high • H: low/moderate • HBE: low Note: 1 resource previously recorded near reservoir	Survey coverage: 0% Site sensitivity: • P: moderate/high • H: low • HBE: low Note: ~5 resources previously recorded nearby	Survey coverage: ~40% Site sensitivity: • P: moderate/high • H: low • HBE: low Note: ~40 resources previously recorded

	Collection System	Local WWTP Site - Kunkle	Local WWTP Site – Clark Road	Local WWTP Site – Neal Road	Pipeline/Infrastructure – Pearson/Pentz Roads	Pipeline/Infrastructure – Clark Road	Pipeline/Infrastructure – Neal Road	Surface Water Discharge – Kunkle Reservoir	Surface Water Discharge – Miocene	Land Discharge
	Sewer pipes buried within existing paved Town streets	10-acre advanced treatment plant on vacant developed parcel next to road	5-acre tertiary treatment plant on vacant developed parcel next to road	5-acre tertiary treatment plant on vacant developed parcel next to road	Pipe buried within existing paved road	Pipe buried within existing paved road with tunneled crossings of two creeks	Pipe buried within existing paved road with tunneled crossings of two creeks	Pipe discharge into existing man-made reservoir	Pipe discharge into existing man-made canal	Water stored in new 122-acre earthen reservoir (total acreage needed is 150 acres with 20% buffer) and discharge to 260 acres of grazing land (total acreage needed is 312 acres with 20% buffer)
Tribal Constraints	No known Tribal Cultural Resources (TCR), Indian Trust Assets (ITA), or resources of cultural importance Need to validate through tribal consultation	No known TCR, ITA, or resources of cultural importance Need to validate through tribal consultation	No known TCR, ITA, or resources of cultural importance Need to validate through tribal consultation	No known TCR, ITA, or resources of cultural importance Need to validate through tribal consultation	No known TCR, ITA, or resources of cultural importance Need to validate through tribal consultation	No known TCR, ITA, or resources of cultural importance Need to validate through tribal consultation	No known TCR, ITA, or resources of cultural importance Need to validate through tribal consultation	No known TCR, ITA, or resources of cultural importance Need to validate through tribal consultation	No known TCR, ITA, or resources of cultural importance Need to validate through tribal consultation	One ITA in this area owned by the Mechoopda Indian Tribe No known TCR or resources of cultural importance Need to validate through tribal consultation
Additional Studies Required	Fish passage assessment Protocol surveys for FYLF and possibly, but unlikely, for CRLF, WIFL, SPOW, and fisher (potential for eagles and falcons to nest will be assessed during habitat assessment) Cultural resources study TCR study	Protocol surveys for FYLF and possibly, but unlikely, for CRLF (potential for eagles and falcons to nest will be assessed during habitat assessment) Cultural resources study TCR study	Fish passage assessment Protocol surveys for FYLF (potential for eagles and falcons to nest will be assessed during habitat assessment) South only: Additional surveys of rare plant populations if early and late season surveys dictate Protocol surveys possibly, but unlikely, for BLRA	Fish passage assessment Protocol surveys for FYLF (potential for eagles and falcons to nest will be assessed during habitat assessment) South only: Elderberry mapping for VELB Protocol surveys possibly, but unlikely, for GGS (potential for BUOW, SWHA, WTKI, and TRBL to nest will be assessed during habitat assessment) Cultural resources study TCR study	Fish passage assessment Protocol surveys for FYLF and possibly, but unlikely, for CRLF, WIFL, SPOW, and fisher (potential for eagles and falcons to nest will be assessed during habitat assessment) Cultural resources study TCR study	Fish passage assessment Protocol surveys for FYLF (potential for eagles and falcons to nest will be assessed during habitat assessment) South only: Additional surveys of rare plant populations if early and late season surveys dictate Protocol surveys possibly, but unlikely, for BLRA	Fish passage assessment Protocol surveys for FYLF (potential for eagles and falcons to nest will be assessed during habitat assessment) South only: Elderberry mapping for VELB Protocol surveys possibly, but unlikely, for GGS (potential for BUOW, SWHA, WTKI, and TRBL to nest will be assessed during habitat assessment) Cultural resources study TCR study	Protocol surveys for FYLF and possibly, but unlikely, for CRLF Cultural resources study TCR study	Protocol surveys for FYLF, as well as a thorough examination of full extent of canal route Cultural resources study TCR study	Additional surveys of rare plant populations if early and late season surveys dictate Elderberry mapping for VELB Protocol surveys for FYLF, TRBL, and possibly, but unlikely, for GGS and/or BLRA (potential for BUOW, SWHA, and WTKI to nest will be assessed during habitat assessment) Cultural resources study TCR study

	Collection System	Local WWTP Site - Kunkle	Local WWTP Site – Clark Road	Local WWTP Site – Neal Road	Pipeline/Infrastructure – Pearson/Pentz Roads	Pipeline/Infrastructure – Clark Road	Pipeline/Infrastructure – Neal Road	Surface Water Discharge – Kunkle Reservoir	Surface Water Discharge – Miocene	Land Discharge
	Sewer pipes buried within existing paved Town streets	10-acre advanced treatment plant on vacant developed parcel next to road	5-acre tertiary treatment plant on vacant developed parcel next to road	5-acre tertiary treatment plant on vacant developed parcel next to road	Pipe buried within existing paved road	Pipe buried within existing paved road with tunneled crossings of two creeks	Pipe buried within existing paved road with tunneled crossings of two creeks	Pipe discharge into existing man-made reservoir	Pipe discharge into existing man-made canal	Water stored in new 122-acre earthen reservoir (total acreage needed is 150 acres with 20% buffer) and discharge to 260 acres of grazing land (total acreage needed is 312 acres with 20% buffer)
Required Permits and Consultations	401/404/1602 if work within channel Potential consultation with NMFS for anadromous fish and/or Incidental Take Permit from CDFW (ITP) for FYLF Consultation with California Native American tribes	401/404 Potential ITP for FYLF Consultation with California Native American tribes	401/404/1602 Potential consultation with NMFS for anadromous fish and/or ITP for FYLF South only: Likely informal consultation (technical assistance) and possibly, but unlikely, ITP for BLRA	401/404/1602 Potential consultation with NMFS for anadromous fish and/or ITP for FYLF South only: Biological Opinion or Letter of Concurrence for vernal pool crustaceans and potentially for VELB Consultation with California Native American tribes	401/404/1602 Potential consultation with NMFS for anadromous fish and/or ITP for FYLF Consultation with California Native American tribes	401/404/1602 Potential consultation with NMFS for anadromous fish and/or ITP for FYLF South only: Likely informal consultation (technical assistance) and possibly, but unlikely, ITP for BLRA Consultation with California Native American tribes	401/404/1602 Potential consultation with NMFS for anadromous fish and/or ITP for FYLF South only: Biological Opinion or Letter of Concurrence for vernal pool crustaceans and potentially for VELB Consultation with California Native American tribes	Coordination with State Water Control Board for discharge to impaired waters 401/404 Potential ITP for FYLF Consultation with California Native American tribes	Coordination with State Water Control Board for discharge to impaired waters 401/404/1602 Potential ITP for FYLF Consultation with California Native American tribes	Coordination with State Water Control Board for discharge to impaired waters 401/404/1602 Biological Opinion or Letter of Concurrence for vernal pool crustaceans (Critical habitat must be completely avoided), potentially for VELB, and possibly, but unlikely, for GGS Likely informal consultation (technical assistance) and possibly, but unlikely, ITP for BLRA Consultation with California Native American tribes

Note: P = Prehistoric; H = Historical; HBE = Historic Built Environment; 401 = Water Quality Certification from Regional Water Quality Control Board; 404 = Clean Water Act Permit from the United States Army Corps of Engineers; 1602 = Streambed Alteration Agreement from California Department of Fish and Wildlife (CDFW)

A.4.2 Land Use Constraints

A.4.2.1 Applicable Land Use Plans and Policies

The local Project alternatives are within the jurisdictions of the Town of Paradise and Butte County. The planning documents and policies of these jurisdictions that are applicable to the siting and development of the WWTP and ancillary facilities are the following:

- **Paradise Municipal Code Title 17 – Zoning:** This section of the code provides the zoning ordinance for the Town and identifies permitted and conditional uses according to zoning category. Wastewater treatment/disposal utilities are considered "permitted land uses upon town approval and issuance of an administrative permit."
- **Butte County General Plan 2030 Water Resources Element:** This element of the general plan includes the following:
    - W-P4.4: Opportunities to recover and utilize wastewater for beneficial purposes shall be promoted and encouraged.
    - W-P4.5: The use of reclaimed wastewater for non-potable uses shall be encouraged, as well as dual plumbing that allows graywater from showers, sinks and washers to be reused for landscape irrigation in new developments.
- **Butte County General Plan 2030 Public Facilities and Services Element – Chapter 6, Wastewater:** This element of the general plan includes the following:
    - PUB-P12.1: Applicants shall be allowed to make case-by-case assessments of septic and other wastewater treatment systems to determine appropriate system designs and densities and shall be allowed to utilize new technologies that are supported by State and County practices.
    - PUB-P12.3: New community sewerage systems shall be managed by a public County sanitation district or other County-approved methods. Proponents shall demonstrate the financial viability of constructing, operating and maintaining the proposed community sewerage system.
    - PUB-P12.4: New sewer collection and transmission systems shall be designed and constructed to minimize potential inflow and infiltration.
    - PUB-P13.1: The County shall encourage all plant operators to begin planning and implementing expansions to the existing Regional Wastewater Treatment Master Plan to meet future demand for wastewater treatment generated by this General Plan at least four years prior to reaching the capacity of existing facilities.
    - PUB-P13.4: Installation of sewer lines shall occur concurrently with construction of new roadways to maximize efficiency and minimize disturbance from construction activity.

- **Butte County Zoning Ordinance (Chapter 24 of the County Code):** Chapter 24 identifies land uses, including wastewater treatment systems, permitted in various zones. Wastewater treatment systems are categorized under *Utilities, Major*. Utilities, Major are defined as large-scale facilities of a regional nature, including Tier 4 solar energy systems, large wind energy systems, power plants, hydro-electric facilities, electricity transmission substations, water storage tanks, community wastewater treatment plants, commercial and industrial composting operations, and similar facilities. Utilities, Major includes uses that are permitted by a Conditional Use Permit in most zones.

A.4.2.2 Paradise Land Use and Zoning

In Paradise, the service area and collection system include the commercial district, public and institutional land uses, and residential areas. The collection system would be on parcels connecting to the main lines within the ROW of Skyway Road, Clark Road, Pearson Road, Elliott Road, and smaller arterials. Land use in the collection system area is shown in Figure A-3. Land use and zoning are described in Table A-2. There are no zoning or land use conflicts that would require a change in the location of the collection system.

Table A-2. Zoning and Land Use in Collection System Area

Zoning	Land Uses
Community Commercial	Locally and regionally oriented commercial land uses, including retail, retail centers, wholesale, storage, hotels and motels, restaurants, service stations, automobile sales and service, and professional and administrative offices
Community Facilities	Bike path, recreation center, town hall, and education facilities
Community Services	Community care facilities, such as day care facilities, shelters, and medical offices
Multiple Family Residential	Apartments, condominiums, and associated parking facilities
Town Residential (1, 1/2, and 1/3 acre)	Single-family houses with outbuildings (garage, shed), and possible accessory uses like guest house, storage buildings, and recreation facilities
Rural Residential (1/2 and 2/3 acre)	Single-family houses with outbuildings (garage, shed), and possible accessory uses like guest house, storage buildings, recreation facilities, and keeping of livestock
Central Business	Commercial retail and services, public space, professional and administrative offices, and multiple-family residential uses
Neighborhood Commercial	Locally oriented commercial retail and services
Agricultural Residential (1 acre minimum)	Large residential parcels with accessory agricultural land uses, including raising of livestock and other forms of agricultural production
Industrial Services	Light industrial and manufacturing uses, warehouses, intensive nonretail commercial uses, and public uses

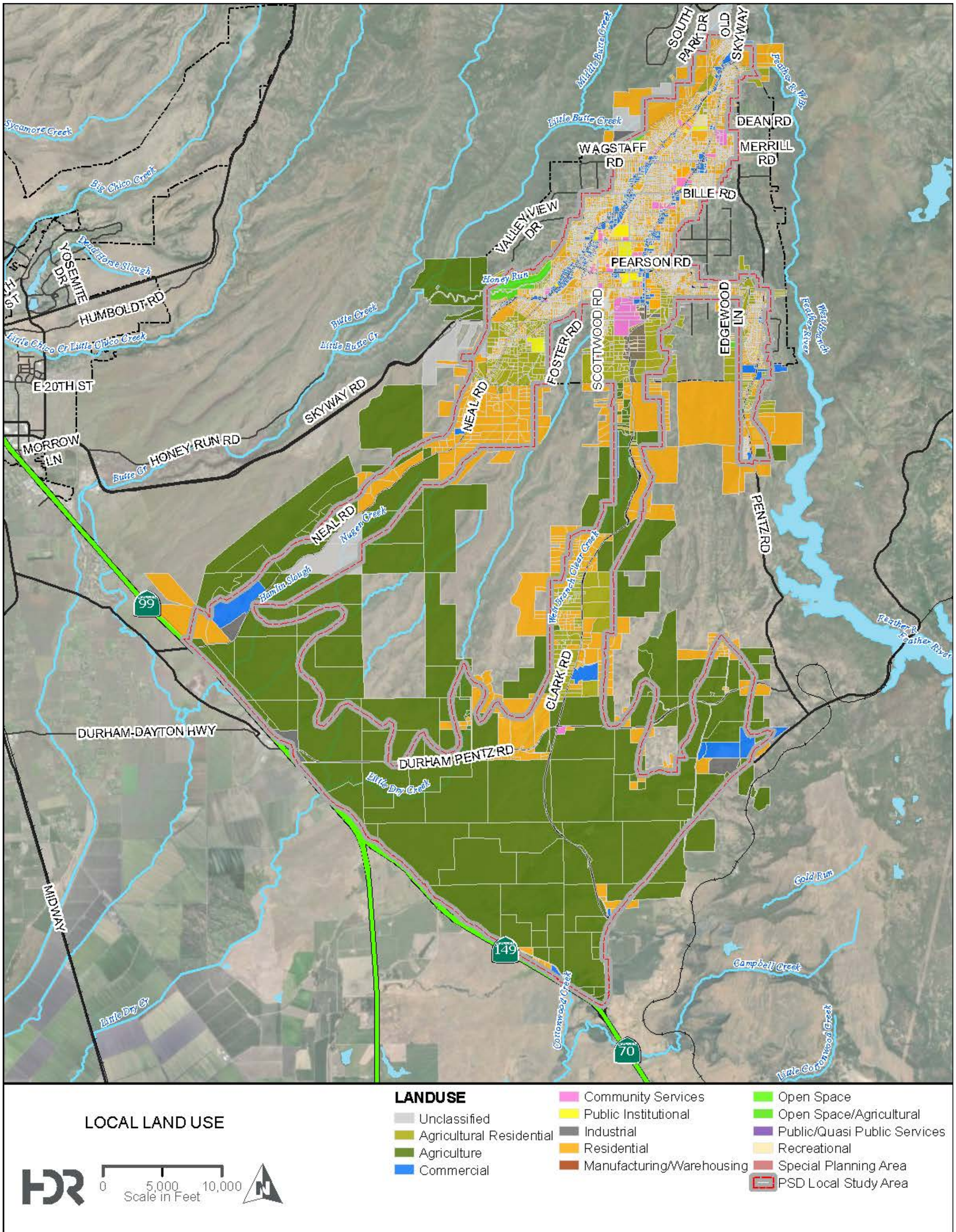

Figure A-3. Land Use

The primary zoning and land uses along the alternative pipeline corridors of Neal Road, Clark Road, and Pearson Road to Pentz Road in Paradise are described in Table A-3. The pipeline would be buried within the roadway corridor and would not present a conflict with zoning or land use in these areas. Under the local alternative, no WWTP, storage reservoir, land application discharge location, or surface water discharge location would be placed within the town limits.

Table A-3. Zoning and Land Use in Pipeline Corridors

Zoning	Land Uses
Neal Road	
Rural Residential (1/2 and 1 acre)	Single-family houses with outbuildings (garage, shed), and possible accessory uses like guest house, storage buildings, recreation facilities, and keeping of livestock
Agricultural Residential (1 acre minimum)	Large residential parcels with accessory agricultural land uses, including raising of livestock and other forms of agricultural production
Clark Road	
Industrial Services	Light industrial and manufacturing uses, warehouses, intensive nonretail commercial uses, and public uses
Agricultural Residential (3 acres minimum)	Large residential parcels with accessory agricultural land uses, including raising of livestock and other forms of agricultural production
Pearson Road to Pentz Road	
Rural Residential (1/2 and 1 acre)	Single-family houses with outbuildings (garage, shed), and possible accessory uses like guest house, storage buildings, recreation facilities, and keeping of livestock
Town Residential (1/3, 1/2, and 1 acre)	Single-family residences on small-sized parcels; no accessory rural land uses, particularly the keeping of livestock
Multiple Family Residential	Multiple-family residential units with residential densities that do not exceed 10 dwelling units per acre and, for mobile home parks, 7 dwelling units per acre
Agricultural Residential (1 acre minimum)	Large residential parcels with accessory agricultural land uses, including raising of livestock and other forms of agricultural production

A.4.2.3 Butte County Land Use and Zoning

Project facilities in Butte County include the pipeline alternatives along Neal, Clark, and Pentz Roads, as well as the WWTP, storage reservoir, and land application or surface water discharge locations. These areas are generally characterized by rural, low-density development and open space. Land use in the areas identified for potential pipeline, WWTP, storage collection system, and land application development are shown in Figure A-3. All areas would require a conditional use permit for development of the WWTP, storage reservoir, and land application or surface water discharge locations.

Neal Road is a two-lane highway. Land adjacent to Neal Road in the northern segment is zoned as Low Density Foothill Residential and Country Residential. There are parcels zoned as Resource Conservation in an area identified as a possible site for the WWTP. The purpose of the Resource Conservation zone is to protect and preserve natural, wilderness, and scientific study areas that are critical to environmental quality in Butte County. This designation allows residential use (one single-family dwelling per 40-acre parcel), and limited recreational and commercial recreational uses that do not detract from the area's value for habitat, open space, or research. South of the Resource Conservation parcels, Neal Road is bordered on both sides by land zoned as Agricultural with 40-acre minimum parcel sizes. The southern segment of the corridor crosses the Neal Road Recycling and Waste Facility overlay zone. The facility is operated by the Butte County Department of Public Works. The overlay zone was established to promote compatible development around the Neal Road Recycling and Waste Facility and to ensure adequate separation between the Neal Road Recycling and Waste Facility and land uses that are potentially incompatible with landfill activities. Another possible location for the WWTP is just north of the Neal Road Recycling and Waste Facility overlay zone.

Clark Road is State Route 191, extending north-south between Paradise and State Route 70. The corridor is predominantly open space and low density residential properties. Paradise Airport is just west of Clark Road, approximately 2 miles south of the Town border. Two general areas are considered possible locations for the WWTP on Clark Road: one north of the airport and one south of the airport. The entrance to Butte College from Clark Road is approximately 6 miles south of the Town border. In this corridor, Clark Road passes land zoned as Public, Foothill Residential, Rural Country Residential, and Agricultural with 40- and 160-acre minimum lot sizes. Land at the intersection of Clark Road and Durham Pentz Road is zoned General Commercial. South of Durham Pentz Road, most of the land is zoned as Agricultural with 160-acre minimum lot sizes. This area south of Durham Pentz Road is included as possible effluent storage and land disposal locations.

Pentz Road is a two-lane highway. The segment of Pentz Road in Butte County would be used for a pipeline corridor to Kunkel Reservoir, which would be the site of the WWTP with discharge to Miocene Canal. Just south of the Town border, land along Pentz Road is zoned for Medium Density Residential and Neighborhood Commercial. Land zoned as Very Low Density Residential borders the road as it continues south to Kunkel Reservoir. The Kunkel Reservoir parcel is zoned as Public and is used for recreational fishing and hiking. Across Pentz Road from the reservoir, land is within a Planned Unit Development. South of Kunkel Reservoir, Pentz Road is a Scenic Highway. The property that includes Kunkel Reservoir and surrounding land is owned by PG&E. PG&E supplies water from Kunkel Reservoir to agricultural users along Miocene Canal by adding 10 cubic feet per second into the canal.

A.4.2.4 Impaired Waters

Figure A-4 presents the locations of impaired waterbodies in the study area. There are no impaired waters, as identified by the California Environmental Protection Agency in accordance with Section 303(d) of the Clean Water Act, within the Town of Paradise; therefore, proposed facility locations in Paradise would not encroach on impaired waterbodies. The pipeline routes along Neal, Clark, and Pentz Roads do not cross impaired waters. The Pentz Road WWTP and Miocene Canal are within the drainage basin of the West Branch of the Feather River, which is an impaired waterbody based on toxicity. Discharge to Miocene Canal would need to demonstrate compatibility with total maximum daily loads for recovery of the impaired waterbody.

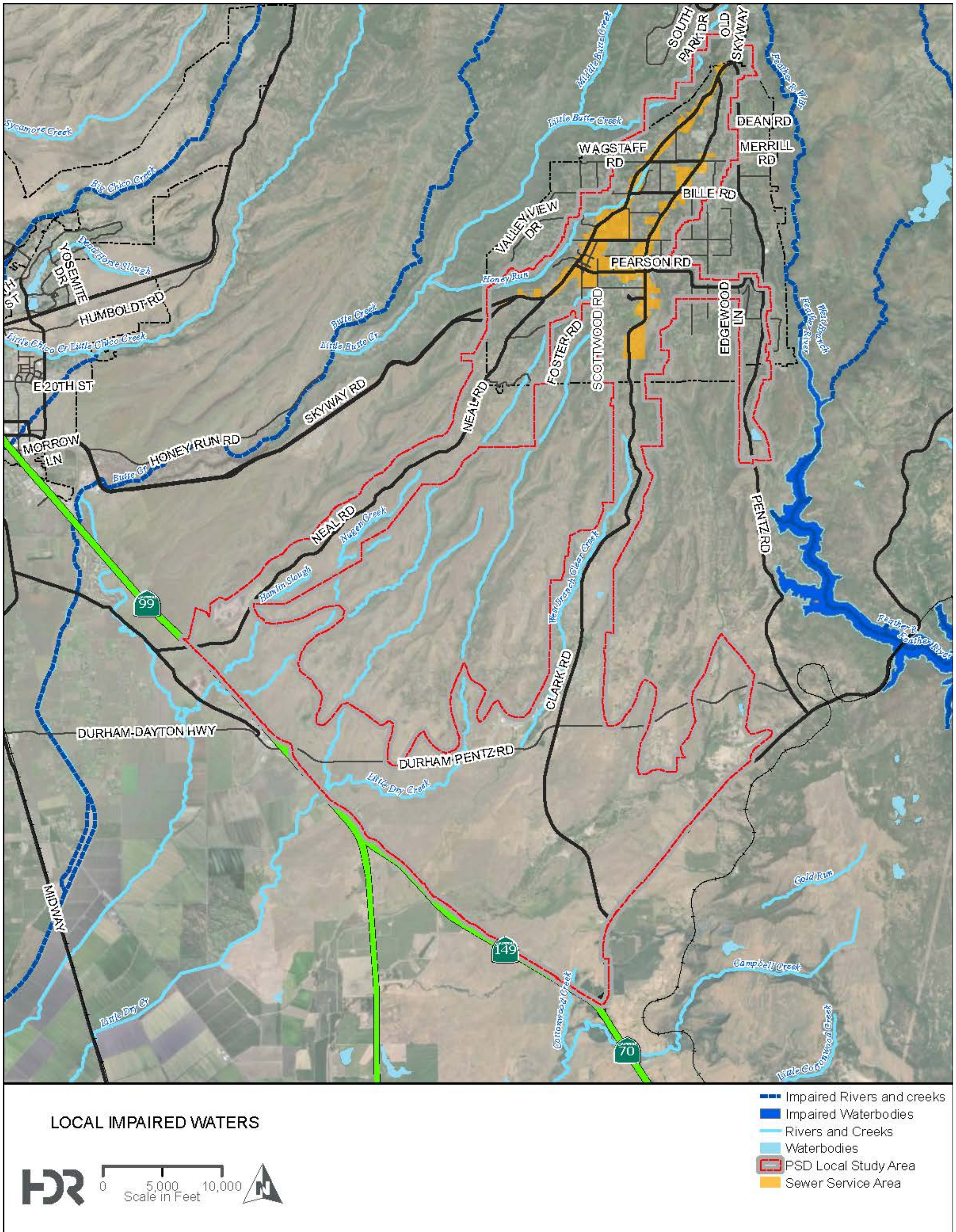

Figure A-4. Impaired Waters

A.4.3 Biological Constraints

This section identifies the biological resources in the study area and the potential constraints that should be considered for development of the WWTP and related facilities. The biological constraints analysis focused on waters of the United States and waters of the state, special-status species and their habitat, and critical habitat. These findings are based on desktop review and are described in the following sections.

A.4.3.1 Waters of the United States and Waters of the State

Section 401 of the Clean Water Act requires any applicant for a federal license or permit to conduct any activity that may result in a discharge of a pollutant into "waters of the United States" to obtain a certification that the discharge will comply with the applicable effluent limitations and water quality standards. The appropriate Regional Water Quality Control Board regulates Section 401 requirements. Section 404 of the Clean Water Act prohibits the discharge of dredged or fill material into "waters of the United States" without a permit from the United States Army Corps of Engineers (USACE). USACE and the United States Environmental Protection Agency administer the Clean Water Act. Waters of the United States include streams that have a defined bed and bank, and wetland areas "that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (33 Code of Federal Regulations [CFR] 328.3).

Waters of the state are regulated by the Regional Water Quality Control Board under the State Water Quality Certification Program, which regulates discharges of dredged and fill material under Section 401 of the Clean Water Act and the Porter-Cologne Water Quality Control Act. Waters of the state are defined as "any surface water or groundwater, including saline waters, within the boundaries of the state."

There are several potential waters of the United States and waters of the state across all components of the study area. Named features such as Hamlin Slough, Clear Creek, and Dry Creek cross the study area, as do extensive seasonal wetland complexes and unnamed agricultural canals and ditches.

As a screening tool in this constraints analysis, aerial imagery was analyzed and existing NWI data imported to show the general location of aquatic features in the study area. An overview of the NWI aquatic features in the study area is shown in Figure A-5, and a more detailed set of figures showing these features at a larger scale is included as Attachment A.1. To determine the precise extent and nature of waters of the United States, waters of the state, and wetlands that could be affected by the Project, a delineation using the standards and procedures presented in the 1987 *Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987) and as clarified in the *Regional Supplement to the Corps of Engineers Wetlands Delineation Manual: Arid West Region* (USACE 2008) to the manual is needed.

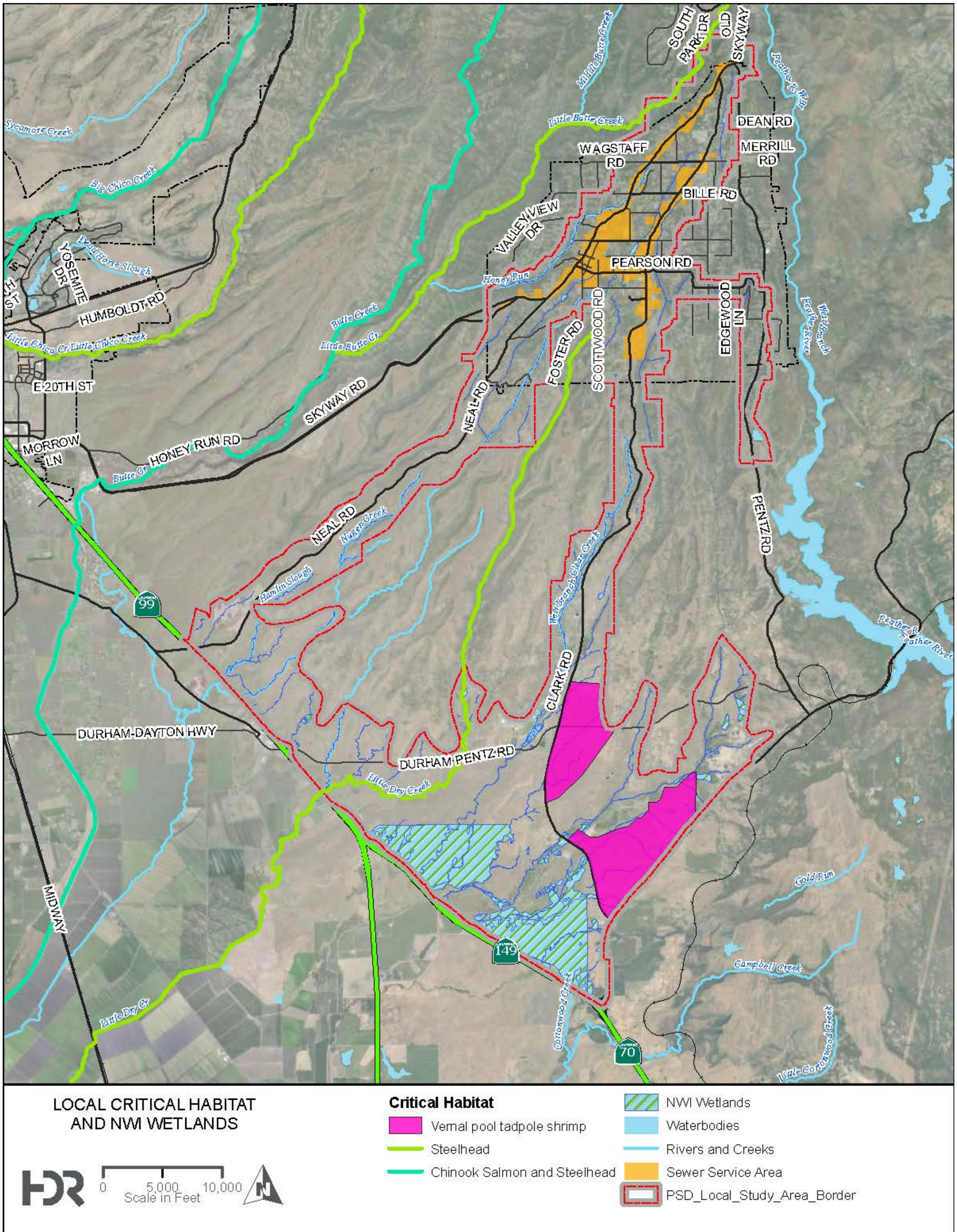

Figure A-5. National Wetlands Inventory Aquatic Features

A.4.3.2 Special-Status Species

Candidate, sensitive, or special-status species are commonly characterized as species that are at potential risk or actual risk in their persistence in a given area or across their native habitat. These species have been identified and assigned a status ranking by governmental agencies such as USFWS and CDFW, and by private organizations such as the CNPS. The degree to which a species is at risk of extinction is the determining factor in the assignment of a status ranking. Some common threats to a species' or population's persistence include habitat loss, degradation, and fragmentation, as well as human conflict and intrusion. For the purposes of this constraints analysis, special-status species are defined as follows:

- Listed, proposed, or candidates for listing under the federal Endangered Species Act (FESA; listed –50 CFR 17.11; candidates – 61 Federal Register 7591, February 28, 1996)
- Listed or proposed for listing under the California Endangered Species Act (CESA; California Fish and Game Code [FGC] 1992 Section 2050 et seq.; 14 California Code of Regulations [CCR] Section 670.1 et seq.)
- Designated as a Species of Special Concern (SSC) by CDFW
- Designated as Fully Protected (FP) by CDFW (FGC Sections 3511, 4700, 5050, 5515)
- Species that meet the definition of rare or endangered under CEQA (14 CCR Section 15380), including CNPS List Rank 1B and 2

A list of special-status species that have the potential to occur in the study area was prepared using information obtained from the USFWS Information for Planning and Conservation (IPaC) database, the USFWS Critical Habitat Portal, the CDFW California Natural Diversity Database (CNDDB), and the CNPS Inventory of Rare and Endangered Plants of California. A search of the USFWS IPaC database was performed to identify species under USFWS jurisdiction that may be affected by the proposed Project. In addition, the USFWS Critical Habitat Portal was queried to identify designated critical habitat in or adjacent to the study area. The CNDDB query provided a list of occurrences of special-status species identified within the United States Geological Survey (USGS) 7.5-minute quadrangles that are encompassed by all of the project components and the USGS quadrangles surrounding them. The CNPS database was also queried to identify those plant species classified as rare under the California Rare Plant Rank system with the potential to occur within the same USGS quadrangles.

The list of special-status species that have the potential to occur in the study area is provided in Attachment A.2, Table A.2-1. Table A.2-1 includes a compiled list of all special-status species identified in the search results, the habitat requirements for each species, and conclusions regarding the potential for each species to occur in which components of the proposed project area.

A.4.3.3 Wildlife Habitat

Wildlife habitat in the study area is classified according to the CWHR system. Attachment A.2, Table A.2-2 lists the CWHR habitat types present across the study area, and summarizes the species determined to have the potential to be affected by project-related activities based on the more detailed habitat requirements in Attachment A.2, Table A.2-1. The CWHR habitats listed in the table are meant as a high-level reference to where these species could occur in the project area. The locations and extent of these habitats have not been verified in the field and species could potentially use habitats other than those identified in Attachment A.2. An overview of CWHR habitat types in the study area is shown in Figure A-6, and a more detailed set of figures showing the study area at a larger scale is included as Attachment A.3.

A.4.3.4 Critical Habitat

When USFWS lists a species as threatened or endangered under the FESA, areas of habitat considered essential to its conservation and survival may be designated as critical habitat. These areas may require special consideration and/or protection because of their ecological importance.

There are two critical habitat units for vernal pool tadpole shrimp (*Lepidurus packardi*) present in the potential land discharge portion of the study area. These units are situated just east of Clark Road between the Foothills Mobile Home Park and the junction of Highway 70 and Table Mountain Road.

Little Butte Creek and Little Dry Creek are critical habitat for Central Valley steelhead (*Oncorhynchus mykiss irideus*), while Butte Creek is critical habitat for both steelhead and Chinook salmon (*Oncorhynchus tshawytscha*). Critical habitat in the study area is shown along with the NWI aquatic features in Figure A-5 and Attachment A.1.

A.4.3.5 Biological Constraints Summary

Table A-4 lists the biological constraints that have the greatest potential to occur in the study area and for which federal, state, or local regulations dictate that survey work should be conducted.

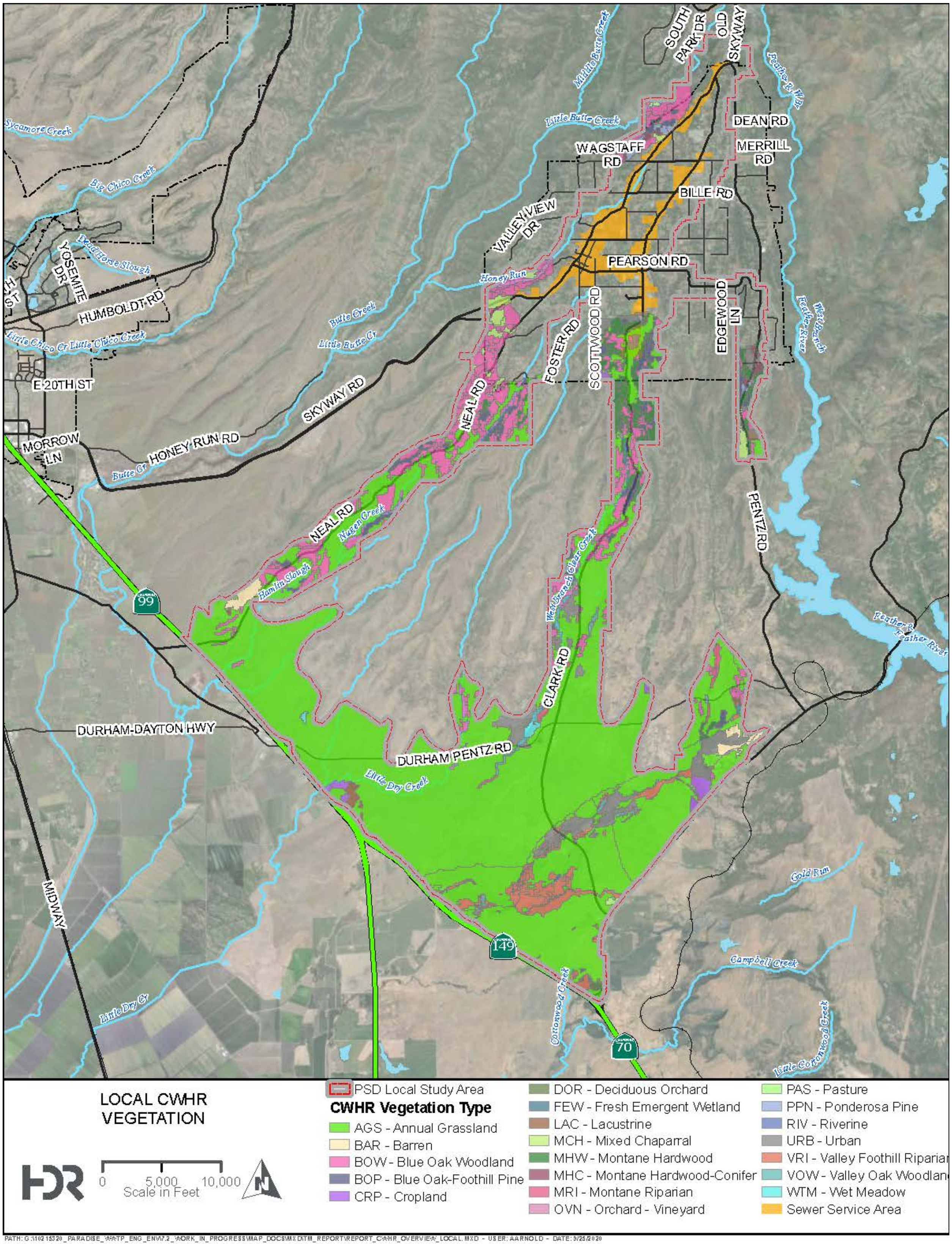

Figure A-6. California Wildlife Habitat Relationships Habitat Types

Table A-4. Biological Constraints with the Potential to Occur in the Study Area

Potential Constraint	Project Component	Regulatory Protection	Survey Work Recommended
Rare plants (general)	Applies to all project components	Plants classified as rare in the California Rare Plant Rank system are protected under CEQA.	Rare plant surveys conducted during appropriate seasons according to the overlapping blooming periods of plant species identified as having potential to occur in the study area. An early season survey in April and a late season survey in July would capture the blooming periods of all such plants as shown in Attachment A.2.
Butte County meadowfoam	Local WWTP Site – Neal Road South and Clark Road South Pipeline/Infrastructure – Neal Road South and Clark Road South, Land Discharge	FE / SE	**Critical habitat** for this species is present immediately adjacent to the southern end of the potential land discharge portion of the study area. If this plant species is found during general rare plant surveys, more extensive surveys to quantify the extent of its presence in the study area should be conducted.
Vernal pool obligate rare plants	Local WWTP Site – Neal Road South, Pipeline/Infrastructure – Neal Road, Land Discharge	Hoover's spurge (FT) hairy Orcutt grass (FE / SE) Greene's tuctoria (FE / SR)	If habitat assessment / wetland delineation efforts identify vernal pool features within the study area, then surveys for these species should be conducted within those features during their overlapping blooming period (Jul-Sep).
Vernal pool crustaceans	Local WWTP Site – Neal Road South, Pipeline/Infrastructure – Neal Road South, Land Discharge	Conservancy fairy shrimp (FE) vernal pool fairy shrimp (FT) vernal pool tadpole shrimp (FE)	**Critical habitat** for vernal pool tadpole shrimp is present within the potential land discharge portion of the study area. If habitat assessment / wetland delineation efforts identify vernal pool features within the study area, then presence of special-status vernal pool crustacean species will be assumed, and a Biological Opinion or Concurrence will be sought from USFWS.
Valley elderberry longhorn beetle	Local WWTP Site – Neal Road South, Pipeline/Infrastructure – Neal Road South, Land Discharge	FT	If habitat assessment efforts identify elderberry shrubs within the study area, then those shrubs should be mapped and investigated for sign of the presence of this species. The 2017 USFWS Framework for Assessing Impacts to the valley elderberry longhorn beetle (VELB) states the following: *The majority of VELB have been documented below 152 meters (500 feet) in elevation. Areas above 152 meters (500 feet) with suitable habitat and known VELB occurrences in that drainage may contain VELB populations in certain circumstances. The Service can assist in determining the likelihood of occupancy above 500 feet.* Much of the study area is above 500 feet. However, there is a CNDDB occurrence of the species from along the Feather River well east of the study area. If elderberry shrubs are found during habitat assessment, it is recommended that informal consultation with USFWS be carried out to determine next steps.

Potential Constraint	Project Component	Regulatory Protection	Survey Work Recommended
Anadromous fish (Central Valley steelhead and Central Valley spring-run chinook salmon)	Collection System, Local WWTP Site – Clark Road and Neal Road, Pipeline/Infrastructure – Pearson/Pentz Roads, Clark Road and Neal Road, Land Discharge	both FT / (chinook is FT / ST)	**Critical habitat** for steelhead is present in Little Butte Creek on the outskirts of the Collection System portion of the study area, and Little Dry Creek within the Land Discharge portion of the study area. **Critical habitat** for steelhead as well as chinook salmon is present in Butte Creek just to the north and west of the study area. These species could occur in multiple creek systems across the study area. A detailed assessment of the creeks within the study area is recommended and depending on results, a National Marine Fisheries Service (NMFS) Biological Assessment may be required if work is to affect these creek systems.
Foothill yellow-legged frog	Applies to all project components	ST / SSC	This species could occur in multiple creek systems across the study area and there are multiple known occurrences of the species from within the study area. Protocol surveys are recommended and depending on results, an Incidental Take Permit (2081) from CDFW may be required.
California red-legged frog	Collection System, WWTP Site – Kunkle, Surface Water Discharge – Kunkle, Pipeline/Infrastructure – Pearson/Pentz Roads	FT / SSC	There appears to be some appropriate habitat for this species within the study area. However, protocol surveys will likely not be necessary as the nearest occurrences of this species are well to the east.
Giant gartersnake	Local WWTP Site – Neal Road South, Land Discharge	FT / ST	Any appropriate habitat for the species should be mapped during habitat assessment. Protocol surveys will likely not be necessary as the nearest occurrences of this species are well to the west.
Tricolored blackbird	Local WWTP Site – Neal Road South, Pipeline/Infrastructure – Neal Road South, Land Discharge	ST / SSC	This species is highly colonial and a colony has been present in the past near the south end of the potential land discharge portion of the study area. If during the habitat assessment appropriate nesting habitat for the species is found and the species is detected, then protocol surveys for the species may be warranted.
Western burrowing owl	Local WWTP Site – Neal Road, Pipeline/Infrastructure – Neal Road South, Land Discharge	SSC	Protocol surveys will likely not be necessary as the nearest occurrences of this species are well to the west. Nevertheless, all small mammal burrow complexes will be mapped and assessed for sign of this species.

Potential Constraint	Project Component	Regulatory Protection	Survey Work Recommended
Bald and golden eagles	Collection System, Local WWTP Site – Kunkle and Clark Road North, Pipeline/Infrastructure – Clark Road North, Pearson/Pentz Roads	BAGEPA	Large nests of bald and potential nest sites of golden eagles should be mapped during habitat assessment. Any such nests or nest sites should then be observed during subsequent avian surveys.
Swainson's hawk	Local WWTP Site – Neal Road South, Pipeline/Infrastructure – Neal Road South, Land Discharge	ST	Any large nests in appropriate (oak savanna or cottonwood riparian) habitat should be assessed for this species during habitat assessment. Protocol surveys will likely not be necessary as the nearest occurrences of this species are well to the west.
White-tailed kite	Local WWTP Site – Neal Road South, Pipeline/Infrastructure – Neal Road South, Land Discharge	SFP	Any large nests in appropriate (oak savanna or willow riparian) habitat should be assessed for this species during habitat assessment. Any such nests or nest sites should then be observed during subsequent avian surveys.
American peregrine falcon	Collection System, Local WWTP Site – Kunkle and Clark Road North, Pipeline/Infrastructure – Clark Road North, Pearson/Pentz Roads	SFP	While there are multiple known occurrences of this species from within the study area, the species is more likely to forage in the study area than nest there. There isn't likely to be appropriate nesting habitat for this species in the study area, but that will be more precisely determined during habitat assessment.
California black rail	Local WWTP Site – Clark Road South Pipeline/Infrastructure – Clark Road South, Land Discharge	ST / SFP	There are multiple known occurrences of this species from wetland habitats in the region, including one from within the potential land discharge portion of the study area. Careful assessment of wetland habitats in the study area for their suitability to the needs of this species, may determine that protocol surveys are warranted, and depending on results, informal consultation with CDFW may be recommended, and they may determine an Incidental Take Permit (2081) is required.
Little willow flycatcher	Collection System, Pipeline/Infrastructure – Pearson/Pentz Roads	SE	This species could occur at the highest elevation portions of the study area. The potential for this species to occur in the study area will be assessed in greater detail during the habitat assessment effort, and it may be determined that protocol surveys are warranted, but this is unlikely.
California spotted owl	Collection System, Pipeline/Infrastructure – Pearson/Pentz Roads	SSC	This species could occur at the highest elevation portions of the study area. The potential for this species to occur in the study area will be assessed in greater detail during the habitat assessment effort, and it may be determined that protocol surveys are warranted.

Potential Constraint	Project Component	Regulatory Protection	Survey Work Recommended
Fisher (West Coast DPS)	Collection System, Pipeline/Infrastructure – Pearson/Pentz Roads	ST / SSC	This species could occur at the highest elevation portions of the study area. The potential for this species to occur in the study area will be assessed in greater detail during the habitat assessment effort, and it may be determined that protocol surveys are warranted, but this is unlikely.
Nesting birds	Applies to all project components	California Fish and Game Code (CFGC)	The active nests of most native bird species are CFGC protected, and preconstruction surveys for nesting birds will be required prior to any ground disturbance or vegetation disturbance associated with the project.
Roosting bats	Applies to all project components	SSC	During the habitat assessment effort, any potential bat roosts (bridges, overpasses, buildings, large hollow trees) will be assessed in detail for their suitability and examined closely for sign of bat use. If it is determined that a site is likely used by roosting bats, protocol surveys will be conducted.

Status: Federal Endangered (FE); Federal Threatened (FT); State Endangered (SE); State Threatened (ST); State Candidate Endangered (SCE); State Fully Protected (SFP); State Rare (SR); State Species of Special Concern (SSC); Bald and Golden Eagle Protection Act (BGEPA)

A.4.4 Sensitive Cultural and Tribal Resources

This section represents a preliminary, high-level review of potential cultural resources constraints in the local Project alternatives study area and the area within a 0.25-mile buffer surrounding the study area.[2] The review should not be considered an identification effort sufficient to complying with local, state, or federal laws. It is recommended that prior to finalizing conceptual design, an archaeological resources inventory and tribal cultural resources study be conducted in compliance with appropriate regulatory framework, including consultation with the appropriate agencies and Native American tribes. About half of the study area has been previously surveyed for archaeological sites; however, most of these surveys occurred over 10 years ago. Professional cultural resources investigations methods and standards change over time, plus environmental factors can expose previously buried cultural resources, bury previously exposed cultural resources, or cause changes to the conditions of previously recorded resources, necessitating the need to conduct new field studies to confirm site locations, assess the current condition of sites, and to find and document previously unknown cultural resources that may exist within the study area.

Based on the records search review described in Section A.4.4.1, the study area exhibits a moderate to high sensitivity for prehistoric, ethnographic, and historical features and buildings in the vicinity of known cultural resources and is largely contingent on proximity to historic roadways, residences, and the town of Paradise, as shown in Figure A-7. Proposed Project activities have the potential to impact any of the cultural resources identified through these efforts and described below, should they be identified within, or potentially in the vicinity of, a proposed work area. Maps depicting archaeological and sensitive Native American site locations are not to be included in copies of documents for general distribution. Archaeological site locations are exempted from the California Public Records Act, as specified in Government Code 6254.10, and from the Freedom of Information Act (Exemption 3), under the legal authority of both the NHPA (PL 102 574, Section 304[a]) and the Archaeological Resources Protection Act (PL 96 95, Section 9[a]).

2 This research includes a 0.25-mile buffer surrounding the study area to gather information on potential constraints to provide flexibility in project planning should the study area require expansions for any reason beyond the study area.

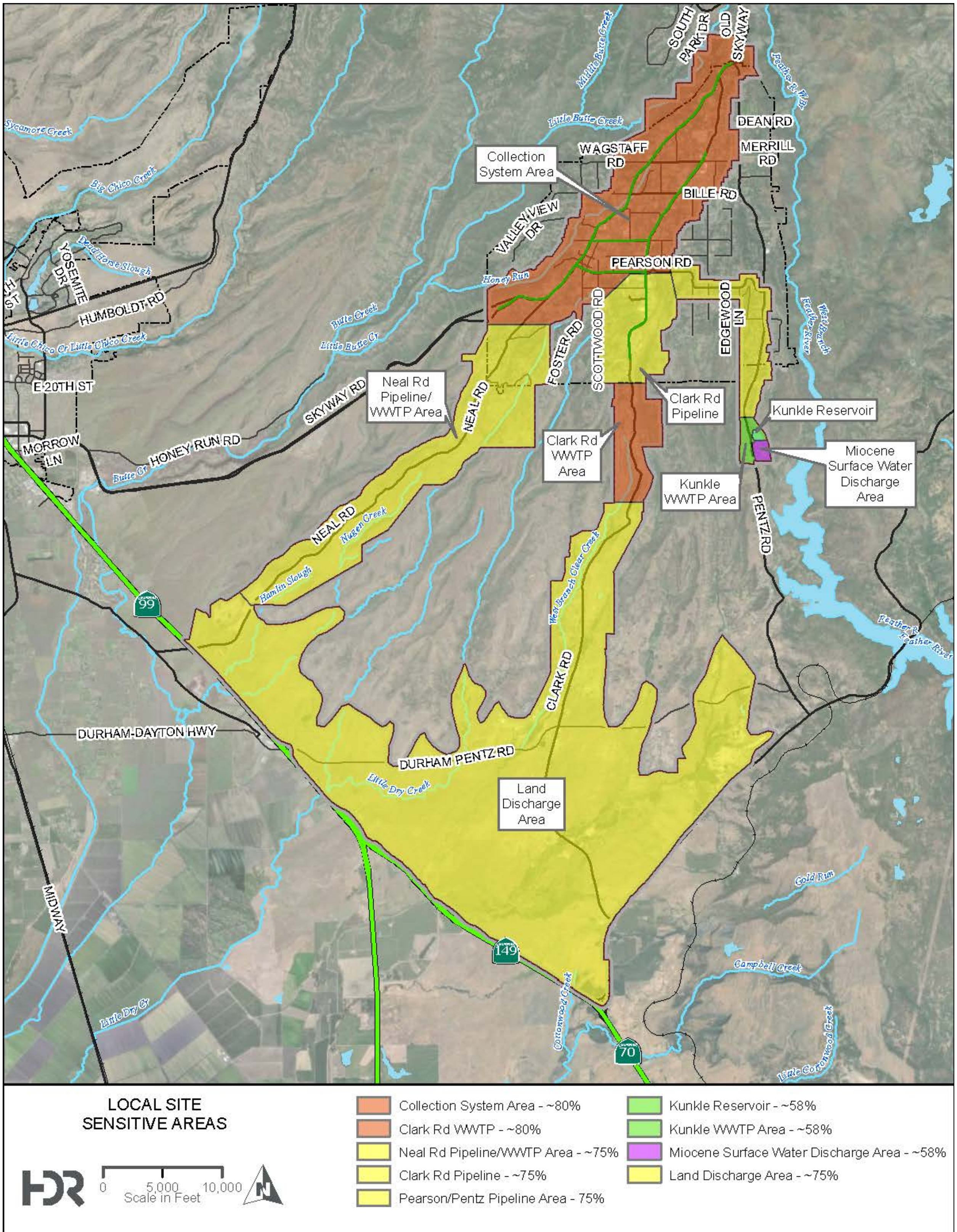

Figure A-7. Sensitivity for Cultural and Tribal Sites

A.4.4.1 Records Search and Results

HDR reviewed records from the California Historical Resources Information System (CHRIS), Northeast Information Center (NEIC) at California State University, Chico, in June and August 2020 to identify previous cultural resources investigations and previously recorded archaeological and historic-period properties within the study area. This research also served to obtain background information pertinent to understanding the archaeology, historical built environment, history, and ethnohistory of the Project vicinity. Relevant data on file at the NEIC included cultural resource records, cultural resource investigation reports, resource location maps, and historic-era maps, National Register of Historic Places (NRHP) listings, California Register of Historical Resources (CRHR) listings, Office of Historic Preservation (OHP) Archaeological Determinations of Eligibility and Built Environment Resource Directory (BERD), 2012 California State Historic Landmarks, 1976 California Inventory of Historic Resources, and the Built Environment Resource Directory. A summary of the information gathered during the records search is provided below, and supporting data is included in a confidential attachment to this memo (see Confidential Attachment A.4).

HDR identified a total of 182 previous cultural resources investigations or related communications within the study area and 0.25-mile buffer (see Confidential Attachment A.4). A total of 57 investigations were conducted within the study area only, 59 investigations were conducted in areas overlapping the study area and the 0.25-mile buffer around the study area, 56 were conducted within the 0.25-mile buffer only, and another 10 investigations were conducted within the 0.25-mile buffer and were immediately adjacent to the study area. The types of investigations previously conducted were for utility projects, private property and development projects, transportation projects, a landfill development, a vernal pool preserve, and tree improvement center projects. No tribal cultural resources were listed in the records search. Most of these investigations (n=162) occurred 10 or more years ago.

A total of 144 cultural resources have been formally recorded within the study area and 0.25-mile buffer examined by HDR and include 11 prehistoric isolated finds,[3] three historic-period isolated finds; 45 prehistoric archaeological sites, 25 historic-period archaeological sites, five multicomponent archaeological sites,[4] and 55 built-environment resources. An additional seven informally documented resources were also identified in the area and consist of two prehistoric archaeological sites and five possible multicomponent archaeological sites.[5]

A review of the United States Geological Survey (USGS) Chico (1949) 15', Paradise, California (1953) 15', and Oroville, California (1944) 15' topographic quadrangle maps was conducted to identify potential cultural resources that may be present in the study area but that may not yet be formally documented, not on file with the NEIC, and subsequently not included in the results of the NEIC records search. This review indicates that Paradise, Southern Pacific Railroad, Crouch Ravine, Coon Ridge, The Narrows, Nugen Canyon, Neal Highway, Clear Creek, Comanche Creek, Clark Road, Honey Run Creek, US Plant Introduction Gardens, Butte Creek, tailings, roads, and

3 Prehistoric isolates are defined herein as three or less artifacts (flakes, groundstone, etc.) per 50 square meters. Prehistoric isolated features, such as a bedrock mortar (BRM), are not treated as isolated finds, but as sites. Historic isolates consist of three or less artifacts per 50 square meters (i.e., several fragments from a single glass bottle are one artifact).

4 Multi-component sites are sites that have both prehistoric and historic-period artifacts and/or features.

5 These sites were not formally recorded on Department of Parks and Recreation forms and submitted to the CHRIS system for recordation, but the information was captured in reporting.

structures are within the study area and a 0.25-mile buffer, either wholly or partially, and may be considered historic properties which may need to be avoided by the Project, or taken into account to address Project impacts if they cannot be avoided.

Evaluations of resources for their potential eligibility to the NRHP and CRHR assist in determining whether significant resources (i.e., historic properties[6] and historical resources[7]) are present in a project's boundary and, subsequently, whether a project is having any effects on eligible properties. Of the total 144 cultural resources, 59 were evaluated for eligibility to be listed on the NRHP and/or CRHR.[8] Of these 59 evaluated resources, 55 were found to not be eligible for listing on the NRHP, one was evaluated as potentially eligible for both the NRHP and CRHR (P-04-1324/499461/499462), one is listed in the NRHP (P-04-3084), and two are recommended not eligible for the CRHR but remain unevaluated for the NRHP. Of note, many of the resources identified within the study area and 0.25-mile buffer were damaged or completely destroyed by the Camp Fire after recordation and evaluation efforts captured in the records search. The potentially eligible (P-04-1324/499461/499462) and one eligible (listed) resource (P-04-3084) are both built environment resources and both appear to have been completely destroyed by the fire from a desktop review of Google Earth and will need to be reassessed for eligibility and integrity if the Project design is unable to avoid them. Reassessment would include a field visit, documentation of current condition and integrity, and consultation the State Historic Preservation Officer. No previously recorded archaeological sites identified during the records search were evaluated as eligible for listing on the NRHP or CRHR and a majority (n=68) remain unevaluated for their potential to be listed on the NRHP or the CRHR.

Under both state and federal statutory requirements, eligible and unevaluated resources <u>that cannot be avoided</u> by the Project must be considered for CRHR and/or NRHP eligibility in order to address Project impacts/effects. Records searches only demonstrate site density within areas that have been previously surveyed. As the above summary demonstrates, numerous previously recorded but unevaluated resources are located throughout the Project study area. However, archaeological and built environment site locations are largely conditioned by the absence/presence of previous cultural resource surveys, i.e. the areas densest with previously recorded resources are also the same areas which have been subject to previous surveys. Additionally, sensitivity for prehistoric archaeological sites is based on a series of variables (landform, proximity to fresh water and tool stone, access to preferred resources, etc.) that are not necessarily equivalent to the variables associated with the absence or presence of historic-era archaeological sites. Accordingly, the absence/presence of previously recorded archaeological and built environment resources do not suggest superiority of any of the local alternatives.

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[6] Historic Properties are prehistoric or historic sites, buildings, structures, objects, districts, or traditional cultural properties included in, or eligible for inclusion in, the NRHP. Historic properties are identified through a process of evaluation against specific criteria found at 36 CFR § 60.4.

[7] Historical Resources are prehistoric or historic sites, buildings, structures, objects, districts, or traditional cultural properties included in, or eligible for inclusion in the CRHR.

[8] Isolates typically do not provide enough data relevant to understanding past events to meet the NRHP significance criteria and are therefore not considered for potential listing on the NRHP or CRHR. Thus the isolated artifacts will not add constraints to the Project.

A.4.4.2 Tribal Cultural Resources and Potentially Interested Native American Contacts

Table A-5 provides a list of tribes and tribal individuals who may have an interest in the Project and expert knowledge of cultural resources of importance to Native American tribes with ancestral ties to the Project area. A search of the Sacred Lands File (SLF) at the Native American Heritage Commission (NAHC) found no sacred lands in the study area or 0.25-mile buffer; however, the absence of specific site information in the SLF does not indicate the absence of cultural resources (see Confidential Attachment A.4).

Table A-5. Tribes and Tribal Representatives Identified by the Native American Heritage Commission Who May Have an Interest in the Project

Tribe	Tribal Representative
Enterprise Rancheria of Maidu Indians of California	Glenda Nelson, Chairperson Reno Franklin, THPO
Grindstone Indian Rancheria of Wintun-Wailaki Indians of California	Ron Kirk, Chairperson
KonKow Valley Band of Maidu	Jessica Lopez, Chairperson
Mechoopda Indian Tribe	Dennis Ramirez, Chairperson Kyle McHenry, THPO
Mooretown Rancheria of Maidu Indians	Benjamin Clark, Chairperson Guy Taylor, Representative
Shoshone Tribe of the Wind River Reservation, Wyoming	Vernon Hill, Chairperson Joshua Mann, THPO
Tsi Akim Maidu	Don Ryberg, Chair

Sources: Native American Heritage Commission (NAHC) letter July 1, 2020; data from Tribal Assessment Directory Tool (TDAT) developed by the Office of Environment and Energy (OEE), accessed July 23, 2020.

Tribal Cultural Resources (TCRs) are defined as a site, feature, place, cultural landscape, sacred place or object, which is of cultural value to a California Native American Tribe, and that is either listed on, or eligible for listing on, the CRHR or a local historical register. Additionally, a project's lead agency, at its discretion, may choose to treat a resource as a TCR (PRC 21074 (a)(1)(A)-(B)). Traditional Cultural Properties (TCPs) are locations associated with cultural practices or beliefs of a living community that are: 1) rooted in that community's history; or 2) important in maintaining the continuing cultural identity of a community, and that are listed on or eligible for listing on the NRHP. No TCRs or TCPs were identified in the records search, however, the absence of recorded TCRs and TCPs does not indicate the absence of cultural resources. Indian Trust Assets (ITAs) are legal interests in property held in trust by the United States for Native American tribes or individuals. The Mechoopda Indian Tribe owns lands held in trust within the study area on the east side of the intersection of Highway 99 and Highway 149. Tribal consultation with the Mechoopda Indian Tribe will be necessary to identify potential impacts/effects to ITA.

A.1

National Wetlands Inventory Aquatic Features and Critical Habitat

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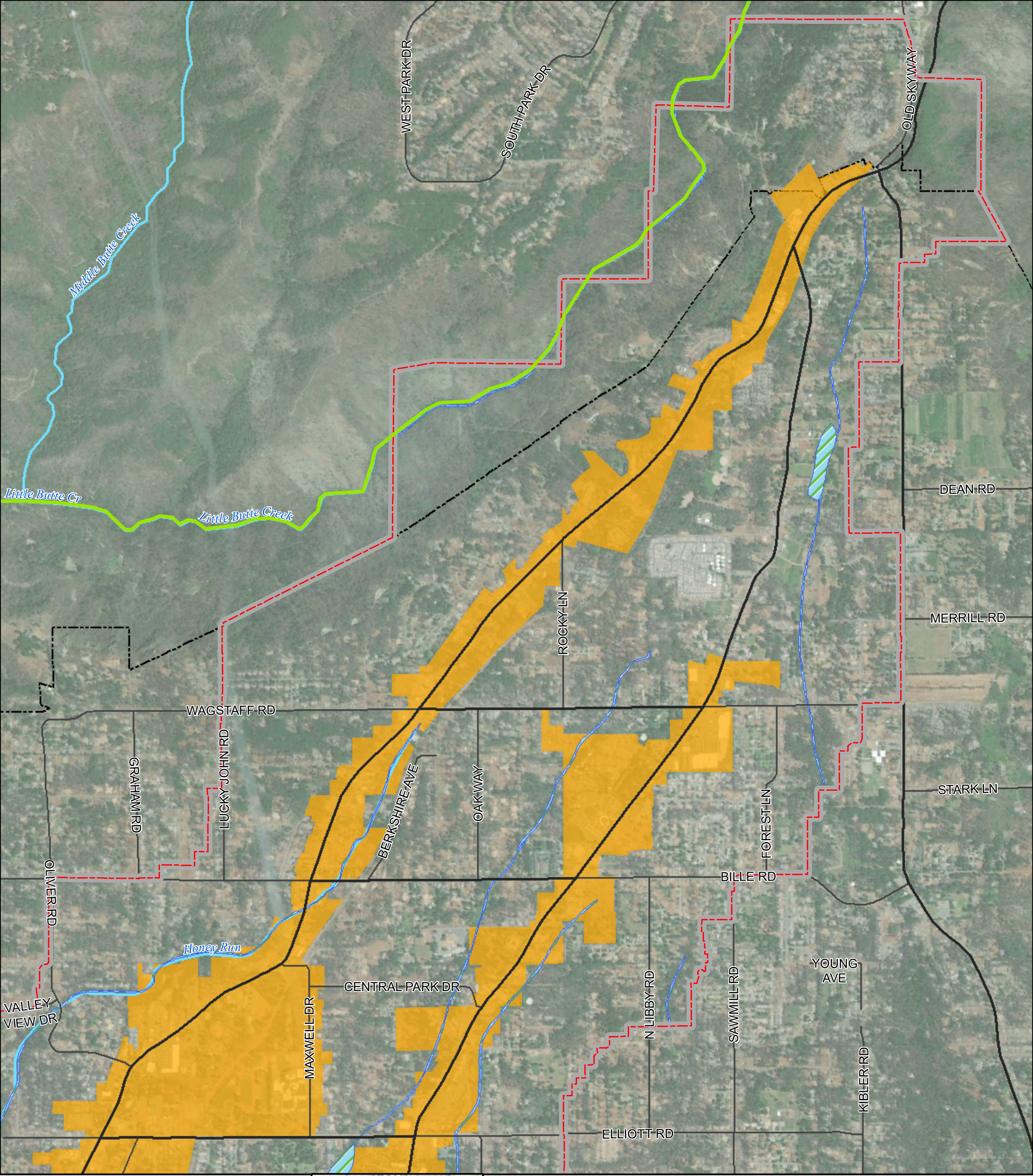
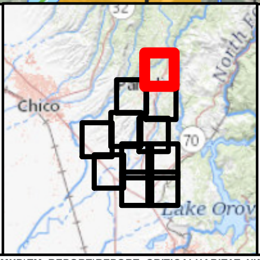


LOCAL CRITICAL HABITAT AND NWI WETLANDS



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Critical Habitat

- Vernal pool tadpole shrimp
- Chinook Salmon and Steelhead
- Steelhead
- NWI Wetlands
- Waterbodies
- Rivers and Creeks
- Sewer Service Area

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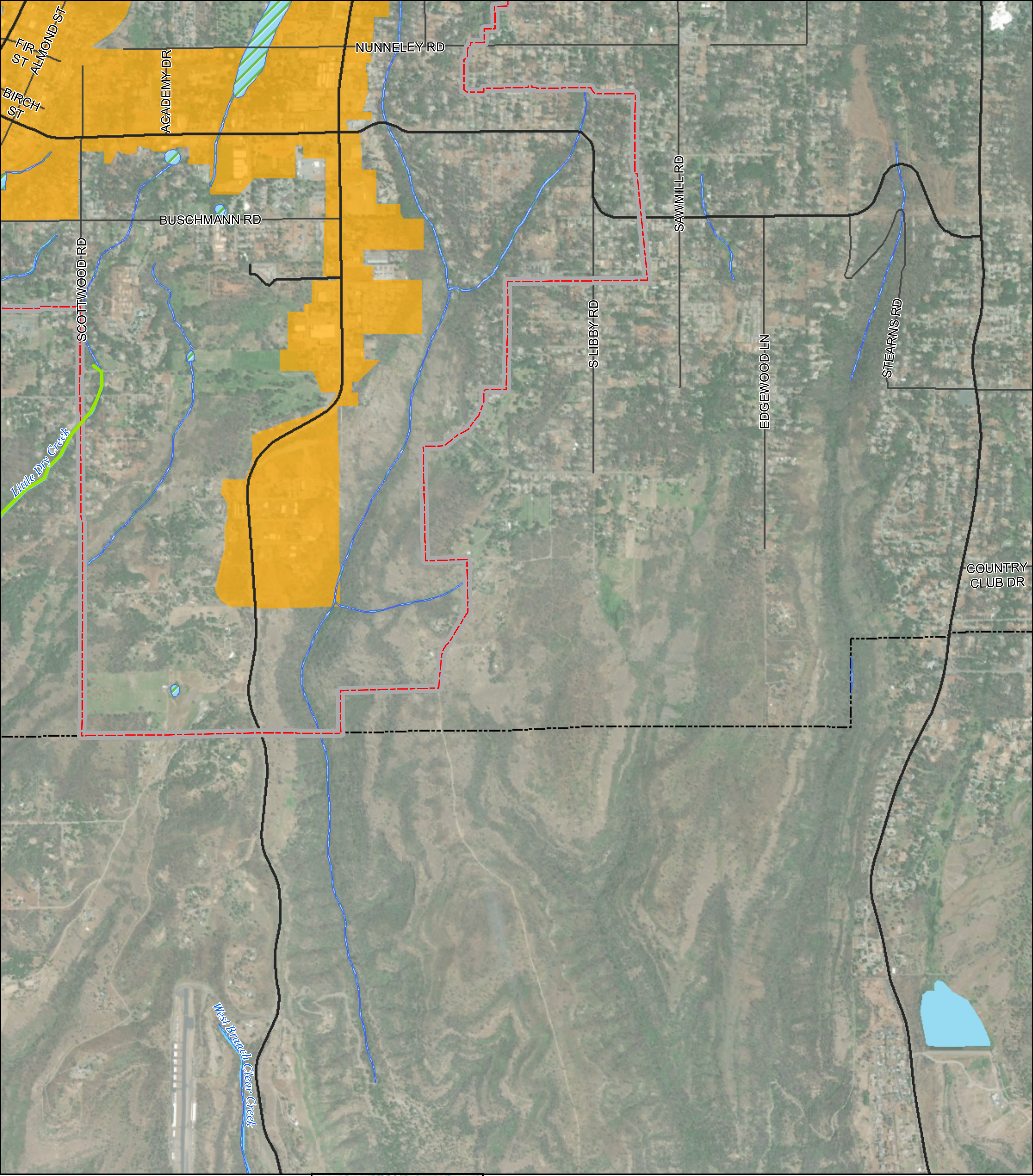

LOCAL CRITICAL HABITAT AND NWI WETLANDS

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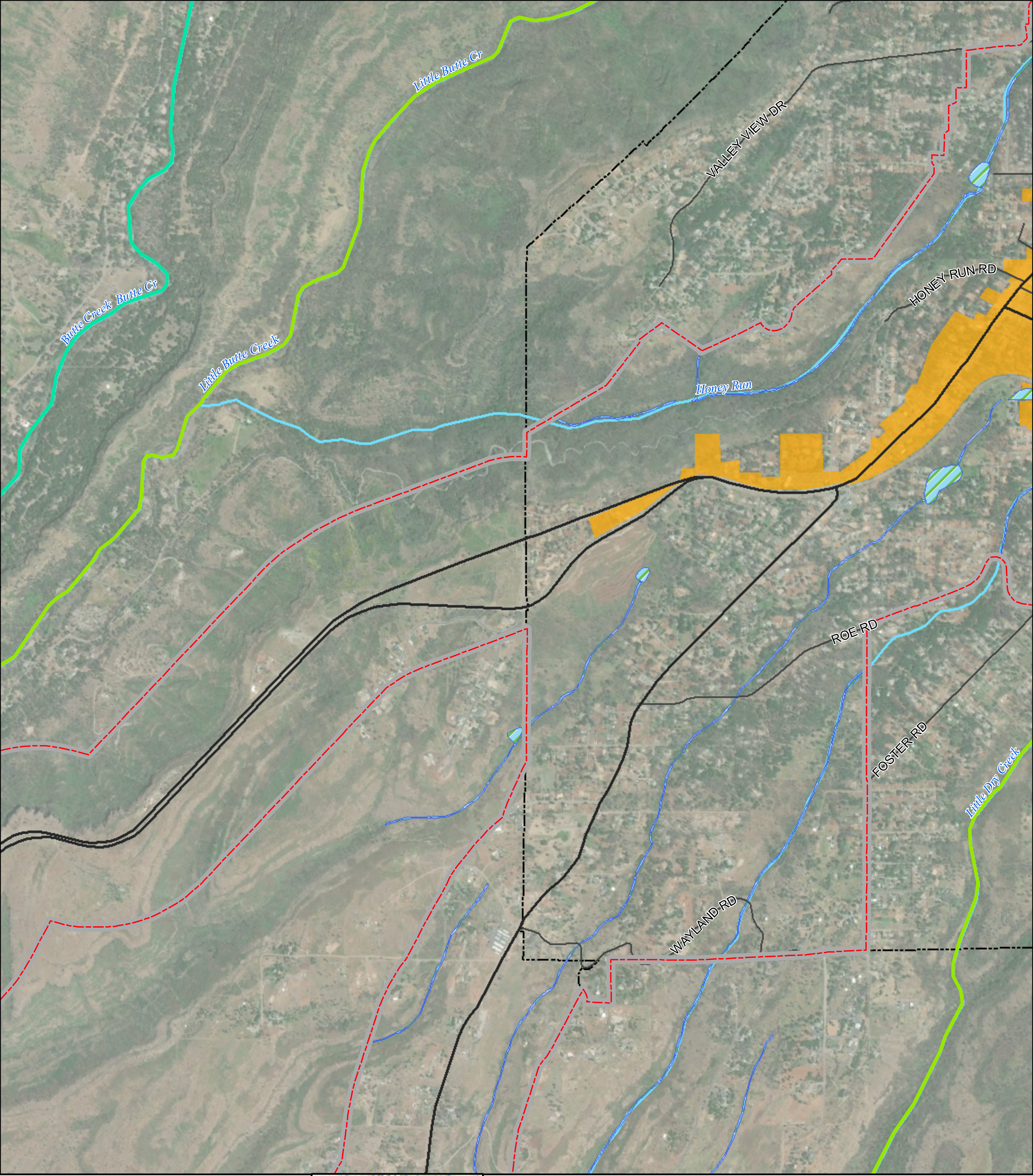

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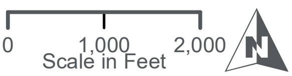

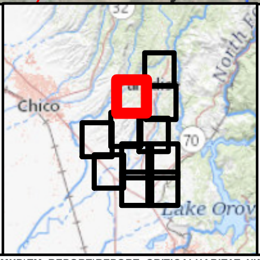

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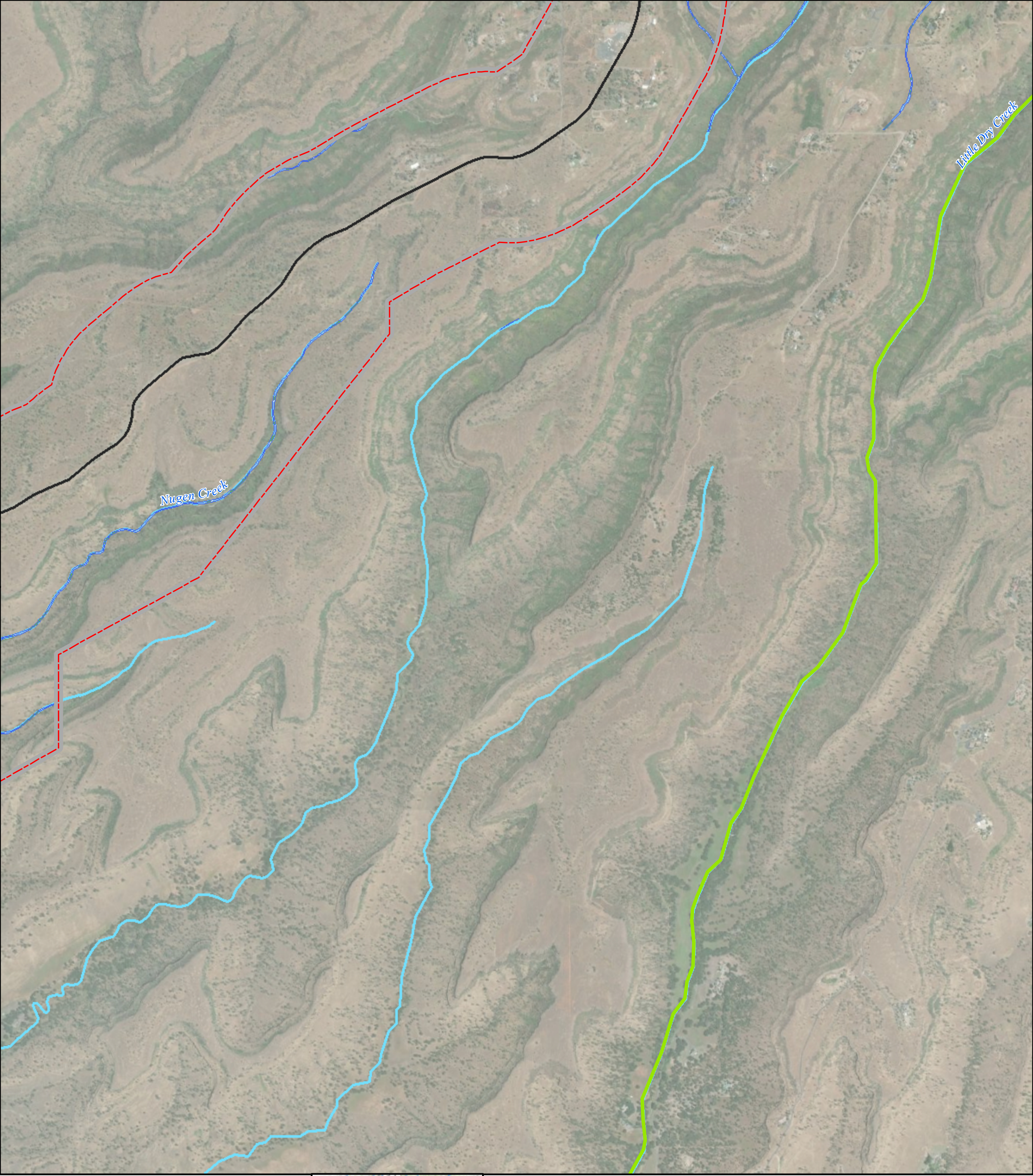

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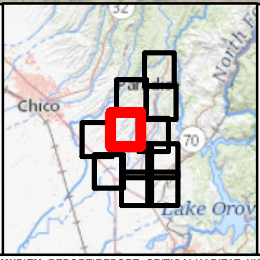

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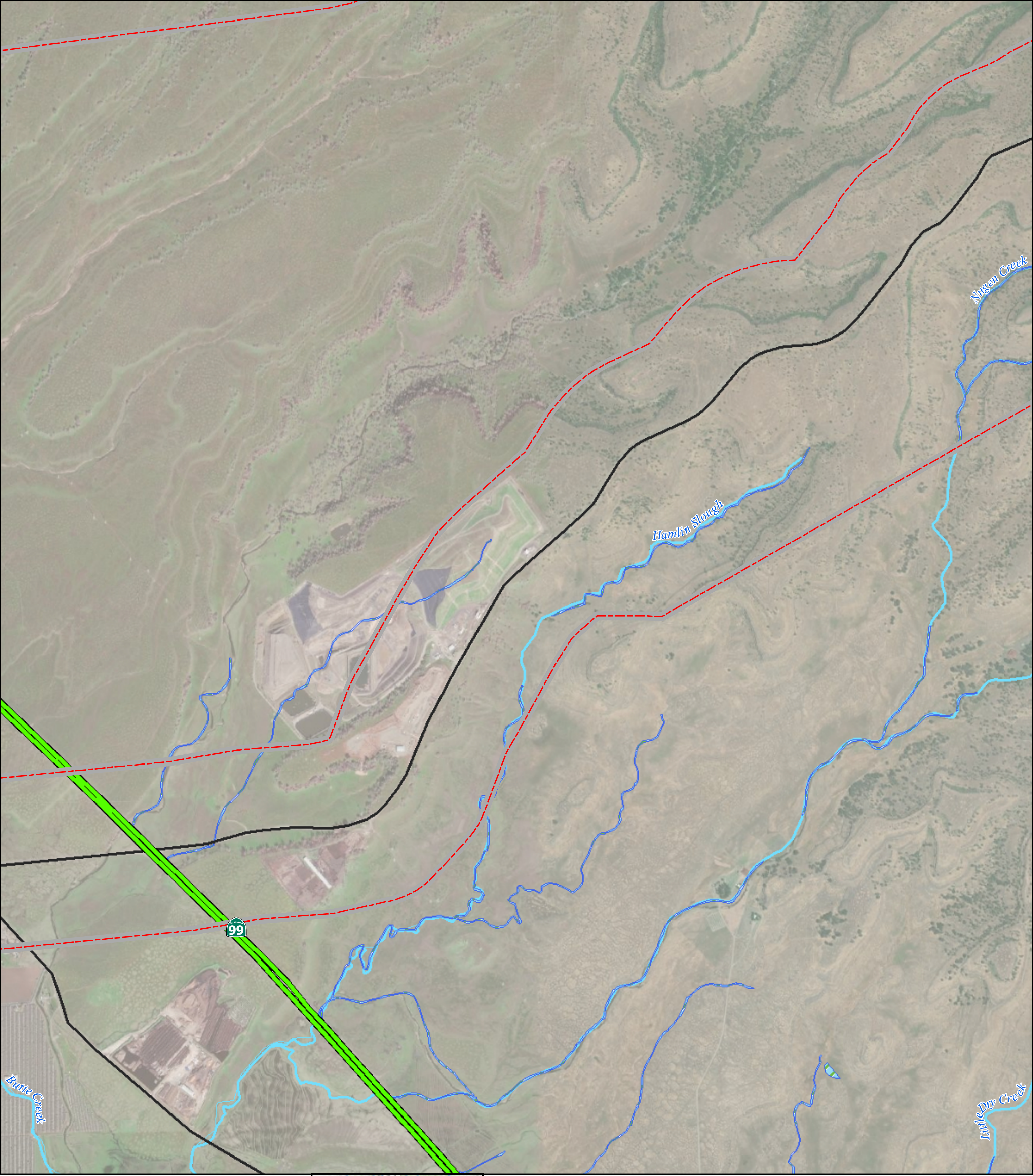

LOCAL CRITICAL HABITAT AND NWI WETLANDS

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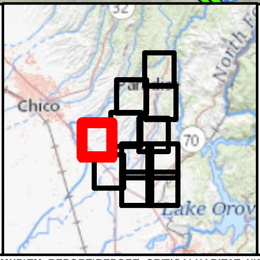

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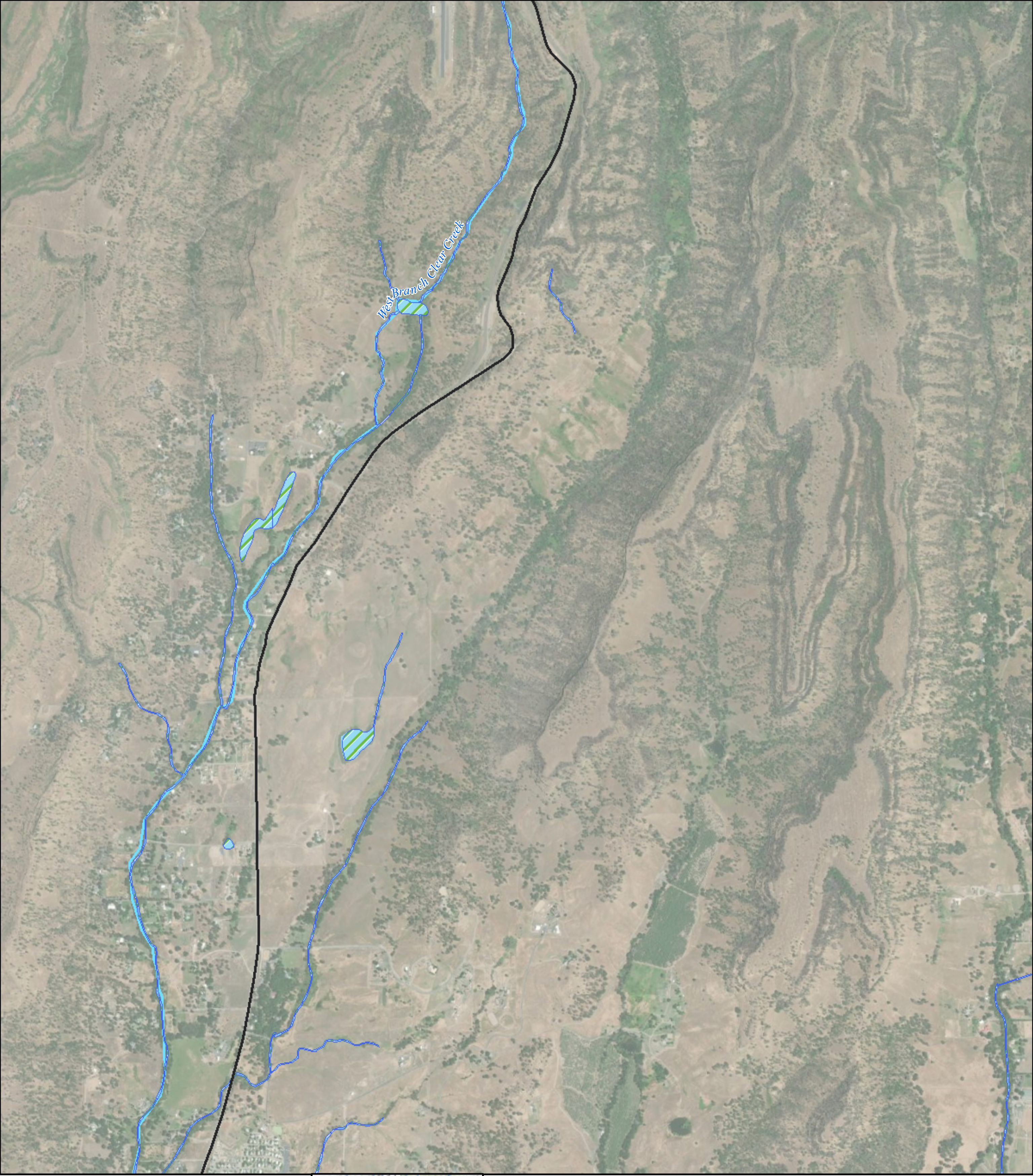

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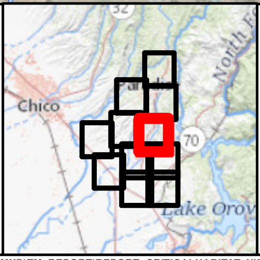

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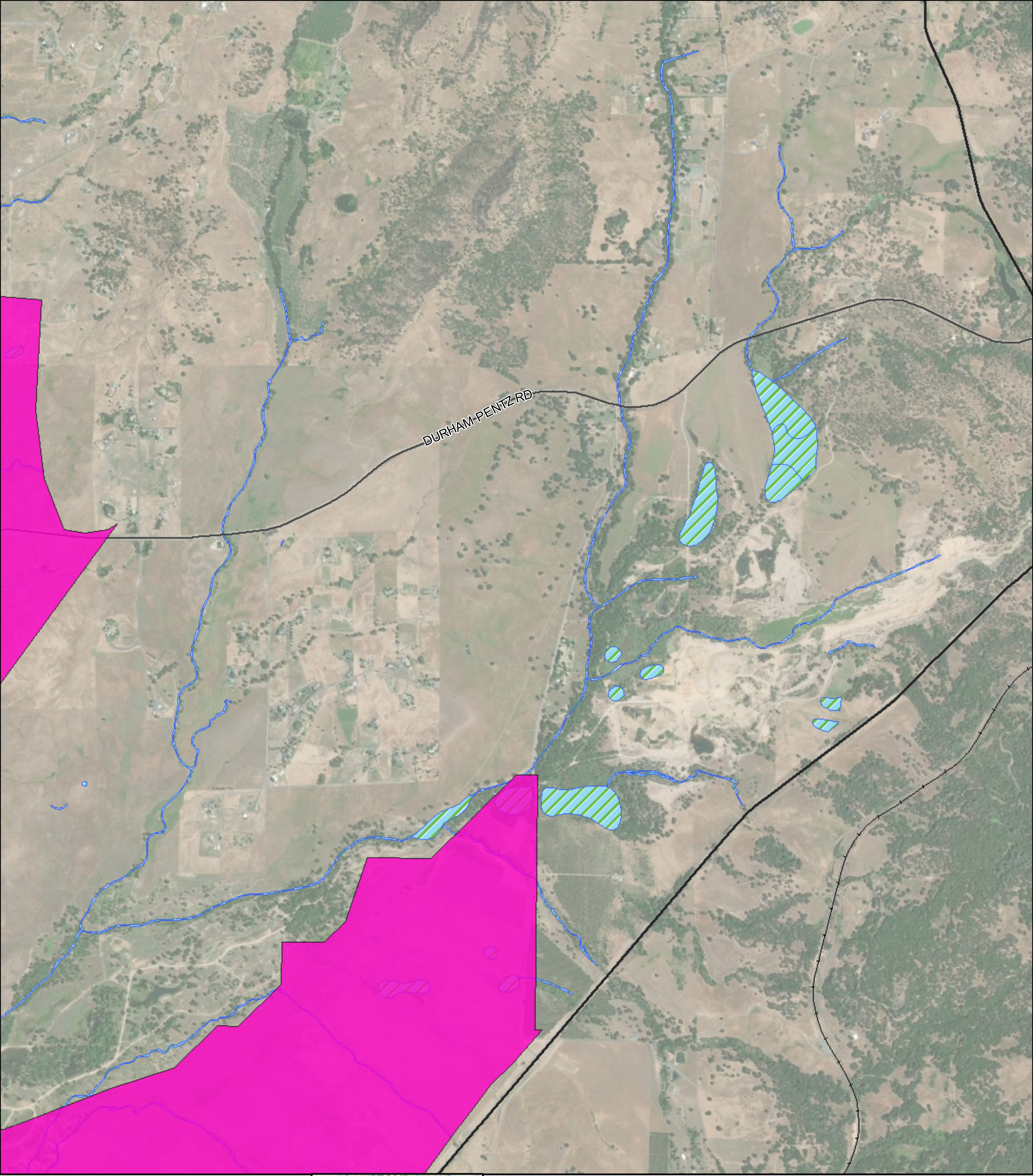

LOCAL CRITICAL HABITAT AND NWI WETLANDS

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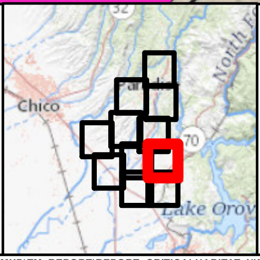

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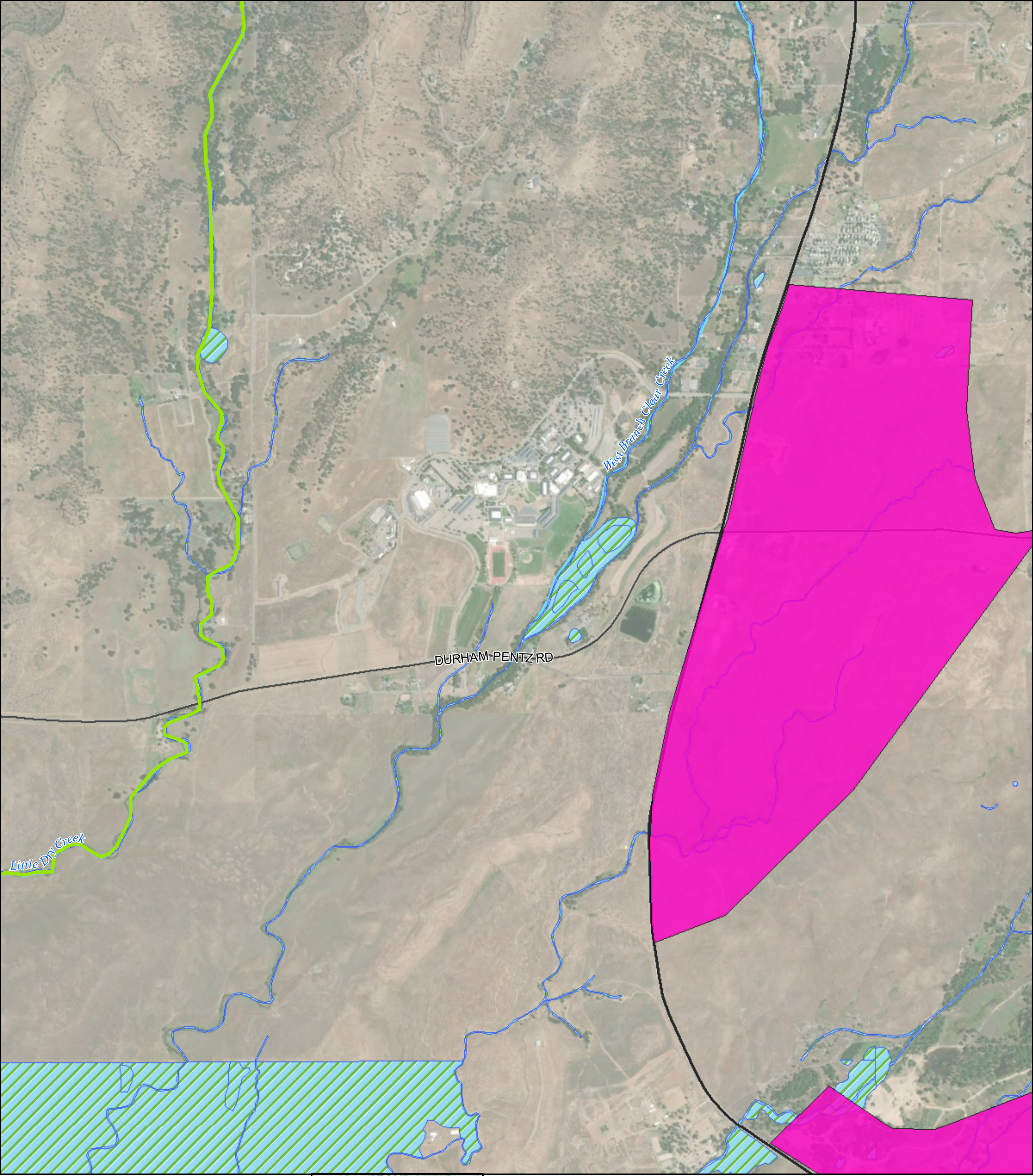

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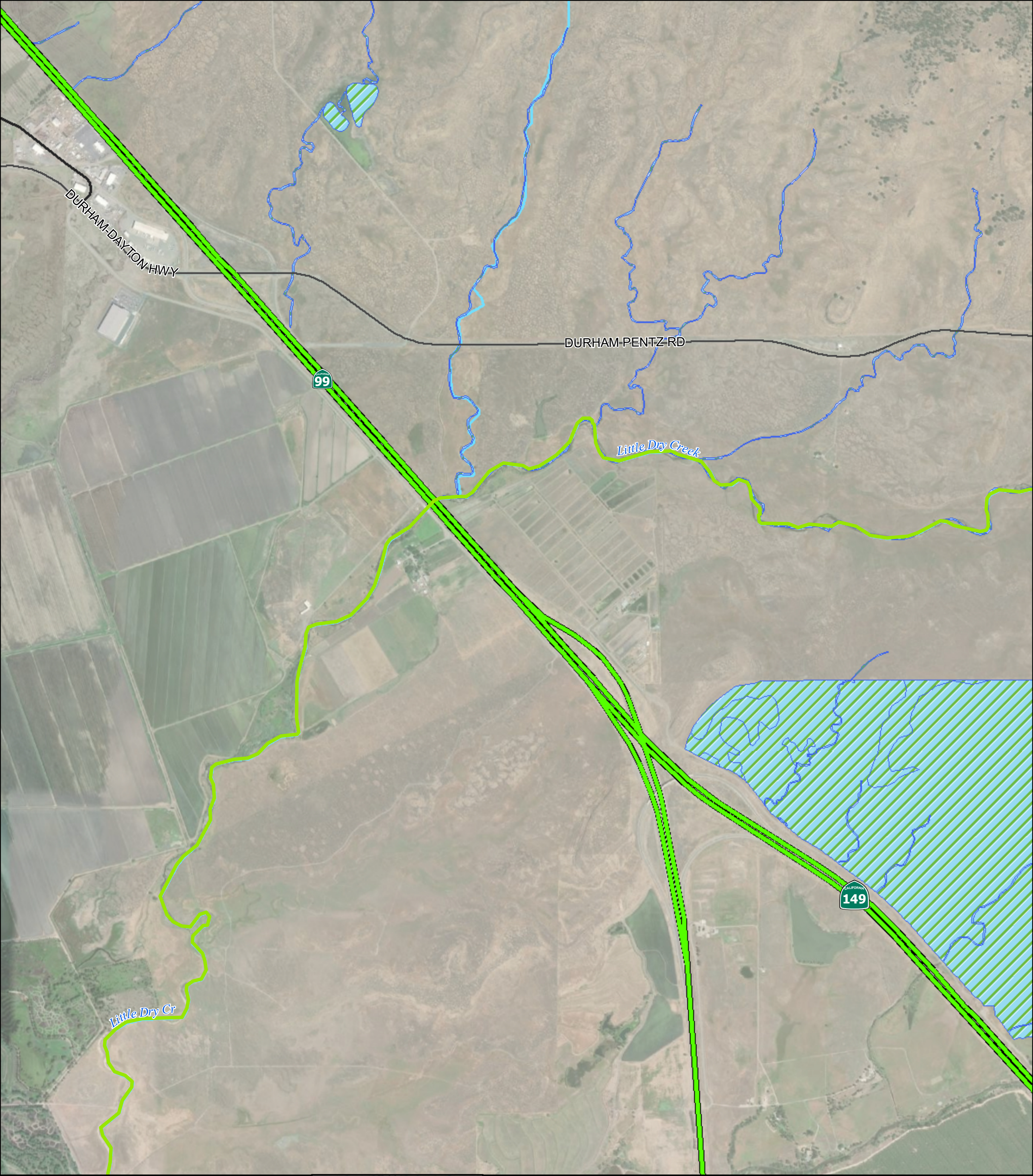

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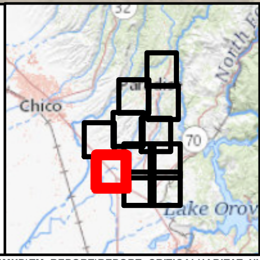

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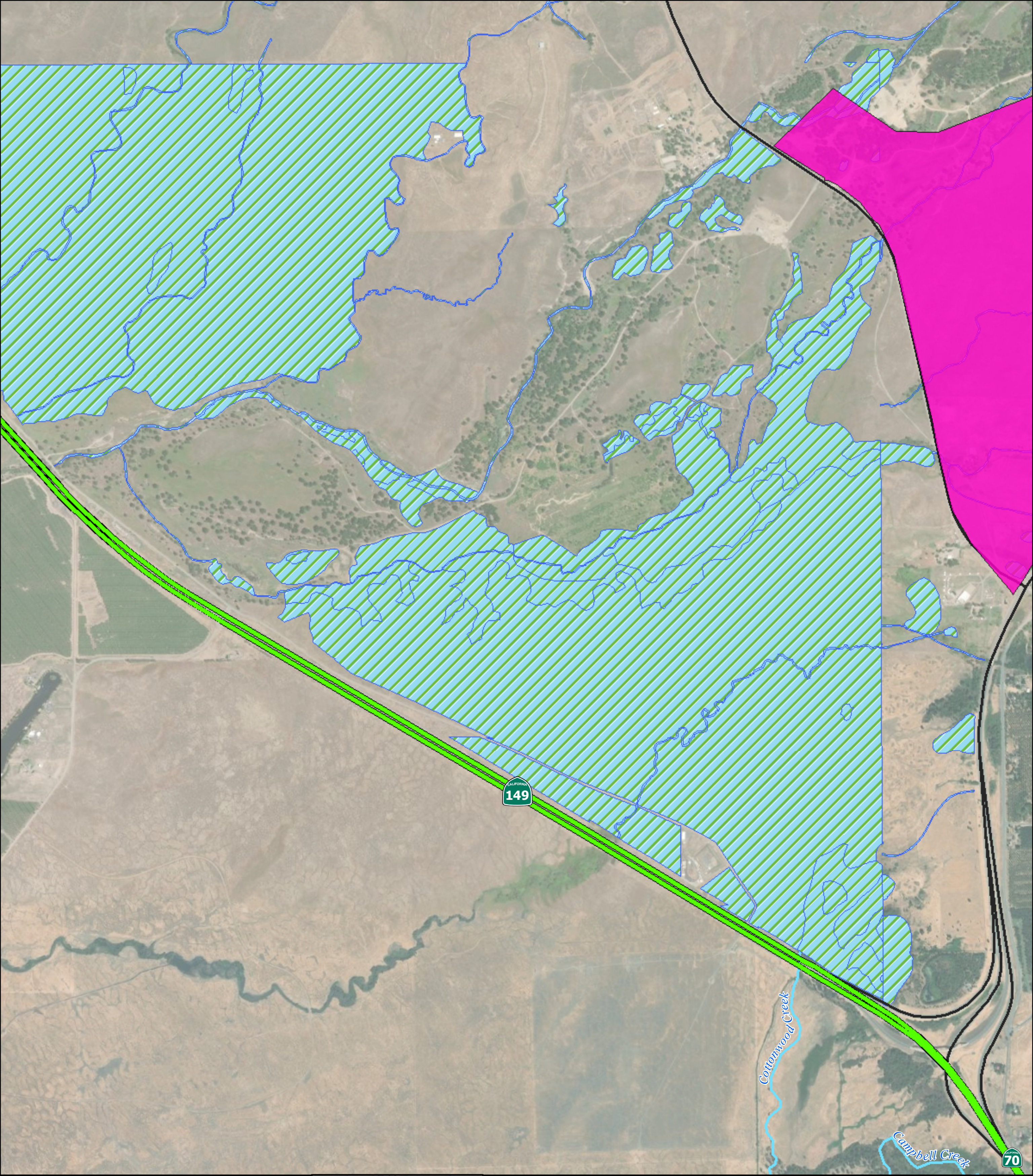

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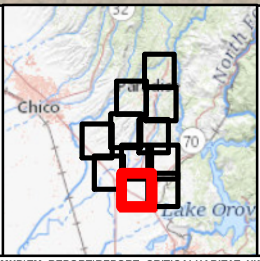

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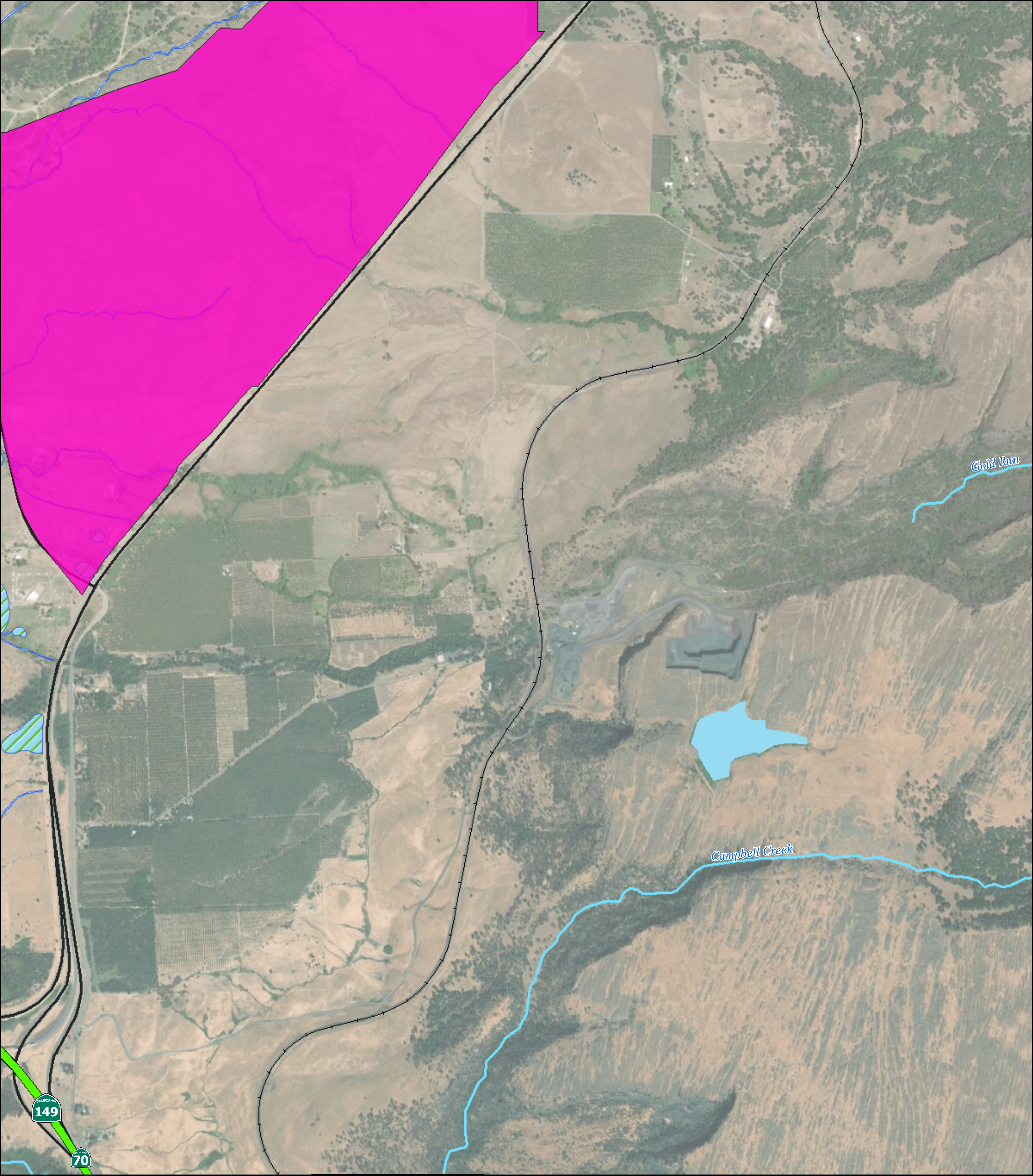

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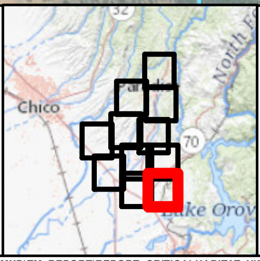

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A.2

Sensitive Biological Resources

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Attachment A.2 – Sensitive Biological Resources

Table A.2-1. Sensitive Biological Resources with Potential to Occur in the Study Area (Local)

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
Plants							
Allium jepsonii	Jepson's onion	None	None	1B.2	Serpentine or volcanic soils in chaparral, cismontane woodland, and lower montane coniferous forest. Elevation: 980–4,330 feet. Blooming period: April–August	Y	Collection System, WWTP Site – Kunkle and Clark Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
Balsamorhiza macrolepis	big-scale balsamroot	None	None	1B.2	Occasionally in serpentine soils in chaparral, cismontane woodland, and grassland. Elevation: 295–5,100 feet. Blooming period: March–June	Y	Collection System, WWTP Site – Kunkle, Clark Road and Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center, Land Discharge
Botrychium crenulatum	scalloped moonwort	None	None	2B.2	Bogs, fens, meadows, seeps, marshes, freshwater swamps, montane coniferous forests. Elevation: 4,159–10,758 feet. Sporing period: June–September	N	Entire proposed project area is below the elevational range of the species.
Botrychium minganense	Mingan moonwort	None	None	2B.2	Mesic soils in bogs, fens, lower and upper montane coniferous forest. Elevation: 4,773–7,152 feet. Sporing period: July–September	N	Entire proposed project area is below the elevational range of the species.
Botrychium montanum	western goblin	None	None	2B.1	Mesic soil in meadows, seeps, and montane coniferous forest. Elevation: 4,805–7,150 feet. Sporing period: July–September	N	Entire proposed project area is below the elevational range of the species.

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
Campylopodiella stenocarpa	flagella-like atractylocarpus	None	None	2B.2	Cismontane woodland, roadsides. Elevation: 935–1,410 feet. (Bryophyte)	Y	Collection System, WWTP Site – Kunkle and Clark Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
Cardamine pachystigma var. *dissectifolia*	dissected-leaved toothwort	None	None	1B.2	Chaparral, lower montane coniferous forest, Serpentine outcrops and gravelly serpentine talus. Elevation: 984-3,117 feet.	Y	Collection System, WWTP Site – Kunkle and Clark Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
Carex xerophila	chaparral sedge	None	None	1B.2	Serpentine and gabbro soils in chaparral, cismontane woodland, and lower montane coniferous forest. Elevation: 1,440–2,525 feet. Blooming period: March–June	Y	Collection System, WWTP Site – Kunkle, Pipeline/Infrastructure - TOP Urban Center
Castilleja rubicundula var. *rubicundula*	pink creamsacs	None	None	1B.2	Serpentine soils in meadows, seeps, grassland, cismontane woodland, and openings of chaparral. Elevation: 65–2,985 feet. Blooming period: April–June	Y	Potential to occur within any of the project components
Clarkia gracilis ssp. albicaulis	white-stemmed clarkia	None	None	1B.2	Sometimes on serpentine soils in chaparral and cismontane woodland. Elevation: 800–3,560 feet. Blooming period: May–July	Y	Collection System, WWTP Site – Kunkle and Clark Road Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
Clarkia mildrediae ssp. *mildrediae*	Mildred's clarkia	None	None	1B.3	Sandy, usually granitic, soils in cismontane woodland and lower montane coniferous forest. Elevation: 800–5,610 feet. Blooming period: May–August	Y	Collection System, WWTP Site – Kunkle and Clark Road Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
Clarkia mosquinii	Mosquin's clarkia	None	None	1B.1	Rocky soils and roadsides in cismontane woodland and lower montane coniferous forest. Elevation: 605–4,890 feet. Blooming period: May–July	Y	Collection System, WWTP Site – Kunkle and Clark Road Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
Delphinium recurvatum	recurved larkspur	None	None	1B.2	Alkaline soils in chenopod scrub, cismontane woodland, and grassland. Elevation: 9–2,591 feet. Blooming period: March–June	Y	Potential to occur within any of the project components
Eremogone cliftonii	Clifton's eremogone	None	None	1B.3	Usually in granitic soils in openings of chaparral and montane coniferous forests. Elevation: 1,490–6,825 feet. Blooming period: April–September	Y	Collection System, WWTP Site – Kunkle, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
Eriogonum umbellatum var. *ahartii*	Ahart's buckwheat	None	None	1B.2	Serpentine soils on slopes in openings of chaparral and cismontane woodland. Elevation: 1,310–6,560 feet. Blooming period: June–September	Y	Collection System, WWTP Site – Kunkle, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
Erythranthe filicifolia	fern-leaved monkeyflower	None	None	1B.2	Usually in slow–draining ephemeral seeps that are among exfoliating granitic slabs in meadows, chaparral, and lower montane coniferous forest. Elevation: 1,360–5,610 feet. Blooming period: April–June	Y	Collection System, WWTP Site – Kunkle, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
Euphorbia hooveri	Hoover's spurge	FT	None	1B.2	Vernal pools. Elevation: 80–820 feet. Blooming period: July–October	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge
Frangula purshiana ssp. *ultramafica*	Caribou coffeeberry	None	None	1B.2	Serpentine soils in chaparral, montane coniferous forests, meadows, and seeps. Elevation: 2,705–6,330 feet. Blooming period: May–July	N	Entire proposed project area is below the elevational range of the species.
Fritillaria pluriflora	adobe-lily	None	None	1B.2	Adobe soils in chaparral, cismontane woodland, and grassland. Elevation: 195–2,315 feet. Blooming period: February–April	Y	Potential to occur within any of the project components
Hibiscus lasiocarpos var. *occidentalis*	woolly rose-mallow	None	None	1B.2	Often in riprap on sides of levees in freshwater marshes and swamps. Elevation: 0–395 feet. Blooming period: June–September	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
Imperata brevifolia	California satintail	None	None	2B.1	Mesic soils in chaparral, coastal scrub, Mojavean desert scrub, riparian scrub, meadows and seeps (often alkali). Elevation: 0–3,985 feet. Blooming period: September–May	Y	Potential to occur within any of the project components
Juncus leiospermus var. *leiospermus*	Red Bluff dwarf rush	None	None	1B.1	Vernally mesic soils in chaparral, cismontane woodland, meadows, seeps, grassland, and vernal pools. Elevation: 110–4,100 feet. Blooming period: March–June	Y	Potential to occur within any of the project components
Layia septentrionalis	Colusa layia	None	None	1B.2	Sandy serpentine soils in chaparral, cismontane woodland, and grassland. Elevation: 325–3,595 feet. Blooming period: April–May	Y	Potential to occur within any of the project components
Lewisia cantelovii	Cantelow's lewisia	None	None	1B.2	Mesic and granitic soils and occasionally serpentine seeps in broadleafed upland and lower montane coniferous forests, chaparral, and cismontane woodland. Elevation: 1,080–4,495 feet. Blooming period: May–October	Y	Collection System, WWTP Site – Kunkle and Clark Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
Limnanthes floccosa ssp. *californica*	Butte County meadowfoam	FE	SE	1B.1	Vernal pools and mesic grassland. Elevation: 150–3,050 feet. Blooming period: March–May	Y	WWTP Site – Clark Road and Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, Land Discharge
Monardella venosa	veiny monardella	None	None	1B.1	Heavy clay soils in cismontane woodland and grassland. Elevation: 195–1,345 feet. Blooming period: May and July	Y	WWTP Site – Clark Road and Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, Land Discharge
Orcuttia pilosa	hairy Orcutt grass	FE	SE	1B.1	Vernal pools. Elevation: 150–655 feet. Blooming period: May–September	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
Packera eurycephala var. *lewisrosei*	Lewis Rose's ragwort	None	None	1B.2	Serpentine soils in chaparral, cismontane woodland, and lower montane coniferous forest. Elevation: 895–6,200 feet. Blooming period: March–September	Y	Collection System, WWTP Site – Kunkle and Clark Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
Paronychia ahartii	Ahart's paronychia	None	None	1B.1	Cismontane woodland, grassland, and vernal pools. Elevation: 95–1,675 feet. Blooming period: February–June	Y	Potential to occur within any of the project components
Penstemon personatus	closed-throated beardtongue	None	None	1B.2	Metavolcanic soils in chaparral and montane coniferous forests. Elevation: 3,490–6,955 feet. Blooming period: June–October	N	Entire proposed project area is below the elevational range of the species.
Poa sierrae	Sierra blue grass	None	None	1B.3	Openings in lower montane coniferous forest. Elevation: 1,195–4,920 feet. Blooming period: April–July	Y	Collection System, WWTP Site – Kunkle and Clark Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
Rhynchospora californica	California beaked-rush	None	None	1B.1	Bogs, fens, meadows, seeps, freshwater marshes and swamps, and lower montane coniferous forest. Elevation: 145–3,315 feet. Blooming period: May–July	Y	Potential to occur within any of the project components
Rhynchospora capitellata	brownish beaked-rush	None	None	2B.2	Mesic soils in meadows, seeps, marshes, swamps, and montane coniferous forests. Elevation: 145–6,560 feet. Blooming period: July–August	Y	Potential to occur within any of the project components
Rupertia hallii	Hall's rupertia	None	None	1B.2	Roadsides and openings of cismontane woodland and lower montane coniferous forest. Elevation: 1,785–7,380 feet. Blooming period: June–September	Y	Collection system
Sagittaria sanfordii	Sanford's arrowhead	None	None	1B.2	Fresh water marshes and swamps that are typically shallow. Elevation: 0–2,132 feet. Blooming period: May–October	Y	Land Discharge, Surface Water Discharge - Kunkle
Sedum albomarginatum	Feather River stonecrop	None	None	1B.2	Serpentine soils in chaparral and lower montane coniferous forest. Elevation: 850–6,400 feet. Blooming period: May–June	Y	Collection System, WWTP Site – Kunkle and Clark Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
Sidalcea robusta	Butte County checkerbloom	None	None	1B.2	Chaparral and cismontane woodland. Elevation: 295–5,250 feet. Blooming period: April–June	Y	Collection System, WWTP Site – Kunkle and Clark Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
Stuckenia filiformis ssp. *alpina*	slender-leaved pondweed	None	None	2B.2	Shallow freshwater marshes and swamps. Elevation: 15–7,055 feet. Blooming period: May–July	Y	Land Discharge, Surface Water Discharge - Kunkle
Trifolium jokerstii	Butte County golden clover	None	None	1B.2	Mesic grassland and vernal pools. Elevation: 160–1,575 feet. Blooming period: March–May	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, Land Discharge
Tuctoria greenei	Greene's tuctoria	FE	SR	1B.1	Vernal pools. Elevation: 95–3,510 feet. Blooming period: May–September	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge
Invertebrates							
Branchinecta conservatio	Conservancy fairy shrimp	FE	None	---	Endemic to California vernal pools, almost entirely in the Central Valley, with the exception of one population along the central coast in Ventura County. Majority of sites inhabited by this species are large and turbid pools which remain inundated much longer than typical vernal pools (USFWS 2012).	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge
Branchinecta lynchi	vernal pool fairy shrimp	FT	None	---	Endemic to the grasslands of the Central Valley and the Central and South Coast Range mountains of California, and the Agate Desert of southern Oregon. Found only in cool water vernal pools and vernal pool-like habitats; does not occur in riverine, marine, or other permanent bodies of water (USFWS 2007).	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
Desmocerus californicus dimorphus	valley elderberry longhorn beetle	FT	None	---	Dependent on host plant, elderberry (*Sambucus* spp.), which most commonly grows in riparian woodlands, but also in some upland habitats such as oak savannas and annual grasslands. Current presumed range in Central Valley extends from Shasta County south to Fresno County, including the valley floor and lower foothills up to about 500 feet in elevation (USFWS 2017).	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge
Lepidurus packardi	vernal pool tadpole shrimp	FE	None	---	Found only in ephemeral freshwater habitats, including alkaline pools, clay flats, vernal lakes, vernal pools, vernal swales, and other seasonal wetlands. Patchily distributed across the Central Valley from Shasta County south to Tulare County with isolated occurrences in the East Bay Area (USFWS 2007).	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge (Critical Habitat present)
Fish							
Acipenser medirostris	green sturgeon (southern DPS)	FT	SSC	---	Spawning occurs primarily in the Sacramento River, but those that spawn in the Feather and Yuba Rivers are also part of the southern DPS. Oceanic waters, bays, and estuaries during non-spawning season. Enters San Francisco Bay late winter through early spring, and spawn occurs from April through early July. Spawn in cool sections of river mainstems in deep pools containing small to medium-sized gravel, cobble, or boulder substrate (NMFS 2015).	N	Sacramento River only
Hypomesus transpacificus	delta smelt	FT	SE	---	Endemic to open waters of San Francisco Bay and Sacramento-San Joaquin River Delta. Distribution includes San Pablo Bay up through Suisun Bay, upstream through the delta to the Sacramento River below Isleton, and the San Joaquin River below Mossdale. Spawning has not been observed in the wild, but is thought to take place in sloughs and shallow edge-water channels in the upper delta and in Montezuma Slough near Suisun Bay. (USFWS 2010).	N	The proposed project area is completely outside the range of this species.

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
Mylopharodon conocephalus	hardhead	None	SSC	---	Small to large streams in low to mid-elevation environments. May also inhabit lakes or reservoirs. Preferred stream temperature might easily exceed 68ºF, though these fish do not favor low dissolved oxygen levels. Usually found in clear deep streams with a slow but present flow. Though spawning may occur in pools, runs, or riffles, the bedding area will typically be characterized by gravel and rocky substrate. Occurs from Sacramento-San Joaquin and Russian River drainages from the Pit River, Modoc County in the north, to the Kern River, Kern County in the south (UC Davis 2017).	Y	Potential to occur within any of the project components
Oncorhynchus mykiss irideus (pop. 11)	steelhead (Central Valley DPS)	FT	None	---	Includes naturally spawned anadromous steelhead originating below natural and manmade impassable barriers from the Sacramento and San Joaquin Rivers and their tributaries; excludes such fish originating from San Francisco and San Pablo Bays and their tributaries. This DPS does include steelhead from two artificial propagation programs: Coleman National Fish Hatchery Program and Feather River Fish Hatchery Program. Spawning habitat includes gravel-bottomed, fast-flowing, well-oxygenated rivers and streams. Non-spawning habitat includes estuarine and marine waters (NOAA 2019).	Y	Potential to occur within any of the project components (Critical Habitat present)
Oncorhynchus tshawytscha (pop. 6)	chinook salmon (Central Valley spring-run ESU)	FT	ST	---	Currently found in the Sacramento-San Joaquin River Delta, the Sacramento River and its tributaries, including American, Yuba and Feather Rivers, and Mill, Deer, and Butte Creeks. The numbers of adults are dependent on pool depth and volume, amount of cover, and proximity to gravel. Water temperatures greater than 80°F are lethal to adults (NMFS 2016).	Y	Potential to occur within any of the project components (Critical Habitat present)

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
Oncorhynchus tshawytscha (pop. 7)	chinook salmon (Sacramento River winter-run ESU)	FE	SE	---	Currently found in the Sacramento River below Keswick Dam. Spawns in the Sacramento River but not its tributaries. Requires clean, cold water over gravel beds with water temperatures between 42 and 57°F for spawning (NMFS 2011).	N	Sacramento River only
Amphibians							
Rana boylii	foothill yellow-legged frog	None	ST, SSC	---	Ranges in the northern half of California except for the Central Valley, Modoc Plateau, and eastern side of the Sierra Nevada Mountains. Generally found in shallow flowing streams and rivers with at least cobble sized substrate. Breeding generally occurs at the margins of wide shallow channels with reduced flow variation near tributary confluences. Specifically, egg masses are placed in low flow locations on or under rocks with preferred substrates being boulders, cobbles, or gravel. Eggs have been found at depths to 34 inches in water velocities of 0 – 0.69 feet per second and at most 40 feet from shore. Maximum water temperature for breeding is 79°F and 48 to 70°F is the preferred range. Tadpoles avoid areas below 55°F and prefer temperatures between 62°F and 72°F (Thomson et al. 2016).	Y	Potential to occur within any of the project components
Rana cascadae	Cascades frog	None	SCE, SSC	---	Ranges in the Cascade Mountains in Shasta, Siskiyou, and Trinity Counties and the northern Sierra Nevada Mountains in Butte, Plumas, Shasta and Tehama Counties. Generally found in a wide range of aquatic habitats and wet meadows that do not freeze. Not often seen on land. Breeding habitat generally consists of montane lentic areas with a preference for small shallow spring fed ponds (Thomson et al. 2016).	N	The proposed project area is completely outside the range of this species.

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
Rana draytonii	California red-legged frog	FT	SSC	---	Ponds and streams in humid forests, woodlands, grasslands, coastal scrub, and streamsides with plant cover in lowlands or foothills. Breeding habitat includes permanent or ephemeral water sources; lakes, ponds, reservoirs, slow streams, marshes, bogs, and swamps. Ephemeral wetland habitats require animal burrows or other moist refuges for estivation when the wetlands are dry. Occurs from sea level to 5,000 feet in elevation. Occurs along the Coast Ranges from Mendocino County south to northern Baja California, and inland across the northernmost reaches of the Sacramento Valley and locally south through portions of the Sierra Nevada foothills as far south as northern Tulare County (Nafis 2020).	Y	Potential to occur within any of the project components
Spea hammondii	western spadefoot	None	SSC	---	Generally found in grasslands, oak woodlands, coastal sage scrub, and chaparral in washes, floodplains, alluvial fans, playas, and alkali flats. Natural and artificial water bodies are used for breeding. Specifically, vernal pools used by this species have an average ponding duration of 81 days, and successful recruitment occurs in ponds that last on average 21 days longer than larval development time. Pool temperature requirements are from 48 to 90°F. Pools with invasive species, such as crayfish (*Pacifasticus* spp.), or bullfrogs (*Lithobates catesbeianus*) often, but not always, exclude this species. (Thomson et al. 2016).	Y	Potential to occur within any of the project components
Reptiles							
Actinemys marmorata	northwestern pond turtle	None	SSC	---	Generally occurs in various water bodies including permanent and ephemeral systems either natural or artificial. Upland habitat that is at least moderately undisturbed is required for nesting and overwintering, in soils that are loose enough for excavation (Thomson et al. 2016).	Y	Potential to occur within any of the project components

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
Phrynosoma blainvillii	Blainville's horned lizard	None	SSC	---	Ranges in the southern half of California outside of the desert, along the foothills of the Sierra Nevada Mountains to Butte County, and along the Central Coast ranges up to Contra Costa County. Generally occurs in sage scrub, dunes, alluvial scrub, annual grassland, chaparral, oak, riparian, and Joshua tree woodland, coniferous forest, and saltbush scrub. Needs loose, fine soils for burrowing, open areas for basking, and dense foliage for cover. Negatively associated with Argentine ants (*Linepithema humi*) (Thomson et al. 2016).	Y	Potential to occur within any of the project components
Thamnophis gigas	giant gartersnake	FT	ST	---	Marshes, sloughs, ponds, small lakes, low gradient streams, irrigation and drainage canals, rice fields and their associated uplands from sea level to 400 feet in elevation. Upland habitat should have burrows or other soil crevices suitable for snakes to reside during their dormancy period (November- mid March). Formerly ranged in the Central Valley from Butte County to Buena Vista Lake in Kern County, but now thought to be absent south of Fresno and in Stanislaus County (USFWS 2012).	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge
Birds							
Accipiter gentilis	northern goshawk	None	SSC	---	Nests in mature and old-growth coniferous forests at high elevations in the Sierra Nevada, Cascade, North Coast, and Transverse Ranges. Prefers stands with Pacific Ponderosa pine (*Pinus ponderosa* var. *pacifica*), Jeffrey pine (*Pinus jeffreyi*), Lodgepole pine (*Pinus contorta*), Douglas-fir (Pseudotsuga menziesii), and rarely pinyon-juniper (*Pinus monophylla* and *Juniperus* spp.) or quaking aspen (*Populus tremuloides*). Prefers stands with larger trees, denser canopies, and relatively open understories (Shuford and Gardali 2008).	Y	Collection System

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
Agelaius tricolor	tricolored blackbird	None	ST, SSC	---	Mostly a year-round resident in California. Common locally throughout Central Valley and in coastal districts from Sonoma County south. Breeds locally in northeastern California. In winter, becomes more widespread along the central coast and San Francisco Bay area, and can be found in portions of the Colorado Desert (Hamilton 2004). Preferred nesting habitat includes cattails (*Typha* spp.), bulrushes (*Schoenoplectus* spp.), Himalayan blackberry (*Rubus armeniacus*), and agricultural silage. Dense vegetation is preferred but heavily lodged cattails not burned in recent years may preclude settlement. Need access to open water. Strips of emergent vegetation along canals are avoided as nest sites unless they are about 30 feet or more wide but in some ponds, especially where associated with Himalayan blackberries and deep water, settlement may be in narrower fetches of cattails. (CDFW 2020).	Y	WWTP Site – Kunkle, Clark Road and Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, Land Discharge
Aquila chrysaetos	golden eagle	BGEPA	SFP	---	Uncommon resident in hills and mountains throughout California, and an uncommon migrant and winter resident in the Central Valley and Mojave Desert. Prefers rolling foothills and mountain terrain, wide arid plateaus deeply cut by streams and canyons, open mountain slopes, cliffs, and rock outcrops. (CDFW 2020).	Y	Collection System, WWTP Site – Kunkle and Clark Road Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
Athene cunicularia	burrowing owl	None	SSC	---	Resident in much of the state in open, dry grasslands and various desert habitats. Requires open areas with mammal burrows; especially those of California ground squirrel (*Otospermophilus beecheyi*) Inhabits rolling hills, grasslands, fallow fields, sparsely vegetated desert scrub, vacant lots and other open human disturbed lands such as airports and golf courses. Absent from northwest coast and elevations above 5,500 feet (CDFW 2020).	Y	WWTP Site – Clark Road and Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, Land Discharge

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
Buteo swainsoni	Swainson's hawk	None	ST	---	Nests in oak savanna and cottonwood riparian areas adjacent to foraging habitat of grasslands, agricultural fields, and pastures where they often follow farm equipment to gather killed and maimed rodents. Increasingly also nests in sparse stands of gum trees (*Eucalyptus* spp.) and Australian pines (*Casuarina equisetifolia*) and often forage along roadsides and grassy highway medians. Breeding resident in the Central Valley, Klamath Basin, Northeastern Plateau, and in juniper-sagebrush flats of Lassen County. Limited breeding reported from Lanfair Valley, Owens Valley, Fish Lake Valley, and Antelope Valley. Winters primarily in Argentina, with most birds absent from California October through February, though a few overwinter in the Sacramento-San Joaquin River Delta. Prolific migrant through southern California in spring and fall, with large mixed-age groups of birds frequently observed kettling high overhead on thermals or foraging together on freshly cut agricultural fields (CDFW 2020).	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge
Circus hudsonius	northern harrier	None	SSC	---	Nests on the ground in patches of dense, tall vegetation in undisturbed areas. Breed and forage in a variety of open habitats such as marshes, wet meadows, weedy borders of lakes, rivers and streams, grasslands, pastures, croplands, sagebrush flats, and desert sinks (Shuford and Gardali 2008).	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, Land Discharge

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
Coccyzus americanus occidentalis	western yellow-billed cuckoo	FT	SE	---	Has declined drastically in California due primarily to loss of habitat. Requires riparian woodland with dense cover; primarily old-growth cottonwood (*Populus* spp.) forests with willow (*Salix* spp.) understory, but will also nest in overgrown orchards adjacent to streams and dense thickets alongside marshes. Persists in small numbers along the Sacramento River between Red Bluff and Colusa, the Feather River between Yuba City and the Bear River, Owens Valley, the Kern River Valley, the Colorado River Valley, the Santa Ana River near Prado Basin, and the San Luis Rey River in northern San Diego County (USFWS 2019).	N	Sacramento River only
Contopus cooperi	olive-sided flycatcher	None	SSC	---	Nests in a wide variety of forest and woodland habitats below 9,000 feet in elevation in the coastal and mountainous portions of California. Occurs only as a migrant elsewhere in the state. Prefers forests and woodlands with adjacent meadows, lakes, or open terrain for foraging (CDFW 2020)	Y	Collection System, WWTP Site – Kunkle, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
Elanus leucurus	white-tailed kite	None	SFP	---	Fairly common resident of the Central Valley, coast, and Coast Range Mountains. Nests in oak savanna, oak and willow riparian, and other open areas with scattered trees near foraging habitat. Forages in open grasslands, meadows, farmlands, and emergent wetlands. Often seen hover foraging over roadsides or grassy highway medians (CDFW 2020).	Y	Collection System, WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge
Empidonax traillii brewsteri	little willow flycatcher	None	SE	---	Uncommon summer resident in wet meadows and montane riparian habitats from 2,000 to 8,000 feet in elevation. Breeds in California from Tulare County north, along the western side of the Sierra Nevada and Cascade Ranges, extending to the coast in northern California (Craig and Williams 1998).	Y	Collection System

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
Falco peregrinus anatum	American peregrine falcon	None	SFP	---	Breeds near wetlands, lakes, rivers, or other waters on cliffs, banks, dunes or mounds, mostly in woodland, forest, and coastal habitats. Nest is a scrape on a depression or ledge in an open site. May use man-made structures (such as bridges, skyscrapers, or electrical towers), large snags, or trees for nesting (CDFW 2020).	Y	Collection System, WWTP Site – Kunkle and Clark Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
Haliaeetus leucocephalus	bald eagle	BGEPA	SE, SFP	---	Permanent resident in the highest Coast Range mountains, across the Cascade Range, and down the Sierra Nevada to the eastern Transverse Ranges of San Bernardino and Riverside Counties. Uncommon migrant and winter visitor to lowland rivers, lakes, and reservoirs. Nests in large, old-growth, or dominant live trees with open branchwork, especially ponderosa pine (*Pinus ponderosa*). Requires large bodies of water or rivers with abundant fish, and adjacent snags (CDFW 2020).	Y	Collection System, WWTP Site – Kunkle and Clark Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center
Icteria virens	yellow-breasted chat	None	SSC	---	Nests in early-successional riparian habitats with a well-developed shrub layer and an open canopy. Restricted to narrow borders of streams, creeks, sloughs, and rivers. Often nest in dense thickets of blackberry (Rubus spp.) and willow (Salix spp.) (Shuford and Gardali 2008).	Y	Collection System, WWTP Site – Kunkle, Clark Road and Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center, Land Discharge
Lanius ludovicianus	loggerhead shrike	None	SSC	---	Shrublands and open woodlands with a fair amount of grass cover and areas of bare ground. Requires tall shrubs or trees, fences, or power lines for hunting perches and territorial advertisement. Also requires open areas of short grasses, forbs, or bare ground for hunting, large shrubs or trees for nest placement, and thorny vegetation or barbed wire fences for impaling prey. Ranges across most of the state, but absent from the highest mountains and the northwest forests and coast (Shuford and Gardali 2008).	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, Land Discharge

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
Laterallus jamaicensis coturniculus	California black rail	None	ST, SFP	---	Saline, brackish, and fresh emergent wetlands. Scarce, but true abundance difficult to determine due to small size and extremely secretive nature. Known to nest at scattered locations in the San Francisco Bay Area and Delta region, Point Reyes National Seashore, San Luis Obispo and Orange Counties, as well as the Imperial and Lower Colorado River Valleys. Appears intermittently and sparingly at a few locations in the Sacramento Valley (CDFW 2020).	Y	WWTP Site –Clark Road and Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, Land Discharge
Melospiza melodia	song sparrow (Modesto population)	None	SSC	---	Often found in emergent freshwater marshes dominated by bulrushes (*Scirpus* spp.), cattails (*Typha* spp.), and willow (*Salix* spp.). Also nests in riparian forests of valley oak (*Quercus lobata*) with a sufficient understory of blackberry (*Rubus* spp.), along vegetated irrigation canals and levees, and in recently planted valley oak restoration sites. Found throughout the Sacramento Valley, from the delta north to Chico (Shuford and Gardali 2008).	Y	WWTP Site –Neal Road, Pipeline/Infrastructure - Neal Road, Land Discharge
Progne subis	purple martin	None	SSC	---	Present in California from mid-March through late September. Requires concentrations of nesting cavities, relatively open air space above accessible nest sites, and relatively abundant aerial insect prey. In the coastal mountains, Cascade Range, and Sierra Nevada foothills, inhabits open forests, woodlands, and riparian areas. Extirpated as a breeder from most of the Central Valley except the Sacramento area where it has taken to nesting in hollow-box bridges.	Y	Collection System, WWTP Site – Kunkle and Clark Road Pipeline/Infrastructure - Clark Road and Neal Road, TOP Urban Center

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
Riparia riparia	bank swallow	None	ST	---	A colonial nester in riparian and lacustrine bluffs or cliffs with fine-textured or sandy soils into which the nest cavities are dug. Also nests in earthen banks as well as sand and gravel pits. Declined drastically in the state over the 20th Century due to loss of riparian habitat and stabilization of natural banks. Currently most numerous in the Sacramento Valley along the Sacramento, Feather, and American Rivers, and Cache Creek in western Yolo County. Scarce and very local on the central coast. Occurs elsewhere in the state as an uncommon to rare migrant (CDFW 2020).	N	Sacramento River only
Setophaga petechia	yellow warbler	None	SSC	---	Usually found in riparian deciduous habitats in summer: cottonwoods (*Populus* ssp.), willows (*Salix* ssp.), alders (*Alnus* ssp.), and other small trees and shrubs typical of low, open-canopy riparian woodland. Also breeds in montane shrubbery in open coniferous forests (CDFW 2020).	Y	Potential to occur within any of the project components
Strix nebulosa	great gray owl	None	SE	---	Breeds in red fir (*Abies magnifica*), lodgepole pine (*Pinus contorta* ssp. *murrayana*), and mixed coniferous habitats, always near wet meadows. Nests in large, broken-topped snags usually 25 to 72 feet above the ground. A rarely seen resident at 4,500 to 7,500 feet in elevation in the Sierra Nevada Range, from the vicinity of Quincy south to the Yosemite region. (CDFW 2020).	N	The proposed project area is completely below the elevation range of this species.
Strix occidentalis occidentalis	California spotted owl	None	SSC	---	Older forests in areas of high canopy cover, with a multi-layered canopy, old decadent trees, a high number of large trees, and coarse downed woody debris. In California, ranges throughout the west slopes of the Sierra Nevada Mountains, and down the Coast Range Mountains from Carmel south through the Transverse Ranges nearly to Baja California (Shuford and Gardali 2008).	Y	Collection System

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
Vireo bellii pusillus	least Bell's vireo	FE	SE	---	Once occupied much of the Central Valley, but has disappeared from most its former range, and is now restricted to southern California from southern Inyo and Monterey Counties south through the South Coast and Inland Empire regions. Obligate riparian breeder, favoring cottonwood (*Populus* spp.), willow (*Salix* spp.), and oak (*Quercus* spp.) woodlands, and mule fat (*Baccharis salicifolia*) scrub along watercourses (USFWS 2006).	N	Extirpated from Sacramento Valley since the mid-1980s.
Xanthocephalus xanthocephalus	yellow-headed blackbird	None	SSC	---	Nests in fresh marshes with tall, emergent vegetation such as bulrushes (*Schoenoplectus* ssp.) and cattails (*Typha* ssp.) adjacent to deep water (Shuford and Gardali 2008).	Y	WWTP Site –Neal Road, Pipeline/Infrastructure – Neal Road, Land Discharge
Mammals							
Antrozous pallidus	pallid bat	None	SSC	---	Ranges across nearly all of California except for high elevation portions of the Sierra Nevada Mountains and Del Norte, western Siskiyou, Humboldt, and northern Mendocino Counties. Generally found in a wide variety of habitats but with some preference for drier areas. Day roosts are in caves, crevices, mines, and occasionally in hollow trees and buildings (CDFW 2020).	Y	Potential to occur within any of the project components
Aplodontia rufa californica	Sierra Nevada mountain beaver	None	SSC	---	Ranges across the Sierra Nevada Mountains from Shasta and Lassen Counties south to Tulare County. Generally found in dense riparian forests and open shrubscapes around most forest types. Specifically found in forests with open to moderate canopy cover and a dense understory near water. Requires deep friable soils and a cool moist microclimate (CDFW 2020).	N	The proposed project area is completely outside the range of this species.

Scientific Name	Common Name	Federal Status	State Status	State Rare Plant Rank	General Habitat Characteristics	Potential to Occur in Study Area	Project Component
Corynorhinus townsendii	Townsend's big-eared bat	None	SSC	---	Ranges throughout California except for high elevation portions of the Sierra Nevada Mountains. Generally prefers mesic habitats but known to occur in all non-alpine habitats of California. Roosting occurs in caves, tunnels, mines, buildings, or other structures and this species may use different roosting sites for day and night (CDFW 2020).	Y	Potential to occur within any of the project components
Eumops perotis californicus	western mastiff bat	None	SSC	---	Ranges throughout all of Southern California, the central coast, and the Sierra Nevada Mountains. Generally occurs in open, arid, or semi-arid habitats. Roosts in rock crevices and buildings. (CDFW 2020).	Y	Potential to occur within any of the project components
Lasiurus blossevillii	western red bat	None	SSC	---	Ranges across the Central Valley, as well as the coast and Coast Range mountains from Mendocino County south, and east across the Los Angeles area into the Inland Empire region. Occurs in most habitats except desert and alpine areas. Roosts in trees, sometimes shrubs, and typically at the margins of habitats (CDFW 2020).	Y	Potential to occur within any of the project components
Pekania pennanti	fisher (West Coast DPS)	None	ST, SSC	---	Large areas of mature, dense forest stands with snags and greater than 50% canopy closure. Uncommon permanent resident of the Sierra Nevada, Cascades, and Klamath Mountains; also found in a few areas in the North Coast Ranges (USFWS 2014).	Y	Collection System
Taxidea taxus	American badger	None	SSC	---	Ranges across nearly all of California except northernmost Humboldt and Del Norte Counties. Most abundant in drier open stages of most shrub, forest, and herbaceous habitats, with friable soils (CDFW 2020).	Y	WWTP Site – Clark Road and Neal Road, Pipeline/Infrastructure - Clark Road and Neal Road, Land Discharge

Status: Federal Endangered (FE); Federal Threatened (FT); State Endangered (SE); State Threatened (ST); State Candidate Endangered (SCE); State Fully Protected (SFP); State Rare (SR); State Species of Special Concern (SSC); Bald and Golden Eagle Protection Act (BGEPA); California Native Plant Society (CNPS) State Rare Plant Rankings: 1B = Rare, Threatened, or Endangered in California and Elsewhere, 2B = Rare, Threatened, or Endangered in California, but More Common Elsewhere, Threat Ranks – 0.1 = Seriously threatened in California, 0.2 = Fairly threatened in California, 0.3 = Not very threatened in California

The CWHR habitat types mapped in the project area include:

- Annual Grassland (AGS)
- Barren (BAR)
- Blue Oak-Foothill Pine (BOP)
- Blue Oak Woodland (BOW)
- Cropland (CRP)
- Deciduous Orchard (DOR)
- Fresh Emergent Wetland (FEW)
- Lacustrine (LAC)
- Mixed Chaparral (MCH)
- Montane Hardwood Conifer (MHC)
- Montane Hardwood (MHW)
- Montane Riparian (MRI)
- Pasture (PAS)
- Ponderosa Pine (PPN)
- Riverine (RIV)
- Urban (URB)
- Valley Oak Woodland (VOW)
- Valley Foothill Riparian (VRI)
- Wet Meadow (WTM)

Table A.2-2. Special-Status Species with the Potential to Occur in the Project Area and Associated CWHR Habitats

Scientific Name	Common Name	USFWS	CDFW	CRPR	CWHR Habitat Associations[a]
Plants					
Allium jepsonii	Jepson's onion	—	—	1B.2	BOP, BOW, MCH, MHC, MHW, PPN
Balsamorhiza macrolepis	big-scale balsamroot	—	—	1B.2	AGS, BOP, BOW, MCH, MHC, MHW, PAS, PPN, VOW
Campylopodiella stenocarpa	flagella-like atractylocarpus	—	—	2B.2	BAR, BOP, BOW, MHC, MHW, MRI, PPN, VOW
Cardamine pachystigma var. dissectifolia	dissected-leaved toothwort	—	—	1B.2	BOP, BOW, MCH, MHC, MHW, PPN
Carex xerophila	chaparral sedge	—	—	1B.2	BOP, BOW, MCH, MHC, MHW, PPN
Castilleja rubicundula var. rubicundula	pink creamsacs	—	—	1B.2	AGS, BOP, BOW, MCH, MHC, MHW, MRI, PAS, PPN, VRI, VOW, WTM
Clarkia gracilis ssp. albicaulis	white-stemmed clarkia	—	—	1B.2	ASP, BOP, BOW, MCH, MHC, MHW, PPN
Clarkia mildrediae ssp. mildrediae	Mildred's clarkia	—	—	1B.3	ASP, BOP, BOW, MHC, MHW, PPN
Clarkia mosquinii	Mosquin's clarkia	—	—	1B.1	ASP, BAR, BOP, BOW, MHC, MHW, PPN
Delphinium recurvatum	recurved larkspur	—	—	1B.2	AGS, ASP, BOP, BOW, MCH, MHC, MHW, MRI, PAS, PPN, VRI, VOW
Eremogone cliftonii	Clifton's eremogone	—	—	1B.3	BOP, MCH, MCP, MHC, MHW, MRI, PPN
Eriogonum umbellatum var. ahartii	Ahart's buckwheat	—	—	1B.2	ASP, BOP, BOW, MCH, MCP, MHC, MHW, PPN
Erythranthe filicifolia	fern-leaved monkeyflower	—	—	1B.2	BOP, MCH, MHC, MRI, PPN, WTM
Euphorbia hooveri	Hoover's spurge	FT	—	1B.2	AGS, WTM
Fritillaria pluriflora	adobe-lily	None	None	1B.2	AGS, BOP, BOW, MCH, MHC, MHW, PAS, PPN, VRI, VOW

Scientific Name	Common Name	USFWS	CDFW	CRPR	CWHR Habitat Associations[a]
Hibiscus lasiocarpos var. occidentalis	woolly rose-mallow	None	None	1B.2	BAR, FEW, WTM
Imperata brevifolia	California satintail	None	None	2B.1	MCH, MCP, MHC, MRI, VRI, WTM
Juncus leiospermus var. leiospermus	Red Bluff dwarf rush	None	None	1B.1	AGS, BOP, BOW, MCH, MHC, MHW, MRI, PAS, PPN, VRI, VOW, WTM
Layia septentrionalis	Colusa layia	None	None	1B.2	AGS, BOP, BOW, MCH, MCP, MHC, MHW, PAS, PPN, VOW, WTM
Lewisia cantelovii	Cantelow's lewisia	None	None	1B.2	ASP, BOP, BOW, MCH, MHC, MHW, MRI, PPN, WTM
Limnanthes floccosa ssp. californica	Butte County meadowfoam	FE	SE	1B.1	AGS, WTM
Monardella venosa	veiny monardella	None	None	1B.1	AGS, BOP, BOW, MHC, MHW, PAS, PPN, VOW
Orcuttia pilosa	hairy Orcutt grass	FE	SE	1B.1	AGS, WTM
Packera eurycephala var. lewisrosei	Lewis Rose's ragwort	None	None	1B.2	BOP, BOW, MCH, MHC, MHW, PPN, VOW
Paronychia ahartii	Ahart's paronychia	None	None	1B.1	AGS, BOP, BOW, MHC, MHW, MRI, PAS, PPN, VRI, VOW, WTM
Poa sierrae	Sierra blue grass	None	None	1B.3	BOP, MHC, PPN, WTM
Rhynchospora californica	California beaked-rush	None	None	1B.1	BOP, FEW, MHC, MRI, PPN, WTM
Rhynchospora capitellata	brownish beaked-rush	None	None	2B.2	BOP, FEW, MHC, MRI, PPN, WTM
Rupertia hallii	Hall's rupertia	None	None	1B.2	BAR, BOP, BOW, MHC, MHW, PPN
Sagittaria sanfordii	Sanford's arrowhead	None	None	1B.2	FEW
Sedum albomarginatum	Feather River stonecrop	None	None	1B.2	BOP, MCH, MHC, PPN
Sidalcea robusta	Butte County checkerbloom	None	None	1B.2	BOP, BOW, MCH, MHC, MHW, MRI, PPN
Stuckenia filiformis ssp. alpina	slender-leaved pondweed	None	None	2B.2	FEW
Trifolium jokerstii	Butte County golden clover	None	None	1B.2	AGS, PAS, WTM
Tuctoria greenei	Greene's tuctoria	FE	SR	1B.1	AGS, WTM
Invertebrates					
Branchinecta conservatio	Conservancy fairy shrimp	FE	None	---	AGS, WTM
Branchinecta lynchi	vernal pool fairy shrimp	FT	None	---	AGS, WTM
Desmocerus californicus dimorphus	valley elderberry longhorn beetle	FT	None	---	AGS, VRI
Lepidurus packardi	vernal pool tadpole shrimp	FE	None	---	AGS, WTM
Fish					
Mylopharodon conocephalus	hardhead	None	SSC	---	LAC, RIV
Oncorhynchus mykiss irideus (pop. 11)	steelhead (Central Valley DPS)	FT	None	---	RIV

Scientific Name	Common Name	USFWS	CDFW	CRPR	CWHR Habitat Associations[a]
Oncorhynchus tshawytscha (pop. 6)	chinook salmon (Central Valley spring-run ESU)	FT	ST	---	RIV
Amphibians					
Rana boylii	foothill yellow-legged frog	—	ST, SSC	—	MRI, RIV
Rana draytonii	California red-legged frog	FT	SSC	—	AGS, LAC, MCH, MHC, MRI, PPN, RIV, WTM
Spea hammondii	western spadefoot	None	SSC	---	AGS, BOP, BOW, LAC, MRI, RIV, WTM
Reptiles					
Actinemys marmorata	northwestern pond turtle	None	SSC	---	FEW, LAC, MRI, RIV, VRI
Phrynosoma blainvillii	Blainville's horned lizard	None	SSC	---	AGS, BAR, BOP, BOW, MCH, MHC, MRI, PPN, VRI, VOW
Thamnophis gigas	giant gartersnake	FT	ST	---	FEW, LAC, RIV
Birds					
Accipiter gentilis	northern goshawk	—	SSC	—	BOP, MRI, PPN
Agelaius tricolor	tricolored blackbird	None	ST, SSC	---	AGS, CRP, FEW, PAS, VRI, WTM
Aquila chrysaetos	golden eagle	—	FP	—	AGS, BOP, MHC, PAS
Athene cunicularia	burrowing owl	None	SSC	---	AGS, BAR, PAS, URB
Buteo swainsoni	Swainson's hawk	None	ST	---	AGS, BOW, PAS, URB, VRI, VOW, WTM
Circus hudsonius	northern harrier	None	SSC	---	AGS, CRP, FEW, PAS, WTM
Contopus cooperi	olive-sided flycatcher	—	SSC	—	BOP, LAC, MHC, MRI, PPN, RIV, WTM
Elanus leucurus	white-tailed kite	—	FP	—	AGS, BOP, BOW, CRP, FEW, PAS, URB, VRI, VOW, WTM
Empidonax traillii brewsteri	little willow flycatcher	—	SE	—	MRI, WTM
Falco peregrinus anatum	American peregrine falcon	None	SFP	---	BOP, FEW, MRI, PPN, URB
Haliaeetus leucocephalus	bald eagle	—	SE, FP	—	LAC, MHC, MRI, PPN, RIV
Icteria virens	yellow-breasted chat	None	SSC	---	MRI, VRI
Lanius ludovicianus	loggerhead shrike	None	SSC	---	AGS, BAR, BOW, PAS, VOW
Laterallus jamaicensis coturniculus	California black rail	None	ST, SFP	---	FEW, WTM
Melospiza melodia	song sparrow (Modesto population)	None	SSC	---	FEW, VRI
Progne subis	purple martin	None	SSC	---	BOP, MHC, MHW, MRI, PPN
Setophaga petechia	yellow warbler	—	SSC	—	BOP, MHC, MRI, PPN, VRI
Strix occidentalis occidentalis	California spotted owl	—	SSC	—	BOP, MHC, MRI, PPN
Xanthocephalus xanthocephalus	yellow-headed blackbird	—	SSC	—	FEW

Scientific Name	Common Name	USFWS	CDFW	CRPR	CWHR Habitat Associations[a]
Mammals					
Antrozous pallidus	pallid bat	—	SSC	—	AGS, BAR, BOP, BOW, MCH, MHC, MHW, MRI, PPN, URB, VRI, VOW
Corynorhinus townsendii	Townsend's big-eared bat	—	SSC	—	AGS, BAR, BOP, BOW, MCH, MHC, MHW, MRI, PPN, URB, VRI, VOW
Eumops perotis	western mastiff bat	—	SSC	—	AGS, BAR, BOP, BOW, MCH, MHC, MHW, PPN, URB, VOW
Lasiurus blossevillii	western red bat	None	SSC	---	AGS, BAR, BOP, BOW, MCH, MHC, MHW, MRI, PPN, URB, VRI, VOW
Pekania pennanti	fisher	FC	ST, SSC	—	MHC, PPN
Taxidea taxus	American badger	—	SSC	—	AGS, BAR

[a] Associations are derived from detailed habitat description in species table.

CWHR habitat acronyms are defined in text above.

Notes: FE = federal endangered; FT = federal threatened; FC = federal candidate; SE = state endangered; ST = state threatened; FP = fully protected; SSC = species of special concern; SR = state rare; CRPR = California Rare Plant Rank; 1B = plants rare, threatened, or endangered in California and elsewhere; 2B = plants rare, threatened, or endangered in California, but more common elsewhere.

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A.3

California Wildlife Habitat Relationships Habitat Types

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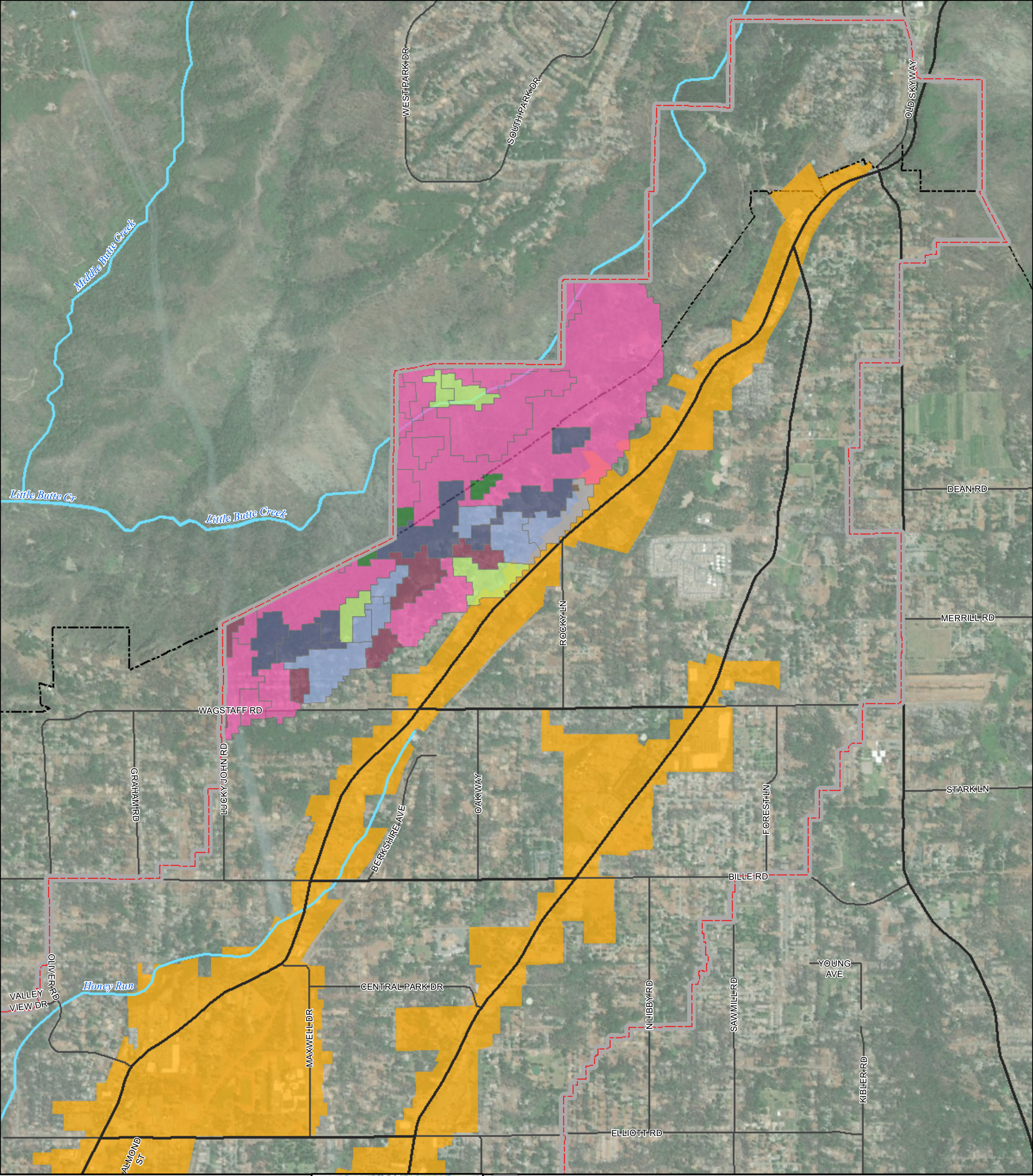

LOCAL CWHR VEGETATION

HDR

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Scale in Feet

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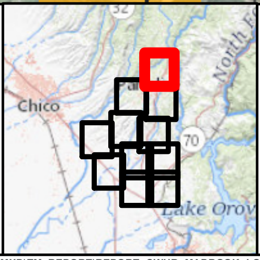

PSD Local Study Area

CWHR Vegetation Type

BOW - Blue Oak Woodland
BOP - Blue Oak-Foothill Pine
MCH - Mixed Chaparral
MHW - Montane Hardwood
MHC - Montane Hardwood-Conifer
PPN - Ponderosa Pine
Sewer Service Area

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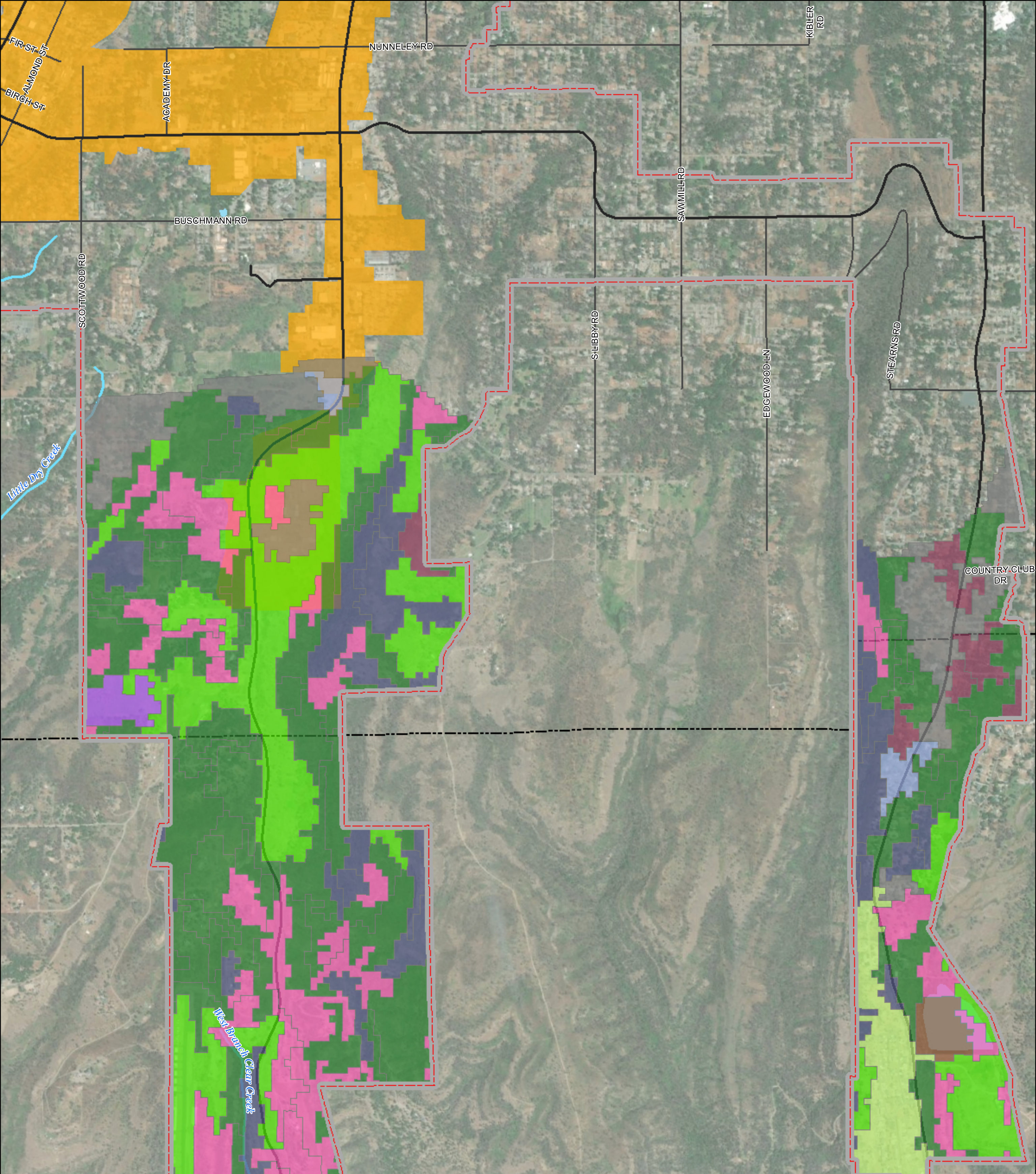

LOCAL CWHR VEGETATION

HDR

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Scale in Feet

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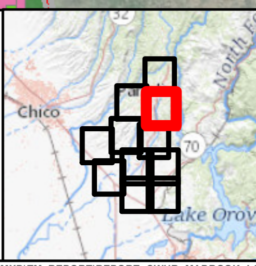

PSD Local Study Area

CWHR Vegetation Type

- AGS - Annual Grassland
- BOW - Blue Oak Woodland
- BOP - Blue Oak-Foothill Pine
- CRP - Cropland
- LAC - Lacustrine
- MCH - Mixed Chaparral
- MHW - Montane Hardwood
- MHC - Montane Hardwood-Conifer
- PPN - Ponderosa Pine
- URB - Urban
- Sewer Service Area

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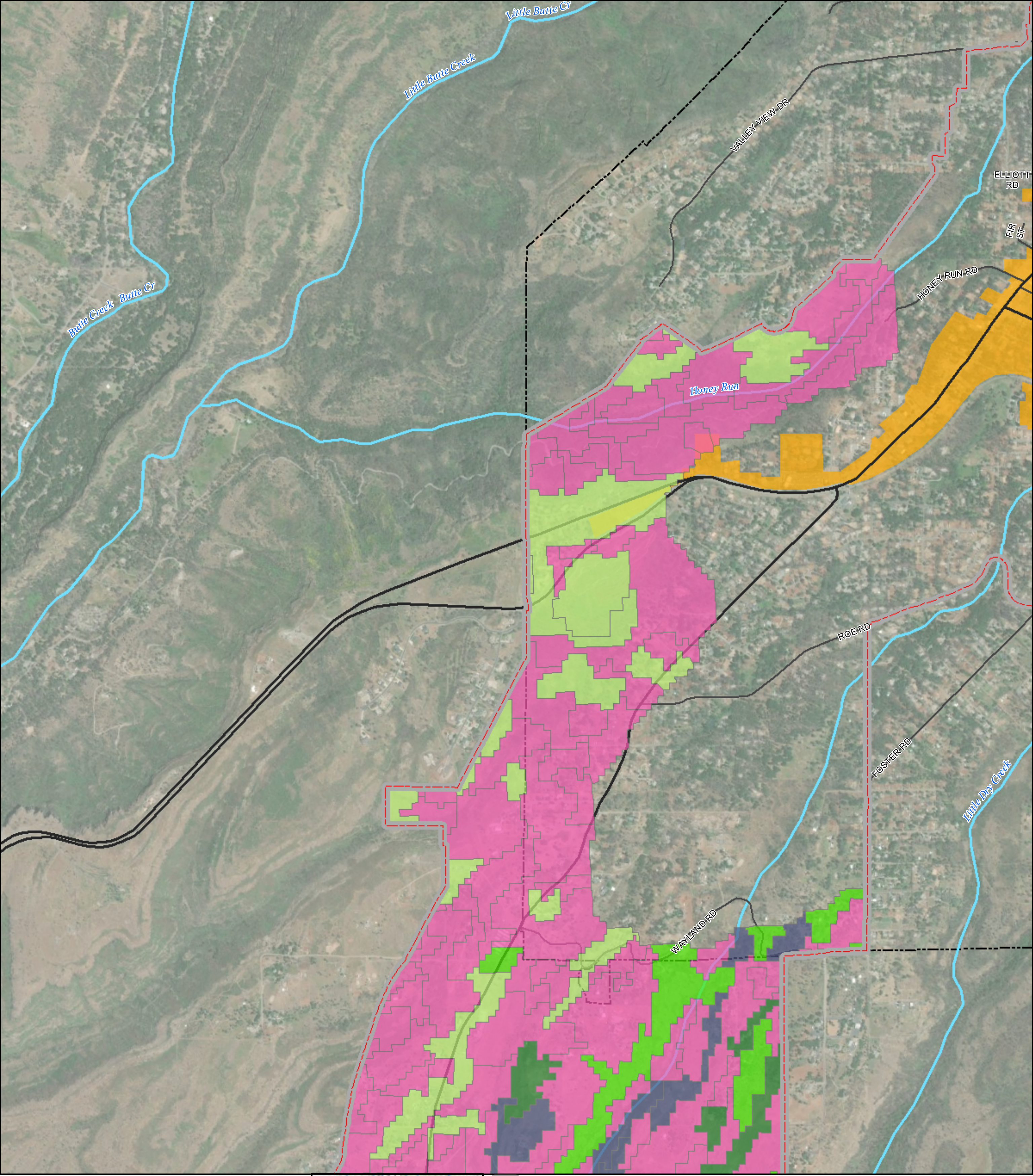

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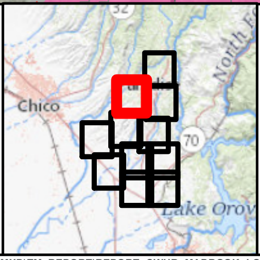

PSD Local Study Area

CWHR Vegetation Type

- AGS - Annual Grassland
- BOW - Blue Oak Woodland
- BOP - Blue Oak-Foothill Pine
- MCH - Mixed Chaparral
- MHW - Montane Hardwood
- URB - Urban
- Sewer Service Area

HDR

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Scale in Feet

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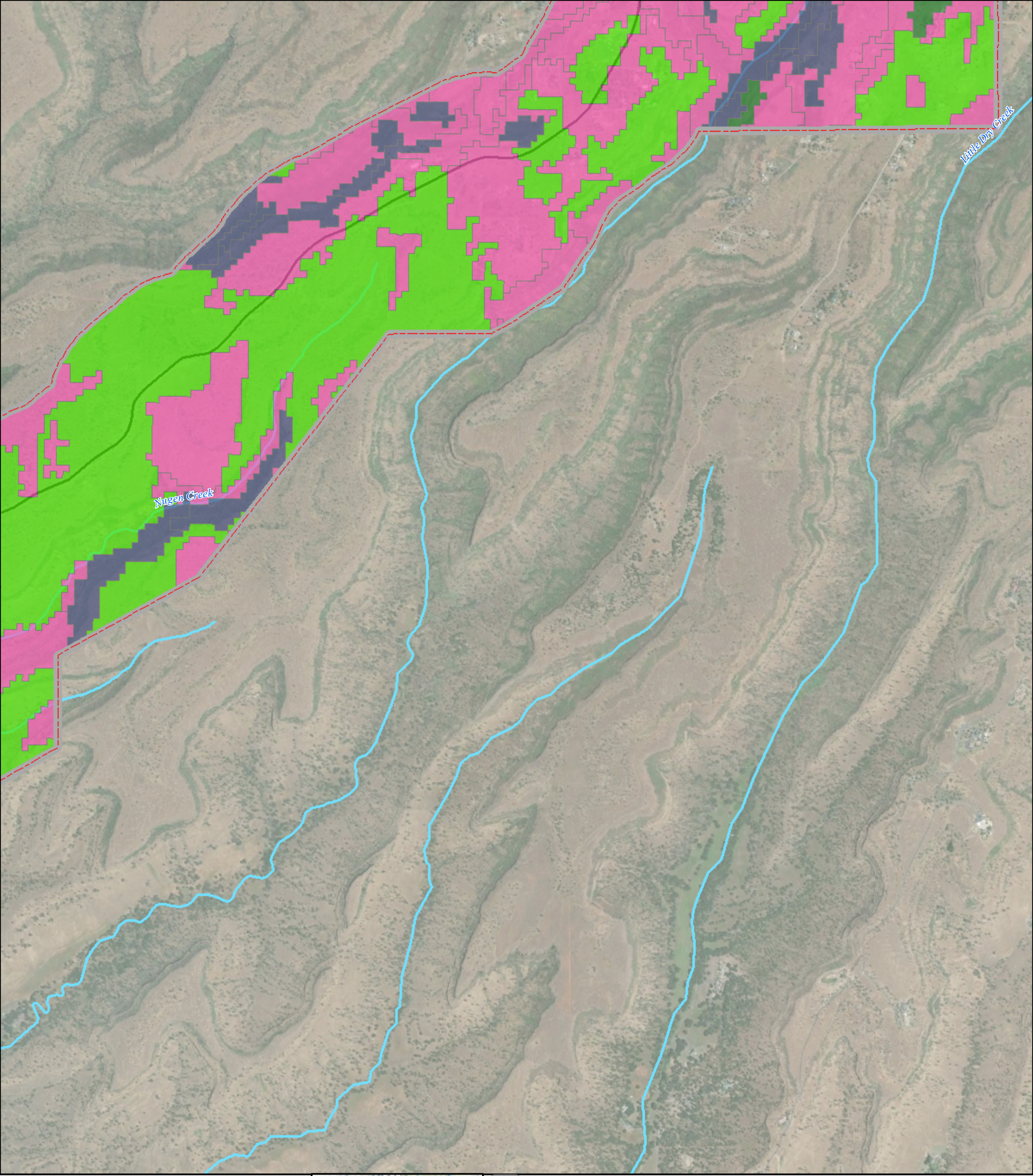

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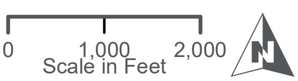

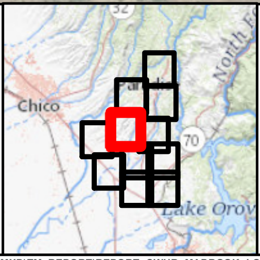

PSD Local Study Area

CWHR Vegetation Type

AGS - Annual Grassland

BOW - Blue Oak Woodland

BOP - Blue Oak-Foothill Pine

MCH - Mixed Chaparral

MHW - Montane Hardwood

Sewer Service Area

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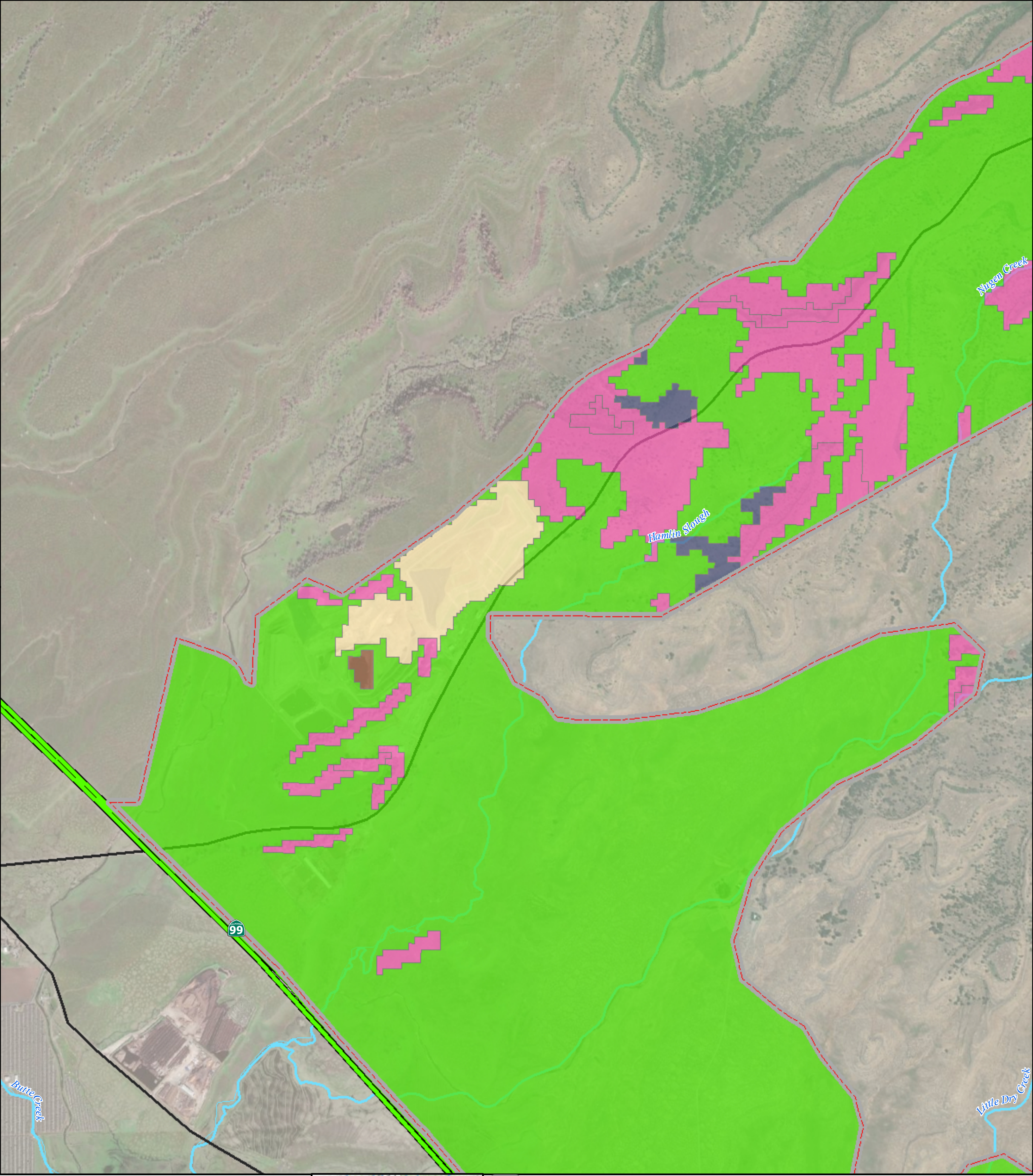
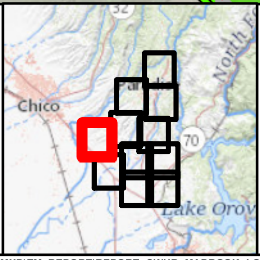


LOCAL CWHR VEGETATION



PSD Local Study Area

CWHR Vegetation Type

AGS - Annual Grassland

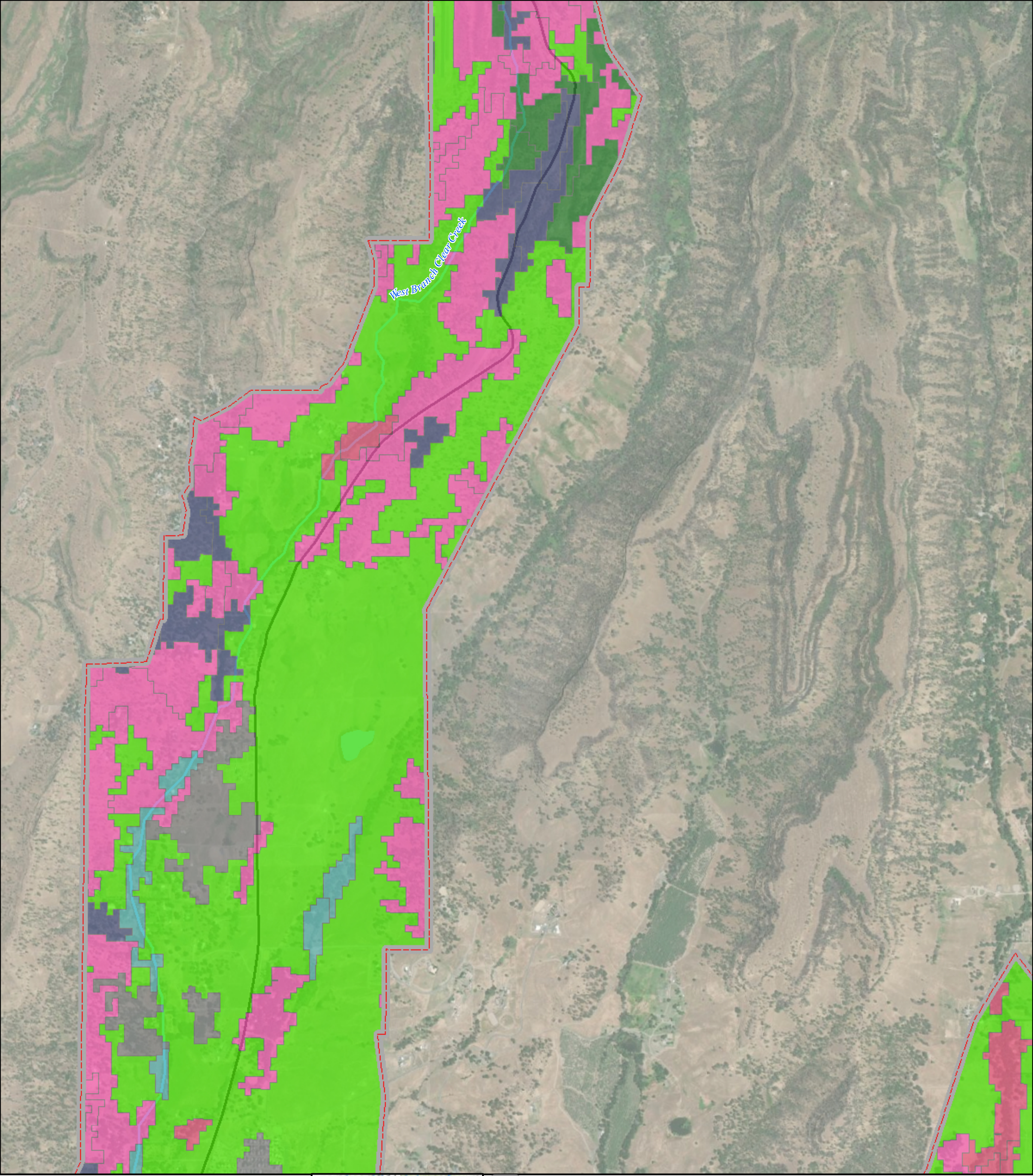
BAR - Barren

BOW - Blue Oak Woodland

BOP - Blue Oak-Foothill Pine

LAC - Lacustrine

Sewer Service Area



LOCAL CWHR VEGETATION

HDR

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Scale in Feet

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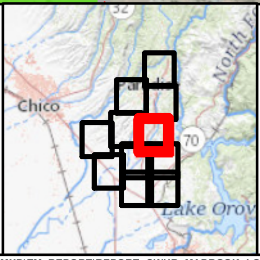

PSD Local Study Area

CWHR Vegetation Type

- AGS - Annual Grassland
- BOW - Blue Oak Woodland
- BOP - Blue Oak-Foothill Pine
- MHW - Montane Hardwood
- MRI - Montane Riparian
- URB - Urban
- VOW - Valley Oak Woodland
- Sewer Service Area

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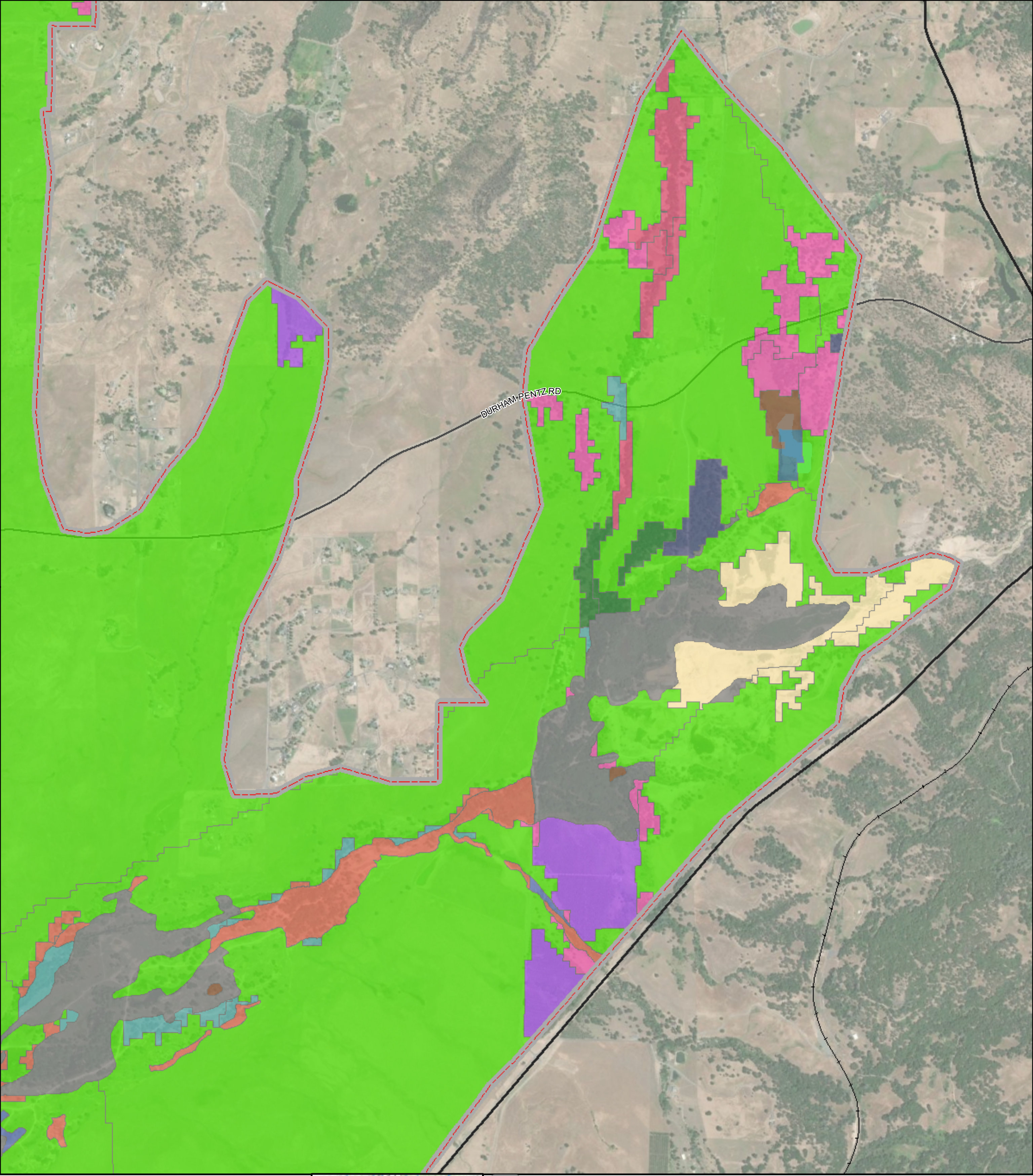

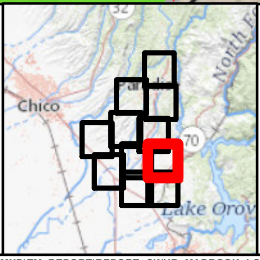

PSD Local Study Area

CWHR Vegetation Type

AGS - Annual Grassland
BAR - Barren
BOW - Blue Oak Woodland
BOP - Blue Oak-Foothill Pine
CRP - Cropland
FEW - Fresh Emergent Wetland
LAC - Lacustrine
MHW - Montane Hardwood
MRI - Montane Riparian
RIV - Riverine
URB - Urban
VRI - Valley Foothill Riparian
VOW - Valley Oak Woodland
Sewer Service Area

LOCAL CWHR VEGETATION

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Scale in Feet

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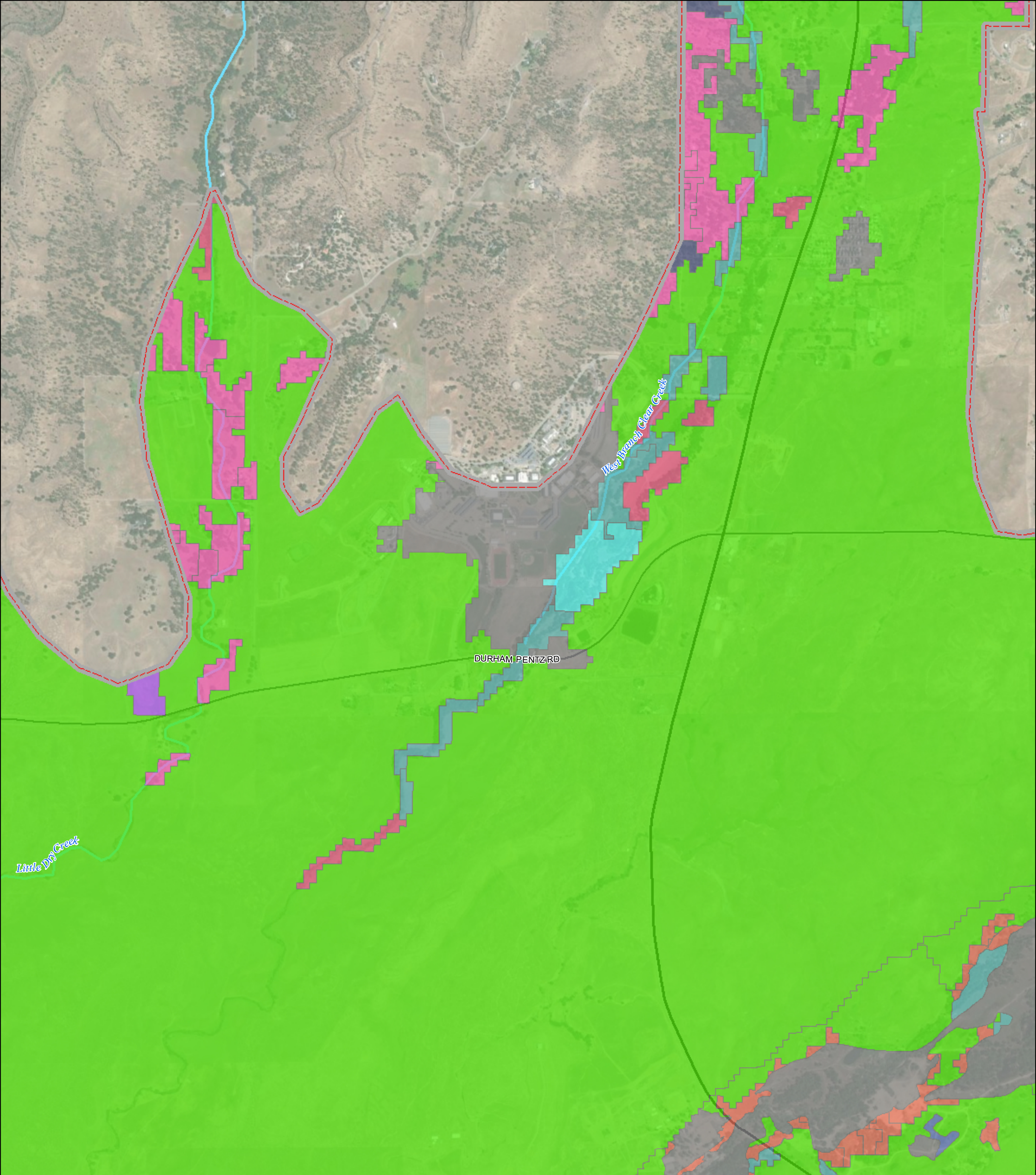

LOCAL CWHR VEGETATION

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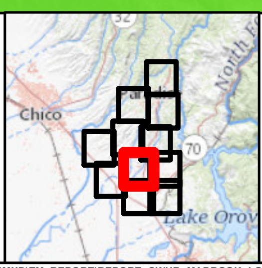
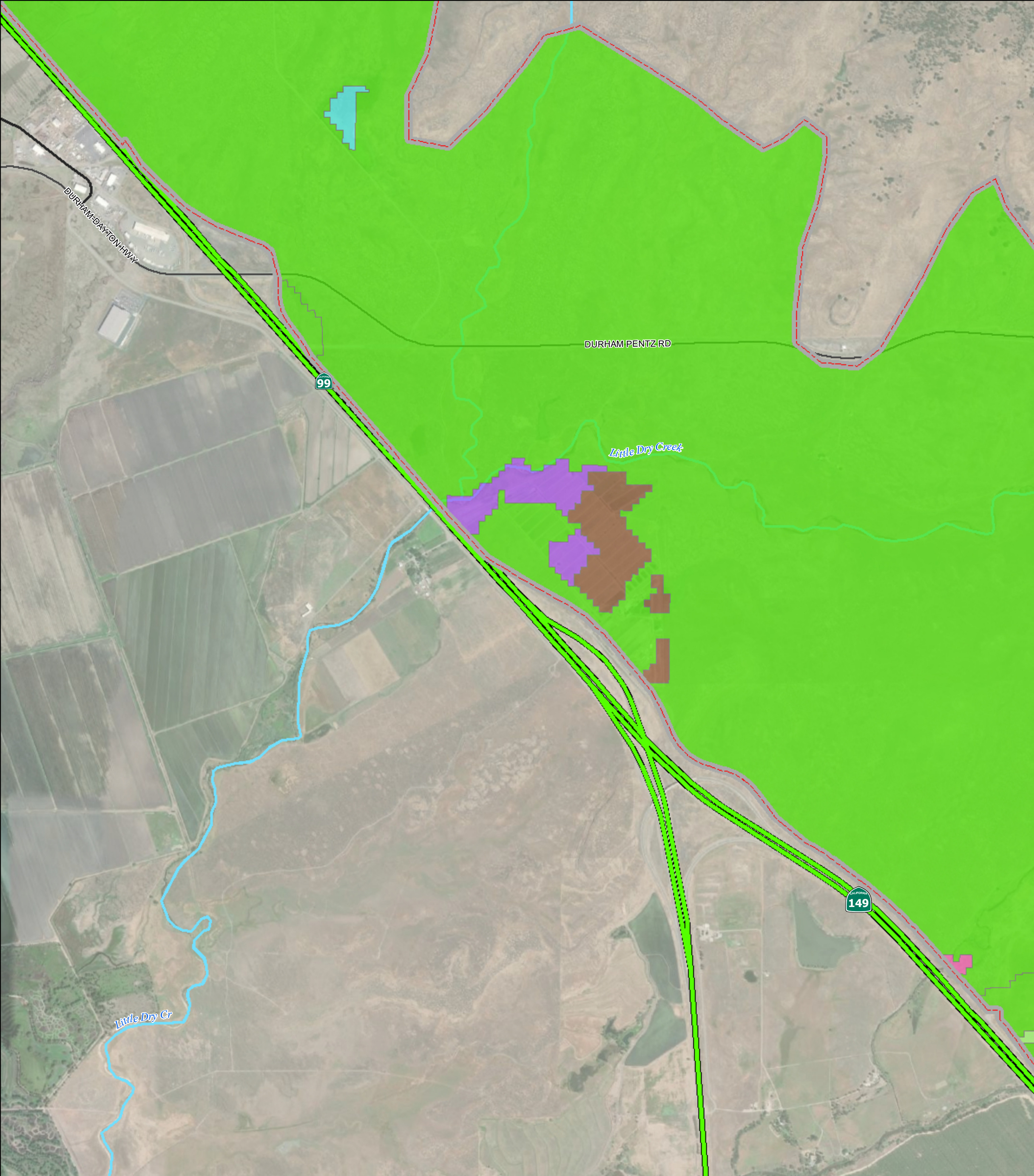
Scale in Feet



PSD Local Study Area

CWHR Vegetation Type

- AGS - Annual Grassland
- BOW - Blue Oak Woodland
- BOP - Blue Oak-Foothill Pine
- CRP - Cropland
- MRI - Montane Riparian
- RIV - Riverine
- URB - Urban
- VRI - Valley Foothill Riparian
- VOW - Valley Oak Woodland
- WTM - Wet Meadow
- Sewer Service Area



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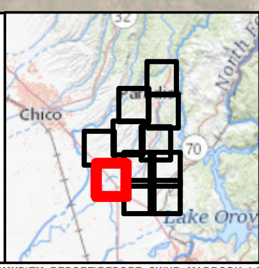

PSD Local Study Area

CWHR Vegetation Type

AGS - Annual Grassland
BOW - Blue Oak Woodland
CRP - Cropland
LAC - Lacustrine
PAS - Pasture
WTM - Wet Meadow
Sewer Service Area

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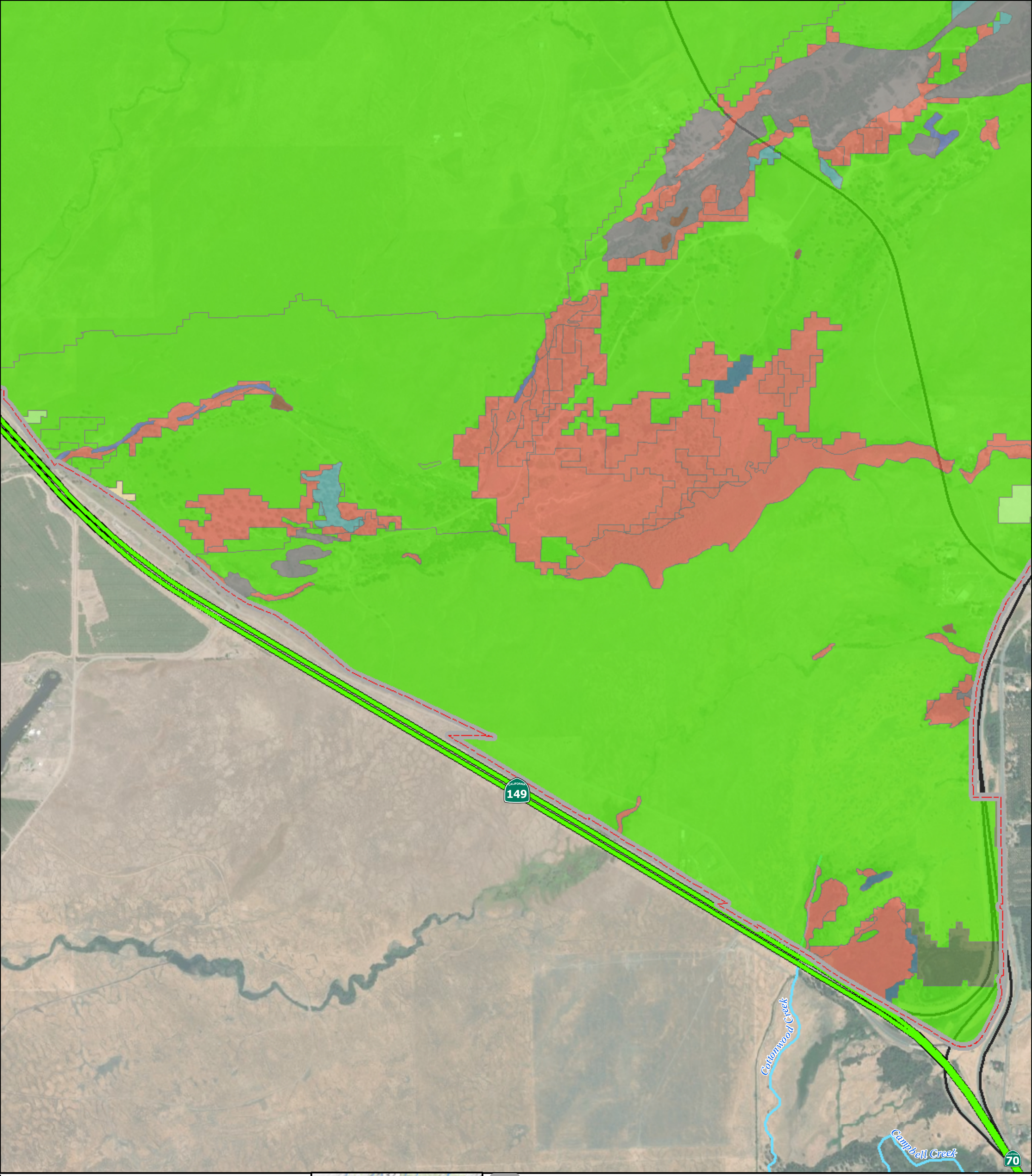

LOCAL CWHR VEGETATION

HDR

0 1,000 2,000
Scale in Feet

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PSD Local Study Area

CWHR Vegetation Type

- AGS - Annual Grassland
- BAR - Barren
- DOR - Deciduous Orchard
- FEW - Fresh Emergent Wetland
- LAC - Lacustrine
- PAS - Pasture
- RIV - Riverine
- URB - Urban
- VRI - Valley Foothill Riparian
- VOW - Valley Oak Woodland
- Sewer Service Area

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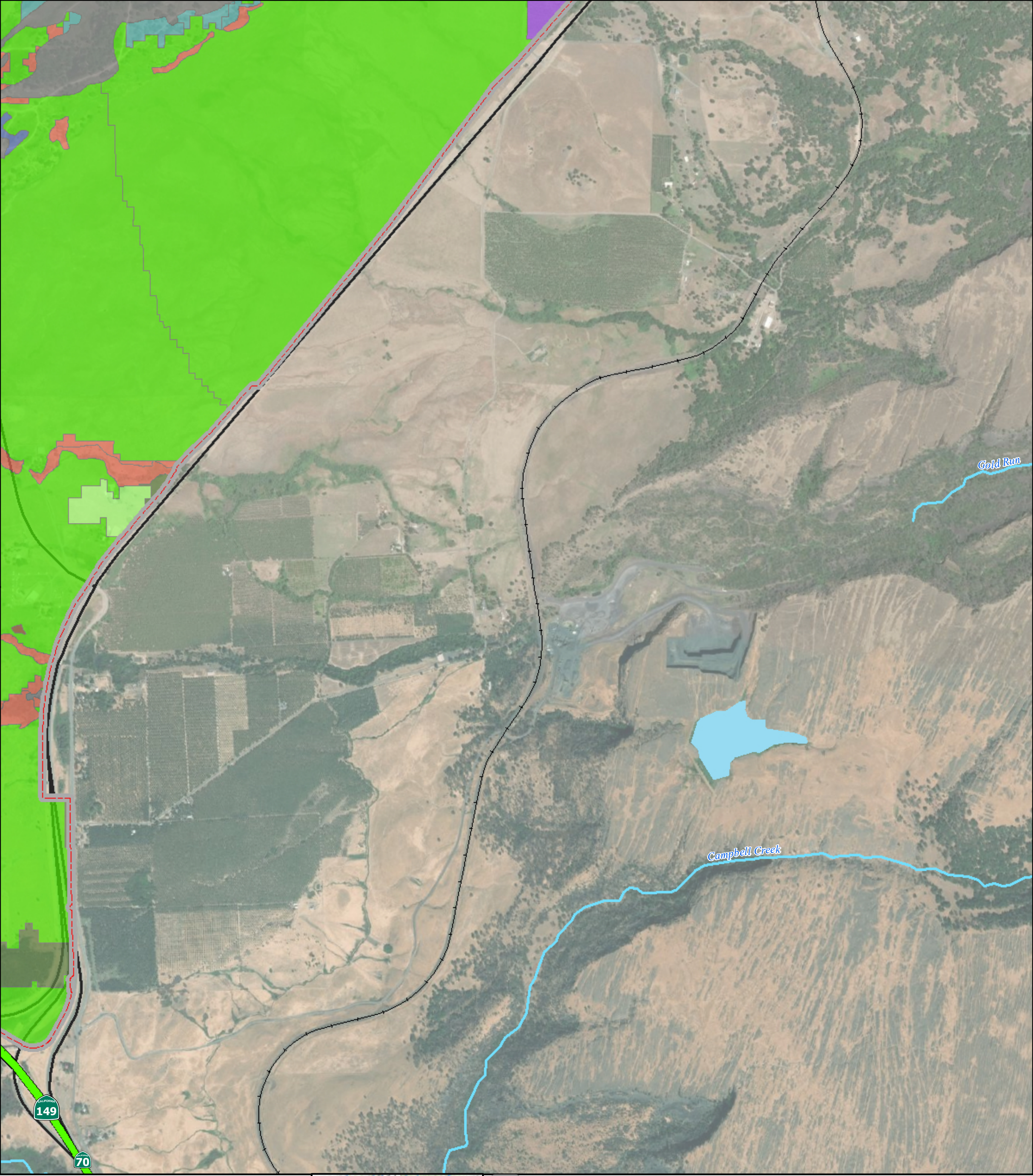

LOCAL CWHR VEGETATION

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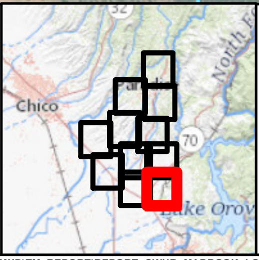

PSD Local Study Area

CWHR Vegetation Type

AGS - Annual Grassland
CRP - Cropland
DOR - Deciduous Orchard
LAC - Lacustrine
PAS - Pasture
RIV - Riverine
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VRI - Valley Foothill Riparian
VOW - Valley Oak Woodland
Sewer Service Area

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Process Equipment Information

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B.1

Secondary Treatment Process by Aero-Mod

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AEROMOD Wastewater Process Solutions

Wastewater Treatment Plant Budgetary Estimate

for

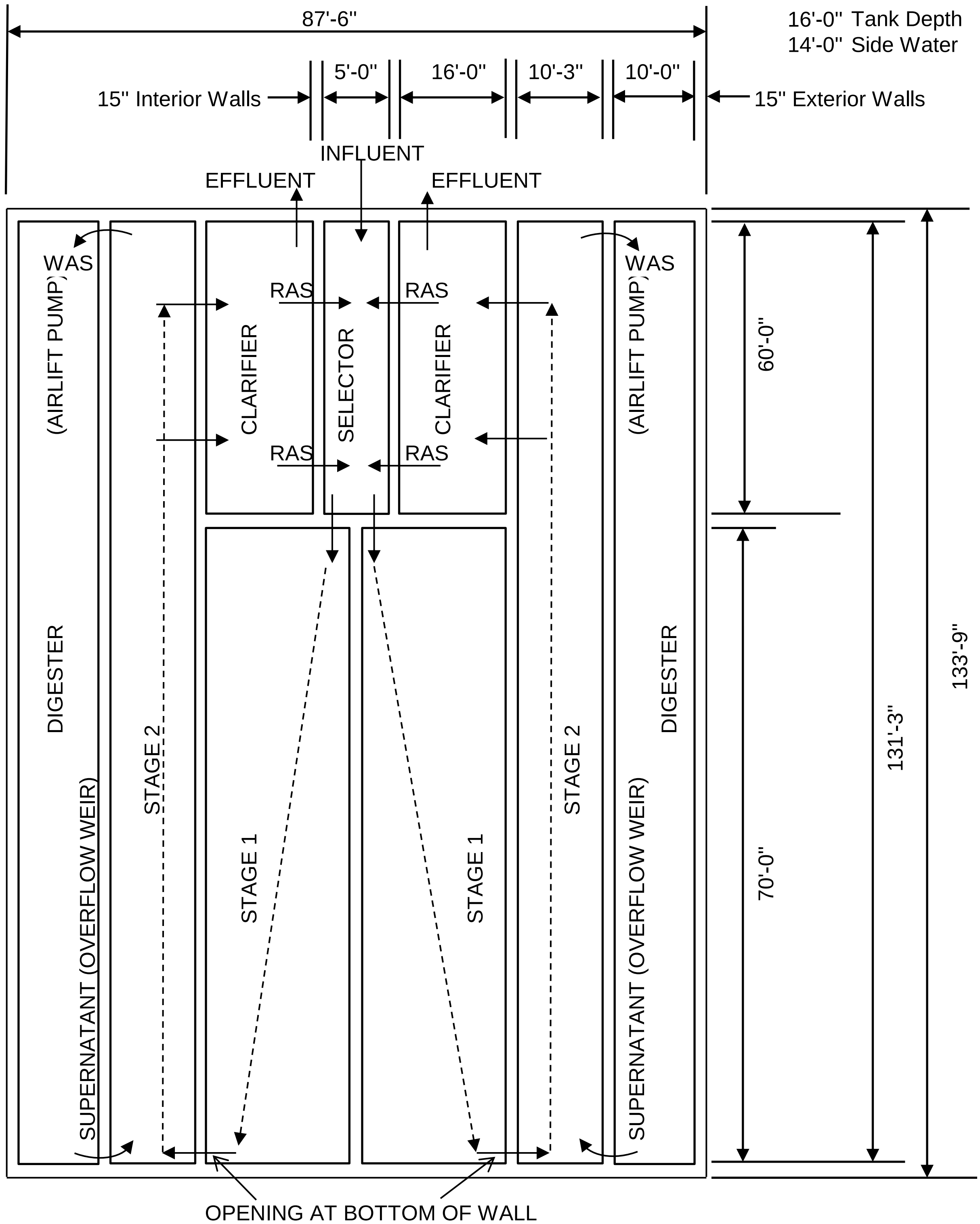
Paradise, CA
HDR
6,550 Population Equivalent
6-Jul-20

Contents

Aero-Mod, Inc.

GENERAL ARRANGEMENT DRAWING

Project: Paradise, CA **Date:** 6-Jul-20
Engineer: HDR Tank Dimensions (Not to Scale)



Aero-Mod, Inc.

PROCESS FLOW DIAGRAM

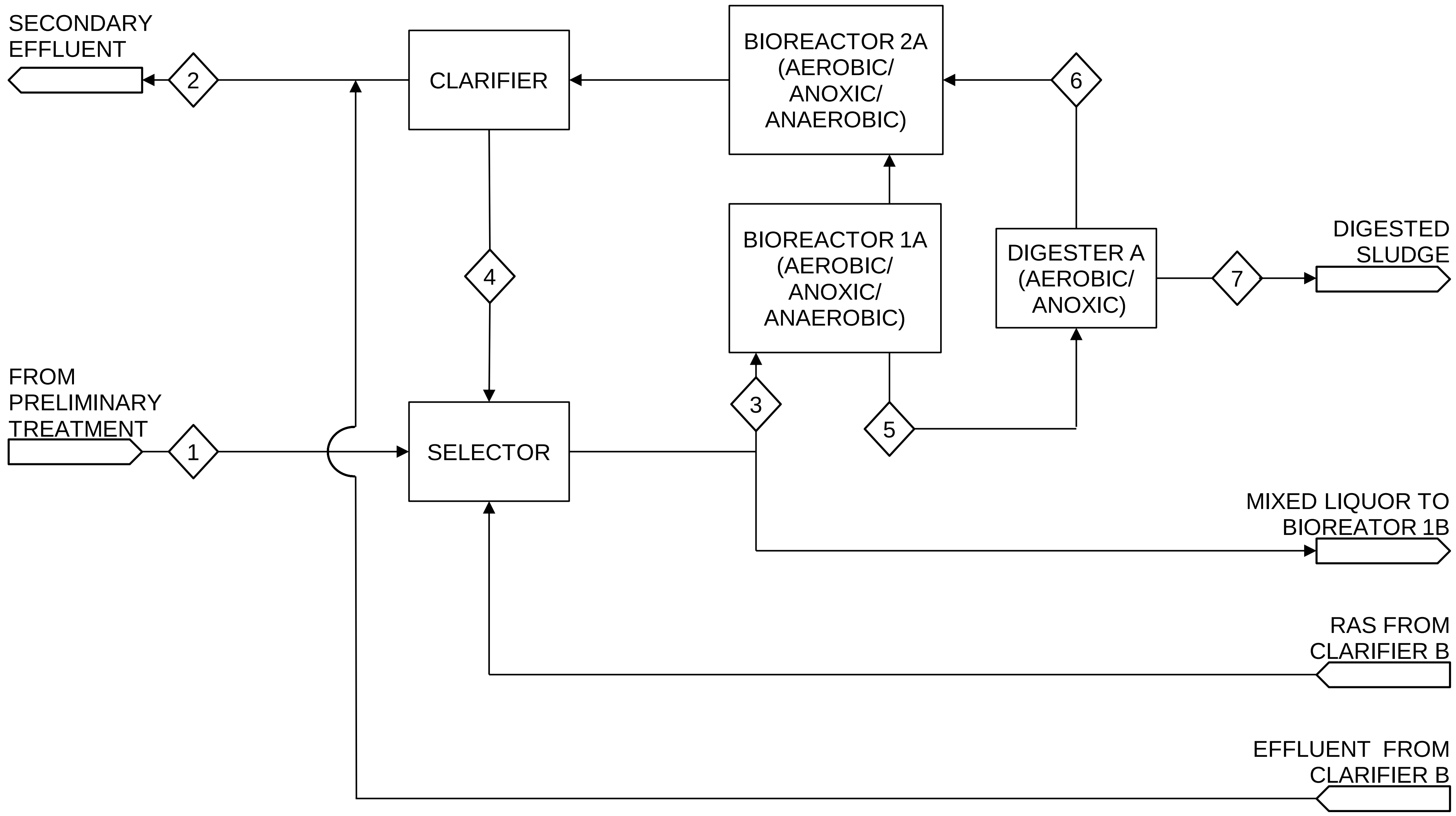
Project: Paradise, CA

Engineer: HDR

July 6, 2020

US Customary Units

Prepared by: BWN



STREAM NO.	1	2	3	4	5	6	7	
DESCRIPTION (AVERAGE)	INFLUENT	SECONDARY EFFLUENT	MIXED LIQUOR	RETURN ACTIVATED SLUDGE	WASTE ACTIVATED SLUDGE	DIGESTER DECANT	DIGESTED SLUDGE	(1) - (2) - (7)
FLOW, MGD	0.448	0.438	0.448	0.224	0.040	0.030	0.010	0.0
BOD, LB/D	1,310	37	N/A	N/A	872	5	600	674
TSS,LB/D	1,500	37	12,938	12,188	1143	8	951	513
VSS, LB/D	1,056	27	6,969	6,565	616	3	424	605
TKN, LB/D	258	11	N/A	N/A	40	0.22	28	219
TIN, LB/D	170	22	N/A	N/A	2.0	0.0	0.0	148
TN, LB/D	258	29	N/A	N/A	41	0.22	28	201
SOL P, LB/D	12.8	16.0	N/A	N/A	1.45	11.9	4	-7.0
TP, LB/D	25.8	18.3	N/A	N/A	40	12.1	7	0.0

Aero-Mod, Inc.

ACTIVATED SLUDGE DESIGN CALCULATIONS - AVERAGE

Project:	Paradise, CA		July 6, 2020
Engineer:	HDR		US Customary Units
Act. Sludge Process:	SEQUOX Plus	Prepared by:	BWN

DESIGN CONDITIONS & PARAMETERS

		Influent	Effluent		
Flow (Q), MGD		0.448		0.20 lb BOD/capita-day = 6550 Pop. Equiv.	
BOD_5, mg/L		351	10	Plant Elevation, FASL	1,778
BOD_5, lbs/day		1,310	37	**Aeration Basin**	
BOD_L, mg/L		513		Retention Time, hours	32
TSS, mg/L		401	10	Aeration Tank Volume, Mgal	0.594
Soluble P, mg/L		3.4	0.00	MCRT, days	15.0
Total P, mg/L		6.9	5.00	Wastewater Temperature, ^oC	10
NH_3-N, mg/L		45	1.00	Net Alkalinity Loss, mg/L as $CaCO_3$(3)	(210)
NO_3-N, mg/L			5.00	**Aerobic Digester**	
TIN, mg/L	(NO_X-N + NH_3-N)		6.00	Volume, Mgal	0.285
rDON, mg/L	(Assumed)		1.50	Max MLSS, mg/l	12,000
TKN, mg/L	(Total)	69	2.84	Digester Temperature, ^oC	10
	(Particulate, pTKN)		0.34	Energy Intensity, kWh/m^3	0.9
TN, mg/L	(TIN+rDON+pTKN)		7.84	kWh/MG	3,292
Notes:	N/A				
	N/A				
	(3) Alkalinity addition may be required (by others)				
	NA				

PROJECTED OPERATING CONDITIONS - AERATION BASIN

Mixed Liquor Suspended Solids, mg/L		3,463
Mixed Liquor Volatile Suspended Solids, %		54%
F/M Ratio, lbs BOD_5/lb MLVSS		0.14
F/M Ratio, lbs BOD_5/lb MLSS		0.08
Organic Loading, lb BOD_5/1000 cf of tank/day		16.5
BOD_5 Oxidized(1), BOD_{inf}	[=(351, mg/L)*0.448 mgd*8.34], lb/d]	1,310
TKN in WAS		
PTKN [(1143 lb WAS/day)*(0.54 VSS/TSS)*(0.064 TKN/WAS VSS)], lb/d		39.4
STKN [(39,571 gal WAS/d)/(10^6)*(1.0 mg NH3N/L+1.5 mg rDON/L)*8.34, lb/d		0.8
Total, lb/d		40.2
Total, Influent Equivalent, mg/L		10.8
TKN Nitrified(2) =TKNin-rDON-TKNwas		
Total	[(68.9-1.5-10.8), mg/L)*0.448 mgd*8.34], lb/d	212
Total, Influent Equivalent	[(212 lb/d)/(0.45 mgd)/8.34], mg/L	53.8
TKN Denitrified=NO3Nproduced-NO3Neffl-NO3Nwas		
Total	[(((53.8-5) mg/L*0.448 mgd)-(5 mg/L*(39,571/10^6 mgd)))*8.34], lb/d	181
Total, Influent Equivalent	[(181 lb/d)/(0.45 mgd)/8.34], mg/L	48.4
Solids Yield (Y), lb TSS/lb BOD_5		0.87
WAS - Solids Wasted, lbs/day		1,143
WAS - Solids Wasted, gal/day		39,571
WAS - Pumping Time, min/(day-pump) @	400 gpm	49

(1) Conservative: does not account for removal in effluent or WAS

(2) Conservative: does not account for removal in effluent

PROJECTED OPERATING CONDITIONS - AEROBIC DIGESTER

Digester Degree C-Days	300
Volatile Solids Reduction in Digester	31.2%
(Net Volatile Solids Reduction Through Process, %)	31.2%
Solids To Waste from Digester, lbs/day	951
Volume to Waste from Digester, gallons/day	9,501
Digester Sludge Age, days	30
Volatile Suspended Solids	45%

Aero-Mod, Inc.

ACTIVATED SLUDGE DESIGN CALCULATIONS - MAX MONTH

Project:	Paradise, CA		July 6, 2020
Engineer:	HDR		US Customary Units
Act. Sludge Process:	SEQUOX Plus	Prepared by:	BWN

DESIGN CONDITIONS & PARAMETERS

		Influent	Effluent		
Flow (Q), MGD		0.582		0.2 lb BOD/capita-day = 6550 Pop. Equiv.	
BOD_5, mg/L		350	10	Plant Elevation, FASL	1,778
BOD_5, lbs/day		1,700	49	**Aeration Basin**	
BOD_L, mg/L		512		Retention Time, hours	24
TSS, mg/L		401	10	Aeration Tank Volume, Mgal	0.594
Soluble P, mg/L		3.4	0.0	MCRT, days	15.0
Total P, mg/L		6.9	0.62	Wastewater Temperature, ^oC	10
NH_3-N, mg/L		45	1.0	Net Alkalinity Loss, mg/L as $CaCO_3$(3)	(210)
NO_3-N, mg/L			5.0	**Aerobic Digester**	
TIN, mg/L	(NO_X-N + NH_3-N)		6.0	Volume, Mgal	0.285
rDON, mg/L	(Assumed)		1.50	Maximum MLSS, mg/l	12,000
TKN, mg/L	(Total)	69	2.85	Digester Temperature, ^oC	10
	(Particulate, pTKN)		0.35		
TN, mg/L			7.85		

Notes: N/A
N/A
(3) Alkalinity addition may be required (by others)

PROJECTED OPERATING CONDITIONS - AERATION BASIN

Mixed Liquor Suspended Solids, mg/L		4,483
Mixed Liquor Volatile Suspended Solids, %		54%
F/M Ratio, lbs BOD_5/lb MLVSS		0.14
F/M Ratio, lbs BOD_5/lb MLSS		0.08
Organic Loading, lb BOD_5/1000 cf of tank/day		21.4
BOD_5 Oxidized(1), BOD_{inf}	[=(350, mg/L)*0.5824 mgd*8.34], lb/d]	1,700
TKN in WAS		
PTKN [(1479 lb WAS/day)*(0.54 VSS/TSS)*(0.064 TKN/WAS VSS)], lb/d		51.1
STKN [(39,571 gal WAS/d)/(10^6)*(1.0 mg NH3N/L+1.5 mg rDON/L)*8.34, lb/d		0.8
Total, lb/d		51.9
Total, Influent Equivalent, mg/L		10.7
TKN Nitrified(2) =TKNin-rDON-TKNwas		
Total	[(68.6-1.5-10.7), mg/L)*0.5824 mgd*8.34], lb/d	274
Total, Influent Equivalent	[(274 lb/d)/(0.58 mgd)/8.34], mg/L	53.6
TKN Denitrified=NO3Nproduced-NO3Neffl-NO3Nwas		
Total	[(((53.6-5) mg/L*0.5824 mgd)-(5 mg/L*39,571/10^6 mgd))*8.34], lb/d	234
Total, Influent Equivalent	[(234 lb/d)/(0.58 mgd)/8.34], mg/L	48.2
Solids Yield (Y), lb TSS/lb BOD_5		0.87
WAS - Solids Wasted, lbs/day		1,479
WAS - Solids Wasted, gal/day		39,571
WAS - Pumping Time, min/(day-pump) @	400 gpm	99

(1) Conservative: does not account for removal in effluent or WAS
(2) Conservative: does not account for removal in effluent

PROJECTED OPERATING CONDITIONS - AEROBIC DIGESTER

Digester Degree C-Days	300
Volatile Solids Reduction in Digester	31%
(Net Volatile Solids Reduction Through Process, %)	54%
Solids To Waste from Digester, lbs/day	1,231
Volume to Waste from Digester, gallons/day	12,295
Digester Sludge Age, days	23
Volatile Suspended Solids	45%

Aero-Mod, Inc.

AERATION REQUIREMENT CALCULATIONS - FIRST STAGE - AVERAGE

Project: Paradise, CA — July 6, 2020
Engineer: HDR — US Customary Units
Diffuser Type Used: Fine 1st/Coarse 2nd/No 3rd/No 4th — Prepared by: BWN

AERATION REQUIREMENTS - FIRST STAGE

		Consumption
Carbonaceous (= 1.20 lb O2/lb BOD * (1,310 * 0.75) lb BOD/d/24), lb O2/hr	49.1	75%
Nitrogenous (= 4.60 lb O2/lb N Nitrified * (201 * 0.75) lb N Nit./day/24), lb O2/hr	28.9	75%
Denit. Credit (= 2.86 lb O2/lb N Denit. * (182 * 0.75) lb N Denit./day/24), lb O2/hr	-16.3	75%
Actual Oxygenation Rate (AOR), lb O_2/hr	61.7	1,482

Standard Oxygenation Rate (SOR), lbs O_2/hr — 169.2

$$SOR = [(AOR * C_{s,20}) / (\alpha * \theta^{\wedge(T-20)} * (\tau * \Omega * \beta * C_{s,20} - C_L))]$$

Where:		
$C_{s,T,H}$	D.O. Saturation @ Sea Level and T, mg/l	8.26
$C_{s,20}$	D.O. Saturation @ Sea Level and 20°C, mg/l	9.09
$C_{s,act}$	D.O. Saturation in Wastewater, mg/l	7.36
α	O_2 Transfer Correction for Wastewater	0.55
θ	Oxygen Transfer T Correction Factor	1.024
T	Temperature of Water, °C (Design Maximum)	25
τ	Oxygen Saturation Correction Factor ($C_{s,T,H}/C_{s,20}$)	0.909
β	Salinity-Surface Tension Correction Factor	0.95
P_H	Pressure at Site Elevation	13.8
Ω	Pressure Correction Factor (P_H/P_s)	0.937
C_L	Residual D.O. Concentration, mg/l	2.00

Air Requirement at Standard Conditions
= [SOR / (Oxygen Density * TE% * Diffuser Depth) / 60], scfm — 699

Where:	
Oxygen Density, lbs O_2/cf air	0.0187
Clean Water Transfer Efficiency/Foot of Submergence, %	1.60%
Diffuser Depth Below Water Surface, ft	13.5

Air Requirement at Plant Conditions

$$\frac{icfm}{scfm} = \frac{(T_{air}+460)}{T_{std}+460} \times \frac{14.7\text{-}RH\%_{std} x SVP_{std}}{14.7\text{-}RH\%_{act} x SVP_{Tair}} \times \frac{14.7}{P_H}$$

Where: $T_{std} = 68^oF$
$RH\%_{std} = 36\%$
$SVP_{std} = 0.34$ psi

T_{air} - Air Temperature, °F	90
RH% - Relative Humidity, %	25%
SVP_{Tair} - Saturated Vapor Pressure of Air @ T_{air}, psi	0.70
icfm/scfm	1.12

Process Air Required in First Stage Aeration Basins, icfm	780
Minimum Air for Mixing First Stage Aeration Basins, icfm	418

Aero-Mod, Inc.

AERATION REQUIREMENT CALCULATIONS - FIRST STAGE - MAX MONTH

Project: Paradise, CA — July 6, 2020
Engineer: HDR — US Customary Units
Diffuser Type Used: Fine 1st/Coarse 2nd/No 3rd/No 4th — Prepared by: BWN

AERATION REQUIREMENTS - FIRST STAGE

		Consumption
Carbonaceous (= 1.20 lb O2/lb BOD * (1,700 * 0.75) lb BOD/d/24), lb O2/hr	63.8	75%
Nitrogenous (= 4.60 lb O2/lb N Nitrified * (260 * 0.75) lb N Nit./day/24), lb O2/hr	37.4	75%
Denit. Credit (= 2.86 lb O2/lb N Denit. * (236 * 0.75) lb N Denit./day/24), lb O2/hr	-21.1	75%
Actual Oxygenation Rate (AOR), lbs O_2/hr	80.1	1,922

Standard Oxygenation Rate (SOR), lbs O_2/hr — 219

$$SOR = [(AOR * C_{s,20}) / (\alpha * \theta^{\wedge(T-20)} * (\tau * \Omega * \beta * C_{s,20} - C_L))]$$

Where:

$C_{s,T}$	D.O. Saturation @ Sea Level and T, mg/l	8.26
$C_{s,20}$	D.O. Saturation @ Sea Level and 20°C, mg/l	9.09
$C_{s,act}$	D.O. Saturation in Wastewater, mg/l	7.36
α	O_2 Transfer Correction for Wastewater	0.55
θ	Oxygen Transfer T Correction Factor	1.024
T	Temperature of Water, °C (Design Maximum)	25
τ	Oxygen Saturation Correction Factor ($C_{s,T,H}/C_{s,20}$)	0.909
β	Salinity-Surface Tension Correction Factor	0.95
P_H	Pressure at Site Elevation	13.8
Ω	Pressure Correction Factor (P_H/P_s)	0.937
C_L	Residual D.O. Concentration, mg/l	2.00

Air Requirement at Standard Conditions
= [SOR / (Oxygen Density * TE% * Diffuser Depth) / 60], scfm — 907

Where:

Oxygen Density, lbs O_2/cf air	0.0187
Clean Water Transfer Efficiency/Foot of Submergence, %	1.60%
Diffuser Depth Below Water Surface, ft	13.5

Air Requirement at Plant Conditions

$$\frac{icfm}{scfm} = \frac{(T_{air}+460)}{T_{std}+460} \times \frac{14.7\text{-}RH\%_{std} x SVP_{std}}{14.7\text{-}RH\%_{act} x SVP_{Tair}} \times \frac{14.7}{P_H}$$

Where: $T_{std} = 68^oF$
$RH\%_{std} = 36\%$
$SVP_{std} = 0.34$ psi

T_{air} - Air Temperature, °F	90
RH% - Relative Humidity, %	25%
SVP_{Tair} - Saturated Vapor Pressure of Air @ T_{air}, psi	0.70
icfm/scfm	1.12

Process Air Required in First Stage Aeration Basin, icfm	1,012
Minimum Air for Mixing Half First Stage Aeration Basins, icfm	418

Aero-Mod, Inc.

AERATION REQUIREMENT CALCULATIONS - SECOND STAGE - AVERAGE

Project: Paradise, CA — July 6, 2020
Engineer: HDR — US Customary Units
Diffuser Type Used: Fine 1st/Coarse 2nd/No 3rd/No 4th — Prepared by: BWN

AERATION REQUIREMENTS - SECOND STAGE

		Consumption
Carbonaceous (= 1.20 lb O2/lb BOD * (1,310 * 0.25) lb BOD/d/24), lb O2/hr	16.4	25%
Nitrogenous (= 4.60 lb O2/lb N Nitrified * (201 * 0.25) lb N Nit./day/24), lb O2/hr	9.6	25%
Denit. Credit (= 2.86 lb O2/lb N Denit. * (182 * 0.25) lb N Denit./day/24), lb O2/hr	-5.4	25%
Actual Oxygenation Rate (AOR), lbs O_2/hr	20.6	494

Standard Oxygenation Rate (SOR), lbs O_2/hr — 34.8

$$SOR = [(AOR * C_{s,20}) / (\alpha * \theta^{\wedge(T-20)} * (\tau * \Omega * \beta * C_{s,20} - C_L))]$$

Where:

$C_{s,T}$	D.O. Saturation @ Sea Level and T, mg/l	8.26
$C_{s,20}$	D.O. Saturation @ Sea Level and 20^{o}C, mg/l	9.09
$C_{s,act}$	D.O. Saturation in Wastewater, mg/l	7.36
α	O_2 Transfer Correction for Wastewater	0.75
θ	Oxygen Transfer T Correction Factor	1.024
T	Temperature of Water, ^{o}C (Design Maximum)	25
τ	Oxygen Saturation Correction Factor ($C_{s,T,H}/C_{s,20}$)	0.909
β	Salinity-Surface Tension Correction Factor	0.95
P_H	Pressure at Site Elevation	13.8
Ω	Pressure Correction Factor (P_H/P_s)	0.937
C_L	Residual D.O. Concentration, mg/l	1.00

Air Requirement at Standard Conditions
= [SOR / (Oxygen Density * TE% * Diffuser Depth) / 60], scfm — 419

Where:

Oxygen Density, lbs O_2/cf air	0.0187
Clean Water Transfer Efficiency/Foot of Submergence, %	0.55%
Diffuser Depth Below Water Surface, ft	13.5

Air Requirement at Plant Conditions

$$\frac{icfm}{scfm} = \frac{(T_{air}+460)}{T_{std}+460} \times \frac{14.7\text{-}RH\%_{std} x SVP_{std}}{14.7\text{-}RH\%_{act} x SVP_{Tair}} \times \frac{14.7}{P_H}$$

Where: T_{std} = 68^{o}F
$RH\%_{std}$ = 36%
SVP_{std} = 0.34 psi

T_{air} - Air Temperature, ^{o}F	90
RH% - Relative Humidity, %	25%
SVP_{Tair} - Saturated Vapor Pressure of Air @ T_{air}, psi	0.70
icfm/scfm	1.12

Process Air Required in Second Stage Aeration Basins, icfm	467
Minimum Air for Mixing Second Stage Aeration Basins, icfm	420

Aero-Mod, Inc.

AERATION REQUIREMENT CALCULATIONS - SECOND STAGE - MAX MONTH

Project: Paradise, CA — July 6, 2020
Engineer: HDR — US Customary Units
Diffuser Type Used: Fine 1st/Coarse 2nd/No 3rd/No 4th — Prepared by: BWN

AERATION REQUIREMENTS - SECOND STAGE

		Consumption
Carbonaceous (= 1.20 lb O2/lb BOD * (1,700 * 0.25) lb BOD/d/24), lb O2/hr	21.3	25%
Nitrogenous (= 4.60 lb O2/lb N Nitrified * (260 * 0.25) lb N Nit./day/24), lb O2/hr	12.5	25%
Denit. Credit (= 2.86 lb O2/lb N Denit. * (236 * 0.25) lb N Denit./day/24), lb O2/hr	-7.0	25%
Actual Oxygenation Rate (AOR), lbs O_2/hr	26.7	

Standard Oxygenation Rate (SOR), lbs O_2/hr — 45

$$SOR = [(AOR * C_{s,20}) / (\alpha * \theta^{\wedge(T-20)} * (\tau * \Omega * \beta * C_{s,20} - C_L))]$$

Where:

$C_{s,T}$	D.O. Saturation @ Sea Level and T, mg/l	8.26
$C_{s,20}$	D.O. Saturation @ Sea Level and 20^{o}C, mg/l	9.09
$C_{s,act}$	D.O. Saturation in Wastewater, mg/l	7.36
α	O_2 Transfer Correction for Wastewater	0.75
θ	Oxygen Transfer T Correction Factor	1.024
T	Temperature of Water, ^{o}C (Design Maximum)	25
τ	Oxygen Saturation Correction Factor ($C_{s,T,H}/C_{s,20}$)	0.909
β	Salinity-Surface Tension Correction Factor	0.95
P_H	Pressure at Site Elevation	13.8
Ω	Pressure Correction Factor (P_H/P_s)	0.937
C_L	Residual D.O. Concentration, mg/l	1.00

Air Requirement at Standard Conditions
= [SOR / (Oxygen Density * TE% * Diffuser Depth) / 60], scfm — 543

Where:

Oxygen Density, lbs O_2/cf air	0.0187
Clean Water Transfer Efficiency/Foot of Submergence, %	0.55%
Diffuser Depth Below Water Surface, ft	13.5

Air Requirement at Plant Conditions

$$\frac{icfm}{scfm} = \frac{(T_{air}+460)}{T_{std}+460} \times \frac{14.7-RH\%_{std}xSVP_{std}}{14.7-RH\%_{act}xSVP_{Tair}} \times \frac{14.7}{P_H}$$

Where: $T_{std} = 68^oF$
$RH\%_{std} = 36\%$
$SVP_{std} = 0.34$ psi

T_{air} - Air Temperature, ^{o}F	90
RH% - Relative Humidity, %	25%
SVP_{Tair} - Saturated Vapor Pressure of Air @ T_{air}, psi	0.70
icfm/scfm	1.12

Process Air Required in Second Stage Aeration Basin, icfm	606
Minimum Air for Mixing Half Second Stage Aeration Basins, icfm	420

Aero-Mod, Inc.

AERATION REQUIREMENT CALCULATIONS - DIGESTER - AVERAGE

Project: Paradise, CA		July 6, 2020
Engineer: HDR		US Customary Units
Diffuser Type Used: Coarse Bubble		Prepared by: BWN

AERATION REQUIREMENTS - DIGESTER

Net O_2 Required, lb O2/hr @ 1.80 lb O_2/lb VSS_{dest} (incl. nit./denite)	14.4
Actual Oxygenation Rate (AOR), lbs O_2/hr	14.4
Standard Oxygenation Rate (SOR), lbs O_2/hr	43.4

$$SOR = [(AOR * C_{s,20}) / (\alpha * \theta^{\wedge(T-20)} * (\tau * \Omega * \beta * C_{s,20} - C_L))]$$

Where:		
$C_{s,T}$	D.O. Saturation @ Sea Level and T, mg/l	8.26
$C_{s,20}$	D.O. Saturation @ Sea Level and 20^{o}C, mg/l	9.09
$C_{s,act}$	D.O. Saturation in Wastewater, mg/l	7.36
α	O_2 Transfer Correction for Wastewater	0.50
θ	Oxygen Transfer T Correction Factor	1.024
T	Temperature of Water, ^{o}C (Design Maximum)	25
τ	Oxygen Saturation Correction Factor ($C_{s,T,H}/C_{s,20}$)	0.909
β	Salinity-Surface Tension Correction Factor	0.95
P_H	Pressure at Site Elevation	13.8
Ω	Pressure Correction Factor (P_H/P_s)	0.937
C_L	Residual D.O. Concentration, mg/l	2.0

Air Requirement at Standard Conditions
= [SOR / (Oxygen Density * TE% * Diffuser Depth) / 60], scfm — 574

Where:	
Oxygen Density, lbs O_2/cf air	0.0187
Clean Water Transfer Efficiency/Foot of Submergence, %	0.50%
Diffuser Depth Below Water Surface, ft	13.5

Denitrification ***Penalty*** (= 0 if sequential aeration ***IS*** used)

= (TKN_{oxy}-O_2 in Effluent NO_3) * 50%, lb O_2/hr	0.0
Air Penalty = O_2Penalty * Air Requirement / AOR, scfm	0
Net Process Aeration Required in Digester, scfm	574

Air Requirement at Plant Conditions

$$\frac{icfm}{scfm} = \frac{(T_{air}+460)}{T_{std}+460} \times \frac{14.7\text{-}RH\%_{std} x SVP_{std}}{14.7\text{-}RH\%_{act} x SVP_{Tair}} \times \frac{14.7}{P_H}$$

Where: T_{std} = 68^{o}F
$RH\%_{std}$ = 36%
SVP_{std} = 0.34 psi

T_{air} - Air Temperature, ^{o}F	90
RH% - Relative Humidity, %	25%
SVP_{Tair} - Saturated Vapor Pressure of Air @ T_{air}, psi	0.70
icfm/scfm =	1.12
Process Air Required for Digestion, icfm	640
Minimum Air Required for Mixing, icfm	425

Aero-Mod, Inc.

BLOWER DESIGN CALCULATIONS

Project: Paradise, CA		July 6, 2020
Engineer: HDR		US Customary Units
Process Configuration:	SEQUOX Plus	Prepared by: BWN

AIR REQUIREMENTS

	Process		Mixing,	Required	
	scfm	icfm	icfm	icfm	scfm
First Stage Aeration	699	780	418	780	699
Second Stage Aeration	419	467	420	467	419
Digesters (Mix Half Digesters)	574	640	425	640	574
Anoxic Selector				0	0
Clarifier RAS Airlift Pumps & Skimmers				154	138
Design Load Air Required (Mix Half Digesters)				2,041	1,830

BLOWER SIZING

Pressure (w/Allowance for Blower Inlet/Outlet)	In. H_2O	psig
First Stage Aeration	198	7.2
Second Stage Aeration, Selector, Clarifiers & Digesters	186	6.7

Estimated Power Requirements for Operation, hp	Full Load	Minimum (Mixing)
First Stage Aeration Basins	34	24
Second Stage Aeration, Selector, Clarifiers & Digesters	55	39
Total	88	63

	Total	Sizing Data	Total
Number of Blowers		scfm ea.	915
Total (Including Backup)	3	P_1, psig	13.8
Backup	1	P_2, psig	7.2
Blower Motor Size, hp	75	RH	25%
		T_{inlet}, ^oF	90
		icfm ea.	1,021

BLOWER SELECTION

	Motor hp	Hz	rpm	hp	icfm	Outlet T
Total	75					
Maximum		60.0	2,690	67.0	1,511	183 F
Design Point		56.9	2,550	63.1	1,421	183 F
Minimum		18.0	810	19.0	314	225 F

Aero-Mod, Inc.
CLARIFIER DESIGN CALCULATIONS

Project:	Paradise, CA		July 6, 2020
Engineer:	HDR		US Customary Units
Clarifier Type:	Split-ClarAtor	Prepared by:	BWN

FLOW CONDITIONS

	Annual Ave	Max Mo	Max Wk	Max Day	Max Hr	Max Flow Through Clarifier
Flow, mgd	0.448	0.582	0.627	0.672	0.896	2.304
Peaking Factor		1.30	1.40	1.50	2.00	5.14
Duration, min				1,440	60	
RAS Flow, mgd	0.448	0.448	0.448	0.448	0.448	0.448

EQUIPMENT SIZING & SELECTION

Number of Clarifiers	2	Surface Area per Clarifier, sf	960
Clarifier Unit Model	16320	Total Surface Area, sf	1,920
Bridge Length, ft	16	Total Weir Length, ft	174
Clarifier Unit Width, ft	60.0	Tank Wall Height, ft	16.0
Bridges per Clarifier	3.0	Tank Water Depth, ft	14.0

CLARIFIER OPERATION	Surface Overflow, gpd/sf	Weir Loading, gpd/lin. ft	Solids Loading, lb/(sf-day)	Solids Loading Limit	Retention Time (Incl. RAS), hr
Annual Average	233	2,575	13		5.4
Max Month	303	3,347	20	30	4.7
Max Wk	327	3,605	21	38	4.5
Max Day	350	3,862	22	41	4.3
Max Hr	467	5,149	26	45	3.6

PEAK FLOW HANDLING: SURGE STORAGE

	Flow Entering Plant, gph	Flow Exiting Plant, gph	Excess Flow, gpm	In-Tank Surge Storage, gal	Capacity of Surge Storage, min	Add'l Surge Storage Req'd, gal	Max Water Depth w/o Add'l Storage, ft
Annual Average	18,667	18,667	0	22,715	n/a	0	
Max Month	24,267	24,267	0	22,715	n/a	0	
Max Wk	26,133	26,133	0	22,715	n/a	0	
Max Day	28,000	28,000	0	22,715	n/a	0	
Max Hr	37,333	37,333	0	22,715	n/a	0	13.9

EFFLUENT PIPE SIZING

Target Max Month Velocity, ft/sec **2.00**

Clarifier Effluent Piping			Plant Effluent Piping		
Number of Pipes per Clarifier	**1**		Number of Main Effluent Pipes		**1**
Hazen-Williams C	**150**		Hazen-Williams C		**150**
Pipe Diameter, in.	8		Pipe Diameter, in.		10
Velocity and Headloss	V, fps	HL, in./ 100 ft		V, fps	HL, in./ 100 ft
Annual Average	0.99	0.5		1.27	0.7
Max Month	1.29	0.9		1.65	1.1
Max Wk	1.39	1.0		1.78	1.2
Max Day	1.49	1.9		1.91	2.4
Max Hr	1.99	11.2		2.54	13.6

Aero-Mod, Inc.
TANKAGE DESIGN CALCULATIONS

Project: Paradise, CA — July 6, 2020
Engineer: HDR — US Customary Units
Tank Construction: Cast-in-Place Concrete — Prepared by: BWN

SELECTOR TANK

Volume Required, gal 29,556

Number of Tanks	1	Tank Width, ft	5.000
Tank Wall Height, ft	16.0	Tank Length, ft	60.000
Tank Water Depth, ft	14.0	Total Volume, gal	31,416
Freeboard, ft	2.0	Retention Time (for $Q_{forward}$), min	101

AERATION TANK

Volume Required, gal 560,000

Tank Wall Height, ft	16.0	Number of Trains	2
Tank Water Depth, ft	14.0	Number of Stages/Train	2

	Stage 1	Stage 2
Number of Tanks	2	2
Tank Length, ft	70.000	131.250
Tank Width, ft	19.125	10.250
Area of Each Tank, sf	1,339	1,345
Total Volume, gal	280,388	281,762

Total Volume, gal 562,150

CLARIFIER TANK

Number of Tanks	2	Tank Width, ft	60.000
Tank Wall Height, ft	16.0	Tank Length, ft	16.000
Tank Water Depth, ft	14.0	Total Volume, gal	201,062

AEROBIC DIGESTER TANK

Volume Required, gal 285,029

Number of Tanks	2	Tank Width, ft	10.000
Tank Wall Height, ft	16.0	Tank Length, ft	131.250
Tank Water Depth, ft	14.5	Total Volume, gal	284,708

TANKAGE DIMENSIONS

Wall Height, ft	16	Wall Thickness, in.	
Plan Length, ft	133.75	Interior	15
Plan Width, ft	87.50	Exterior	15
Total Plan Area, sf	11,703	Floor Thickness, in.	20
Wall Length, lineal ft		Total Concrete for Slab, cy	924
Interior	765	Total Grout for Clarifier, cy	127
Exterior	428	Total Concrete for Walls, cy	927
Total	1,192		

Aero-Mod, Inc.

POWER, PARTS, CONSUMABLES AND LABOR COST ESTIMATES

Project: Paradise, CA — July 6, 2020
Engineer: HDR
Diffuser Type Used: Fine 1st/Coarse 2nd/Coarse 3rd/Coarse 4th — Prepared by: BWN

POWER REQUIREMENTS

Power Requirements, hp		Max Month	Minimum (Mixing)	Design Yr Ave
Process				
Stage 1 Aeration (Includes Cyclic Aeration)		43.0	24.2	32.3
Stage 2 Aeration (Includes Cyclic Aeration)		25.8	14.5	19.3
Stage 3 Aeration (Includes Cyclic Aeration)		0.0	0.0	0.0
Stage 4 Aeration (Includes Cyclic Aeration)		0.0	0.0	0.0
Clarifier & Selector		1.2	0.5	0.9
Digester		35.3	19.8	26.5
	Subtotal	105.2	59.0	78.9
Ancillary				
Blower VFD Control Panels		4.31	2.42	3.23
PLC-based Process & D.O. Control		0.30	0.17	0.23
	Subtotal	4.61	2.58	3.46
	TOTAL (hp)	109.8	61.6	82.4
Annual Power Costs @ **$0.10**	/kWh	$71,782	$40,234	$53,837

REPLACEMENT PARTS, CONSUMABLES AND MAINTENANCE LABOR REQUIREMENTS

	Qty/ Unit		Events/yr	Unit Cost	Units	Annual Allowance	Labor Hrs/Unit	Labor Hrs/Yr
Service Blowers			**1**	**$280**	3.0	$840	**8.00**	24
Service Compressors			**1**	**$130**	2.0	$260	**4.00**	8
*Replace:	Frequency							
Fine Bubble Diffusers Every	**7.00**	yrs		$72	30.00	$2,156	**1.00**	30.00
Blowers & VFDs Every	**20.00**	yrs		$65,106	3.00	$9,766	**40.00**	6.00
Chemical Requirements	Dosage							
Alkalinity (as $CaCO_3$)	**0**	lb/MG		**$0.07**		$0		
Precipitant (as Al)	**0**	lb/MG		**$1.00**		$0		
Allowance for Other @	**20%**	of total (excl chemicals)				$4,439		19.00
Estimated Totals						$22,194		93.40

*Sinking fund costs excluding interest

OPERATIONS LABOR REQUIREMENTS

	Hrs/ Event	Events/yr Design	Total Hours/yr Design
Collect Process Samples	**1.0**	**52**	52
Analyze Process Samples	**6.0**	**52**	312
Evaluate & Record Data	**1.0**	**52**	52
Reporting	**4.0**	**12**	48
Inspect/Clean Diffusers	**32.0**	**2**	64
Inspect/Clean DO Probes	**1.0**	**52**	52
Plant Housekeeping	**8.0**	**52**	416
Rounds/Other Activities	**2.0**	**260**	520
Estimated Yearly Hours			1,516

TOTAL ESTIMATED O&M LABOR

Design	
1,609	hr/yr
31	hr/wk
$31.00	/hr
$49,891	/yr

Aero-Mod, Inc.

ITEMIZED EQUIPMENT AND SERVICES (& CONCRETE ESTIMATES)

Project: Paradise, CA — July 6, 2020
Engineer: HDR — US Customary Units
Prepared by: BWN

<u>EQUIPMENT SUPPLIED</u>

AERATION EQUIPMENT

3	Aeration Blower w/Sound Enclosure, P.D.,	75	HP - 230/460 V, 3 ph,	1,511	icfm
	Outdoor Enclosure(s)? **N**				
2	First-Stage SEQUOX butterfly valve, pneumatically-actuated, 10"				
2	First Stage air isolation butterfly valve, gear-operated, 10"				
52	Wall mounted aeration assembly, 1st Stage Basins, Model WA-PFL4-2				
2	Second-Stage Air Flow Control Assembly, 8" x 6"				
28	Wall mounted aeration assembly, 2nd Stage Basins, Model WA-PS2-2				

SELECTOR TANK EQUIPMENT

4	Wall mounted aeration assembly, Selector, Model WA-HSS2-2
1	Isolation Butterfly Valve, 4"

CLARIFIER & RAS EQUIPMENT

6	Aero-Mod Split-ClarAtor Clarifier System,	Model 16320,	320	sf/each

WAS & DIGESTION EQUIPMENT

2	WAS airlift pump, Model AL-600
30	Wall mounted aeration assembly, Model WA-PS2-2
2	Digester Air Flow Control Assembly, 8" x 6"

ELECTRICAL & CONTROLS EQUIPMENT

1	SEQUOX Control Panel, Model: PLC SQC-200-PLC - 115 V		
3	Blower VFDs - 460 V, 3 ph 75 HP		
2	Air compressor system(s),	**2**	hp each, 460 V, 3 ph
2	Air compressor auto-drain - 115 V wall outlet		
2	Regenerative desiccant dryer mounted on dry storage tank - 115 V wall outlet		
1	Dissolved Oxygen Control System(s)	4	Probes Total

WALKWAYS & ANCILLARY EQUIPMENT

889	Wall mounted walkway & handrail, LF
2	Wall mounted stop plates & frames
2	Sonication algae control system(s)
LS	Spare Parts
LS	Interior tank installation materials - SS brackets, SS bolts, PVC wall inserts, pneumatic tubing, misc.

SERVICES

LS	Freight to Jobsite		
LS	Aero-Mod equipment dry inspection,	1	Days
LS	Aero-Mod equipment wet inspection,	1	Days
LS	Aero-Mod equipment final startup,	1	Days
LS	Aero-Mod post-startup review,	1	Days
LS	Post-Start Op School, 2 days at Factory in Manhattan, KS	2	Person(s)
LS	Seismic Analysis of Equipment Anchorage		

BUDGET EQUIPMENT COST (Excluding all taxes, duties, fees and similar charges) $1,389,000

ESTIMATED EQUIPMENT & INTERIOR PIPING INSTALLATION COST (BY OTHERS) $181,000

<u>ESTIMATED</u> CONCRETE TANK COST (BY OTHERS) $1,385,000

Concrete for Tank Walls, cy	927	
<u>Assumed</u> Installed Concrete Cost, $/cy		**$700**
Concrete for Tank Slab, cy	924	
<u>Assumed</u> Installed Concrete Cost, $/cy		**$700**
Grout for Clarifier Bottom, cy	127	
<u>Assumed</u> Installed Concrete Cost, $/cy		**$700**

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TOTAL ESTIMATED COST **$2,955,000**

B.2

Tertiary Treatment
Membrane Bioreactor by
Suez

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Water Technologies & Solutions

budget proposal for the

Town of Paradise, CA

ZeeWeed membrane bioreactor package system

submitted to:
HDR

August 10th, 2020

proposal number: 416612-Rev 1

submitted by:
Chris Allen, P.E. - Regional Manager
cell: (503) 307-2238
email: chris.allen@suez.com

local representation by:
Brad Leidecker, P.E.
Coombs Hopkins

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1 benefits of SUEZ system design

At SUEZ, our goal is to create long term partnerships with our customers, which is why we design our systems with you in mind. Our approach to the proposed ZeeWeed membrane bioreactor system has been optimized around the following three key system attributes;

- robust design – proven design parameters with scope and configuration options for a wide variety of conditions
- simple operations – simple & automated operations coupled with SUEZ support for the operating team
- lowest cost of ownership for the Owner

We are continuously striving to improve our system designs to provide optimal solutions for our customers. Highlighted below are several systems that we have optimized to meet your needs.

1.1 pre-engineered Z-MOD L process pump skid

The Z-MOD L process pump skid is a pre-engineered equipment skid that helps simplify ZeeWeed membrane filtration system design and installation. The Z-MOD L skid is a "plug and go" skid that incorporates most of dedicated membrane train equipment onto a single pre-fabricated equipment skid for simple onsite installation.

The Z-MOD L skid is designed to handle all membrane train flow conditions and includes a bi-directional process pump that performs both permeation and backpulse duty. A train-dedicated remote I/O panel is installed on the Z-MOD L skid, with all skidded equipment and instrumentation pre-wired and tested within the panel.

1.2 membrane aeration system design

Aeration is one of the most important operating parameters for successful long term MBR operations and is a significant component of operating cost.

SUEZ MBR system utilizes a very simple aeration strategy which minimizes the amount of instrumentation and controls required to achieve energy efficient membrane aeration.

No complex control loops or complicated airflow measurement devices are required for LEAPmbr aeration technology to achieve energy efficiency.

1.3 membrane cleaning systems

SUEZ has developed membrane design principles based on best engineering practices that ensure the permeability of the membrane is maintained over the life of the membranes.

A fully automated suite of membrane maintenance procedures will ensure long-term, successful operation, including:

- in-situ chemical membrane cleaning performed directly in the membrane process tanks so your operators don’t waste time moving cassettes;
- the ability to increase or decrease the frequency of chemical cleans to fit the operating conditions;
- the ability to backpulse, when needed, to greatly improve your operator’s ability to recover from non-design conditions.

The above cleaning systems can be automated, resulting in operators having available a full suite of comprehensive cleaning systems which are simple to use and initiate.

2 basis of design

The following proposed ZeeWeed membrane bioreactor design for the town of paradise WWTP has been designed based on the design parameters summarized in the follow sections.

2.1 influent flow data

The influent design flows are summarized in the table below.

average day flow (ADF)	0.45	mgd
maximum month flow (MMF)	0.56	mgd
maximum day flow (MDF)	0.68	mgd
peak hour flow (PHF)	0.90	mgd
maximum flow with one train offline for maintenance or cleaning (less than 24 hours)	0.56	mgd

note 1: any flow conditions that exceed the above-noted flow limits must be equalized prior to treatment in the ZeeWeed membrane bioreactor system.

- ADF – the average flow rate occurring over a 24-hour period based on annual flow rate data.
- MMF – the average flow rate occurring over a 24-hour period during the 30-day period with the highest flow based on annual flow rate data.
- MDF – the maximum flow rate averaged over a 24-hour period occurring within annual flow rate data.
- PHF – the maximum flow rate sustained over a 1-hour period based on annual flow rate data.

2.2 influent quality

The design solution proposed is based on the wastewater characteristics entering into the MBR bioreactor tanks. The below concentrations are specific to the flow used for the biological design as listed in section 2.5 below.

design influent temperature range	10-20	ºC
BOD_5	350	mg/L
TSS	400	mg/L
inert solids fraction of TSS	20	%
NH_3-N	45	mg/L
TKN	68	mg/L
soluble alkalinity as $CaCO_3$ [1]	250	mg/L

note 1: SUEZ is assuming that sufficient influent alkalinity is available for proper performance of the biological system. Should influent alkalinity be insufficient, chemical addition by buyer will be required.

note2 : pH adjustment system (if needed- by others)

2.3 effluent quality

The following performance parameters are expected upon equipment startup and once the biological system has stabilized based on the data listed in sections 5.1 and 5.2.

BOD_5	≤ 5	mg/L
TSS	≤ 1	mg/L
NH_3-N	≤ 1	mg/L
TN [1]	≤ 10	mg/L
turbidity[2]	≤ 0.5 100% of the time ≤ 0.2 NTU 95% of the time	NTU

note 1: TN ≤ 10 mg/L corresponds to a minimum design temperature of 10ºC and <1.5 mg/L recalcitrant dissolved organic nitrogen in the influent.

note 2 : as per title 22

2.4 influent variability

Influent wastewater flows or loads in excess of the design criteria defined above must be equalized prior to entering the membrane tanks. In the event that the influent exceeds the specifications used in engineering this proposal, or the source of influent changes, the ability of the treatment system to produce the designed treated water quality and/or quantity may be impaired. Buyer may choose to continue to operate the system, but assumes the risk of damage to the system and/or additional costs due to increased membrane cleanings, potential for biological upset and/or increased consumable usage.

2.5 biological system design

The biological system for this project consists of anoxic and aerobic zone. The corresponding volumes for each zone are listed in the table below.

design parameters	design value	units
flow basis for biological design	0.56	mgd
number of biological trains	2	
total pre anoxic tank working volume	70,000	US gallons
pre anoxic tank volume per train	35,000	US gallons
total post anoxic tank working volume	110,000	US gallons
post anoxic tank volume per train	55,000	US gallons
total aerobic working volume	300,000	US gallons
aerobic tank volume per train	150,000	US gallons
total design HRT[2]	21	hours
aerobic design SRT[2]	16	days
waste sludge volume (based on ADF and 10 g/L)	15,500	US gpd /day
design MLSS concentration in bioreactor	≤ 8,000	mg/L
AOR	2,600	lb O_2/day

design liquid depth in bioreactor	18	ft

note 1: standby carbon-dosing system is highly recommended to keep up with any fluctuations of the WW quality.

note 2: excluding membrane tank volume

note 3: the biological system is designed for installation within concrete tanks supplied by buyer

2.6 ZeeWeed ultrafiltration system design

The ZeeWeed ultrafiltration system design is summarized in the table below. Membrane modules are assembled into cassettes and cassettes are installed in concrete tanks supplied by buyer.

type of membrane	ZeeWeed 500D RX12
Mdule surface area (ft^2)	422
number of trains	2
number of Z-MOD L-630 process pump skids	2
type of cassette	52M
number of cassette spaces per train	2
number of cassettes installed per train	2
total number of cassettes installed per plant	4
Cassette configuration	52 x 1 + 32 x 1
total number of modules installed per train	84
total number of modules installed per plant	168
spare space (%)	19
membrane tank internal dimensions (L x W x H) (ft)	15 x 8 x 13

note 1: dimensions are preliminary only and may change during detailed engineering design.

3 equipment description

The following is a description of the equipment included in SUEZ's scope of supply. Pre-assembled components include the process pump skids, membrane cassette assemblies, and membrane cleaning chemical pump panels. Critical items that will be shipped loose for installation by buyer include the master control panel, tank, blowers, RAS pumps and other associated equipment. Please refer to section 3.1 below for a complete list of SUEZ supplied equipment.

master PLC panel

An Allen-Bradley Compact Logix Programmable Logic Controller (PLC) and Panel View Plus 6 1250 Human Machine Interface (HMI), installed in the UL Type 4 main control panel, monitors and manages all critical process operations.

The master PLC panel communicates using Ethernet TCP/IP, and includes I/O for common equipment items such as membrane blowers, air compressors, RAS pumps and other items (if included in SUEZ Scope).

Level transmitters monitor the level of mixed liquor in the membrane tanks and transmit this information to the SUEZ PLC. The PLC will automatically adjust the process pumps based on the influent flowmeter signal and liquid level in the membrane tanks. RAS pumps are controlled proportionally to the process pump speed.

Z-MOD L process pump skid

One reversible process pump per train is used to draw water through the membranes. The process pump, associated valves, and pump suction and discharge spools are mounted on a factory assembled, epoxy-coated carbon steel skid.

Each Z-MOD L process pump skid is designed with a remote I/O panel UL ype 4, which distributes control wiring to the pump, skid mounted VFD UL type 4 and instrumentation including a magnetic flowmeter required to operate the pump system, all located on the process pump skid.

Optional turbidity meter is available for inclusion onto the Z-MOD L process pump skid for train-dedicated permeate turbidity monitoring.

air ejector system

One air ejector system per train is used to prime the dedicated process pump. The air ejector system is installed at the highest point between the membranes installed and process pump, to ensure that all air is removed in the process pump suction line.

membrane scour aeration system

One duty membrane blower per train will be supplied with one common standby blower to be shared by all trains.

Blowers will typically come complete with required isolation valves, check valves, pressure relief valve, pressure indicators and flow indicators.

process aeration system

The process aeration blowers provide air for the biological tank and ensure that sufficient oxygen is available to maintain the biological processes in the tank.

For best efficiency and reduction of the aeration energy, SUEZ has used 1 duty blower per train with a 1 same-size standby common blower.

fine bubble diffusers

A fine bubble diffused aeration system delivers air from the process aeration blowers to the aerobic zone of the process tank.

process mixers

Process mixers are used for mixing in the anoxic chambers to prevent solids from settling.

mixed liquor recirculation equipment

Recirculation (RAS) pumps are used to transfer mixed liquor from the the membrane tanks to the bioreactor at a rate of 4 × ADF.

Recirculation pumps will be supplied with check valves, isolation valves magmeter and pressure indicator.

sodium hypochlorite dosing system

The sodium hypochlorite dosing system is used for membrane cleaning to remove organic foulants from the membrane surface.

citric acid dosing system

The citric acid dosing system is used for membrane cleaning to remove inorganic foulants from the membrane surface.

effluent flow measurement

Each train will include a flow meter to provide discharged permeate flow measurements.

effluent turbidity analyzer

Effluent turbidity analyzers monitor effluent water quality and alert operators if effluent turbidity rises beyond acceptable set point. For optimal performance monitoring, one turbidity analyzer per train has been included.

InSight Basic – digital asset monitoring

Water and process applications generate vast amounts of operating data. InSight, SUEZ's easy-to-use, cloud-based knowledge management platform, captures and transforms your plant data into meaningful and actionable information, ultimately providing the knowledge you need to maximize performance, avoid operational interruptions, optimize your processes, and reduce the total cost of operation.

InSight Basic – Digital Asset Monitoring has been provided with your MBR system for the first year of operation. With InSight Basic, you will gain visibility into your plant's current and future performance by having complete access to your plant data through InSight. InSight Basic allows you to perform your own process monitoring, trending and analysis suited to your individual plant operations and success criteria. You will have access to the tools in InSight to add your own annotations, load your own analytical data and configure your own reports and alerts.

InSight Basic is enhanced with weekly automated performance reports and daily alarm notification summaries, allowing you to identify emerging problems earlier so that action can be taken now, before a failure can occur. In addition, InSight Basic customers will have access to InSight's built in analytics workspace where you can go beyond standard time based data analytics to uncover more valuable information and understand the underlying causal factors of your plant.

InSight Basic customers have access to personnel from SUEZ's Service Reliability Center (SRC) who will provide training and support on the use and features of InSight.

3.1 scope of supply by SUEZ

quantity	description
The MBR system will include the following equipment:	
ZeeWeed membranes & tankage	
lot	membrane tank cassette mounting assemblies
4	ZeeWeed 500D membrane cassettes
168	membrane modules
2 sets	permeate collection & air distribution header piping
2	membrane tank level transmitter
ejector & associated equipment	
2	air ejector and air supply assemblies
master control panel	
1	master control panel w/ Allen Bradley Compact Logix PLC, Panelview plus 6 1250 HMI, and Flexlogic I/O
Z-MOD L-630 process pump skid	
2	process pump equipment skid - epoxy coated carbon steel
2	positive displacement, bi-directional rotary lobe process pump
2	required pump isolation valves and check valves
2	remote I/O panel - includes Allen Bradley Flexlogic I/O
2	process pump VFD
2	motor disconnect
lot	pressure gauge and flow meter
lot	chemical injection ports and valves
2	Turbidimeter- one per membrane train; includes isolation valves, throttle valve and backplate
backpulse system	
incl	process pumps will also provide backpulse duty
1	flow through backpulse water storage tank, with tank level control and associated valves
membrane air scour blowers	
3	membrane air scour blowers (2 duty + 1 standby) - includes isolation valves, flow switches, pressure gauges and acoustical enclosures
mixed liquor recirculation equipment	
2	Membrane train dedicated recirculation (RAS) pumps (2 duty), used to transfer mixed liquor from the membrane tanks to the bioreactor – includes isolation valves
biological equipment	
2 lot	fine bubble diffused air system for process aeration - loose shipped (without tank downcomer piping)
3	process blowers (2 duty + 1 standby) - includes flow switches, isolation valves and

quantity	description
	acoustical enclosures
4	process mixers for pre anoxic and post anoxic tank
2	supplementary recirculation pumps, used to transfer mixed liquor from the aerobic zone to the pre-anoxic zone – includes isolation valves and flow meters
2	aerobic dissolved oxygen sensor
2	pH sensor
membrane cleaning systems	
1	loose shipped sodium hypochlorite chemical feed system - includes dosing pump and associated valves
1	loose shipped citric acid chemical feed system - includes dosing pump and associated valves.
miscellaneous	
2	air compressor (2 duty + 1 standby) for pneumatic valve operation and refrigerated air drier
1	RS4000 ethernet router for InSight/Remote Connectivity
general	
included	P&IDs and equipment general arrangement and layout drawings for SUEZ supplied equipment
included	operating & maintenance manuals
included	field service and start-up assistance - 35 days support over 3 site visits from SUEZ field-service personnel for commissioning, plant start-up and operator training
included	InSight Basic – digital asset monitoring – 1 year
included	24/7 emergency phone support – 1 year
included	equipment mechanical warranty - 1 year or 18 months from shipment
included	membrane warranty– 5 year (2 year cliff and 3 year prorated)

note 1: additional man-hours will be billed separately from the proposed system capital cost at a rate of $1,400 per day plus living and traveling expenses. Detailed SUEZ service rates are available upon request.

note 2: all SUEZ supplied equipment is designed for installation in an unclassified area.

note 3: to receive complete 24/7 Emergency Telephone Technical Support Service and to allow for InSight Monitor Service, a suitable secure remote internet connection, by buyer, is required.

4 buyer scope of supply

The following items are for supply by buyer and will include, but are not limited to:

- overall plant design responsibility
- installation on site of all SUEZ-supplied skids and loose-shipped equipment
- review and approval of design and design parameters related to the biological process and membrane separation system
- review and approval of SUEZ supplied equipment drawings and specifications
- detail drawings of all termination points where SUEZ equipment or materials tie into equipment or materials supplied by others
- equipment foundations, civil work, full floor coverage equipment contact pads, buildings, etc.
- receiving, unloading and safe storage of SUEZ-supplied equipment at site until ready for installation
- HVAC equipment design, specifications and installation (where applicable)
- UPS, Power Conditioner, Emergency power supply and specification (where applicable)
- lifting devices including crane able to lift 5,000 kg (10,000lbs) for membrane removal, lifting davits and guide rails for submersible mixers and pumps, hoists, etc…
- MCC, VFD's, or Starters for 3-ph motors, including loose ship SUEZ supplied equipment
- 1 to 2 mm pretreatment fine screens
- equalization tank and associated equipment – as required
- bioreactor tank – complete with anoxic and aerobic zones
- membrane tanks c/w tank covers, grating, and their support over membrane tanks.
- sludge wasting pumps or sludge wasting valves and flow meters
- all chemical storage tanks, day tanks, and secondary containments
- treated water storage tank – as required
- process and utilities piping, pipe supports, hangers, valves, etc. including but not limited to:
  - piping, pipe supports and valves between SUEZ-supplied equipment and other plant process equipment
  - piping between any loose-supplied SUEZ equipment
  - process tank aeration system air piping, equalization tank system piping, etc.

- interconnecting piping between SUEZ-supplied skids, loose shipped equipment and tanks (as applicable)

- ❑ electrical wiring, conduit and other appurtenances required to provide power connections as required from the electrical power source to the SUEZ control panel and from the control panel to any electrical equipment, pump motors and instruments external to the SUEZ-supplied enclosure
- ❑ suitable, secure remote internet connection for 24/7 emergency telephone technical support service and InSight remote monitoring & diagnostics service
- ❑ all bolts, brackets and fasteners to install SUEZ-supplied equipment.
- ❑ seismic structural analysis and anchor bolt sizing
- ❑ alignment of rotating equipment
- ❑ raw materials, chemicals, and utilities during equipment start-up and operation
- ❑ supply of seed sludge for biological process start-up purposes
- ❑ disposal of initial start-up wastewater and associated chemicals
- ❑ weather protection as required for all SUEZ supplied equipment. Skids and electrical panels are designed for indoor operation and will need shelter from the elements.
- ❑ laboratory services, operating and maintenance personnel during equipment checkout, start-up and operation
- ❑ touch up primer and finish paint surfaces on equipment as required at the completion of the project
- ❑ all permits

5 commercial

5.1 pricing

Pricing for the proposed equipment and services, as outlined in section 3, is summarized in the table below. All pricing is based on the design operating conditions and influent characteristics that are detailed in section 2 of the proposal. The pricing herein is for budgetary purposes only and does not constitute an offer of sale. No sales, consumer use or other similar taxes or duties are included in the pricing below.

price: all equipment & service	
Proposed system price as per scope of supply proposed in section 3.1	$ 1,145,000

5.2 annual power & chemical consumption estimates

The data presented below is for information purposes only and is based on the design information provided by the Buyer and presuming that the equipment is operated according to the design basis and in accordance with Seller's Operations and Maintenance manuals.

annual power consumption estimate [1]

equipment	kWh/year
process pumps [2]	32,500
membrane blowers	140,000
process blowers	303,000
recirculation (RAS) pumps	58,000
process mixers	13,000
air compressors	8,000
Total	**554,500**

note 1: annual power consumption estimate is calculated at ADF condition.

note 2: assumes membrane relaxation mode used.

annual chemical consumption estimate

chemical	USgal/year
sodium hypochlorite (10.3% w/w, SG: 1.168)	855
citric acid (50.0% w/w, SG: 1.24)	690

note 1: cleaning chemical consumption estimates are based on the frequencies and concentrations summarized in the table below. Frequencies are typical for ZW-MBR operation, actual frequency of maintenance and recovery cleans may change with final design, or may change once system is in operation.

basis of chemical consumption estimates

chemical		maintenance clean	recovery clean
sodium hypochlorite solution (10.3% w/w, SG: 1.168)	frequency	2 times per week	2 times per year
	concentration	200 mg/L	1,000 mg/L
citric acid solution (50.0% w/w, SG: 1.24)	frequency	1 time per week	2 times per year
	concentration	2,000 mg/L	2,000 mg/L

5.3 freight

The following freight terms used are as defined by INCOTERMS 2010.

All pricing is FCA, project site.

5.4 equipment shipment and delivery

Equipment shipment is estimated at 24 to 36 weeks after order acceptance. The buyer and seller will arrange a kick-off meeting after contract acceptance to develop a firm shipment schedule.

typical drawing submission and equipment shipment schedule

		6-8 weeks	2 weeks	16-26 weeks		2 weeks
acceptance of PO	■					
submission of drawings		■				
drawings approval			■			
equipment manufacturing				■		
equipment shipment					■	
plant operations manuals						■

SWTS would like to note that under the current exceptional circumstances under the COVID 19 Pandemic situation, SWTS may not be in a position to guarantee and comply with the planned schedule for project delivery or performance and that should there be any new measures taken by any governmental authority which may impede or delay the said schedule or performance, SWTS reserves the right to modify the schedule / contract accordingly. SWTS will promptly inform you of any changes which may impact the contract or the project.

The delivery schedule is presented based on current workload backlogs and production capacity. This estimated delivery schedule assumes no more than 2 weeks for buyer review of submittal drawings. Any delays in buyer approvals or requested changes may result in additional charges and/or a delay to the schedule.

5.5 conditional offering

Buyer understands that this proposal has been issued based upon the information provided by buyer, and currently available to seller, at the time of proposal issuance. Any changes or discrepancies in site conditions (including but not limited to system influent characteristics, changes in environmental health and safety ("EH&S") conditions, and/or newly discovered EH&S concerns, buyer's financial standing, Buyer's requirements, or any other relevant change, or discrepancy in, the factual basis upon which this proposal was created, may lead to changes in the offering, including but not limited to changes in pricing, warranties, quoted specifications, or terms and conditions. Seller's offering in this proposal is conditioned upon a full seller EH&S, and buyer financial review.

5.6 terms and conditions of sale

This proposal has been prepared and is submitted based on seller's standard terms and conditions of sale.

C

Recycled Water Criteria

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Recycled Water Uses* Allowed in California

This summary is prepared by WateRuse Association of California, from the December 2, 2000, Title 22 adopted **Water Recycling Criteria**, and supersedes all earlier versions.

<table>
<tr><th rowspan="2">Recycled Water Use</th><th colspan="4">Treatment Level</th></tr>
<tr><th>Disinfected Tertiary Recycled Water</th><th>Disinfected Secondary 2.2 Recycled Water</th><th>Disinfected Secondary 23 Recycled Water</th><th>Undisinfected Secondary Recycled Water</th></tr>
<tr><th colspan="5">Irrigation for:</th></tr>
<tr><td>Food crops where recycled water contacts the edible portion of the crop, including all root crops</td><td rowspan="20">ALLOWED</td><td rowspan="6">NOT ALLOWED</td><td rowspan="7">NOT ALLOWED</td><td rowspan="13">NOT ALLOWED</td></tr>
<tr><td>Parks and playgrounds</td></tr>
<tr><td>School grounds</td></tr>
<tr><td>Residential landscaping</td></tr>
<tr><td>Unrestricted-access golf courses</td></tr>
<tr><td>Any other irrigation uses not specifically prohibited by other provisions of the California Code of Regulations</td></tr>
<tr><td>Food crops, surface-irrigated, above-ground edible portion, not contacted by recycled water</td><td rowspan="14">ALLOWED</td></tr>
<tr><td>Cemeteries</td><td rowspan="13">ALLOWED</td></tr>
<tr><td>Freeway landscaping</td></tr>
<tr><td>Restricted-access golf courses</td></tr>
<tr><td>Ornamental nursery stock and sod farms with unrestricted public access</td></tr>
<tr><td>Pasture for milk animals for human consumption</td></tr>
<tr><td>Nonedible vegetation with access control to prevent use as a park, playground or school grounds</td></tr>
<tr><td>Orchards with no contact between edible portion and recycled water</td><td rowspan="7">ALLOWED</td></tr>
<tr><td>Vineyards with no contact between edible portion and recycled water</td></tr>
<tr><td>Non food-bearing trees, including Christmas trees not irrigated less than 14 days before harvest</td></tr>
<tr><td>Fodder and fiber crops and pasture for animals not producing milk for human consumption</td></tr>
<tr><td>Seed crops not eaten by humans</td></tr>
<tr><td>Food crops undergoing commercial pathogen-destroying processing before consumption by humans</td></tr>
<tr><td>Ornamental nursery stock, sod farms not irrigated less than 14 days before harvest</td></tr>
<tr><th colspan="5">Supply for impoundment:</th></tr>
<tr><td>Nonrestricted recreational impoundments, with supplemental monitoring for pathogenic organisms</td><td>ALLOWED[2]</td><td>NOT ALLOWED</td><td rowspan="2">NOT ALLOWED</td><td rowspan="3">NOT ALLOWED</td></tr>
<tr><td>Restricted recreational impoundments and publicly accessible fish hatcheries</td><td rowspan="2">ALLOWED</td><td rowspan="2">ALLOWED</td></tr>
<tr><td>Landscape impoundments without decorative fountains</td><td>ALLOWED</td></tr>
<tr><th colspan="5">Supply for cooling or air conditioning:</th></tr>
<tr><td>Industrial or commercial cooling or air conditioning involving cooling tower, evaporative condenser, or spraying that creates a mist</td><td>ALLOWED[3]</td><td>NOT ALLOWED</td><td>NOT ALLOWED</td><td rowspan="2">NOT ALLOWED</td></tr>
<tr><td>Industrial or commercial cooling or air conditioning not involving cooling tower, evaporative condenser, or spraying that creates a mist</td><td>ALLOWED</td><td>ALLOWED</td><td>ALLOWED</td></tr>
</table>

Prepared by Bahman Sheikh and edited by EBMUD Office of Water Recycling, who acknowledge this is a summary and not the formal version of the regulations referenced above.

WateReuse Association of California • (916) 442-2746 • www.watereuse.org/h2o

Recycled Water Uses* Allowed in California

This summary is prepared by WateReuse Association of California, from the December 2, 2000, Title 22 adopted **Water Recycling Criteria**, and supersedes all earlier versions.

Recycled Water Use	Treatment Level: Disinfected Tertiary Recycled Water	Disinfected Secondary 2.2 Recycled Water	Disinfected Secondary 23 Recycled Water	Undisinfected Secondary Recycled Water
Other Uses:				
Groundwater Recharge	**ALLOWED** under special case-by-case permits by the **RWQCB**[4]			
Flushing toilets and urinals Priming drain traps Industrial process water that may contact workers Structural fire fighting Decorative fountains Commercial laundries Consolidation of backfill material around potable water pipelines Artificial snow making for commercial outdoor use Commercial car washes, not heating the water, excluding the general public from the washing process	ALLOWED	NOT ALLOWED	NOT ALLOWED	NOT ALLOWED
Industrial process water that will not come into contact with workers Industrial boiler feed Nonstructural fire fighting Backfill consolidation around nonpotable piping Soil compaction Mixing concrete Dust control on roads and streets Cleaning roads, sidewalks and outdoor work areas		ALLOWED	ALLOWED	
Flushing sanitary sewers				ALLOWED

*Refer to the full text of the the December 2, 2000 version Title 22: **California Water Recycling Criteria**. This chart is only an informal summary of the uses allowed in this version. Adapted for use in Site Supervisor Training Workshops by **South Bay Water Recycling**, San Jose, California. October 29, 2002. Jerry Brown, Coordinator, Site Supervisor Training The complete and final 12/02/2000 version of the adopted criteria can be downloaded from:

http://dhs.ca.gov/ps/ddwenm/publications/regulations/recycleregs_index.htm

2 With "Conventional tertiary treatment". Additional monitoring for two years or more is necessary with direct filtration.

3 Drift eliminators and/or biocides are required if public or employees can be exposed to mist.

4 Refer to Groundwater Recharge Guidelines, available from the California Department of Health Services.

D

OMB Circular

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APPENDIX C
(Revised November 2019)

DISCOUNT RATES FOR COST-EFFECTIVENESS, LEASE PURCHASE, AND RELATED ANALYSES

Effective Dates. This appendix is updated annually. This version of the appendix is valid for calendar year 2020. A copy of the updated appendix can be obtained in electronic form through the OMB home page at https://www.whitehouse.gov/wp-content/uploads/2019/12/Appendix-C.pdf. The text of the Circular is found at https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/circulars/A94/a094.pdf, and a table of past years' rates is located at https://www.whitehouse.gov/wp-content/uploads/2019/12/discount-history.pdf. Updates of the appendix are also available upon request from OMB's Office of Economic Policy (202-395-3585).

Nominal Discount Rates. A forecast of nominal or market interest rates for calendar year 2020 based on the economic assumptions for the 2021 Budget is presented below. These nominal rates are to be used for discounting nominal flows, which are often encountered in lease-purchase analysis.

Nominal Interest Rates on Treasury Notes and Bonds of Specified Maturities (in percent)

3-Year	5-Year	7-Year	10-Year	20-Year	30-Year
1.6	1.7	1.8	2.0	2.3	2.4

Real Discount Rates. A forecast of real interest rates from which the inflation premium has been removed and based on the economic assumptions from the 2021 Budget is presented below. These real rates are to be used for discounting constant-dollar flows, as is often required in cost-effectiveness analysis.

Real Interest Rates on Treasury Notes and Bonds of Specified Maturities (in percent)

3-Year	5-Year	7-Year	10-Year	20-Year	30-Year
-0.4	-0.3	-0.2	0.0	0.3	0.4

Analyses of programs with terms different from those presented above may use a linear interpolation. For example, a four-year project can be evaluated with a rate equal to the average of the three-year and five-year rates. Programs with durations longer than 30 years may use the 30-year interest rate.

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Cost Estimates

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ESTIMATED COSTS FOR VARIOUS TREATMENT ALTERNATIVES

Description	Secondary Treatment with Chlorine Contact Tank (Land Application Only)		Tertiary Treatment (MBR) with Chlorine Contact Basin		Tertiary Treatment (MBR) with Chlorine Contact Basin		Tertiary Treatment (MBR) with UV Disinfection		Tertiary Treatment (MBR) with Advanced Treatment and UV Disinfection	
Disposal Method	**Land Application**		**Land Application**		**Water Recycling**		**Surface Water Discharge, Water Recycling**		**Surface Water Discharge to Miocene Canal**	
Biosolids Classification	**Class B Biosolids**	**Class A Biosolids**	**Class B Biosolids**	**Class A Biosolids**	**Class B Biosolids**	**Class A Biosolids**	**Class B Biosolids**	**Class A Biosolids**	**Class B Biosolids**	**Class A Biosolids**
Influent Pump Station (submersible in 6 ft dia circular wet well)	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000
Headworks (screenings, grit removal and metering)	$1,200,000	$1,200,000	$1,427,000	$1,427,000	$1,427,000	$1,427,000	$1,427,000	$1,427,000	$1,427,000	$1,427,000
Odor Control (biological with carbon scrubber w/ redundancy)	$1,430,000	$1,430,000	$1,430,000	$1,430,000	$1,430,000	$1,430,000	$1,430,000	$1,430,000	$1,430,000	$1,430,000
AeroMod System (Secondary Treatment and Aerobic Digestion)										
Equipment	$2,469,000	$2,469,000	NA	NA	NA	NA	NA	NA	NA	NA
Concrete Basins (process and aerobic digester)	$2,291,000	$2,291,000	NA	NA	NA	NA	NA	NA	NA	NA
Suez MBR										
Equipment	NA	NA	$2,004,000	$2,004,000	$2,004,000	$2,004,000	$2,004,000	$2,004,000	$2,004,000	$2,004,000
Concrete Basins (process only)	NA	NA	$1,295,000	$1,295,000	$1,295,000	$1,295,000	$1,295,000	$1,295,000	$1,295,000	$1,295,000
Blower Building (20' x 20')	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000
Disinfection (chlorine contact basin)	$188,000	$188,000	$188,000	$188,000	$188,000	$188,000	NA	NA	NA	NA
Disinfection (UV)	NA	NA	NA	NA	NA	NA	$813,000	$813,000	NA	NA
Chemical Feed and Storage	$95,000	$95,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000	$100,000
Chemical Building	$131,000	$131,000	$131,000	$131,000	$131,000	$131,000	$131,000	$131,000	$131,000	$131,000
Effluent Pump Station	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000
Supply Pump Station to Land Disposal Sites	$250,000	$250,000	$250,000	$250,000	NA	NA	NA	NA	NA	NA
Aerobic Digester (MBR alt only)	Included in AeroMod Equipment Cost		$831,000	$831,000	$831,000	$831,000	$831,000	$831,000	$831,000	$831,000
Solids Handling (mechanical dewatering w/odor control)	$1,118,000	$1,118,000	$1,118,000	$1,118,000	$1,118,000	$1,118,000	$1,118,000	$1,118,000	$1,118,000	$1,118,000
Sludge Drying (Class A sludge only)	NA	$4,123,000	NA	$4,123,000	NA	$4,123,000	NA	$4,123,000	NA	$4,123,000
Utility Water Pump Station	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000
Potable Water to Site (pipeline and connection fee)	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000
Electrical Building (20' x 30')	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000
Generator w/Enclosure and Integral Fuel Tank (outdoor installation)	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000
Advanced Treatment (Ultra-filtration, reverse osmosis, advanced oxidation process, UV disinfection)	NA	NA	NA	NA	NA	NA	NA	NA	$29,500,000	$29,500,000
Brine Treatment (resulting in 22,400 gallons/day of brine solution needing disposal)	NA	NA	NA	NA	NA	NA	NA	NA	$3,130,000	$3,130,000
Subtotal 1	**$10,722,000**	**$14,845,000**	**$10,324,000**	**$14,447,000**	**$10,074,000**	**$14,197,000**	**$10,699,000**	**$14,822,000**	**$42,516,000**	**$46,639,000**
Sitework and Yard Piping (@15% of Subtotal 1)	$1,608,000	$2,227,000	$1,549,000	$2,167,000	$1,511,000	$2,130,000	$1,605,000	$2,223,000	$6,377,000	$6,996,000
Electrical/Instrumentation (@25% of Subtotal 1)	$2,681,000	$3,711,000	$2,581,000	$3,612,000	$2,519,000	$3,549,000	$2,675,000	$3,706,000	$10,629,000	$11,660,000
Subtotal 2	**$15,011,000**	**$20,783,000**	**$14,454,000**	**$20,226,000**	**$14,104,000**	**$19,876,000**	**$14,979,000**	**$20,751,000**	**$59,522,000**	**$65,295,000**
Mobilization/Demobilization (2%)	$300,000	$416,000	$289,000	$405,000	$282,000	$398,000	$300,000	$415,000	$1,190,000	$1,306,000
Sales Tax (7.25%, assumes 20% of Subtotal 2 is equipment/material)	$218,000	$301,000	$210,000	$293,000	$205,000	$288,000	$217,000	$301,000	$863,000	$947,000
Contractor Profit (15%)	$2,252,000	$3,117,000	$2,168,000	$3,034,000	$2,116,000	$2,981,000	$2,247,000	$3,113,000	$8,928,000	$9,794,000
Bonds and Insurance (2%)	$300,000	$416,000	$289,000	$405,000	$282,000	$398,000	$300,000	$415,000	$1,190,000	$1,306,000
Subtotal 3	**$18,081,000**	**$25,033,000**	**$17,410,000**	**$24,363,000**	**$16,989,000**	**$23,941,000**	**$18,043,000**	**$24,995,000**	**$71,693,000**	**$78,648,000**
Undefined Scope (30%)	$5,424,000	$7,510,000	$5,223,000	$7,309,000	$5,097,000	$7,182,000	$5,413,000	$7,499,000	$21,508,000	$23,594,000
Total WWTP Construction Cost	**$23,505,000**	**$32,543,000**	**$22,633,000**	**$31,672,000**	**$22,086,000**	**$31,123,000**	**$23,456,000**	**$32,494,000**	**$93,201,000**	**$102,242,000**
Construction Contingency (10%)	$2,351,000	$3,254,000	$2,263,000	$3,167,000	$2,209,000	$3,112,000	$2,346,000	$3,249,000	$9,320,000	$10,224,000
Land Costs										
Wastewater Treatment Plant (5 acres secondary and tertiary, 7 acres for advanced treatment)	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$280,000	$280,000
Effluent Disposal (312 acres)	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	$0	$0	$0	$0	$0	$0
Total WWTP Construction Cost with Contingency and Land Purchase	**$26,056,000**	**$35,997,000**	**$25,096,000**	**$35,039,000**	**$24,495,000**	**$34,435,000**	**$26,002,000**	**$35,943,000**	**$102,801,000**	**$112,746,000**

ESTIMATED COSTS FOR VARIOUS TREATMENT ALTERNATIVES

Description	Secondary Treatment with Chlorine Contact Tank (Land Application Only)		Tertiary Treatment (MBR) with Chlorine Contact Basin		Tertiary Treatment (MBR) with Chlorine Contact Basin		Tertiary Treatment (MBR) with UV Disinfection		Tertiary Treatment (MBR) with Advanced Treatment and UV Disinfection	
Disposal Method	Land Application		Land Application		Water Recycling		Surface Water Discharge, Water Recycling		Surface Water Discharge to Miocene Canal	
Biosolids Classification	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids
Implementation (Soft) Costs (percentage of Total Construction Cost w/o Land Costs)										
Project Administration (2%)	$517,000	$716,000	$498,000	$697,000	$486,000	$685,000	$516,000	$715,000	$2,050,000	$2,249,000
Legal Council/Bond Council (1%)	$259,000	$358,000	$249,000	$348,000	$243,000	$342,000	$258,000	$357,000	$1,025,000	$1,125,000
Planning (3%)	$776,000	$1,074,000	$747,000	$1,045,000	$729,000	$1,027,000	$774,000	$1,072,000	$3,076,000	$3,374,000
Design (13%)	$3,361,000	$4,654,000	$3,236,000	$4,529,000	$3,158,000	$4,451,000	$3,354,000	$4,647,000	$13,328,000	$14,621,000
Environmental Documentation/Permitting (3%)	$776,000	$1,074,000	$747,000	$1,045,000	$729,000	$1,027,000	$774,000	$1,072,000	$3,076,000	$3,374,000
ROW Acquisition (1%)	$259,000	$358,000	$249,000	$348,000	$243,000	$342,000	$258,000	$357,000	$1,025,000	$1,125,000
Construction Management (8%)	$2,068,000	$2,864,000	$1,992,000	$2,787,000	$1,944,000	$2,739,000	$2,064,000	$2,859,000	$8,202,000	$8,997,000
Engineering Services During Construction (4%)	$1,034,000	$1,432,000	$996,000	$1,394,000	$972,000	$1,369,000	$1,032,000	$1,430,000	$4,101,000	$4,499,000
Environmental Monitoring/Regulatory Compliance (3%)	$776,000	$1,074,000	$747,000	$1,045,000	$729,000	$1,027,000	$774,000	$1,072,000	$3,076,000	$3,374,000
Environmental Mitigation (6%)	$1,551,000	$2,148,000	$1,494,000	$2,090,000	$1,458,000	$2,054,000	$1,548,000	$2,145,000	$6,151,000	$6,748,000
Implementation Cost Total	**$11,377,000**	**$15,752,000**	**$10,955,000**	**$15,328,000**	**$10,691,000**	**$15,063,000**	**$11,352,000**	**$15,726,000**	**$45,110,000**	**$49,486,000**
TOTAL WWTP CAPITAL COST	**$37,433,000**	**$51,749,000**	**$36,051,000**	**$50,367,000**	**$35,186,000**	**$49,498,000**	**$37,354,000**	**$51,669,000**	**$147,911,000**	**$162,232,000**
O&M COSTS										
O&M Cost (annual)	$1,261,000	$1,314,899	$1,301,492	$1,355,872	$1,675,874	$1,730,245	$1,669,525	$1,723,901	$6,410,403	$6,464,792
O&M Cost NPV (20 yrs, 0.3%)	**$24,434,000**	**$25,488,000**	**$25,228,000**	**$26,282,000**	**$32,485,000**	**$33,538,000**	**$32,361,000**	**$33,415,000**	**$124,257,000**	**$125,311,000**
SALVAGE VALUE										
Land Cost Value, Infinite Life, no escalation or depreciation	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$280,000	$280,000
Equipment Cost Value (20% of Total Construction Cost, 20 year life, 0.3%)	$5,171,000	$7,159,000	$4,979,000	$6,968,000	$4,859,000	$6,847,000	$5,160,000	$7,149,000	$20,504,000	$22,493,000
Non-Equipment Cost Value (80% of Total Construction Cost, 50 year life, 0.3%)	$20,685,000	$28,638,000	$19,917,000	$27,871,000	$19,436,000	$27,388,000	$20,642,000	$28,594,000	$82,017,000	$89,973,000
Salvage Value of Land	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$280,000	$280,000
Salvage Value of Equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Salvage Value of Non-Equipment	$12,411,000	$17,183,000	$11,950,000	$16,723,000	$11,662,000	$16,433,000	$12,385,000	$17,156,000	$49,210,000	$53,984,000
Net Present Value of Salvage Value of Land	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$200,000	$280,000	$280,000
Net Present Value of Salvage Value of Equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Net Present Value of Salvage Value of Non-Equipment	$11,689,000	$16,184,000	$11,255,000	$15,751,000	$10,984,000	$15,477,000	$11,665,000	$16,158,000	$46,348,000	$50,845,000
TOTAL NET PRESENT VALUE	**$49,978,000**	**$60,853,000**	**$49,824,000**	**$60,698,000**	**$56,487,000**	**$67,359,000**	**$57,850,000**	**$68,726,000**	**$225,540,000**	**$236,418,000**

ESTIMATED COSTS FOR VARIOUS DISPOSAL ALTERNATIVES

Description	Secondary Treatment with Chlorine Contact Tank (Land Application Only)		Tertiary Treatment (MBR) with Chlorine Contact Basin		Tertiary Treatment (MBR) with Chlorine Contact Basin		Tertiary Treatment (MBR) with UV Disinfection		Tertiary Treatment (MBR) with Advanced Treatment and UV Disinfection	
Disposal Method	**Land Application**		**Land Application**		**Water Recycling**		**Surface Water Discharge, Water Recycling**		**Discharge to Miocene Canal**	
Biosolids Classification	**Class B Biosolids**	**Class A Biosolids**	**Class B Biosolids**	**Class A Biosolids**	**Class B Biosolids**	**Class A Biosolids**	**Class B Biosolids**	**Class A Biosolids**	**Class B Biosolids**	**Class A Biosolids**
Collection System Pump Station	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000	$250,000
Forcemain from Collection System Pump Station to WWTP Site to Disposal Location	$7,461,000	$7,461,000	$7,461,000	$7,461,000	$4,963,000	$4,963,000	$4,963,000	$4,963,000	$4,467,000	$4,467,000
On-Site Irrigation System ($5,000/acre)	$1,300,000	$1,300,000	$1,300,000	$1,300,000						
Effluent Disposal Equipment	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs and No Equipment Costs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	NA	NA	NA	NA	NA	NA
Effluent Storage (excavation for 150 MG of unlined storage, 4 ft deep plus 2 ft of freeboard)	$3,884,000	$3,884,000	$3,884,000	$3,884,000	NA	NA	NA	NA	NA	NA
Effluent Disposal Land Leveling	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	NA	NA	NA	NA	NA	NA
Effluent Disposal Equipment	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	NA	NA	NA	NA	NA	NA
Subtotal 1	**$12,895,000**	**$12,895,000**	**$12,895,000**	**$12,895,000**	**$5,213,000**	**$5,213,000**	**$5,213,000**	**$5,213,000**	**$4,717,000**	**$4,717,000**
Mobilization/Demobilization (2%)	$109,000	$109,000	$109,000	$109,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
Sales Tax (7.25%, assumes 20% of Subtotal 2 is equipment/material)	$79,000	$79,000	$79,000	$79,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000
Contractor Profit (15%)	$815,000	$815,000	$815,000	$815,000	$38,000	$38,000	$38,000	$38,000	$38,000	$38,000
Bonds and Insurance (2%)	$109,000	$109,000	$109,000	$109,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
Subtotal 3	**$14,007,000**	**$14,007,000**	**$14,007,000**	**$14,007,000**	**$5,265,000**	**$5,265,000**	**$5,265,000**	**$5,265,000**	**$4,769,000**	**$4,769,000**
Undefined Scope (30%)	$4,202,000	$4,202,000	$4,202,000	$4,202,000	$1,580,000	$1,580,000	$1,580,000	$1,580,000	$1,431,000	$1,431,000
Total Construction Cost	**$18,209,000**	**$18,209,000**	**$18,209,000**	**$18,209,000**	**$6,845,000**	**$6,845,000**	**$6,845,000**	**$6,845,000**	**$6,200,000**	**$6,200,000**
Construction Contingency (10%)	$1,821,000	$1,821,000	$1,821,000	$1,821,000	$685,000	$685,000	$685,000	$685,000	$620,000	$620,000
Land Costs										
Effluent Storage (150 acres)	$4,106,000	$4,106,000	$4,106,000	$4,106,000	$0	$0	$0	$0	$0	$0
Effluent Disposal (312 acres)	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	Assumes Agreements with Local Farmers to Use Treated Effluent for Agricultural Irrigation Occurs	$0	$0	$0	$0	$0	$0
Total Construction Cost with Contingency and Land Purchase	**$24,136,000**	**$24,136,000**	**$24,136,000**	**$24,136,000**	**$7,530,000**	**$7,530,000**	**$7,530,000**	**$7,530,000**	**$6,820,000**	**$6,820,000**

ESTIMATED COSTS FOR VARIOUS DISPOSAL ALTERNATIVES

Description	Secondary Treatment with Chlorine Contact Tank (Land Application Only)		Tertiary Treatment (MBR) with Chlorine Contact Basin		Tertiary Treatment (MBR) with Chlorine Contact Basin		Tertiary Treatment (MBR) with UV Disinfection		Tertiary Treatment (MBR) with Advanced Treatment and UV Disinfection	
Disposal Method	Land Application		Land Application		Water Recycling		Surface Water Discharge, Water Recycling		Discharge to Miocene Canal	
Biosolids Classification	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids	Class B Biosolids	Class A Biosolids
Implementation (soft) Costs (percentage of Total Construction Cost w/o Land Costs)										
Project Administration (2%)	$401,000	$401,000	$401,000	$401,000	$151,000	$151,000	$151,000	$151,000	$136,000	$136,000
Legal Council/Bond Council (1%)	$200,000	$200,000	$200,000	$200,000	$75,000	$75,000	$75,000	$75,000	$68,000	$68,000
Planning (3%)	$601,000	$601,000	$601,000	$601,000	$226,000	$226,000	$226,000	$226,000	$205,000	$205,000
Design (13%)	$2,604,000	$2,604,000	$2,604,000	$2,604,000	$979,000	$979,000	$979,000	$979,000	$887,000	$887,000
Environmental Documentation/Permitting (3%)	$601,000	$601,000	$601,000	$601,000	$226,000	$226,000	$226,000	$226,000	$205,000	$205,000
ROW Acquisition (1%)	$200,000	$200,000	$200,000	$200,000	$75,000	$75,000	$75,000	$75,000	$68,000	$68,000
Construction Management (8%)	$1,602,000	$1,602,000	$1,602,000	$1,602,000	$602,000	$602,000	$602,000	$602,000	$546,000	$546,000
Engineering Services During Construction (4%)	$801,000	$801,000	$801,000	$801,000	$301,000	$301,000	$301,000	$301,000	$273,000	$273,000
Environmental Monitoring/Regulatory Compliance (3%)	$601,000	$601,000	$601,000	$601,000	$226,000	$226,000	$226,000	$226,000	$205,000	$205,000
Environmental Mitigation (6%)	$1,202,000	$1,202,000	$1,202,000	$1,202,000	$452,000	$452,000	$452,000	$452,000	$409,000	$409,000
Implementation Cost Total	**$8,813,000**	**$8,813,000**	**$8,813,000**	**$8,813,000**	**$3,313,000**	**$3,313,000**	**$3,313,000**	**$3,313,000**	**$3,002,000**	**$3,002,000**
TOTAL CAPITAL COST	**$32,949,000**	**$32,949,000**	**$32,949,000**	**$32,949,000**	**$10,843,000**	**$10,843,000**	**$10,843,000**	**$10,843,000**	**$9,822,000**	**$9,822,000**
O&M COSTS										
O&M Cost (annual)	$173,000	$173,000	$173,000	$173,000	$58,000	$58,000	$115,000	$115,000	$115,000	$115,000
O&M Cost NPV (20 yrs, 0.3%)	**$3,344,000**	**$3,344,000**	**$3,344,000**	**$3,344,000**	**$1,115,000**	**$1,115,000**	**$2,229,000**	**$2,229,000**	**$2,229,000**	**$2,229,000**
SALVAGE VALUE										
Land Cost Value, Infinite Life, no escalation or depreciation	$4,106,000	$4,106,000	$4,106,000	$4,106,000	$0	$0	$0	$0	$0	$0
Equipment Cost Value (20% of Total Construction Cost, 20 year life, 0.3%)	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000
Non-Equipment Cost Value (80% of Total Construction Cost, 50 year life, 0.3%)	$19,980,000	$19,980,000	$19,980,000	$19,980,000	$7,480,000	$7,480,000	$7,480,000	$7,480,000	$6,770,000	$6,770,000
Salvage Value of Land	$4,106,000	$4,106,000	$4,106,000	$4,106,000	$0	$0	$0	$0	$0	$0
Salvage Value of Equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Salvage Value of Non-Equipment	$11,988,000	$11,988,000	$11,988,000	$11,988,000	$4,488,000	$4,488,000	$4,488,000	$4,488,000	$4,062,000	$4,062,000
Net Present Value of Salvage Value of Land	$4,106,000	$4,106,000	$4,106,000	$4,106,000	$0	$0	$0	$0	$0	$0
Net Present Value of Salvage Value of Equipment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Net Present Value of Salvage Value of Non-Equipment	$11,291,000	$11,291,000	$11,291,000	$11,291,000	$4,227,000	$4,227,000	$4,227,000	$4,227,000	$3,826,000	$3,826,000
TOTAL NET PRESENT VALUE	**$20,896,000**	**$20,896,000**	**$20,896,000**	**$20,896,000**	**$7,731,000**	**$7,731,000**	**$8,845,000**	**$8,845,000**	**$8,225,000**	**$8,225,000**

ESTIMATED OPERATION AND MAINTENANCE COSTS FOR VARIOUS TREATMENT ALTERNATIVES

Description	Secondary Treatment with Chlorine Contact Tank (Land Application Only)		Tertiary Treatment with Chlorine Contact Basin		Tertiary Treatment with Chlorine Contact Basin		Tertiary Treatment with UV Disinfection		Tertiary Treatment with Advanced Treatment (UF/RO/AOP/UV)		Septic Receiving and Handling
Disposal Method	**Land Application**		**Land Application**		**Beneficial Reuse**		**Surface Water Discharge, Water Recycling**		**Surface Water Discharge to Miocene Canal**		
Biosolids Classification	**Class B Biosolids**	**Class A Biosolids**	**Class B Biosolids**	**Class A Biosolids**	**Class B Biosolids**	**Class A Biosolids**	**Class B Biosolids**	**Class A Biosolids**	**Class B Biosolids**	**Class A Biosolids**	
Power Costs											
Horsepower (hp)											
Influent Pump Station (submersible in 6 ft dia circular wet well)	5	5	5	5	5	5	5	5	5	5	
Headworks (screenings, grit removal and metering)	25	25	25	25	25	25	25	25	25	25	
Odor Control (biological with carbon scrubber w/ redundancy)	25	25	25	25	25	25	25	25	25	25	
AeroMod System (Secondary Treatment and Aerobic Digestion)	90	90									
Suez MBR			90	90	90	90	90	90	90	90	
Disinfection (chlorine contact basin)	10	10	10	10	10	10					
Disinfection (UV)							15	15			
Chemical Feed and Storage	5	5	5	5	5	5	5	5	5	5	
Effluent Pump Station	20	20	20	20	20	20	20	20	20	20	
Supply Pump Station to Land Disposal Sites	20	20	20	20							
Aerobic Digester (MBR alt only)			30	30	30	30	30	30	30	30	100
Solids Handling (mechanical dewatering w/odor control)	53	53	53	53	53	53	53	53	53	53	
Sludge Drying (Solar Drying, Class A sludge only)		10		10		10		10		10	
Utility Water Pump Station	15	15	15	15	15	15	15	15	15	15	
Total Horsepower	268	278	298	308	278	288	283	293	268	278	100
Total Power Costs (@$0.1704/kw-hr)	**$298,318**	**$309,449**	**$331,712**	**$342,843**	**$309,449**	**$320,581**	**$315,015**	**$326,146**	**$298,318**	**$309,449**	**$111,313**
Chemical Costs											
Hypochlorite for CCB, incidental use (15 mg/l, $0.6523/gal)	$10,675	$10,675	$10,675	$10,675	$10,675	$10,675					
Hypochlorite (for membrane cleaning 859 gals/yr, $0.6523/gal)			$560	$560	$560	$560	$560	$560	$560	$560	
Bisulfite (8 mg/l, $1.35/gal)	$5,891	$5,891	$5,891	$5,891	$5,891	$5,891					
Citric Acid (for membrane cleaning $7.62/gal, 677 gals/yr)			$5,159	$5,159	$5,159	$5,159	$5,159	$5,159	$5,159	$5,159	
Polymer (25 Lbs. poly/DT, $7.52/gallon)	$32,203	$32,203	$32,203	$32,203	$32,203	$32,203	$32,203	$32,203	$32,203	$32,203	
Total Chemical Costs	**$48,769**	**$48,769**	**$54,488**	**$54,488**	**$54,488**	**$54,488**	**$37,922**	**$37,922**	**$37,922**	**$37,922**	**$0**
Main Plant Staff Costs											
Plant Manager/Supervisor ($110,000)	$110,000	$110,000	$110,000	$110,000	$110,000	$110,000	$110,000	$110,000	$110,000	$110,000	
Operators ($81,000)	$243,000	$243,000	$243,000	$243,000	$243,000	$243,000	$243,000	$243,000	$324,000	$324,000	
Maintenance ($70,000)	$70,000	$70,000	$70,000	$70,000	$70,000	$70,000	$70,000	$70,000	$140,000	$140,000	
Secretary ($60,000)	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	$30,000	
Total Main Plant Staff Costs	**$453,000**	**$453,000**	**$453,000**	**$453,000**	**$453,000**	**$453,000**	**$453,000**	**$453,000**	**$604,000**	**$604,000**	**$0**
Effluent Disposal											
Monitoring/Lab	$150,000	$150,000	$150,000	$150,000	$500,000	$500,000	$500,000	$500,000	$500,000	$500,000	
Total Effluent Disposal Costs	**$150,000**	**$150,000**	**$150,000**	**$150,000**	**$500,000**	**$500,000**	**$500,000**	**$500,000**	**$500,000**	**$500,000**	**$0**
Sludge Disposal											
Disposal Cost	$52,000	$52,000	$52,000	$52,000	$52,000	$52,000	$52,000	$52,000	$52,000	$52,000	
Total Brine Disposal Costs	**$52,000**	**$52,000**	**$52,000**	**$52,000**	**$52,000**	**$52,000**	**$52,000**	**$52,000**	**$52,000**	**$52,000**	**$0**

ESTIMATED OPERATION AND MAINTENANCE COSTS FOR VARIOUS TREATMENT ALTERNATIVES

Description	Secondary Treatment with Chlorine Contact Tank (Land Application Only)		Tertiary Treatment with Chlorine Contact Basin		Tertiary Treatment with Chlorine Contact Basin		Tertiary Treatment with UV Disinfection		Tertiary Treatment with Advanced Treatment (UF/RO/AOP/UV)		Septic Receiving and Handling
Disposal Method	**Land Application**		**Land Application**		**Beneficial Reuse**		**Surface Water Discharge, Water Recycling**		**Surface Water Discharge to Miocene Canal**		
Biosolids Classification	**Class B Biosolids**	**Class A Biosolids**	**Class B Biosolids**	**Class A Biosolids**	**Class B Biosolids**	**Class A Biosolids**	**Class B Biosolids**	**Class A Biosolids**	**Class B Biosolids**	**Class A Biosolids**	
Advanced Treatment											
UF/RO/AOP/UV Treatment Cost									$722,300	$722,300	
VSEP Treatment									$370,599	$370,599	
Brine Disposal Cost ($0.32 per gallon)									$2,616,320	$2,616,320	
Advanced Treatment Disposal Costs	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**	**$3,709,219**	**$3,709,219**	**$0**
Equipment and Maintenance: (20% of Construction Cost with 2% set aside for equipment and maintenance)	**$94,020**	**$130,172**	**$90,532**	**$126,688**	**$88,344**	**$124,492**	**$93,824**	**$129,976**	**$372,804**	**$408,968**	**$24,460**
SUBTOTAL OPERATION AND MAINTENANCE COSTS	**$1,096,107**	**$1,143,391**	**$1,131,732**	**$1,179,020**	**$1,457,282**	**$1,504,561**	**$1,451,761**	**$1,499,044**	**$5,574,263**	**$5,621,558**	**$135,773**
General Administration (15% of subtotal operation and maintenance costs)	$164,416	$171,509	$169,760	$176,853	$218,592	$225,684	$217,764	$224,857	$836,139	$843,234	$20,366
TOTAL OPERATION AND MAINTENANCE COSTS PLUS GENERAL ADMINISTRATION	**$1,260,523**	**$1,314,899**	**$1,301,492**	**$1,355,872**	**$1,675,874**	**$1,730,245**	**$1,669,525**	**$1,723,901**	**$6,410,403**	**$6,464,792**	**$156,139**
NET PRESENT VALUE OF TOTAL O&M COSTS: (20 years, 0.3%, 19.38362)	**$24,433,508**	**$25,487,507**	**$25,227,628**	**$26,281,716**	**$32,484,504**	**$33,538,414**	**$32,361,440**	**$33,415,439**	**$124,256,806**	**$125,311,073**	**$3,026,533**

ESTIMATED OPERATION AND MAINTENANCE COSTS FOR VARIOUS DISPOSAL ALTERNATIVES

Description	Secondary Treatment with Chlorine Contact Tank (Land Application Only)		Tertiary Treatment with Chlorine Contact Basin		Tertiary Treatment with Chlorine Contact Basin		Tertiary Treatment with UV Disinfection		Tertiary Treatment with Advanced Treatment and UV Disinfection	
Disposal Method	**Land Application**		**Land Application**		**Beneficial Reuse**		**Surface Water Discharge, Beneficial Reuse**		**Surface Water Discharge to Miocene Canal**	
Biosolids Classification	**Class B Biosolids**	**Class A Biosolids**	**Class B Biosolids**	**Class A Biosolids**	**Class B Biosolids**	**Class A Biosolids**	**Class B Biosolids**	**Class A Biosolids**	**Class B Biosolids**	**Class A Biosolids**
Effluent Disposal										
Forcemain Maintenance	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000
Storage Pond Maintenance	$100,000	$100,000	$100,000	$100,000						
Outfall Maintenance							$50,000	$50,000	$50,000	$50,000
Total Effluent Disposal Costs	**$150,000**	**$150,000**	**$150,000**	**$150,000**	**$50,000**	**$50,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**
SUBTOTAL OPERATION AND MAINTENANCE COSTS	**$150,000**	**$150,000**	**$150,000**	**$150,000**	**$50,000**	**$50,000**	**$100,000**	**$100,000**	**$100,000**	**$100,000**
General Administration (15% of subtotal operation and maintenance costs)	$22,500	$22,500	$22,500	$22,500	$7,500	$7,500	$15,000	$15,000	$15,000	$15,000
TOTAL OPERATION AND MAINTENANCE COSTS PLUS GENERAL ADMINISTRATION	**$172,500**	**$172,500**	**$172,500**	**$172,500**	**$57,500**	**$57,500**	**$115,000**	**$115,000**	**$115,000**	**$115,000**
NET PRESENT VALUE OF TOTAL O&M COSTS: (20 years, 0.3%, 19.38362)	**$3,343,674**	**$3,343,674**	**$3,343,674**	**$3,343,674**	**$1,114,558**	**$1,114,558**	**$2,229,116**	**$2,229,116**	**$2,229,116**	**$2,229,116**

ESTIMATED SEPTAGE TREATMENT COSTS

Description	Septic Receiving Station/Treatment
Septic Receiving Equipment	$262,000
Aerobic Digester	
Concrete	$2,389,000
Equipment	$245,000
Subtotal 1	**$2,896,000**
Sitework and Yard Piping (@15% of Subtotal 1)	$434,000
Electrical/Instrumentation (@25% of Subtotal 1)	$724,000
Subtotal 2	**$4,054,000**
Mobilization/Demobilization (2%)	$81,000
Sales Tax (7.25%, assumes 20% of Subtotal 2 is equipment/material)	$59,000
Contractor Profit (15%)	$608,000
Bonds and Insurance (2%)	$81,000
Subtotal 3	**$4,883,000**
Undefined Scope (30%)	$1,465,000
Total Septic Tank Construction Cost	**$6,348,000**
Construction Contingency (10%)	$635,000
Implementation (soft) Costs (percentage of Total Construction Cost w/o Land Costs)	**$6,983,000**
Project Administration (2%)	$140,000
Legal Council/Bond Council (1%)	$70,000
Planning (3%)	$209,000
Design (13%)	$908,000
Environmental Documentation/Permitting (3%)	$209,000
ROW Acquisition (1%)	$70,000
Construction Management (8%)	$559,000
Engineering Services During Construction (4%)	$279,000
Environmental Monitoring/Regulatory Compliance (3%)	$209,000
Environmental Mitigation (6%)	$419,000
Implementation Cost Total	**$3,072,000**
Land Costs (1 acre @ $40,000 per acre)	**$40,000**
TOTAL CAPITAL COST	**$10,095,000**
O&M COSTS	
O&M Cost (annual)	$156,000
O&M Cost NPV (20 yrs, 0.3%)	**$3,027,000**
SALVAGE VALUE	
Land Cost Value, Infinite Life, no escalation or depreciation	$40,000
Equipment Cost Value (20% of Total Construction Cost, 20 year life, 0.3%)	$1,223,000
Non-Equipment Cost Value (80% of Total Construction Cost, 50 year life, 0.3%)	$5,760,000
Salvage Value of Land	$40,000
Salvage Value of Equipment	$0
Salvage Value of Non-Equipment	$3,456,000
Net Present Value of Salvage Value of Land	$40,000
Net Present Value of Salvage Value of Equipment	$0
Net Present Value of Salvage Value of Non-Equipment	$3,255,000
TOTAL NET PRESENT VALUE	**$9,827,000**

Description	Septic Receiving Station/Treatment
TOTAL CAPITAL COST	$10,095,000
O&M Cost NPV (20 yrs, 0.3%)	$3,027,000
TOTAL NET PRESENT VALUE	$9,827,000