Climate Induced Hatchery Upgrades

Coyote Valley Fish Facility

Alternatives Analysis Submittal

Final Report
Revision No. 3

McMillen

January 2025

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Revision Log

Revision No.	Date	Revision Description
0	4/10/2024	65% Draft Submittal
1	8/30/2024	Draft Final Submittal
2	10/31/2024	Final Submittal
3	1/31/2025	Final Submittal to CDFW, ADA Accessible Document

Appendices

The appendices that accompany this document are not ADA compliant. For access to the following appendices, contact Fisheries@wildlife.ca.gov. If assistance is needed for an ADA compliant version of the appendices, please include that in the email.

- Appendix A. Site Visit Report
- Appendix B. Bioprogramming
- Appendix C. Concept Alternative Drawings
- Appendix D. Design Criteria TM
- Appendix E. Alternatives Development TM
- Appendix F. Cost Estimate
- Appendix G. Meeting Minutes
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Executive Summary

McMillen, Inc. (McMillen) was retained by the California Department of Fish and Wildlife (CDFW) to provide an assessment of 21 CDFW fish hatcheries throughout the State of California in the context of their vulnerability to the effects of climate change. Climate modeling was performed by Northwest Hydraulic Consultants (NHC).

Coyote Valley Fish Facility has an aging infrastructure and deficiencies that need to be addressed in the near future in order to meet fish production goals. The primary areas of concern for the facility are emergency intake pump deficiencies, inoperable valves, potentially leaking water lines, aging concrete, unsafe working conditions and so on throughout the hatchery are items that have been noted to hinder current production. The effects of which will magnify with climate change.

The preferred alternative for facility upgrades includes replacing the emergency intake pumps, replacing valves and pipes throughout the facility, excavating and stabilizing the ground near the raceways and spawning area, improving worker safety in the spawning area, replacing media in the degassing tower, providing additional adult holding capacity, and skim coating the concrete throughout the facility.

The Class 5 Opinion of Probable Construction Cost (OPCC) for constructing the preferred alternative upgrades can be found in the table below (Table 6-2 provides the Class 5 OPCC). The table also includes the estimated cost of photovoltaic systems to offset the energy consumption of the new equipment and to maintain zero net energy. These upgrades would not significantly affect fire or flood risks at the facility, and all work would occur within already developed areas. These proposed upgrades would provide a solid foundation for CDFW to sustain fish production at the hatchery, even as climate change increasingly disrupts current and future operations.

Total Cost Estimate	$3,239,000
Photovoltaic for ZNE	$962,000

1.0 Introduction

1.1 Project Authorization

McMillen, Inc. (McMillen) was retained by the California Department of Fish and Wildlife (CDFW) to provide a climate change evaluation for 21 hatcheries operated by CDFW throughout the State of California. The contract for this Climate Induced Hatchery Upgrade Project (Project) was executed on March 21, 2023.

1.2 Project Background

California relies on CDFW hatcheries to provide recreational fishing opportunities for the public and for the conservation of endangered or threatened species. However, climate change threatens the business-as-usual production of fish with the existing CDFW hatchery infrastructure. Climate change impacts have already affected many CDFW hatcheries, resulting in altered or inconsistent operation schedules, lowered production, and emergency fish evacuations. These climate impacts include increasing water and air temperatures, changes to groundwater availability, low flows and water shortages, increased flood and fire risks, and other second-hand impacts associated with each of these categories (i.e., emerging pathogens and non-infectious diseases, low adult salmon returns, decreased worker safety, etc.).

A total of 21 hatcheries were visited by McMillen to evaluate the existing infrastructure and fish production operations. During these visits, McMillen assessed the existing hatchery infrastructure deficiencies and replacement needs. The assessment was used to aid in determining the potential upgrades for each hatchery that would maintain the existing program production goals for the various species reared at each facility while providing conceptual alternatives for climate resilience. Climate change has had an impact worldwide and will continue to affect CDFW's statewide fish production operations. Developing technologies and methods to meet fishery conservation and sport fisheries is critical to CDFW's goal of maintaining hatchery productivity while conserving precious cold-water supplies for native species.

We have based our detailed work plan on achieving the following project objectives stated in the Request for Proposals (RFP). As presented in Sections 2 and 3 of our proposal, we have intentionally comprised our team of experts in all required disciplines with experience in fish husbandry and hatchery engineering and design to successfully meet all CDFW's project goals.

- **Objective 1:** Review the state of each facility via data collection, review of documents, site visits, and discussions with hatchery personnel. Identify climate change impacts that are likely to negatively impact operations at each hatchery over the next 40 years.
- **Objective 2:** Develop cost effective and programmatically viable alternatives that will maintain current fish propagation goals given climatic impacts in the future.
- **Objective 3:** Assess the risks of each alternative to natural biological systems, environmental conditions, husbandry techniques for fish health and fish safety, and potential impacts to water quality.
- **Objective 4:** Determine the short- and long-term economic costs for the modifications to each hatchery in current year dollars. Account for construction, permitting, design, operational, and maintenance costs within the overall economic analysis. Prioritize the list of alternatives and associated hatcheries based on limited annual hatchery budgets.
- **Objective 5, Phase 2 Work:** Provide complete designs with issued for construction drawings and specifications for projects at as many hatcheries as are feasible. The focus shall be on those hatcheries that are deemed most susceptible to negative climate change impacts identified from the evaluation in the four previous objectives.

1.3 Project Purpose

The purpose of the Project is to determine the CDFW hatcheries and the existing infrastructure conditions that are most susceptible to reduced fish production attributable to climate change and provide a prioritization of the hatcheries for improvements. With input from CDFW, designs for climate change resiliency upgrades will be advanced for as many facilities as is feasible.

1.4 Project Site Location

The Coyote Valley Fish Facility is located approximately 4 miles north of Ukiah, CA (Figure 1-1).

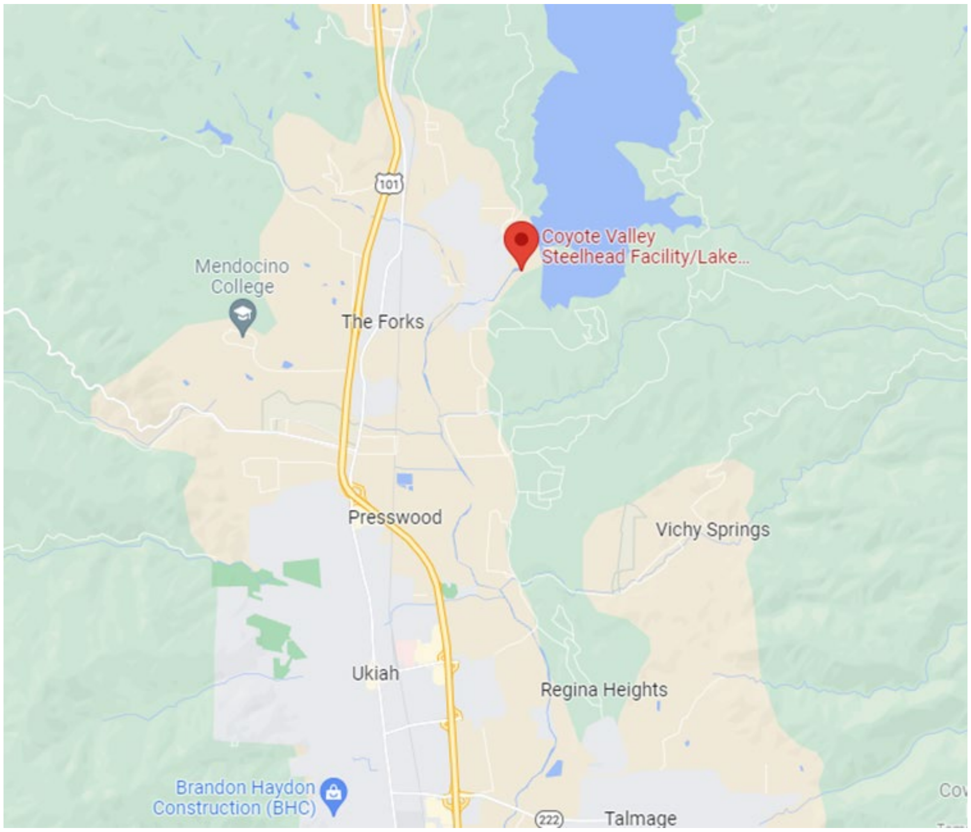

Figure 1-1. Coyote Valley Fish Facility Location Map.

In the early 1990s, the Coyote Valley Fish Facility (Coyote Valley) was constructed by the U.S. Army Corps of Engineers (USACE) to offset the loss of upstream spawning and rearing grounds due to the construction and operation of the Coyote Dam, which forms Lake Mendocino on the East Fork of the Russian River. USACE is the mitigator for the facility and provides 100% of the funding to cover operations and maintenance. The fish ladder was first opened in November 1992. Coyote Valley operates seasonally with start-up and broodstock collection for Russian River steelhead trout (*Oncorhynchus mykiss*) beginning in November and continuing through April. The facility serves primarily as an egg take facility with spawning occurring weekly from January and extending 16 consecutive weeks through mid-April. As eggs are collected via spawning efforts at the facility, they are transported to the Warm Springs Hatchery where they are incubated, and fish are reared to the target release size and transported back to the Coyote Valley Fish Facility for acclimation in the raceways and then directly released into the East Fork Russian River. The production goal for the facility is 200,000 smolts at a mean size of 8 fish per pound (fpp). The general facilities are shown in Figure 1-2. See the Site Visit Report (Appendix A) for additional details and photos regarding the facility.

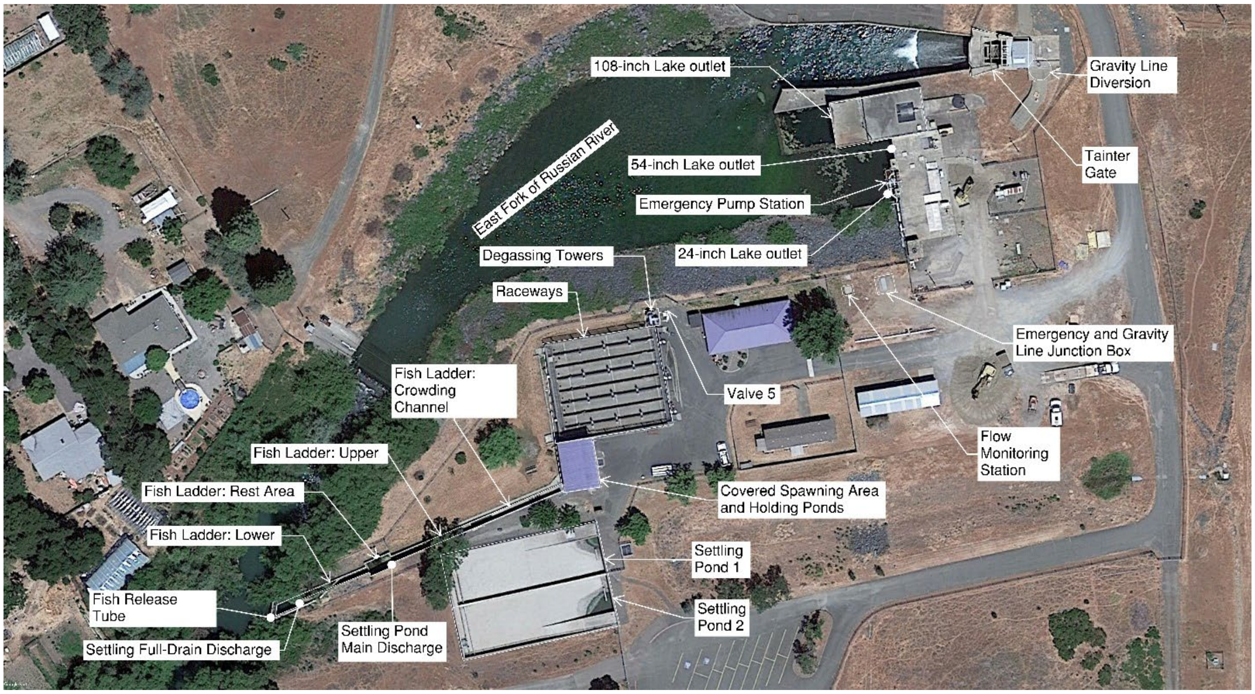

Figure 1-2. Coyote Valley Facilities. Google Earth image date: 6/2/2021.

2.0 Bioprogram

2.1 Production Goals and Existing Capacity

The Coyote Valley Fish Facility was constructed in 1990 to mitigate for the construction and operation of the Lake Mendocino Dam. The USACE is the mitigator for Coyote Valley. Additionally, the City of Ukiah also provides support to the facility. Coyote Valley traps and spawns Russian River steelhead over a 16-week period from January through mid-April. As eggs are collected, they are transferred to the Warm Springs Hatchery, where they are incubated, reared to a smolt size, and transferred back to Coyote Valley for acclimation/imprinting and release into the East Fork Russian River. The current production goal for Coyote Valley is shown in Table 2-1.

The Capacity Biological Program (Capacity Bioprogram) for the facility was developed for the Site Visit Report (Appendix A) and provides the total numbers of fish and biomass that can be produced for all rearing tanks based on tank volume, operational water flows, and size of the fish. Since the steelhead are reared at the Warm Springs Hatchery, the bioprogram provides the total number of fish that can be held for acclimation/imprinting at the smolt size. The calculations utilize the density and flow indices previously identified for the preliminary bioprograms, which encompass water temperature and elevation criteria to ensure oxygen levels appropriately align with production (Piper, 1982). This information is available in the Site Visit Report (Appendix A). The calculations include a 10% safety factor to provide a 90% maximum capacity based on both the density index (DI) and flow index (FI) requirements identified. The annual production goal for Coyote Valley is 200,000 fish weighing 25,000 pounds as provided by CDFW in the initial questionnaire. The fish production goal and rearing capacity determined by the Capacity Bioprogram are shown in Table 2-1.

Table 2-1. Production Goal and Capacity of Various Rearing Units at the Coyote Valley Fish Facility per the Capacity Bioprogram (Appendix A).

Rearing Unit (max. fish size)	Total Capacity (Fish)[a]	Limiting Factor	Goal
Raceways (8 fpp/7.1 inches)	212,490	Rearing Volume	200,000 smolts (25,000 pounds)

[a] This is an estimate of 90% production capacity to allow for a buffer in circumstances where more flexibility is needed for facility operations.

2.2 Bioprogram Summary

The Capacity Bioprogram in the Site Visit Report (Appendix A) demonstrates the total capacity of the raceways at Coyote Valley for holding and acclimating smolts prior to release. The capacity of the raceways (-10% to provide an additional safety factor), limited by water flow or available rearing volume, is shown in Table 2-1. The total capacity for Coyote Valley aligns with the production goal shown in Table 2-1. Details about the various rearing areas and infrastructure are discussed in the Site Visit Report, found in Appendix A.

In this current report, we developed an initial Production Bioprogram (Appendix B) to illustrate the potential maximum production that the facility is capable of while remaining within the limits set by the Capacity Bioprogram.

2.2.1 Criteria

The methods and reasoning used to determine the criteria associated with biological programming for Coyote Valley can be found in Appendix A. For reference, the established criteria are shown in Table 2-2. To model the production cycle schedule for the Production Bioprogram, several assumptions are made and included in Table 2-3. Additional assumptions include the following:

- CDFW will have the ability to trap and spawn as many Russian River steelhead as required at Coyote Valley to obtain eggs for their production program.
- There will be optimal conditions for egg development and fish growth, given the existing water temperatures at the Warm Springs Fish Hatchery.

Klontz (1991) provided optimal growth rates for Rainbow Trout at designated water temperatures, and survival rates were provided in the questionnaire completed by Coyote Valley/Warm Springs Hatchery staff. Note that for the growth rate, fish rearing occurs at the Warm Springs Hatchery for the Coyote Valley smolts (i.e., Russian River Steelhead); therefore, timing and growth information is available in the Warm Springs Hatchery Alternatives Analysis Submittal Final Report.

Table 2-2. Criteria Used for the Production Bioprogram. Criteria are Discussed in Detail in Appendix A.

Criteria	Value
Density Index (DI)	0.3
Flow Index (FI)	1.91

Criteria	Value
Water Temperature	Consistent 46°F to 54°F

Table 2-3. Survival Assumptions Used for the Production Bioprogram.

Life Stage	Value
Egg-to-fry	78.5%
Fry-to-juvenile (400 fpp)	85%
Juvenile-to-outplant (8 fpp)	89%

2.2.2 Production Bioprogram

This bioprogram (Appendix B) is meant to view facility operations at a high level and does not capture the nuances of specific timing of fish transfers or releases. Coyote Valley is operated seasonally and serves as a broodstock collection and spawning facility and as an acclimation facility for smolts prior to release into the East Fork Russian River. In December, broodstock collection begins via the fish ladder and continues throughout the spawning cycle in April to capture the entire run spectrum. Spawning occurs weekly from January through April resulting in 16 spawning events. The gametes from each spawning event are transferred as green eggs to the Warm Springs Hatchery where they are reared to the target size of 8 fpp (7.1 inches). Approximately 12-14 months later, the smolts are transferred back to Coyote Valley for acclimation and release. This can occur with all smolts acclimating at the same time or in a staggered fashion with half of the smolts being acclimated at a time. Table 2-4 provides an example of both scenarios with all smolts being acclimated at one time and if half of the smolts are acclimated at a time. Acclimation of half of the smolts in a staggered fashion is logistically feasible since the progeny from the spawning events occurring in January and February start on feed earlier than the progeny from the later spawning events. Eggs collected at the start of the season have more time to achieve growth and reach the target release size earlier. Progeny from the later spawning events in March and April may achieve the target size later and can be acclimated a month or more after the earlier group of smolts are released. The typical schedule for the progeny from the later spawning events is to accelerate their growth to achieve the target release size of 8 fpp by the end of January.

Table 2-4. End of Month Production Information for the Acclimation of the Russian River Steelhead Smolts Bioprogram Including Realized DI and FI Values.

Production Stage/Month	Tank Type	Tanks Occupied	fpp	Length (in)	Total Fish (#)	Biomass (lbs)	Max. Flow (cfs)	DI	FI
Smolt Acclimation	Raceways	8	8.0	7.10	200,000	25,000.0	8.9	0.25	0.88
Smolt Acclimation Staggered[a]	Raceways	8	8.0	7.10	100,000	12,500.0	8.9	0.13	0.44

[a] This example results in half of the smolts being acclimated and released earlier during the release window and the remaining half of the smolts being released later during the release window.

2.2.3 Summary

It should be noted that the DIs and FIs during the acclimation period remain within the criteria specified in Table 2-2. The DI reaches 0.25 and the FI reaches 0.88 if the full goal of 200,000 smolts are held and released all at once and the DI and FI are well below the limits at 0.13 and 0.44 if half of the smolts are held for acclimation and released at a time. Water demand remains consistent with the seasonal operation of the facility (i.e., November through April) as the water used for the raceways for acclimation also flows through the adult holding ponds and through the fish ladder (Figure 2-1). Note that the different colored blocks in the following figure correspond to the months for when steelhead are acclimating to the raceways and the adult holding/ladder operations.

The Coyote Valley seasonal operational cycle is repeated year after year and provides larger windows of downtime for cleaning and performing maintenance. The fish production occurs at the Warm Springs Hatchery with the exception of the spawning and final acclimation/release processes occurring at Coyote Valley to achieve the 200,000 smolt goal with fish weighing 25,000 pounds.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
STEELHEAD																								
Acclimation in Raceways																								
Adult Holding/Ladder Operations																								
Max Flow in CFS	8.9	8.9	8.9	8.9	0.0	0.0	0.0	0.0	0.0	0.0	8.9	8.9	8.9	8.9	8.9	8.9	0.0	0.0	0.0	0.0	0.0	0.0	8.9	8.9

Figure 2-1. Production Rearing Schedule Over 2 Years with Peak Water Demand Occurring Annually November through April (as highlighted in the Max Flow in CFS row).

3.0 Climate Evaluation

3.1 Introduction

In this section, climatic and hydrologic projections of conditions at the facility are presented for the next 20 years (2024-2043) and the following 20 years (2044-2063). These time horizons are referred to as the near-future period and the mid-century period, respectively. These projections inform the project team of potential needs for adaptive changes.

3.2 Water Sources

The facility only operates from November through April. The primary water source is Lake Mendocino, fed by the East Fork Russian River, and water is delivered through a gravity line from an outlet at the base of the lake spillway. The facility utilizes 13-16 cfs. Water turbidity and sulfate concentrations are recurrent issues. Water temperatures are good during the period of operation, ranging from 46°F to 54°F. At other times of year, water temperatures exceed the range of tolerance for steelhead. There have not been any issues with water availability. There is a potential impact to the water supply in the form of competing use of the Lake Mendocino supply as other potential users are discussing options for water diversion projects. This could impact the quality and quantity of water available if the reservoir's water is managed differently in the future. Impacts could be magnified especially during drought cycles if other competing users reduce the water availability which in turn my impact water quality.

3.3 Methodology for Climate Change Evaluation

This study uses future climatic and hydrologic projections based on global climate model (GCM) simulations associated with the data set known as CMIP5, which was part of the fifth assessment report of the Intergovernmental Panel on Climate Change (IPCC 2013). The projections in this report are based on results from 10 different global climate models under the RCP4.5 scenario of future greenhouse gas emissions, which represents a future with modest reductions in global emissions compared to current levels.

An ensemble of 10 global climate models (GCMs), listed in Table 3-1, is used for capturing a wide range of plausible climate projections. Since this project's future time horizon is limited to 40 years, the dominant source of uncertainty in climate projections is expected to be the natural variability of the earth's climate (and the variability present in every GCM model run), with the second major source of uncertainty being differences between GCMs. Using this ensemble will simultaneously address both uncertainty sources. The selection of 10 GCMs was based on tests of their ability to accurately simulate California climate, following the study of 35 CMIP5 models by (Krantz et al., 2021).

Table 3-1. List of Global Climate Models Used in This Study.

No.	GCM	Research Institution
1	ACCESS-1.0	CSIRO, Australia
2	CanESM2	Canadian Centre for Climate Modelling and Analysis, Canada
3	CCSM4	National Center for Atmospheric Research, United States
4	CESM1-BGC	National Science Foundation, Department of Energy, and National Center for Atmospheric Research, United States
5	CMCC-CMS	Centro Euro Mediterraneo per Cambiamenti Climatici, Italy
6	CNRM-CM5	Centre National de Recherches Météorologiques / Centre Européen de Recherche et Formation Avancées en Calcul Scientifique, France/European Union
7	GFDL-CM3	NOAA Geophysical Fluid Dynamics Laboratory, United States
8	HadGEM2-CC	Met Office Hadley Centre, United Kingdom
9	HadGEM2-ES	Met Office Hadley Centre, United Kingdom
10	MIROC5	Japan Agency for Marine-Earth Science and Technology, Atmosphere and Ocean Research Institute (The University of Tokyo), and National Institute for Environmental Studies, Japan

Hydrologic projections utilize daily timestep results from the VIC hydrologic model (Figure 3-1) that was driven by the projected daily climate time series. VIC divides the watershed into grid cells (about 5x7 km in this study) where properties of the soil column and land cover and all major fluxes of water and energy are represented. Soil infiltration capacity is spatially variable within each grid cell, and baseflow is represented as a non-linear function of soil water storage.

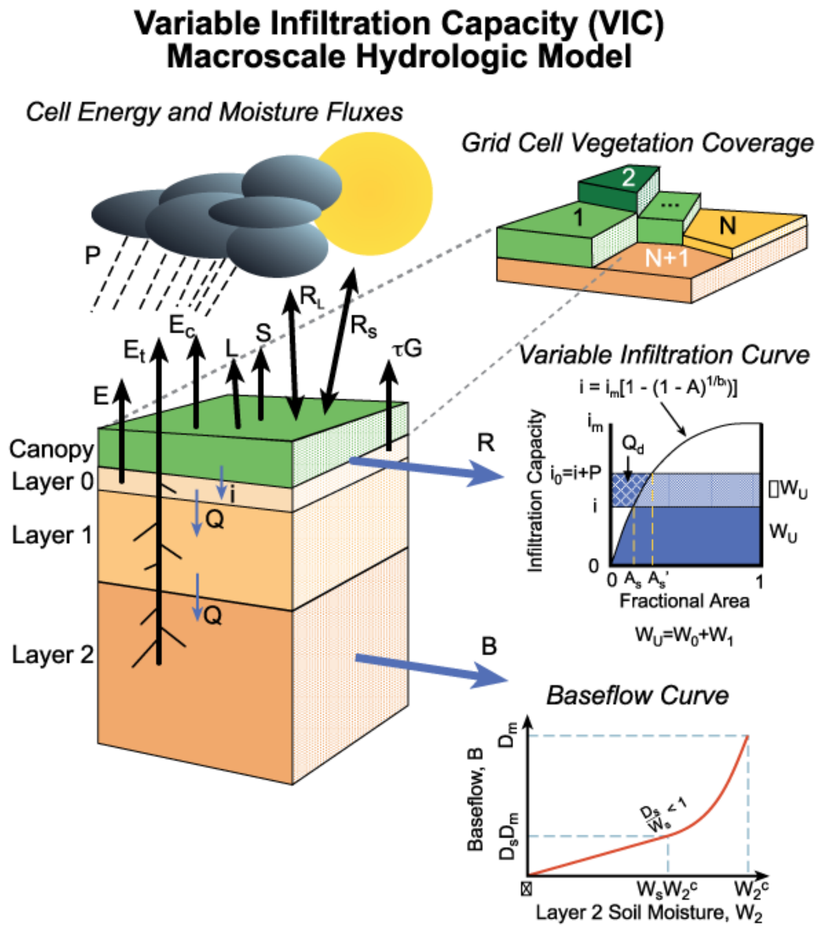

Figure 3-1. The VIC Hydrologic Model. Figure source: University of Washington, 2021.[1]

The methodology used for obtaining projections of climate, water temperature, hydrology and flood risk is summarized in Figure 3-2. The sections below provide additional detail, as well as discussion of fire risk:

1. **Projections of climatic variables** (air temperature and precipitation) were based on simulations by the 10 selected CMIP5 global climate models (GCMs). The GCM projections were statistically downscaled (using different methodologies) by a consortium of research institutions and made publicly available for all of California at a grid cell spatial resolution of 1/16° x 1/16° (about 5 km x 7 km) (Vano et al., 2020). In this report, the downscaling methodology named “Localized Constructed Analogs” (LOCA) is used. The choice of the LOCA data set was guided by its proven ability to represent extreme values of the downscaled climatic variables (important to this study) and because the hydrologic projections made available by the same research

1 https://vic.readthedocs.io/en/master/Overview/ModelOverview/

consortium (item [2] below) used the LOCA-downscaled climate projections. The difference between greenhouse gas emissions scenarios is small for a time horizon of 20 years; therefore, it is sufficient to use one greenhouse gas emissions scenario in this study, and the moderate scenario RCP4.5 is used.

2. **Projections of daily stream flows entering Lake Mendocino** were obtained by aggregating, over the watershed, the grid cell-based streamflow projections made available by the same research consortium as in item (1) above (Vano et al., 2020). These publicly available projections were obtained by driving the VIC hydrologic model with the CMIP5 daily climate projections. The watershed delineation was obtained using the StreamStats program by USGS (2019).
3. **Projections of water temperature** are not obtained due to absence of an observed time series of water temperatures that would allow studying its dependence on three determining factors: air temperature, storage level at Lake Mendocino, and choice of water intake from Lake Mendocino.
4. **Projections of wildfire risk** at each hatchery site were evaluated at a high level based on the projections by Westerling (2018), which are available through the California government Cal-Adapt.org website (Cal-Adapt, 2023). In addition to the risk that fire poses to the facility, it has the effect of reducing soil permeability and increasing peaks of runoff and stream flows that impact flooding and water quality.

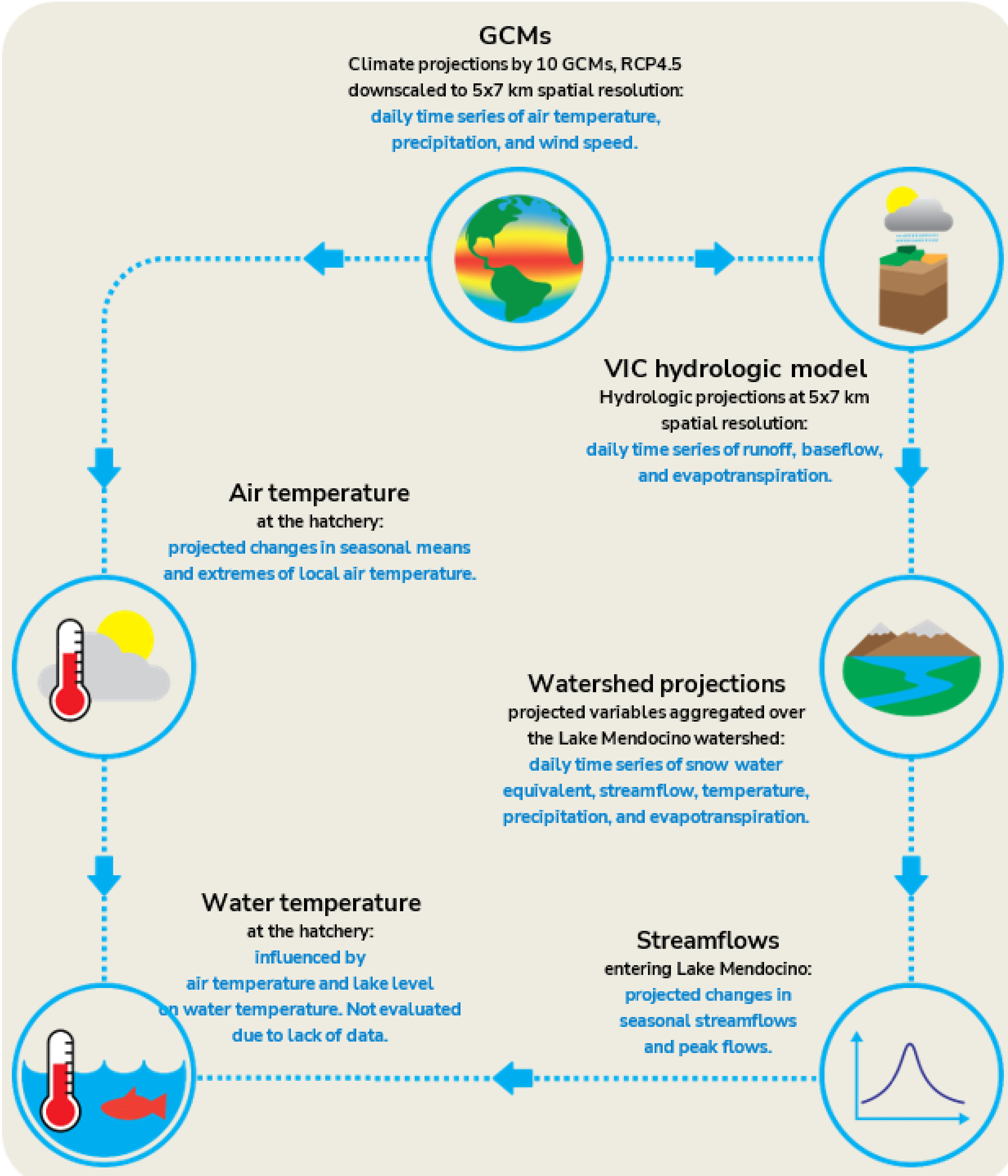

Figure 3-2. Methodology for Obtaining Projections.

3.4 Uncertainty and Limitations

It is important to acknowledge the uncertainty associated with these and any projections of climate and hydrology. While there is a need to provide climate projections for a variety of planning purposes, the underlying projections of climate change are subject to large and unquantifiable uncertainty. There is also uncertainty associated with the VIC hydrologic model simulations, and evaluating how well the model had been calibrated to the watershed was beyond the scope of this project. The changes in seasonal streamflows and peak flows projected by VIC (i.e. the difference between a future period and the reference period) are reported but the absolute streamflow values are omitted because model calibration over the historical period was not verified.

The projections of air temperature, precipitation, evapotranspiration, streamflow and wildfire risk developed in this work should therefore be considered as plausible representations of the future, given the best current scientific information, and do not represent specific predictions. The actual future realizations of these variables over the areas studied will differ from any of the projections considered here, and their differences compared to historical climate may be greater or smaller than the differences in the projections considered.

3.5 Projected Changes in Climate at the Facility Site

3.5.1 Air Temperature

Figure 3-3 displays the simulated mean daily air temperature (solid lines) and its range from minimum to maximum (shaded areas) for each day of the year, for the near-future time period (red) and the reference period (blue). All data are simulated by the ensemble of 10 GCMs for each time period. Higher peaks of daily temperature are seen for the near-future compared to the reference period (1984-2003), while the historical period has lower minima.

Table 3-2 and Table 3-3 list the projected mean seasonal air temperature for two future time periods, and the temperature change relative to the reference period. All time horizons, including the reference period, are simulated by the ensemble of 10 GCMs. The lowest and highest of the 10 GCM daily projections define the lower and upper limits of the shaded areas in Figure 3-3, and are given in Table 3-2 and Table 3-3. Table 3-4 and Table 3-5 list the projected percentiles of highest air temperature in each day (T_{max}) for two future time periods, relative to the reference period. All time horizons, including the reference period, are simulated by the ensemble of 10 GCMs.

At the facility site, mean annual air temperature is projected to rise by 2.0°F in the near future period compared to the reference period (1984-2003), and by an additional 1.1°F in the mid-century period. The season with the most warming is the summer (Figure 3-3, Table 3-2, Table

3-3) and the highest temperature rises are projected to occur in the hottest days. Days with maximum daytime temperatures representing the 75th percentile (i.e., the upper quartile of temperatures) are projected to warm by 2.4°F in the next 20 years, relative to the reference period. The 97th percentile of the daytime maximum temperature is projected to rise by even more, 2.5°F, reaching 100°F. These projected temperatures represent potentially hazardous outdoor working conditions at the facility.

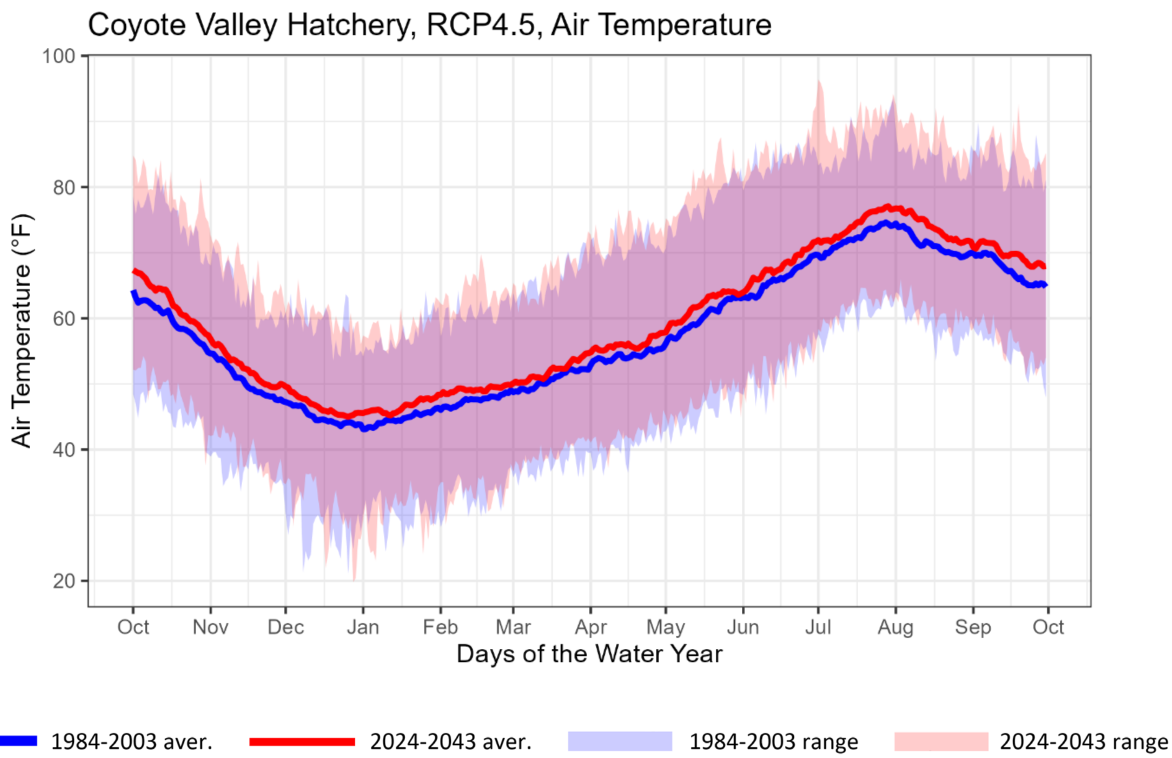

Figure 3-3. Mean Daily Air Temperature and Range for Each Day of the Water Year.

Table 3-2. Projected GCM 2024-2043 Mean Seasonal Air Temperature. (change relative to 1984-2003)

GCM	Annual	Winter (DJF)	Spring (MAM)	Summ. (JJA)	Fall (SON)
Ensemble mean	59.0°F (+2.0°F)	47.0°F (+1.7°F)	56.4°F (+1.6°F)	71.6°F (+2.3°F)	60.9°F (+2.4°F)
Lowest	58.1°F (+1.1°F)	46.2°F (+0.9°F)	55.7°F (+0.9°F)	70.2°F (+0.9°F)	59.8°F (+1.3°F)
Highest	59.9°F (+2.9°F)	47.8°F (+2.5°F)	57.4°F (+2.6°F)	72.9°F (+3.6°F)	61.8°F (+3.3°F)

Table 3-3. Projected GCM 2044-2063 Mean Seasonal Air Temperature. (change relative to 1984-2003)

GCM	Annual	Winter (DJF)	Spring (MAM)	Summ. (JJA)	Fall (SON)
Ensemble mean	60.1°F (+3.1°F)	48.2°F (+2.9°F)	57.7°F (+2.9°F)	72.6°F (+3.3°F)	61.9°F (+3.4°F)
Lowest	59.4°F (+2.4°F)	47.2°F (+1.9°F)	57.0°F (+2.2°F)	71.3°F (+2.0°F)	60.8°F (+2.3°F)
Highest	61.1°F (+4.1°F)	48.8°F (+3.5°F)	58.6°F (+3.8°F)	74.3°F (+5.0°F)	64.0°F (+4.5°F)

Table 3-4. Projected GCM 2024-2043 Percentiles of Highest Air Temperature in Each Day (T_{max}). (change relative to 1984-2003)

GCM	3rd perc.	25th perc.	50th perc.	75th perc.	97th perc.
Ensemble mean	49.6°F (+1.7°F)	59.8°F (+1.7°F)	72.6°F (+1.9°F)	86.2°F (+2.4°F)	100.0°F (+2.5°F)
Lowest	48.6°F (+0.7°F)	58.7°F (+0.6°F)	71.8°F (+1.1°F)	85.0°F (+1.2°F)	98.9°F (+1.4°F)
Highest	51.5°F (+3.6°F)	60.5°F (+2.4°F)	73.3°F (+2.6°F)	86.9°F (+3.1°F)	101.4°F (+3.9°F)

Table 3-5. Projected GCM 2044-2063 Percentiles of Highest Air Temperature in Each Day (T_{max}) (change relative to 1984-2003).

GCM	3rd perc.	25th perc.	50th perc.	75th perc.	97th perc.
Ensemble mean	50.8°F (+2.9°F)	60.8°F (+2.7°F)	73.9°F (+3.2°F)	87.2°F (+3.4°F)	101.0°F (+3.5°F)
Lowest	49.9°F (+2.0°F)	60.1°F (+2.0°F)	73.1°F (+2.4°F)	86.4°F (+2.6°F)	99.3°F (+1.8°F)
Highest	52.6°F (+4.7°F)	61.4°F (+3.3°F)	74.6°F (+3.9°F)	88.9°F (+5.1°F)	102.2°F (+4.7°F)

3.5.2 Seasonal Streamflows

In this section we look at streamflow input to Lake Mendocino from the East Fork Russian River. The watershed upstream from Lake Mendocino (estimated to cover 105 square miles) receives little snowfall, and the main factor determining seasonal streamflows into the reservoir is rainfall, followed by evapotranspiration. Given the intense variability of precipitation, especially marked over California, from year to year and decade to decade, future seasonal streamflows are subject to great stochastic uncertainty regardless of any long-term trend in their mean values due to anthropogenic climate change. Therefore, the streamflow projections based on 10 global climate model run under RCP4.5 shown in Figure 3-4, and Table 3-6 and Table 3-7 contain a strong stochastic element and are very uncertain.

Due to stochastic variability and other sources of uncertainty in these projections (Section 3.4), the future climate may differ considerably in magnitude and in the sign of change projected for each season in Table 3-6 and Table 3-7. For example, a seasonal decrease in streamflow may occur where an increase had been projected, and vice-versa. The intense uncertainty is exemplified by the wide interval between minimum and maximum projected from among the 10 GCMs, which are also given in the table. The projections given by the ensemble of 10 GCMs considered together are for increased runoff in the wettest season, winter (December-February), by +4% in the near-future period and +21% in the mid-century period. The second-wettest season is fall (September-November), and while a streamflow increase by +15% is projected for the near-future period, a decline (-9%) is projected for the mid-century period, a reverse in the direction of change, which is likely to be the product of random chance. Despite projected declines in streamflow in spring and summer, the mean annual runoff is projected by the ensemble of 10 global climate models to increase by +6% in the near-future period and +13% in the mid-century period.

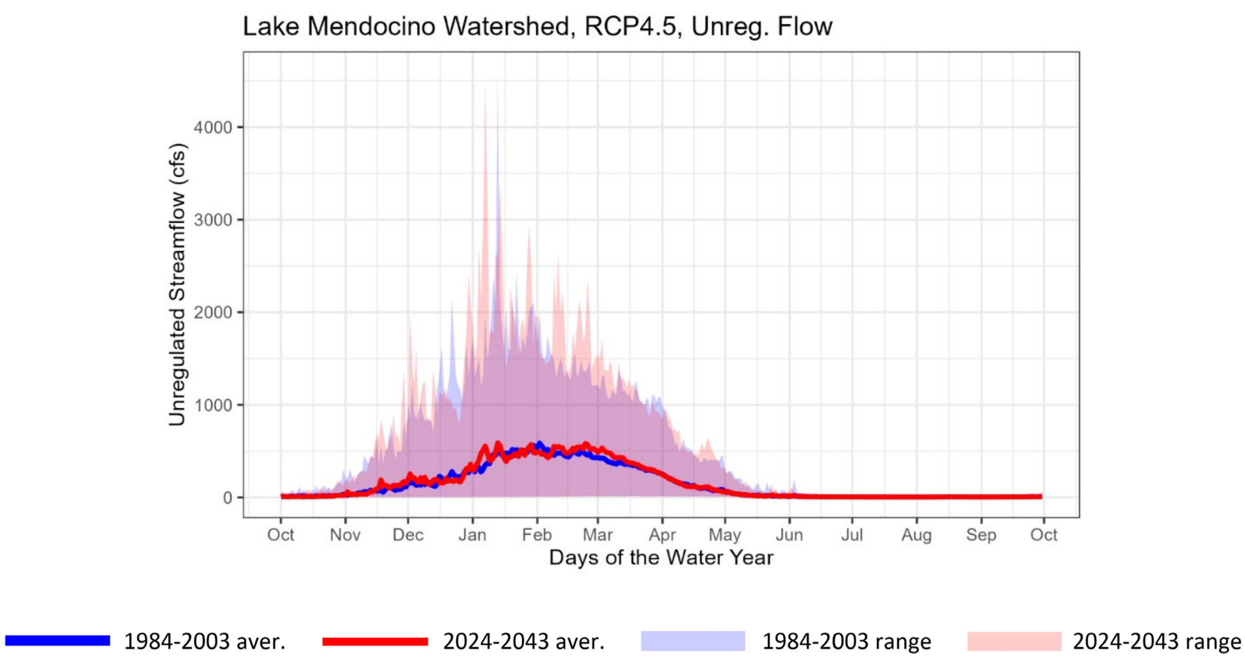

Figure 3-4. Mean Daily Streamflow and Range for Each Day of the Year for Lake Mendocino Watershed.

Table 3-6. Projected GCM 2024-2043 Percent Change in Annual and Seasonal Streamflow for Lake Mendocino Watershed (relative to 1984-2003).

GCM	Annual	Winter (DJF)	Spring (MAM)	Summ. (JJA)	Fall (SON)
Ensemble mean	+6%	+4%	+8%	-2%	+15%
Lowest	-20%	-25%	-23%	-21%	-26%
Highest	+59%	+73%	+51%	+19%	+98%

Table 3-7. Projected GCM 2044-2063 Percent Change in Annual and Seasonal Streamflow for Lake Mendocino Watershed (relative to 1984-2003).

GCM	Annual	Winter (DJF)	Spring (MAM)	Summ. (JJA)	Fall (SON)
Ensemble mean	+13%	+21%	-1%	+7%	-9%
Lowest	-31%	-36%	-26%	-20%	-34%
Highest	+68%	+98%	+27%	+114%	+48%

3.5.3 Peak Streamflows

Water turbidity may possibly increase following large rainfall events. For this reason, we include projected changes in peak flow frequency.

The daily streamflow values, which in the reference period (1984-2003) had a probability of being exceeded in any given year equal to 1-in-5, 1-in-10, and 1-in-20, i.e., being surpassed once every 5 years, 10 years, and 20 years, were determined by frequency analysis of the VIC hydrologic model simulations for the 10 GCMs. The new return period for these peak flows projected for the current period and each future period is given in Table 3-8. These streamflow peaks, which occur mostly in winter (December-February) correspond to heavy rainfall events.

The confidence associated with flood-frequency analysis results for periods of 20 years is low, and the study of 30 or more years of streamflow data is usually recommended. Twenty-year periods are used here for consistency with other results in this study, all of which use the same 20-year time horizons. Despite resulting imprecision in absolute values, the rapid shortening of return periods at 20-year intervals seen in Table 3-8 is a robust result which is seen also in all other facility locations where future flood frequency was studied.

It is found that the return period of a fixed peak flow declines over time, which means these peak flows are projected to become more frequent. For example, the peak flow that in 1984-2003 had an estimated return period of 20 years is projected to recur every 13 years on average under the climate of 2024-2043, and 12 years on average in 2044-2063 (Table 3-8).

Table 3-8. Projected Change in Peak Streamflow Frequency for the Inputs to Lake Mendocino.

Time Horizon	Return period (yr)	Return period (yr)	Return period (yr)
1984-2003	5	10	20
2004-2023	4	8	16
2024-2043	4	8	13
2044-2063	3	6	12

3.5.4 Fire Risk

Historical wildfires have been documented within the watershed, including some large fires, as mapped in Figure 3-5. About half of the watershed has not burned in the past century and therefore has relatively high amounts of fuel stores. The rest of the watershed last burned in 2017 and 2018. The 2018 Ranch Fire burned over 400,000 acres and got within six miles of the facility (Figure 3-5). Vegetated land cover transitions from grasslands near the facility to mostly forested in the uplands, with anticipated fuel recovery rates ranging from 2 to 5 years in grasslands to more than 10 years in the uplands (depending on burn severity and tree type).

Expressing wildfire risk as a percent chance of occurring at least once in a decade per Westerling (2018), the projected wildfire risk at the facility site is approximately 15% through mid-century (Figure 3-5). Across the watershed, the projected fire risk is higher, at 20% mean probability.

The primary risks to the facility operations include local infrastructure impacts from local fires, as well as reservoir impacts from fires throughout the basin. Increased runoff along burn scars can lead to increased flooding, debris, and turbidity, all of which can have impacts to the reservoir and the facility's water intake infrastructure. These increased risks of floods and high turbidity are highest during the first five to ten years post fire. There is also a risk of the facility itself from the potential of direct fire on the facility grounds and its local infrastructure.

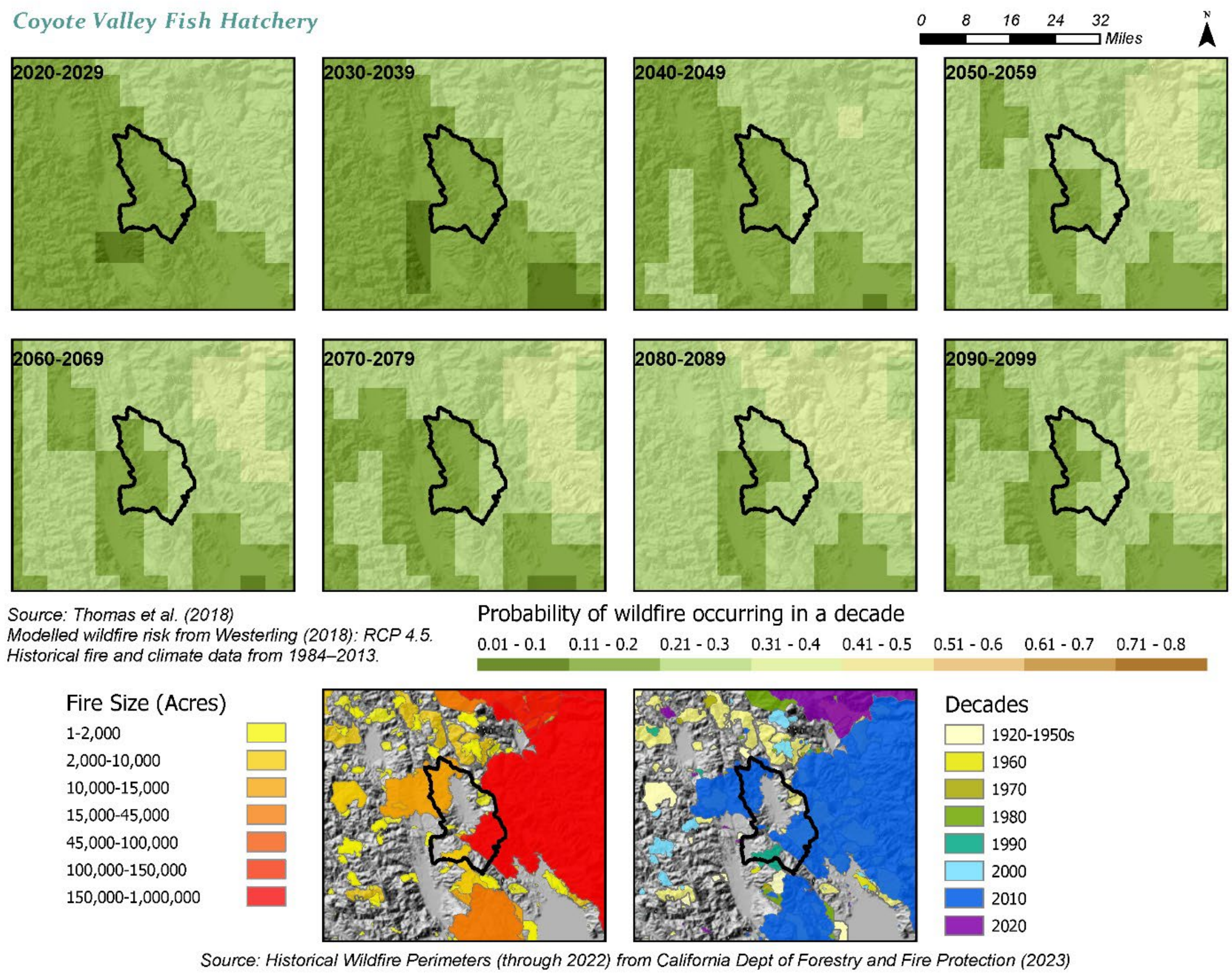

Figure 3-5. Wildfire Risk as Probability of Future Occurrence, and Known Historical Fires.

3.6 Conclusions

Significant increases in air temperature and water temperature are expected for the Coyote Valley Fish Facility. Mean annual air temperature is projected to rise by 2.0°F in the next 20 years (2024-2043) and by an additional 1.1°F in the mid-century period (2044-2063), compared to the reference period (1984-2003). The summer will experience the most warming, and the largest temperature increases are projected to occur on the hottest days. Days with temperatures representing the 75th percentile and 97th percentile of daily temperatures are projected to warm by 2.4°F and 2.5°F, respectively, in the next 20 years, relative to the reference period.

According to gridded air temperatures for the reference period 1984-2003 (Livneh et al., 2013), the 75th and 97th percentiles of peak daytime temperature (i.e., the temperature at the hottest time of day) were 83.8°F and 97.5°F. For the near-future period (2024-2043), these percentiles are projected to rise to 86.2°F and 100°F, respectively. Such an increase in the peak air daytime temperature requires adaptation measures for protection of facility workers against heat stroke and other health effects of heat exposure. Roads and roofs may also need to be replaced using more heat-resistant and reflective materials.

Analysis of the observational data shows that water temperature in Lake Mendocino responds to air temperature depending on lake level, with higher levels capable of maintaining cool water temperatures during November-April. While projections of seasonal streamflows are highly uncertain, it is known that California’s year-to-year climate variability brings recurring low-storage conditions in Lake Mendocino, such as in 2021 and 2022, which are conducive to excessively warm water temperatures, surpassing 60°F in November and December (Figure 3-3).

The facility is at high risk of wildfires. There is a history of large historical fires both within the facility watershed and surrounding basins, including the 2018 Ranch Fire burning within six miles of the facility. The projected chance of at least one wildfire occurring in a 10-year period at the facility site is estimated as 15% through mid-century. Across the watershed, this risk is estimated as 20%. Post-fire conditions risks to the facility, including scar-induced debris and turbidity, are likely to affect the reservoir during the first five to ten years post fire. Local impacts to infrastructure from nearby fires is also likely.

4.0 Existing Infrastructure Deficiencies

Multiple facility deficiencies were identified during the site visit and described in Section 4 of the Site Visit Report (Appendix A). Section 5.4 of the Site Visit Report identified potential technologies and solutions needed to address specific deficiencies that would allow the facility to maintain current production goals. The primary areas of concern for the facility are emergency intake pump deficiencies, inoperable valves, potentially leaking water lines, aging concrete, and unsafe working conditions.

Sections 3.0 and 3.2 of the Site Visit Report identified biosecurity deficiencies and potential solutions for addressing these concerns. The facility's primary biosecurity concerns are the untreated and unfiltered water supply and fish exposure in the raceways. Sections 4.1 and 4.2 expand upon the details of these deficiencies.

4.1 Water Process Infrastructure

4.1.1 Emergency Pump Size and Intake Deficiencies

Under normal operating conditions, Coyote Valley receives its water from a gravity-fed pipeline. However, the facility cannot use the gravity flow pipeline during releases of high flows from the reservoir. The facility then relies on emergency pumps to provide water. The two existing emergency pumps cannot meet the facility's full water needs. The facility requires 13 to 15 cfs for normal operating conditions, and the emergency pumps only provide 9 to 10 cfs. When the emergency pumps are in use, three diesel-powered pumps are supplied by the City of Ukiah to supplement the water. These diesel pumps are connected to the degassing tower and draw water from the East Fork of the Russian River. If both emergency pumps fail, the diesel pumps together can only provide enough water to evacuate fish from the facility – not enough for full operation.

When the gravity line cannot be used, water can be directed to a 24-inch, 54-inch, 108-inch, or large Tainter Gate outlet. The 24-inch and 54-inch pipe outlets are located near the emergency pump intake. The facility staff reported that when water is discharged through the 54-inch outlet, air and water mix, which can cause the pumps to cavitate and create high total dissolved gas issues. Additionally, the screen around the pump intake frequently becomes covered in debris. The screen is difficult for Facility staff to clean since it is underwater and can only be reached with a long pole. The limitations of the emergency pumps create water reliability issues at Coyote Valley Fish Facility.

4.1.2 Limited Incoming Water Treatment

The water supply for production comes from Lake Mendocino, and the water quality can vary depending on the weather and the dam's operations. The only water treatment at Coyote Valley is two degassing towers. The degassing towers provide passive aeration, using Koch rings to break up the water as it cascades downward. These units are important to reduce the total dissolved gas pressure, which can be high at the base of a dam. However, the Koch rings have never been replaced and are likely starting to deteriorate. This can reduce the efficiency of the degassing towers. The facility staff reported no issues with high total dissolved gas pressure but did not regularly take measurements.

Since the water supply comes from surface water, there are likely pathogens of concern in the water. With no incoming water treatment, there is the potential for disease in the facility if the conditions are right. Furthermore, New Zealand Mud Snails (*Potamopyrgus antipodarum*) have been found at the bottom of the fish ladder and a quarter mile downstream in the receiving water.

4.2 Rearing Infrastructure

4.2.1 Inoperable Valve #5

The incoming 24-inch water supply line providing water to the raceways has a large valve that is heavily aged and unable to be turned. The valve is left in its current position and does not provide the intended function to control the flow. As a temporary mode of operation, the main valve located at the upstream end of the facility is being used as a control valve. The main valve is typically in either the open or closed position. Because valve #5 is inoperable, the facility staff cannot reduce the flow into the rearing facilities. Furthermore, if the main valve were to fail or become inoperable, the facility would have no control over water entering the facility.

4.2.2 Potential Leaks in Water Lines

The condition of the supply line that directs water from the southeast corner of the raceways to the adult holding ponds is unknown and likely to leak. The pavement on top of the pipeline is sagging and cracking (potentially indicating a pipeline leak), and the quantity of water reaching the adult ponds appears less than a few years ago, per CDFW staff observations. The smolt release pipe which is routed underground from the tail end of the raceways and then parallels the fish ladder above ground leading to the East Fork Russian River is another potentially damaged pipe. Both pipelines are from the original construction of the facility.

4.2.3 Aging Concrete throughout the Facility

The fish ladder, adult holding ponds, raceways, and effluent ponds are all comprised of aging concrete that needs repair and preventative maintenance. The most significant signs of deteriorating concrete are on the fish ladder. The CDFW staff have identified a significant gap in the fish ladder concrete and noted the gap is growing. The concrete steps on the fish ladder are aged and have multiple areas showing signs of severe decline, such as cracks and missing chinks. The damaged steps can cause harm to the fish trying to return to the facility. The raceways and adult holding ponds also have multiple locations showing cracks and exposed aggregate. Concrete that has aggregate exposed can promote algae growth, create a more abrasive environment for fish, and be difficult for facility staff to clean.

4.2.4 Hazardous Working Environment for Staff

The adult holding and spawning area had an overhead crane system to operate lift baskets for stocking trucks. However, the baskets were found to harm the fish, and the staff no longer uses the overhead crane system. The structure on which the crane is mounted is high up and not easily accessible. The mechanical and supporting systems have not been inspected since installation. To accommodate the crane system, the roof over the adult holding and spawning area is so high that it provides very little protection from sunlight. During the spawning season, the crew works long days, performing labor-intensive work in the direct sunlight.

5.0 Alternative Selected

During the site visit several deficiencies were identified that currently limit the facility's ability to meet fish production goals. These deficiencies have been summarized in Section 4.0 of this report. Appendix E provides a discussion of alternative technologies that may be used to address the existing deficiencies and potentially expand production, improve biosecurity, and increase operational efficiencies. The following section presents a summary of the preferred alternative that would best utilize the alternative technologies to respond to the existing deficiencies, maximize fish production and respond to the climate change projections described in Section 3.0. The conceptual layout of the alternative described below is shown in Appendix C.

5.1 Alternative Description

5.1.1 Replace Emergency Intake Pumps

It is the preferred alternative to replace the current two existing emergency pumps with four new pumps that could provide approximately 8 cfs each. This would allow two pumps operating together to deliver the needed 13-15 cfs for facility operations with two pumps remaining on standby in case of a failure or maintenance need. It is preferred to keep the pumps smaller in size and have four rather than have two pumps capable of meeting 15 cfs each (one operating and one acting as backup) due to the size and cost of installation.

5.1.2 Add Automatic Transfer Switch for Emergency Power Generator

If the gravity water flow system fails, the hatchery relies on emergency pumps. If commercial power is lost, a staff member is required to respond and manually convert the pumps over to the backup generator power source. The preferred alternative is to install an automatic transfer switch (ATS) to convert from commercial power to generator power without delay to restore operation of the emergency pumps and water flow to the fish in the raceways, holding ponds and ladder. This alternative eliminates the delay associated with staff response times and any associated safety concerns with staff manually converting between commercial to generator power.

5.1.3 Replace Valves and Pipes throughout the Facility

The facility first opened for operation in 1992, so, much of the infrastructure is aged and nearing the end of its lifespan. It is the preferred alternative to inspect the valves and pipes throughout the facility and to replace them as needed. There are specific locations where known issues are already present. It is believed that leaking is occurring in the pipe connecting the head of the raceways to the adult holding ponds due to water loss. Additionally, valve #5 is inoperable and, according to facility staff, likely to fail at any moment.

5.1.4 Excavate, Stabilize, Backfill, and Repave Area near Raceways and Spawning Area

It is evident from the movement and cracking of the pavement around the raceways and spawning facility and the movement and cracking of the concrete in the spawning facility that the ground is settling in that area. This could be a result of a number of different conditions from expansive soils to improper installation and backfill of the pipes to leaking pipes causing dislocation of material and settlement. The facility staff have noticed a decrease in the flow reaching the spawning facility indicating that the settlement may be due to leaks in the supply pipes.

The preferred alternative includes excavating the soil in the area between the raceways and spawning facility, inspecting the pipes and replacing broken/leaking pipes, stabilizing, backfilling and compacting the area.

5.1.5 Improve Safety in Spawning Area

The metal roof over the spawning area was constructed at an excessive height. This results in a roof that does not accomplish its intended purpose of protecting the spawning area. The preferred alternative is to remove the existing roof structure and construct a new roof that is at a lower height providing additional protection for the spawning area.

The existing crane used to lift fish is supported by the roof. This crane should be inspected, serviced, and possibly upgraded to meet current operational requirements and safety codes. With the lower roof, the support structure for the crane will be redesigned and constructed as part of the roof structure.

5.1.6 Replace Media in Degassing Tower

The incoming water is treated using two degassing towers filled with plastic media, also referred to as Koch rings. As the water flows downward through the degassing tower, the plastic media breaks up the water, releasing unwanted gases and adding oxygen. These treatment units are essential for reducing total dissolved gas pressure since the water comes from the base of a dam. However, the media and top screen of the units have never been replaced since they were installed in 1992. The screen has visible signs of age and wear, and the plastic media is likely reaching the end of its lifespan.

The preferred alternative is to replace both the plastic media and the top screen. Replacing these components will extend the life of the treatment equipment and ensure that the degassing removal efficiency is maintained.

5.1.7 Provide Space for Additional Adult Holding

The facility has four concrete adult holding ponds located in the spawning area under a metal roof cover. The holding ponds can hold up to 250 adult fish if needed, but the facility has limited ability to separate the natural origin (NOR) fish from the facility-origin fish (HOR).

The preferred alternative would be to add three, 10-foot circular tanks with an operating depth of 5.0 feet. The tanks would be positioned adjacent to the existing adult holding and spawning area along the raceways. Each tank would be supplied with 150 gpm and operate as a flow through system. Assuming the adults average 8 pounds each and the water temperature is 50°F, 50 adults could be held in each tank at a loading rate of 1.0 pound per cubic foot and 3.0 gallons per minute water flow per adult fish. This is below the holding criteria established by the National Marine Fisheries Service (NMFS 2022) of 2 pounds per cubic foot and 1.34 gallon per minute flow per adult. For water temperatures above 50°F, volume and water supply rates should be increased by 5% for each 1°F increase in water temperature. Additional sides or enclosures would be necessary to prevent adults from jumping out of the tanks per NMFS guidelines. A roof structure will be included to eliminate direct sunlight exposure for these tanks and the staff handling, sorting and spawning the adults.

5.1.8 Skim Coat Concrete Throughout the Facility

Concrete throughout the facility is aged and showing signs of deterioration. The concrete raceways, adult holding ponds, crowding channels, fish ladder, and settling ponds are all showing exposed aggregate. In particular, the concrete U-shaped plates or steps in the fish ladder are heavily aged and exhibit an extremely rough surface.

It is the preferred alternative to skim coat the concrete infrastructure throughout the facility to help extend the life of the infrastructure, promote a safer environment for fish rearing, and to allow for maintenance to be more easily performed.

5.1.9 Backup Power Generator(s)

An electrical assessment will be conducted for the facility to include the existing electrical requirements along with additional components encompassing the suite of alternatives selected to determine the electrical requirements for the facility to appropriately size backup generators.

5.2 Pros/Cons of Selected Alternative

Table 5-1 provides a high-level summary of the pros and cons for Coyote Valley's selected alternative.

Table 5-1. Pros/Cons of Selected Alternative – Coyote Valley.

Description	Pros	Cons
Replace emergency intake pumps.	• Improves security and resiliency of water supply. • Improves capacity. • Replaces aging infrastructure.	• Increases cost. • Requires coordination with the City of Ukiah.
Add ATS for emergency power generator.	• Transfers power immediately. • Restores water flow with minimal delay and minimal risk to the fish. • Does not require staff presence to transfer power from commercial to generator. • Provides a safer work environment for staff.	• Increases cost. • May disrupt facility operations during construction.
Replace valves and pipes throughout the facility.	• Addresses aging infrastructure. • Increases flow control. • Improves security from failure when Valve 5 is replaced.	• Increases cost. • May disrupt facility operations during construction.
Excavate, stabilize, backfill, and repave areas near raceways and spawning area.	• Protects existing facilities from further settlement. • Stabilizes walls of spawning facility tanks.	• May disrupt facility operations during construction.
Lower roof over the spawning area.	• Provides more shade and protection for the infrastructure, fish, and staff.	• Increases cost.
Inspect and maintain overhead crane.	• Improves staff safety. • Restores function of the crane.	• Increases cost.

Description	Pros	Cons
Replace media in degassing tower.	• Extends the life of existing facility. • Improves degassing and aeration for the fish. • Low cost alternative with the hatchery directly purchasing and installing Koch rings utilizing CDFW staff.	• Increases cost.
Provide space for additional adult holding.	• Allows for reduced crowding of broodstock. • Allows staff to separate males/females or natural origin fish for spawning.	• Increases cost. • Requires additional plumbing and infrastructure. • Requires tank covers.
Apply skim coat to the concrete throughout the facility.	• Is a low-cost solution. • Increases abrasion resistance. • Minimizes algae buildup. • Improves cleaning efficiency. • Extends the life of the infrastructure.	• Has a limited life span for skim coat (10-20 yrs). • Does not improve predation protection.
Add backup power generators.	• Provides power to all life support systems in the event of a power outage.	• Increases cost. • Increases complexity. • Increases maintenance.

5.3 Alternatives for Short Term Improvements

5.3.1 Add Automatic Transfer Switch for Emergency Power Generator

If the gravity water flow system fails, the hatchery relies on emergency pumps. If commercial power is lost, a staff member is required to respond and manually convert the pumps over to the backup generator power source. The installation of an automatic transfer switch (ATS) to convert from commercial power to generator power without delay to restore operation of the emergency pumps and water flow to the fish in the raceways, holding ponds and ladder. This alternative eliminates the delay associated with staff response times and any associated safety concerns with staff manually converting from commercial to generator power.

5.3.2 Replace Valve #5

The incoming 24-inch water supply line providing water to the raceways has a large valve (i.e., valve #5) that is left in its current position and does not provide the intended function to control the flow into the rearing facilities. It is strongly recommended that a replacement valve be purchased and installed to restore water flow control rather than relying on the main valve at the upstream of the hatchery to be utilized to control flow for the facility.

5.4 Natural Environment Impacts

The proposed upgrades to the Coyote Valley Fish Facility should have negligible impacts on the natural resources in the surrounding area. All improvements would occur within currently developed areas, avoiding requirements for additional environmental or cultural permits not identified in Section 7.0. An exception may occur if any existing structures fall under the jurisdiction of California's Office of Historic Preservation (OHP).

5.4.1 Fire and Flood Risk

The recommended changes to the Coyote Valley Fish Facility will change the existing infrastructure and the number of rigid structures on site. However, they will not increase or decrease the fire risk. Based on the climate change evaluation, the projected fire risk at the hatchery site is approximately 15% and 20% across the watershed through mid-century.

Flood potential increases with the increased incidence of fire, therefore, as fire risk increases, the risk of flooding also increases. The recommended changes to the Coyote Valley Fish Facility will likely have no impact of flooding on the facility. Fiberglass circular tanks for additional broodstock holding will occur in an area which is already developed and paved. These tanks will not be susceptible to flooding as they will be installed with tank tops at heights 30 to 36 inches above ground. The tank height will provide protection from overland flow entering the fish rearing vessels, and the ground will be graded to carry water away from the tanks to the extent feasible.

Additionally, upgrading the valves and piping will provide the hatchery with better flow control into the facility. Specifically, the replacement of valve #5 will allow the hatchery to regulate flows to raceways, adult holding and ladder facilities.

5.4.2 Effluent Discharge

The recommended changes to the hatchery do not include an overall increase in production goals at the Coyote Valley Fish Facility as the facility will continue to serve as a broodstock collection, spawning and smolt acclimation facility. This will ensure there will be no change to the NPDES permit requirements. The recommended alternatives will likely have no impact to the water quality of the effluent discharge. The hatchery meets current NPDES permit requirements. The addition of fiberglass circular tanks for additional broodstock holding capability will tie into the existing effluent and off-line settling ponds. The broodstock will not be fed; therefore, there will be no impact to the current NPDES permit.

It is important to note that changes to existing aquaculture programs (renovations, new construction) may trigger (administratively) the requirement for new and/or updated NPDES permits. Acknowledging that waste load (fish biomass) is not anticipated to change with the proposed alternatives, we assume that the increase in effluent removal efficiencies provided by the PRAS systems will result in net effluent “gains” to the overall aquaculture program.

5.5 Hatchery Operational Impacts/Husbandry

There were not any facility changes identified for Coyote requiring changes in operational protocols. Broodstock collection and spawning operations will continue using the hatchery’s standard practices. Green eggs will continue to be transferred immediately after spawning to the Warm Springs Hatchery and follow their standard operating procedures for all rearing until the smolts are transferred back to the Coyote facility for acclimation. During the acclimation phase, standard feeding and raceway cleaning practices will be implemented. The smolts will be direct released into the East Fork Russian River via the smolt release pipe following standard release protocols.

One of the benefits of the hatchery’s design is to provide the means for staff to maintain fish health and welfare. The raceways allow for administering chemical treatments as needed (e.g., *Gyrodactylus*) during the acclimation phase if necessary.

5.5.1 Feeding

All fish culture activities for Coyote Valley are conducted at the Warm Springs Fish Hatchery with the exception of the final stage of rearing. In January, the smolts are transferred from the Warm Springs Fish Hatchery to Coyote Valley and reared over a 4–8-week period for acclimation/imprinting. CDFW staff will continue feeding using their standard practices during the acclimation phase.

5.6 Biosecurity

The goal of biosecurity measures is to minimize the risk of pathogens entering the facility and spreading between rearing areas at the facility. The Coyote Valley Fish Facility temporarily rears smolts for acclimation prior to release. The facility has identified Gyros (*Gyrodactylus* spp.) as a parasite present during the acclimation process. Otherwise, no other pathogens were identified. New Zealand Mud Snails (NZMS) are present in the East Fork Russian River where the steelhead smolts are released. The most likely pathways for pathogens to enter and spread through the facility is through the incoming water supply or environmental exposure within the hatchery.

5.6.1 Incoming Water Supply

Coyote Valley Fish Facility has limited measures to prevent pathogens from entering the facility. Although there is no filtration or UV disinfection for the surface water supply (i.e., Lake Mendocino), the risk is low given the smolts are on site for a short duration for acclimation and direct release. Replacing outdated valves and piping will improve the hatchery's ability to control the flow to operate the new systems correctly and maximize the protection of the hatchery from pathogens.

5.6.2 Environmental Exposure/Bio Vectors

The existing concrete raceways are enclosed by perimeter fencing with bird exclusion overtop and the raceway walls are approximately 36 inches above the asphalt limiting potential predators for accessing the raceways. There is still some risk of predators entering the raceway area and broodstock holding area, but the risks are minimal.

5.7 Water Quality Impacts

The recommended alternatives will improve water reliability in instances when the gravity flow supply is not functioning and in the event of commercial power loss. The emergency pumps will provide full flow of water and automation (i.e., automatic transfer switch [ATS]) of the systems will restore water flow promptly in the event of a power outage. The ATS eliminates the delays associated with staff response and manual conversion time from commercial power to the emergency backup power system.

6.0 Alternative Cost Evaluation

6.1 Introduction

McMillen has utilized historical costs as a self-performing general contractor in the performance of similarly-technical projects, as the basis of the Preliminary Concept Planning – Opinion of Probable Construction Cost (OPCC) estimate for this Project. Additionally, McMillen has solicited pricing or utilized recently received material quotes for similar materials and equipment or components. The appropriate overhead and profit markups have been included in the project pricing. The detailed cost estimates, including assumptions and inflation information are presented in Appendix F.

6.2 Estimate Classification

This OPCC estimate is consistent with a Class 5 estimate as defined by the Association for Advancement of Cost Engineering (AACE) classification system, as shown in Table 6-1 below. As stated in the estimate description below, "Class 5 estimates are generally prepared based on very limited information, and subsequently have wide accuracy ranges." For purposes of this project, McMillen has utilized an accuracy range of -30% to +50% in the estimates presented in Table 6-2.

Table 6-1. AACE Class 5 Estimate Description (Source: Association for Advancement of Cost Engineering).

Criteria	Details
Description	Class 5 estimates are generally prepared based on very limited information, and subsequently have wide accuracy ranges. As such, some companies and organizations have elected to determine that due to the inherent inaccuracies, such estimates cannot be classified in a conventional and systemic manner. Class 5 estimates, due to the requirements of end use, may be prepared within a very limited amount of time and with little effort expended—sometimes requiring less than an hour to prepare. Often, little more than proposed plant type, location, and capacity are known at the time of estimate preparation.
Level of Project Definition Required	0% to 2% of full project definition.

Criteria	Details
End Usage	Class 5 estimates are prepared for any number of strategic business planning purposes, such as but not limited to market studies, assessment of initial viability, evaluation of alternate schemes, project screening, project location studies, evaluation of resource needs and budgeting, long-range capital planning, etc.
Estimating Methods Used	Class 5 estimates virtually always use stochastic estimating methods such as cost/capacity curves and factors, scale of operations factors, Lang factors, Hand factors, Chilton factors, Peters-Timmerhaus factors, Guthrie factors, and other parametric and modeling techniques.
Expected Accuracy Range	Typical accuracy ranges for Class 5 estimates are -20% to -50% on the low side, and +30% to +100% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances.
Effort to Prepare (for US$20MM project)	As little as 1 hour or less to perhaps more than 200 hours, depending on the project and the estimating methodology used.
ANSI Standard Reference Z94.2-1989 Name	Order of magnitude estimate (typically -30% to +50%).
Alternate Estimate Names, Expressions, Synonyms:	Ratio, ballpark, blue sky, seat-of-pants, ROM, idea study, prospect estimate, concession license estimate, guesstimate, rule-of-thumb.

6.3 Cost Evaluation Assumptions

The following assumptions were made while developing the Class 5 cost estimates for this alternatives analysis:

- All unit costs assume total cost for installation including any applicable taxes.
- The cost estimate is at a Class 5 level with an accuracy range of -30% to +50% and includes 25% contingency. This range accounts for current inflation variability within aquaculture projects, unforeseen conditions, and anticipated cost escalation leading up to the projected construction year.
- Prevailing wages are provided as a general increase based on past construction pricing.
- All Division costs are rounded up to the nearest $1,000.

- Length and area dimensions for the estimate were derived from scaled AutoCAD drawings of the facility and the property. A survey was not utilized for this initial estimate.
- Geotech investigation cost assumes seven bore holes (20 feet deep), material testing, piezometer installation, and a written report.
- Topographic survey cost assumption is based on $1,000/acre.
- Building joist/eve height will be 18 feet.
- Additional division specific cost evaluation assumption may be found in Appendix F.

6.4 LEED/Net Zero Energy Evaluation

RIM Architects (RIM) and STŌK have reviewed and assessed the facility's location along with reviewing the combination of state law and Leadership in Energy and Environmental Building (LEED) eligibility requirements. From this review, it is determined that this location is not eligible or required under state law to pursue LEED due to the lack of human occupancy in the proposed structures and/or the minimum square footage requirements. There is insufficient scope to pursue LEED certification. Refer to Appendix H for more information.

RIM and STŌK also prepared a zero net energy (ZNE) assessment of the facility. This assessment summarized the anticipated power needs at the facility and estimated the size of the photovoltaic (PV) system that would be required to offset the power use. Refer to Appendix H for more information.

6.5 Alternative Cost Estimate

The following tables illustrate the estimated costs for each of the alternatives evaluated and depicted within the worksheets in Appendix F.

Table 6-2. Alternative Cost Estimate.

Item	Estimate ($)
Division 01 – General Requirements	329,000
Division 02 – Existing Conditions	252,000
Division 03 – Concrete	5,000
Division 05 – Metals	50,000
Division 08 – Openings	20,000
Division 13 – Special Construction	396,000
Division 23 – Mechanical & HVAC	335,000

Item	Estimate ($)
Division 26 – Electrical	234,000
Division 31 – Earthwork	36,000
Division 32 – Exterior Improvements	197,000
Division 33 – Utilities	120,000
Direct Construction Cost	**1,974,000**
Contingency (Construction Cost)	494,000
Overhead	118,000
Profit	158,000
Bond Rate (Approximate)	20,000
Total Construction Cost	**2,764,000**
Design, Permitting and Construction Support	475,000
Total Cost Estimate	**3,239,000**
Accuracy Range +50%	4,859,000
Accuracy Range -30%	2,268,000
Photovoltaic	962,000

7.0 Coyote Valley Steelhead Facility Environmental Permitting

7.1 Anticipated Permits and Supporting Documentation

The proposed Project would involve the modification to the existing hatchery or construction of a new hatchery facility and associated infrastructure. It would potentially involve the development of an updated emergency pump station, requiring instream construction, for the hatchery operations. A list of anticipated permits, agency review time, submittal requirements, and supporting documentation for the proposed project regardless of which alternative is selected are summarized in Table 7-1, Table 7-2, and Table 7-3. The review timeframes are estimated and are based on the recommendations presented in permit guidance documentation and experience with other permitting projects in California.

We reviewed the location through online mapping tools (USFWS IPAC and California BIOS) to determine if species listed under the Endangered Species Act (ESA) and the California Endangered Species Act (CESA) potentially occur at the site. The results indicated that the site has the potential for species to be present identified as endangered or threatened. The site does not contain critical habitat. The results of these mapping tools indicate that a Biological Assessment of the area would need to be prepared prior to consultation with the USFWS, NOAA, and other state agencies.

The list is developed at a high level and additional permits may need to be assessed as the project is advanced.

Table 7-1. Anticipated Federal Permits and Approvals for Selected Location

Agency and Permit/Approval	Submittal / Document Type	Supporting Documentation	Anticipated Time Frame	Notes
USFWS National Environmental Policy Act (NEPA) Compliance	Environmental Assessment	Analysis of potential impacts on various natural resources, Design Package	12 – 18 months	Evaluation of the selected alternative to identify if there would be a significant impact.

Agency and Permit/Approval	Submittal / Document Type	Supporting Documentation	Anticipated Time Frame	Notes
U.S. Army Corps of Engineers (USACE) Clean Water Act (CWA) Section 404 - Nationwide Permit Authorization	Pre-Construction Notification Application	Wetland and Stream Delineation, Design Package	3 months	Required if jurisdictional waters of the U.S. or wetlands are affected by the Project area.
USFWS ESA Section 7 Consultation	Biological Assessment	Field surveys of affected area, Design Package	4 months	The site has potential for species listed under the ESA to occur.
National Oceanic and Atmospheric Administration (NOAA) Section 10(a)(1)(A) of the ESA	Application	Supplemental information to include description of proposed project, analysis of potential take and potential impact to species, proposed minimization and mitigation measures, and funding source	4 months	Authorization for scientific purposes or to enhance the propagation or survival of an endangered or threatened species.

Table 7-2. Anticipated State Permits and Approvals for Selected Location

Agency and Permit/Approval	Submittal / Document Type	Supporting Documentation	Anticipated Time Frame	Notes
Lead Agency TBD California Environmental Quality Act (CEQA)	Environmental Impact Report	Analysis of potential impacts on various natural resources, Design Package	12 – 18 months	Required for issuing state permits. Potential to be coordinated with the NEPA compliance for efficiency.

Agency and Permit/Approval	Submittal / Document Type	Supporting Documentation	Anticipated Time Frame	Notes
California Department of Fish and Wildlife (CDFW) California Fish and Wildlife Code Section 2081 Incidental Take	Application	Supplemental information to include description of proposed project, analysis of potential take and potential impact to species, proposed minimization and mitigation measures, and funding source	4 months	Required for the authorization to take any species listed under the California Endangered Species Act.
California Department of Fish and Wildlife (CDFW) California Fish and Wildlife Code Section 1600 Lake and Streambed Permits	Application/ Notification	N/A	1-3 months	Required for hatchery intake diversions.
North Coast Regional Water Quality Control Board (RWQCB) 401 Water Quality Certification	Application	Wetland and Stream Delineation USACE Review NEPA/CEQA Compliance	3 months	Required if jurisdictional waters of the U.S. or wetlands are affected by the Project area.
California Office of Historic Preservation Section 106 Review	Concurrence Request Letter	Cultural Resources Survey, Design Package	3 months	Required as part of the NEPA/CEQA process.

Agency and Permit/Approval	Submittal / Document Type	Supporting Documentation	Anticipated Time Frame	Notes
California Division of Water Rights Water Rights	Application or Transfer	N/A	4 months	N/A
California State Water Resources Control Board (SWRCB) National Pollutant Discharge Elimination System (NPDES)	Application (Note Facility renovation/construction may trigger “New Source” permit for NPDES)	N/A	1 month	Required if hatchery effluent is discharged to a jurisdictional waterway.
SWRCB Construction General Permit	Application	Stormwater Pollution Prevention Plan (SWPPP)	2 months	Required if construction activities disturb greater than one acre.

Table 7-3. Anticipated Mendocino County Permits and Approvals for Selected Location

Agency and Permit/Approval	Submittal / Document Type	Supporting Documentation	Anticipated Time Frame	Notes
Mendocino County Planning and Building Services	Grading, Building, Electrical, Mechanical, Pumping Applications	Project Summary and Design Package	2 months	N/A

7.2 National Pollutant Discharge Elimination System (NPDES) Permitting

The Coyote Valley Steelhead Facility is classified as a cold water Concentrated Aquatic Animal Production (CAAP) facility and is eligible to operate under General Order R1-2015-0009 issued by the Regional Water Quality Control Board, North Coast (Region 1) and NPDES Permit No. CAG131015.

Wastewater is discharged through Discharge Point 001: Fish Ladder.

The permit identifies suspended solids and settleable solids as potential pollutants from the hatchery. The following limitations for effluent are specified:

- Suspended solids: 8 mg/L (monthly average) and 15 mg/L (daily maximum)

7.3 Water Rights

Water rights documentation can be obtained from the client if requested by an agency.

8.0 Conclusions and Recommendations

This report provides a summary of the state of the Coyote Valley Fish Facility, identifies and quantifies the impacts that the Facility could experience as a result of climate change, and provides proposed facility design modifications to increase the resiliency of the hatchery in conjunction with the associated costs and the potential impacts of the proposed modifications.

The in-depth analysis of the available hydrologic and climatologic data performed by NHC provides projections to forecast changes that may be experienced at the facility. In general, air and water temperatures will rise in the future, but Coyote Valley is operated seasonally starting in late fall until spring minimizing the risk associated with warmer water temperatures. There will be an increasing risk of wildfires at the hatchery as the climate changes by up to 15% by mid-century.

To meet CDFW's goal of continuing to provide recreational fishing opportunities for the public and for the conservation of endangered or threatened species as the climate changes, the resiliency of existing hatcheries will need to be increased. Increasing resiliency will also require updating existing infrastructure that is nearing the end of its effective lifespan.

Some recommendations that would help to achieve this goal include the following:

- Replacing the emergency intake pumps with redundancy and automating the operation of these systems while incorporating backup power systems to maximize reliability.
- Replacing pipes and valves that are leaking, near the end of their effective lifespan, or are currently inoperable due to age.
- Repairing the concrete assets extending the life of these critical assets into the future.
- Expanding adult holding tanks to allow for sorting of natural origin and hatchery origin adults.
- Addressing safety items (i.e., roof, crane) associated with the adult holding/spawning area.

The proposed upgrades to the Coyote Valley Fish Facility would have negligible impacts on the natural resources in the surrounding area. All improvements would occur within currently developed areas, which lessen the permit requirements. The total cost estimate of the proposed design modifications is $3,239,000.

9.0 References

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