Climate Induced Hatchery Upgrades

American River Hatchery

Alternatives Analysis Submittal

Final Report
Revision No. 4

McMillen

January 2025

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Revision Log

Revision No.	Date	Revision Description
0	05/03/2024	65% Draft Internal Technical Review
1	05/26/2024	65% Draft for CDFW Review
2	08/23/2024	100% Draft for CDFW and Internal Technical Review
3	10/31/2024	Final Submittal to CDFW
4	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 Estimates
- Appendix G. Meeting Minutes
- Appendix H. LEED and NZE Evaluations

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).

American River Hatchery has an aging infrastructure and multiple deficiencies that need to be addressed in the near future in order to meet fish production goals. In previous years, water temperatures at the facility have risen too high and resulted in both partial and full evacuations of all fish. Egg incubation and early rearing systems are supplied with chilled water, but chilling capabilities are limited and lead to high operating costs during use. Additionally, the raceway valving system does not allow for individual isolation of raceways; water must constantly flow through all raceways which limits the ability to perform maintenance on the concrete surfaces. Concrete surfaces in the raceways and asphalt surfaces between the raceways are cracking and deteriorating. The effluent drain piping is undersized, and if flow rates are too high, it can lead to effluent water backing up into the raceways. The water supply infrastructure is shared with the Nimbus facility; some valves lack operators, and others do not fully close which makes it difficult to control flow to various hatchery facilities. Predation is a significant issue in the raceways even with existing predator exclusion measures. This impacts survival rates for production fish, but also compounds biosecurity risks. Aquatic invasive species (AIS) have been observed in the American River, and predators could introduce AIS to the hatchery and severely limit fish stocking locations.

The preferred alternatives identified in this report include improvements to the water supply and conveyance infrastructure. This would provide the facility with more flexibility to isolate specific areas of the hatchery for maintenance and repairs. Improved screening at the intake pipe and additional filtration and oxygenation for the water supply is suggested to improve rearing conditions and fish welfare. To manage increasing water temperatures, the production raceways would be replaced with a partial recirculating aquaculture system (PRAS) with circular tanks to reduce the water chilling requirements. The PRAS would be covered with a solid roof and enclosed to improve biosecurity and reduce predation. Other proposed improvements include retrofitting PRAS equipment onto existing circular tanks, relocating Hatchery Building A production into the new PRAS structures, and improving the effluent drainage system. All improvements would include additional low-flow alarms and power upgrades, including emergency generators, required for smooth operation of new equipment and systems.

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 summary). 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. Operationally, CDFW would need to update feeding, harvesting, and water quality monitoring protocols to accommodate the transition to partial recirculating aquaculture systems with circular tanks. The 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.

Project Total	$69,687,000
Photovoltaic – Zero Net Energy	$25,164,000

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 Location Description

The American River Hatchery is located approximately 15 miles east of Sacramento, CA and is adjacent to the Nimbus Hatchery (Figure 1-1).

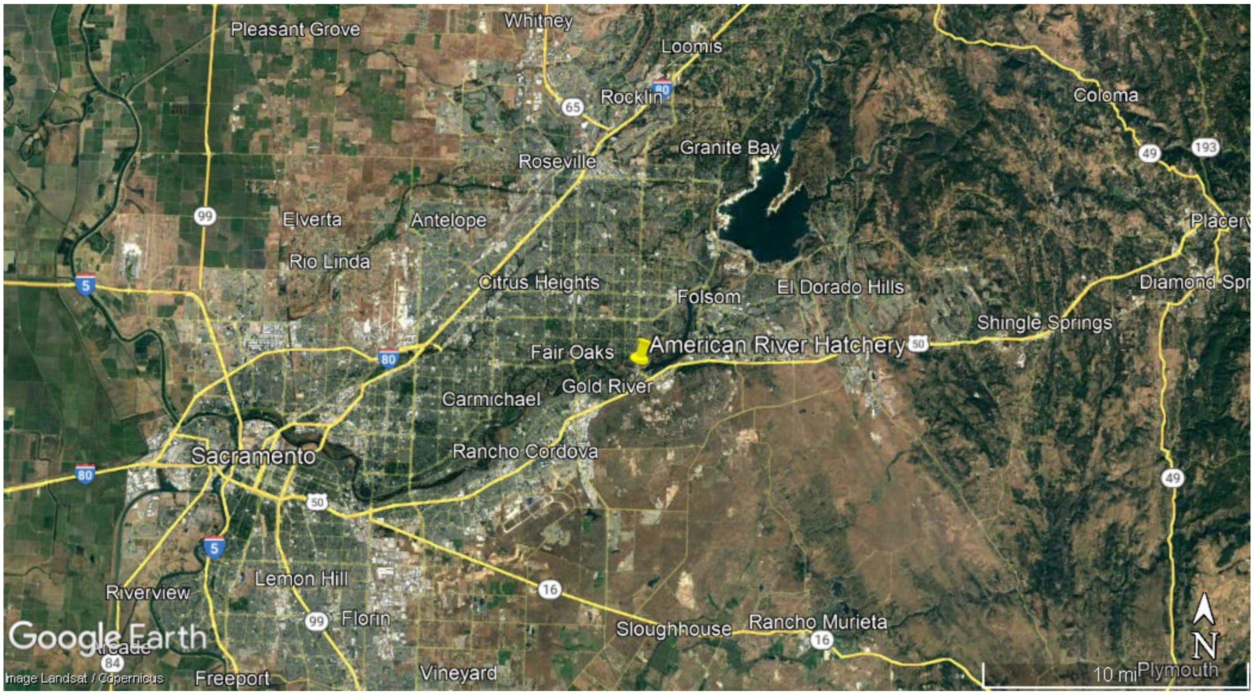

Figure 1-1. American River Hatchery Location Map.

The American River Hatchery was constructed in 1968 to increase angler opportunities throughout Northern California and is comprised of a hatchery building and ten concrete raceways for fish production. In 1978, four additional raceways were added along with two earthen settling ponds to improve water quality downstream of the hatchery in the American River. Additional renovations and modernizations were made in 2013, replacing the old hatchery building with a larger, state-of-the-art hatchery building, doubling egg incubation and early rearing capabilities. The settling ponds were enlarged to handle the increased production.

The hatchery is primarily a flow-through facility operating on gravity-fed water from Lake Natoma. The American River Hatchery raises catchable Rainbow Trout (*Oncorhynchus mykiss*), Brown Trout (*Salmo trutta*), kokanee salmon (*O. nerka*), and Cutthroat Trout (*O. clarkii henshawi*). In addition to raising production Lahontan Cutthroat Trout (LCT), the American River Hatchery also operates an egg take operation at Heenan Lake to collect eggs for itself, Hot Creek, and Fish Springs Hatcheries. Part of the American River Hatchery's Cutthroat Trout production is reserved for supplementing Heenan Lake with adult LCT. The fish that are returned to Heenan Lake are reared in two recirculating aquaculture systems (RASs), and a third RAS module is kept empty to allow American River to accept emergency fish transfers from other CDFW facilities. American River Hatchery receives water directly from Lake Natoma at the Nimbus Dam and shares a water intake with the Nimbus Hatchery, operated by CDFW and funded by the U.S. Bureau of Reclamation (USBR). The general hatchery facilities are shown in Figure 1-2. More detailed descriptions and photos of the American River Hatchery facilities are described in the Site Visit Report (Appendix A).

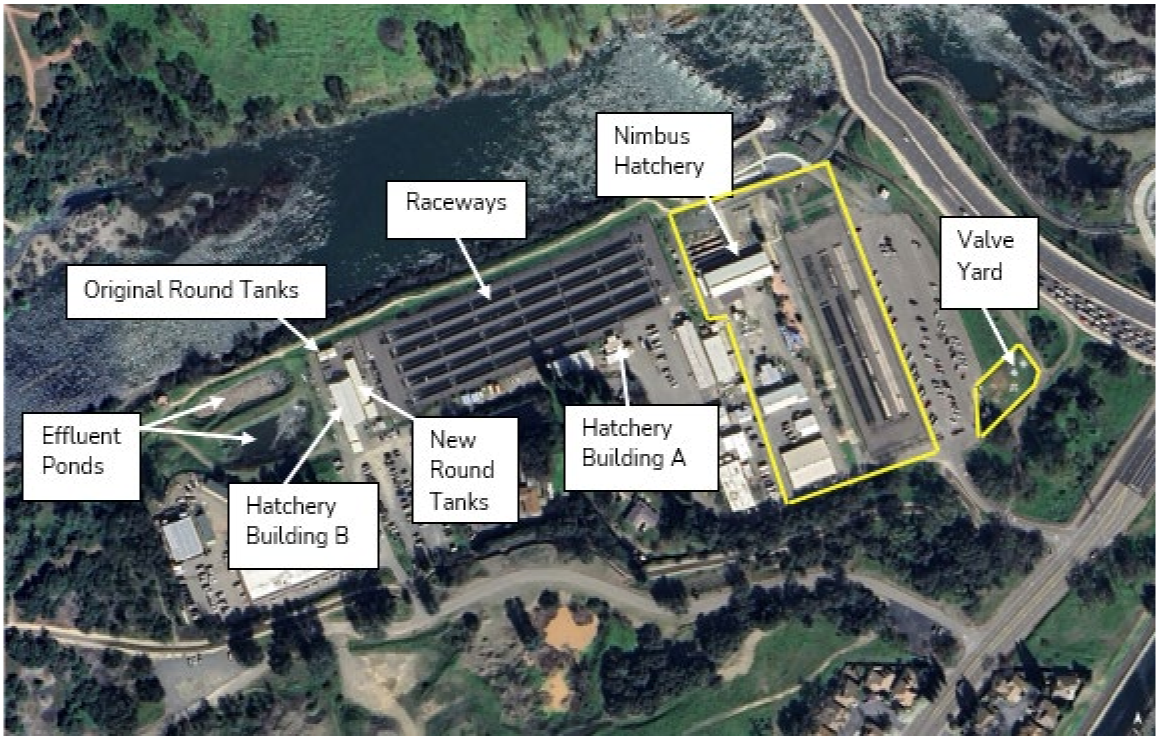

Figure 1-2. American River Hatchery Layout. Google Earth overview.

2.0 Bioprogram

2.1 Production Goals and Existing Capacity

2.1.1 Inland Fisheries

California's hatchery production goal for inland trout is based on sport fishing licenses sold in the previous calendar year. This requirement sets a production goal for CDFW hatcheries to produce and release 2.75 pounds of trout per sport fishing license sold. The requirement stipulates that the majority of released fish be of a catchable size (2 fish per pound) or larger and requires CDFW to achieve this goal in compliance with certain policies, including the Strategic Plan for Trout Management. Currently, CDFW achieves approximately 35% of the required production based on sport fishing license sales. CDFW is also required, to the extent possible, to establish and maintain native wild trout stocks and protect native aquatic and nonaquatic species. CDFW currently utilizes a trout triploid program (sterile trout) to avoid genetic impacts to native trout populations through the stocking program.

The American River Trout Hatchery (ARTH) produces multiple strains of Rainbow Trout, Brown Trout, kokanee salmon, and LCT. 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. The calculations use 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. 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 most recent annual production goal for ARTH was approximately 315,000 pounds of fish. In recent years, issues associated with water temperature and hatchery infrastructure have prevented the facility from reaching production goals; 2012 was the last calendar year where ARTH production exceeded 300,000 pounds, demonstrating almost 10 consecutive years of reduced productivity at this facility. The rearing capacity for each species, determined by the Capacity Bioprogram, are shown in Table 2-1, Table 2-2, and Table 2-3. The total goal for all species is 1,825,010 fish (314,154 lbs). The following are the fish production goals for each fish species:

- Rainbow and Brown trout: 1,086,300 fish (291,034 lbs)
- Kokanee: 420,000 fish (4,200 lbs)

- Lahontan Cutthroat Trout:
  - RAS Modules – Heenan Lake Returns: 3,000 fish (600 lbs)
  - All other rearing units: 318,710 fish (18,920 lbs)

Table 2-1. Rainbow and Brown Trout Production Capacity of Various Rearing Units at the American River Trout Hatchery per the Capacity Bioprogram (Appendix A).

Rearing Unit (max. fish size)	Total Capacity (Fish)[a]	Limiting Factor (Flow or Volume)
Deep Tanks – Early Rearing (400 fpp[b]/1.8 inches)	306,180 (765.5 lbs)	Rearing Volume
Round Tanks – Intermediate Rearing (100 fpp/3.0 inches)	300,591 (3,006 lbs)	Rearing Volume
Raceways – Sub-catchable (10 fpp/6.3 inches)	1,148,345 (114,835 lbs)	Water Flow
Raceways – Catchable (2 fpp/10.8 inches)	393,718 (196,859 lbs)	Water Flow

[a] This is an estimate of 90% production capacity to allow for a buffer in circumstances where more flexibility is needed for hatchery operations.
[b] Fish per pound (fpp).

Table 2-2. Kokanee Production Capacity of Various Rearing Units at the American River Trout Hatchery per the Capacity Bioprogram (Appendix A).

Rearing Unit (max. fish size)	Total Capacity (Fish)[a]	Limiting Factor (Flow or Volume)
Deep Tanks – Early Rearing (100 fpp[b]/3.2 inches)	136,080 (1,361 lbs)	Rearing Volume
Round Tanks – Intermediate/Release Rearing (60 fpp/3.8 inches)	228,449 (3,807 lbs)	Rearing Volume

[a] This is an estimate of 90% production capacity to allow for a buffer in circumstances where more flexibility is needed for hatchery operations.
[b] Fish per pound (fpp).

Table 2-3. Lahontan Cutthroat Trout Capacity of Various Rearing Units at the American River Trout Hatchery per the Capacity Bioprogram (Appendix A).

Rearing Unit (max. fish size)	Total Capacity (Fish)[a]	Limiting Factor (Flow or Volume)
Deep Tanks – Early Rearing (400 fpp[b]/1.9 inches)	323,190 (808 lbs)	Rearing Volume
Round Tanks – Intermediate Rearing (100 fpp/3.1 inches)	310,611 (3,106 lbs)	Rearing Volume
Raceways – Sub-catchable (10 fpp/6.6 inches)	1,398,870 (139,887 lbs)	Water Flow
Round Tanks (chilled) – Catchable (2 fpp/11.2 inches)	7,481 (3,741 lbs)	Rearing Volume
RAS Modules – Heenan Lake Returns (5 fpp/8.3 inches)	3,801 (760 lbs)	Rearing Volume

[a] This is an estimate of 90% production capacity to allow for a buffer in circumstances where more flexibility is needed for hatchery operations.
[b] Fish per pound (fpp).

2.2 Bioprogram Summary

The Capacity Bioprogram in the Site Visit Report (Appendix A) demonstrates the total capacity of each rearing area at the ARTH for several species and stages of production. The capacity of each rearing area (-10% to provide an additional safety factor), limited by water flow or available rearing volume, is shown in Table 2-1 to Table 2-3. At a high level, the total capacity for the ARTH falls short of the production goal shown in Table 2-1 to Table 2-3, though nuances of the timing of egg arrivals, fish stocking, and fish release sizes allow for annual production to exceed this total capacity. 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 the ARTH can be found in Appendix A. For reference, the established criteria are shown in Table 2-4. To model the production cycle schedule for the Production Bioprogram, several assumptions are made and included in Table 2-5. Additional assumptions include the following:

- CDFW will have the ability for Rainbow Trout eggs to be available throughout the year through purchases from private vendors or supply from CDFW photoperiod programs.
- There will be optimal conditions for egg development and fish growth given the existing water temperatures at the facility.

Klontz (1991) provided optimal growth rates for Rainbow and Brown Trout at specific water temperatures. The growth rate is variable based on species, strain, and water temperature (Klontz 1991). CDFW staff provided information about fish release timings to estimate approximate inches gained per month. This guidance was combined with information from ARTH staff about the duration of production cycles for each species. Survival rates were also provided by ARTH staff. Rainbow Trout strains have variable survival rates, and the strains produced at ARTH vary from year to year; an average survival was used to model production for all potential Rainbow Trout strains grown at the facility.

Table 2-4. Criteria Used for the Production Bioprogram. Criteria are Discussed in Detail in Appendix A.

Criteria	Value
Density Index (DI)	0.3
Flow Index (FI)	Chilled Water – 1.50 Raw Water – 1.29
Water Temperature	Chilled Water – 52 to 55°F Raw Water – 55 to over 70°F

Table 2-5. Survival Assumptions Used for the Production Bioprogram.

Species	Survival
Rainbow Trout	Egg-to-fry: Assume 67% (Varied between 42% to 87% depending on strain) Fry-to-catchable (2 fpp): 70%
Brown Trout	Egg-to-fry: 85% Fry-to-catchable (2 fpp): 65%
Kokanee	Egg-to-fry: 75% Fry-to-outplant (100 fpp): 85%
Lahontan Cutthroat Trout	Egg-to-fry: 69% Fry-to-sub-catchable (10 fpp; in raceways): 60% Fry-to-Heenan Lake Return (RAS): 95%

2.2.2 Production Bioprogram

This bioprogram (Appendix B) is meant to view hatchery operations at a high level and does not capture the nuances of specific timing of fish transfers, grading, sorting, or stocking. The model is meant to show an example of how production may occur given the criteria and assumptions outlined in the previous section.

2.2.2.1 Kokanee

Kokanee salmon eggs are collected and shipped to the ARTH as green eggs in October. Current operations consist of incubating more than 1 million eggs to achieve kokanee production goals. This scenario requires hatchery operations to exceed the identified DI and FI criteria or transferring fish to other rearing areas prior to fish reaching the ideal size. Advanced design phases would take the egg incubation requirements into account. For this bioprogram, approximately 168,000 eggs are incubated, which results in 126,000 first feeding fry each 3,300 fpp (1 inch) by the end of November (Table 2-6). Fry are spread among 10 deep tanks in Hatchery Building B, the remaining tanks in the building are reserved for incoming Brown and Rainbow Trout. Kokanee are raised in deep tanks until the middle of February when they reach approximately 400 fpp (2 inches) when about 120,000 fish are transferred to two 15-foot-diameter round tanks. Fish are held in round tanks until they reach approximately 100 fpp (3.2 inches) by the end of May, annual production would provide approximately 106,998 fish (1,070 pounds). However, actual hatchery operations may include earlier releases at smaller sizes depending on environmental conditions of receiving waters which would allow for more fish to be released.

Table 2-6. End of Month Production Information for the Kokanee 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
Nov	Deep Tanks	10	3,300	1.0	126,000	38.2	0.8	0.08	0.11
Dec	Deep Tanks	10	1,200	1.4	122,833	102.4	0.8	0.17	0.17
Jan	Deep Tanks	10	675	1.7	119,666	177.3	0.8	0.23	0.30
Feb	Round Tanks	2	360	2.1	116,499	323.6	0.7	0.13	0.44
Mar	Round Tanks	2	240	2.4	113,332	472.2	0.7	0.16	0.65

Production Stage/Month	Tank Type	Tanks Occupied	fpp	Length (in)	Total Fish (#)	Biomass (lbs)	Max. Flow (cfs)	DI	FI
Apr	Round Tanks	2	150	2.8	110,165	734.4	0.7	0.21	0.77
May	Round Tanks	2	100	3.2	106,998	1,070.0	0.7	0.27[a]	1.11

[a] The rearing area becomes volume-limited at these stages (end of January and end of May).

2.2.2.2 Lahontan Cutthroat Trout

The ARTH operates the annual trap and spawning program for LCT at Heenan Lake. The hatchery is responsible for fish production for recreational opportunities and for maintaining the Heenan Lake broodstock source with quality genetics. This bioprogram assumes eggs are collected in early May, though actual timing is subject to change based on environmental conditions. Approximately 602,900 eggs are collected and incubated at the ARTH, which will produce approximately 416,000 first feeding fry (3,900 fpp, 0.9 inches) by the end of June (Table 2-7). A representative portion of eggs from the spawning population are separated initially and are used to replenish the broodstock population in Heenan Lake known as the Hennan Lake selects.

The first feeding fry will initially be spread into 15 deep tanks at hatch, but by the end of July they will be spread among all 35 deep tanks in Hatchery Building B. LCT are held in the hatchery building until early September when they reach 400 fpp (1.9 inches) and 325,000 fish are transferred to six 15-foot-diameter round tanks. Fish are held in round tanks until they reach 100 fpp (3 inches) in early November. By the end of November, approximately 308,334 fish are split into two raceways. Fish will initially be held in the uppermost 100-foot section of the raceways and given more room as they grow. Approximately 250,000 will reach the sub-catchable size of 10 fpp (6.6 inches) by the end of June. Fish must be stocked out prior to water temperatures increasing to 60°F in the summer; high water temperatures increase risk and mortality associated with the parasite *Nucleospora salmonis.* There are opportunities to stock fish at the fingerling size (100 fpp) as required by CDFW's stocking allotments; however, this was not modeled in order to show the maximum production of sub-catchable fish.

Table 2-7. End of Month Production Information for the Lahontan Cutthroat Trout Production 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
Jun	Deep Tanks	15	3,900	0.9	416,000	106.7	1.2	0.18	0.23
Jul	Deep Tanks	35	1,040	1.4	385,667	370.8	2.7	0.17	0.22

Production Stage/Month	Tank Type	Tanks Occupied	fpp	Length (in)	Total Fish (#)	Biomass (lbs)	Max. Flow (cfs)	DI	FI
Aug	Deep Tanks	35	490	1.8	355,334	725.2	2.7	0.25[a]	0.32
Sep	Round Tanks	6	235	2.3	325,000	1,383.0	2.0	0.16	0.67
Oct	Round Tanks	6	130	2.8	316,667	2,435.9	2.0	0.24[a]	0.97
Nov	Raceways	2	79	3.3	308,334	3,903.0	9.0	0.05	0.30
Dec	Raceways	2	56	3.7	300,000	5,357.1	9.0	0.06	0.36
Jan	Raceways	2	38.5	4.2	291,668	7,575.8	9.0	0.08	0.45
Feb	Raceways	2	27.5	4.7	283,335	10,303.1	9.0	0.09	0.55
Mar	Raceways	2	21.5	5.1	275,000	12,790.7	9.0	0.10	0.62
Apr	Raceways	2	16.3	5.6	266,669	16,360.1	9.0	0.12	0.72
May	Raceways	2	12.5	6.1	258,336	20,666.9	9.0	0.14	0.84
Jun	Raceways	2	10.0	6.6	250,000	25,000.0	9.0	0.16	0.94

[a] The rearing area becomes volume-limited at these stages (end of August and October).

When LCT are transferred from deep tanks to the round tanks in September, the Heenan Lake select group is instead transferred to the RAS modules in Hatchery Building A (Table 2-8). The Heenan Lake selects are maintained in the RAS modules until their release. Approximately 6,315 fish are transferred to six 6-foot-diameter tanks by the end of September. Fish are held until the following June when they reach approximately 10 fpp (6.6 inches) and are released into Heenan Lake. Excess fish from this group may supplement sub-catchable allotments for other receiving waters as needed.

Table 2-8. End of Month Production Information for the Lahontan Cutthroat Trout Heenan Lake Select Bioprogram Including Realized DI and FI Values.

Production Stage/Month	Tank Type	Tanks Occupied	fpp	Length (in)	Total Fish (#)	Biomass (lbs)	Max. Flow (cfs)[a]	DI	FI
Sep	RAS	6	235.0	2.3	6,315	26.9	0.5	0.03	0.05
Oct	RAS	6	130.0	2.8	6,280	48.3	0.5	0.05	0.07
Nov	RAS	6	79.0	3.3	6,245	79.1	0.5	0.07	0.10
Dec	RAS	6	56.0	3.7	6,210	110.9	0.5	0.09	0.12
Jan	RAS	6	38.5	4.2	6,175	160.4	0.5	0.11	0.16
Feb	RAS	6	27.5	4.7	6,140	223.3	0.5	0.14	0.20
Mar	RAS	6	21.5	5.1	6,105	284.0	0.5	0.16	0.23

Production Stage/Month	Tank Type	Tanks Occupied	fpp	Length (in)	Total Fish (#)	Biomass (lbs)	Max. Flow (cfs)[a]	DI	FI
Apr	RAS	6	16.3	5.6	6,070	372.4	0.5	0.20	0.28
May	RAS	6	12.5	6.1	6,035	482.8	0.5	0.23	0.33
Jun	RAS	6	10.0	6.6	6,000	600.0	0.5	0.27[b]	0.38

[a] The RAS modules operate at recirculation rates of 95%; the maximum flow represents the process flow and not the make-up flow requirement which is approximately 5 gpm.

[b] The rearing area becomes volume-limited at these stages (end of January and end of May).

2.2.2.3 Brown Trout

Brown Trout eggs typically arrive as eyed eggs in late November or early December. For this bioprogram it is assumed that fry will be ready to feed at the end of December at approximately 3,400 fpp (0.9 inches). Approximately 327,882 eggs will be incubated and result in 278,700 first feeding fry (Table 2-9). Early rearing occupies 25 deep tanks in Hatchery Building B until fish reach 400 fpp (1.8 inches) in early February; approximately 218,700 fish will be transferred to four 15-foot-diameter round tanks by the end of February. In early April, fish reach 100 fpp (2.9 inches) and are stocked into two raceways. At this time, 30,000 fingerlings will be stocked out and approximately 178,700 fish will remain in the raceways. Brown Trout will initially be held in the uppermost 100-foot sections of the raceways but will be given more space downstream as needed throughout the production cycle. Fish reach 10 fpp (6.3 inches) in September; 50,000 sub-catchable Brown Trout will be stocked out. By the end of September, approximately 117,225 fish will remain in the raceways. At the end of the following April, approximately 101,250 fish will reach a catchable size (2 fpp, 10.8 inches) and be stocked out. Variations in growth rates and feed rates within the population will allow for earlier or later stocking, provided the FI remains under 1.29 in the raceways.

Table 2-9. End of Month Production Information for the Brown Trout 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
Dec	Deep Tanks	25	3,400	0.9	278,700	82.0	1.9	0.08	0.10
Jan	Deep Tanks	25	740	1.5	248,700	336.1	1.9	0.20	0.25
Feb	Round Tanks	4	270	2.1	218,700	810.0	1.3	0.15	0.63
Mar	Round Tanks	4	113	2.8	208,700	1,846.9	1.3	0.27	1.12
Apr	Raceways	2	63	3.4	178,700	2,836.5	9.0	0.03	0.21
May	Raceways	2	39	4.0	176,405	4,523.2	9.0	0.05	0.28

Production Stage/Month	Tank Type	Tanks Occupied	fpp	Length (in)	Total Fish (#)	Biomass (lbs)	Max. Flow (cfs)	DI	FI
Jun	Raceways	2	25.6	4.6	174,110	6,801.2	9.0	0.06	0.36
Jul	Raceways	2	17.7	5.2	171,815	9,707.1	9.0	0.08	0.46
Aug	Raceways	2	12.1	5.9	169,520	14,009.9	9.0	0.10	0.59
Sep	Raceways	2	9.1	6.5	117,225	12,881.9	9.0	0.08	0.49
Oct	Raceways	2	6.9	7.1	114,930	16,656.5	9.0	0.10	0.58
Nov	Raceways	2	5.4	7.7	112,635	20,858.3	9.0	0.11	0.67
Dec	Raceways	2	4.3	8.3	110,340	25,660.5	9.0	0.13	0.76
Jan	Raceways	2	3.4	9.0	108,045	31,777.9	9.0	0.15	0.88
Feb	Raceways	2	2.8	9.6	105,750	37,767.9	9.0	0.16	0.98
Mar	Raceways	2	2.3	10.2	103,455	44,980.4	9.0	0.18	1.09
Apr	Raceways	2	2.0	10.8	101,250	50,625.0	9.0	0.20	1.16[a]

[a] Some fish must be stocked out in order for the Brown Trout population to remain under the FI criteria of 1.29.

2.2.2.4 Rainbow Trout Pulse 1

Rainbow Trout eggs typically arrive at the ARTH shortly after Brown Trout eggs. In this bioprogram it is assumed that eggs arrive in late January or early February and fish are ready to feed by the end of February. Approximately 500,000 eggs are incubated and result in 337,430 first feeding fry at the end of February (Table 2-10). The first feeding fry are spread among all 35 deep tanks in Hatchery Building B until 306,180 fish reach 400 fpp (1.8 inches) by the end of March and are transferred to six 15-foot-diameter round tanks. Fish reach 100 fpp (2.9 inches) in early May and 25,000 are stocked out as fingerlings. By the end of May fish reach 76 fpp (3.2 inches) and 243,679 are transferred to three raceways. Rainbow Trout are initially held at the uppermost 100-foot sections and are eventually provided the full length of the raceway as they grow. In early October, fish reach approximately 10 fpp (6.3 inches) and 60,000 fish are stocked out as sub-catchable allotments, leaving 155,685 total Rainbow Trout spread among the three raceways. The remaining fish will reach the target catchable size of 2 fpp (10.8 inches) by the end of March, and 151,875 fish will be stocked out.

Table 2-10. End of Month Production Information for the Rainbow Trout Pulse 1 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
Feb	Deep Tanks	35	3,400	0.9	337,430	99.2	2.7	0.07	0.09
Mar	Deep Tanks	35	400	1.8	306,180	765.5	2.7	0.27[a]	0.35
Apr	Round Tanks	6	180	2.4	275,930	1,532.9	2.0	0.17	0.70
May	Round Tanks	6	76	3.2	243,679	3,206.3	2.0	0.27[a]	1.12
Jun	Raceways	3	42	3.9	217,929	5,188.8	13.5	0.04	0.22
Jul	Raceways	3	24	4.7	217,181	9,049.2	13.5	0.05	0.32
Aug	Raceways	3	15	5.5	216,433	14,428.9	13.5	0.07	0.44
Sep	Raceways	3	10.4	6.2	215,685	20,738.9	13.5	0.09	0.55
Oct	Raceways	3	7.2	7.0	155,685	21,622.9	13.5	0.09	0.51
Nov	Raceways	3	5.4	7.7	154,923	28,689.4	13.5	0.10	0.61
Dec	Raceways	3	4.0	8.5	154,161	38,540.3	13.5	0.13	0.75
Jan	Raceways	3	3.1	9.3	153,399	49,483.5	13.5	0.15	0.88
Feb	Raceways	3	2.5	10.0	152,637	61,054.8	13.5	0.17	1.01
Mar	Raceways	3	2.0	10.8	151,875	75,937.5	13.5	0.20	1.16[b]

[a] The rearing area becomes volume-limited at these stages (end of March and May).

[b] Some fish must be stocked out in order for the Rainbow Trout population to remain under the FI criteria of 1.29.

2.2.2.5 Rainbow Trout Pulse 2

For this bioprogram, it is assumed that survival and growth rates for each Rainbow Pulse are identical. For the Pulse 2 Rainbow Trout, eggs arrive in late August or early September, and fry are ready to feed by the end of September. Approximately 440,000 eggs are incubated and result in 294,800 first feeding fry at the end of September (Table 2-11). The first feeding fry are spread among all 30 deep tanks in Hatchery Building B, the remaining 5 tanks are reserved for kokanee egg incubation in October. Approximately 262,440 fish reach 400 fpp (1.8 inches) by the end of October and are transferred to six 15-foot-diameter round tanks. Fish reach 100 fpp (2.9 inches) in early December and 20,000 are stocked out as fingerlings. By the end of December fish reach 76 fpp (3.2 inches) and 207,924 are transferred to three raceways. Rainbow Trout are initially held at the uppermost 100-foot sections and are eventually provided the full length of the raceway as they grow. In early May, fish reach approximately 10 fpp (6.3 inches) and 35,000 fish are stocked out as sub-catchable allotments, leaving 162,144 total Rainbow Trout spread among the three raceways at the end of May. The remaining fish will reach the target catchable size of 2 fpp (10.8 inches) by the end of October, and 151,875 fish will be stocked out.

Table 2-11. End of Month Production Information for the Rainbow Trout Pulse 2 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
Sep	Deep Tanks	30	3,400	0.9	294,800	86.7	2.3	0.07	0.09
Oct	Deep Tanks	30	400	1.8	262,440	656.1	2.3	0.27[a]	0.35
Nov	Round Tanks	6	180	2.4	230,080	1,278.2	2.0	0.14	0.59
Dec	Round Tanks	6	76	3.2	207,924	2,735.8	2.0	0.23[a]	0.96
Jan	Raceways	3	42	3.9	205,768	4,899.2	13.5	0.03	0.21
Feb	Raceways	3	24	4.7	203,612	8,483.8	13.5	0.05	0.30
Mar	Raceways	3	15	5.5	201,456	13,430.4	13.5	0.07	0.41
Apr	Raceways	3	10.4	6.2	199,300	19,163.5	13.5	0.09	0.51
May	Raceways	3	7.2	7.0	162,144	22,520.0	13.5	0.09	0.53
Jun	Raceways	3	5.4	7.7	159,988	29,627.4	13.5	0.11	0.63
Jul	Raceways	3	4.0	8.5	157,832	39,458.0	13.5	0.13	0.77
Aug	Raceways	3	3.1	9.3	155,676	50,218.1	13.5	0.15	0.90
Sep	Raceways	3	2.5	10.0	153,520	61,408.0	13.5	0.17	1.01
Oct	Raceways	3	2.0	10.8	151,875	75,937.5	13.5	0.20	1.16[b]

[a] The rearing area becomes volume-limited at these stages (end of October and December).

[b] Some fish must be stocked out in order for the Rainbow Trout population to remain under the FI criteria of 1.29.

2.2.2.6 Summary

The bioprogram uses existing infrastructure and scheduling for kokanee and LCT egg availability to demonstrate the potential production scenario while maintaining the established criteria. Annual production results are shown in Table 2-12. CDFW may choose to alter the fish stocking strategies to provide different sized release groups, such as stocking fingerling LCT or stocking more/fewer Rainbow Trout fingerlings or sub-catchables, at their discretion. The bioprogram models the production and release of 987,998 fish, and 244,420 pounds of fish each year. This falls short of the facility's goals, but maintains the established criteria outlined in Section 2.2.1.

Table 2-12. Annual Production of Fish and Pounds for Each Species and Release Size Group.

Species	Fingerlings (100 fpp) Released: Fish	Fingerlings (100 fpp) Released: Pounds	Sub-catchables (10 fpp) Released: Fish	Sub-catchables (10 fpp) Released: Pounds	Catchables (2 fpp) Released: Fish	Catchables (2 fpp) Released: Pounds
Kokanee	106,998	1,067	NA	NA	NA	NA
Lahontan Cutthroat Trout	NA	NA	256,000	25,600	NA	NA
Brown Trout	30,000	300	50,000	5,000	101,250	50,625
Rainbow Trout Pulse 1	25,000	250	60,000	6,000	151,875	75,937.5
Rainbow Trout Pulse 2	20,000	200	35,000	3,500	151,875	75,937.5
Total	**181,998**	**1,820**	**401,000**	**40,100**	**405,000**	**202,500**

Stocking occurs throughout the year; limited overlap among fish groups in the raceways also provides opportunities for staff to hold fish longer in order to stock later if desired. The current design of the raceways does not allow for isolation and dewatering of a single raceway, so the bioprogram assumes that water is flowing through them year-round. Space in Hatchery Building B is limited; in April of each year there is a short period to completely dewater the building and perform necessary equipment maintenance (Figure 2-1). The maximum flow demand for this bioprogram occurs in February and March (49.7 cubic feet per second [cfs]), when nearly all deep tanks, round tanks, and raceways are occupied. The lowest water demand occurs in April, May, and November (34.2 cfs) after large cohorts of fish are expected to be released and some raceways are being prepared for next year's cohort. Water flow for the RAS tanks was not included in the maximum flow requirements because the make-up water requirements is expected to be less than 10 gpm (as denoted by [a] and highlighted in red in Figure 2-1). Note that the different colored blocks in the following figure correspond to the months for when each species (kokanee, Cutthroat Trout, Brown and Rainbow trout) is in either the deep or round tanks or in the raceways, along with noting when eggs are received and incubated.

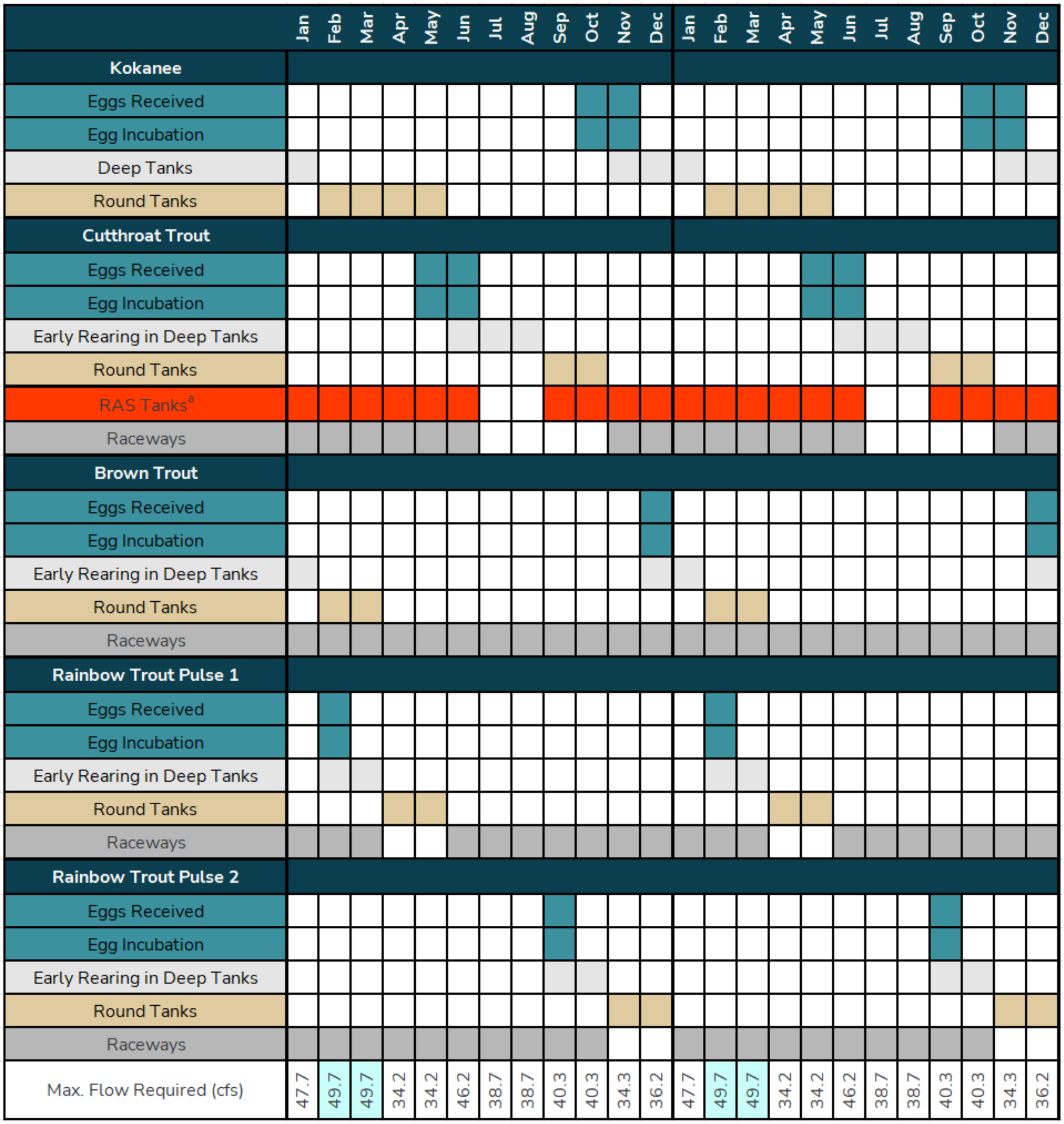

Figure 2-1. Production Rearing Schedule Over 2 Years with Peak Water Demand Occurring Annually in February and March (as highlighted in the Max Flow Required row).

3.0 Climate Evaluation

This section presents projections of air temperature and wildfire risk for the hatchery site.

The ARTH falls within California's Central Valley Project, a complex network of dams, reservoirs, canals, and other water resource facilities. The network is tightly controlled based on the domestic water and power needs of the Sacramento and San Francisco Bay population centers. Due to the complexity of the system and the significant level of influence that the U.S. Bureau of Reclamation (USBR) and other water control agencies have on operations and management, effects of future climate change will depend not only on the seasonal hydrologic response of the American River watershed but also on future water demand and especially on management decisions such as user allocations, which cannot be anticipated in this work. For these reasons, CDFW directed NHC to forgo a climate evaluation for this facility during the Central Valley Water Temperature and Flow Control Meeting held on May 30, 2023.

Other sources available that provide insight on the conditions of the Central Valley Project in the context of climate change are reported every five years by the California Department of Water Resources in their California Water Plan Update Future Scenarios Analysis, with 2023 as the most recent update (CDWR, 2023). Additional resources include California Climate Change Assessments, with reports specific to California's Central Valley water system (Schwarz et al., 2018).

3.1 Introduction

In this section, projections of air temperature conditions at the hatchery site are presented for the next 20 years (2024-2043) and the following 20 years (2044-2063) and will be compared against the reference period (1984-2003). 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. Projections of wildfire risk are also presented.

3.2 Methodology for Projecting Air Temperature

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 2014). The projections in this report are based on results from 10 different global climate models under the Representative Concentration Pathway (RCP) 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 (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

The methodology used for obtaining projections of air temperature, which is summarized in Figure 3-1, was 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 used for other California fish hatchery studies were based on 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.

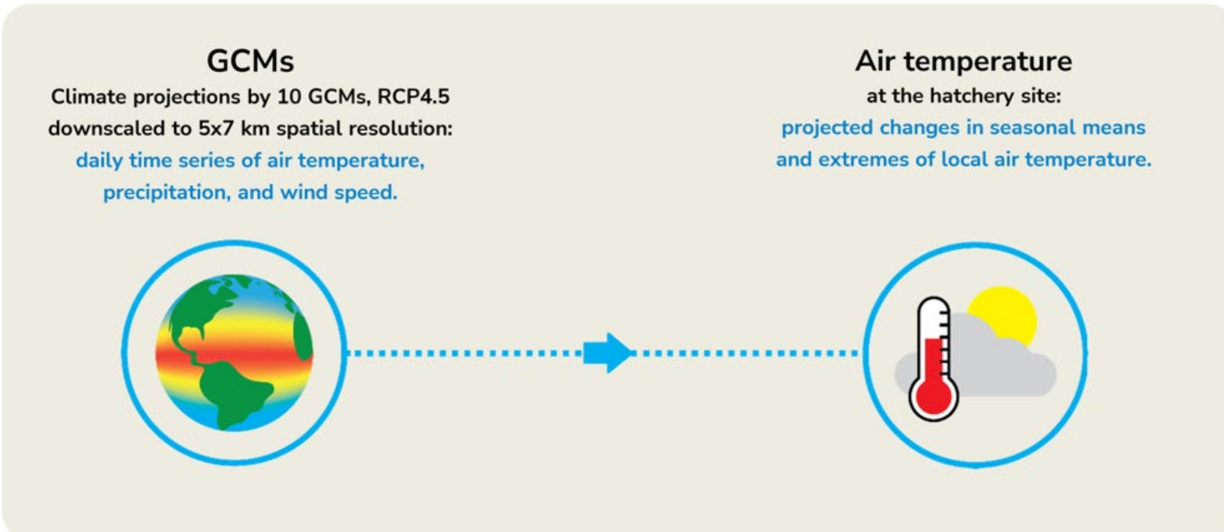

Figure 3-1. Methodology for Obtaining Air Temperature Projections.

3.3 Uncertainty and Limitations

It is important to acknowledge the large and unquantifiable uncertainty associated with these and any climate projections. The projections of air temperature presented here 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 air temperature over this hatchery area 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.

3.4 Projected Changes in Air Temperature at the Hatchery Site

Figure 3-2 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, while the historical period has lower minima.

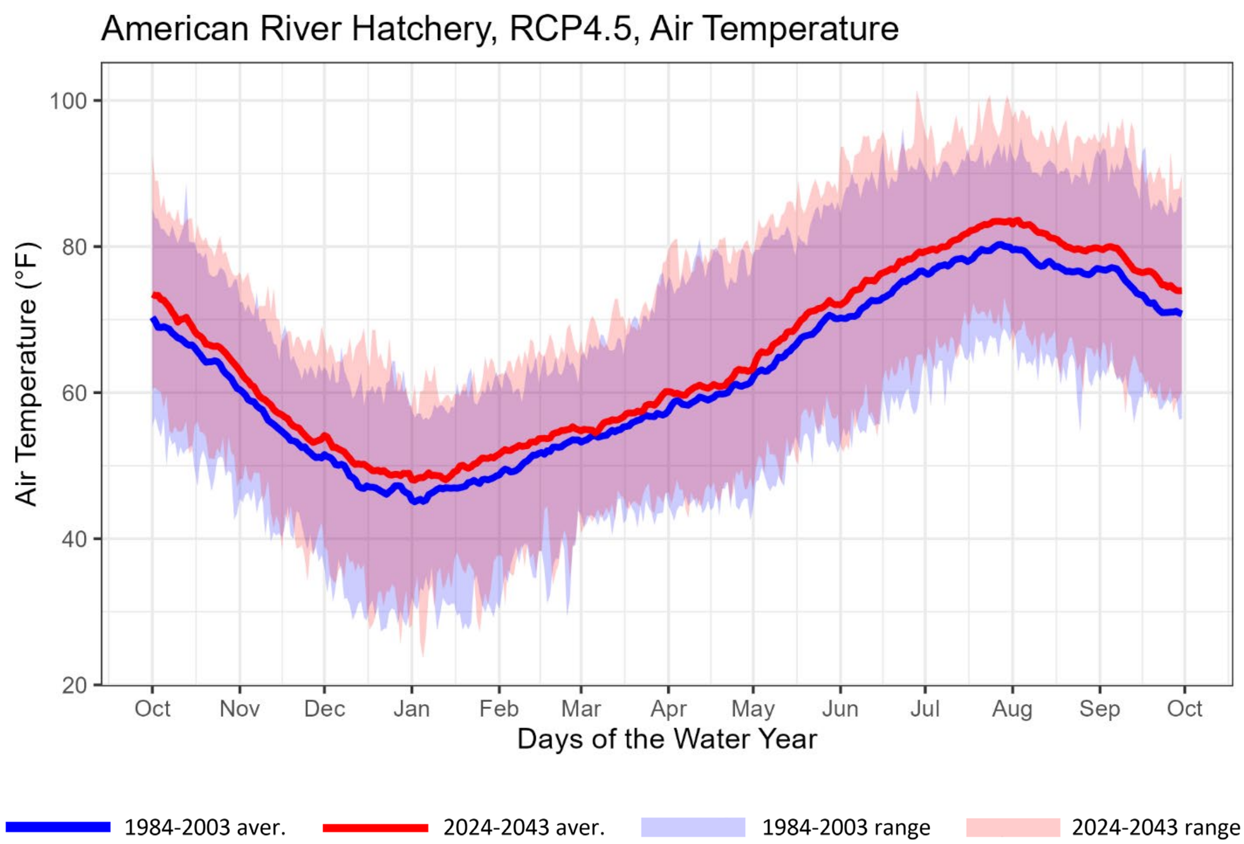

Figure 3-2. Mean Daily Air Temperature and Range for Each Day of the Water Year.

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 3-2, and are given in Table 3-4 and Table 3-5.

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

GCM	Annual	Winter (DJF)	Spring (MAM)	Summ. (JJA)	Fall (SON)
Ensemble mean	65.7°F (+2.5°F)	51.7°F (+2.4°F)	63.2°F (+1.8°F)	79.8°F (+3.2°F)	68.0°F (+2.7°F)
Lowest	65.3°F (+2.1°F)	50.7°F (+1.4°F)	62.7°F (+1.3°F)	78.6°F (+2.0°F)	66.8°F (+1.5°F)
Highest	66.4°F (+3.2°F)	52.5°F (+3.2°F)	64.1°F (+2.7°F)	81.0°F (+4.4°F)	68.9°F (+3.6°F)

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

GCM	Annual	Winter (DJF)	Spring (MAM)	Summ. (JJA)	Fall (SON)
Ensemble mean	66.8°F (+3.6°F)	52.8°F (+3.5°F)	64.3°F (+2.9°F)	81.1°F (+4.5°F)	68.9°F (+3.6°F)
Lowest	66.3°F (+3.1°F)	51.9°F (+2.6°F)	63.7°F (+2.3°F)	79.4°F (+2.8°F)	67.6°F (+2.3°F)
Highest	67.5°F (+4.3°F)	54.0°F (+4.7°F)	65.1°F (+3.7°F)	82.5°F (+5.9°F)	69.9°F (+4.6°F)

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.

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

GCM	3rd perc.	25th perc.	50th perc.	75th perc.	97th perc.
Ensemble mean	52.5°F (+2.3°F)	63.8°F (+2.0°F)	77.2°F (+2.1°F)	92.1°F (+3.1°F)	105.2°F (+3.4°F)
Lowest	51.5°F (+1.3°F)	63.3°F (+1.5°F)	76.8°F (+1.7°F)	91.0°F (+2.0°F)	103.6°F (+1.8°F)
Highest	54.4°F (+4.2°F)	64.2°F (+2.4°F)	78.0°F (+2.9°F)	93.1°F (+4.1°F)	107.3°F (+5.5°F)

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

GCM	3rd perc.	25th perc.	50th perc.	75th perc.	97th perc.
Ensemble mean	54.0°F (+3.8°F)	64.8°F (+3.0°F)	78.3°F (+3.2°F)	93.2°F (+4.2°F)	106.3°F (+4.5°F)
Lowest	52.6°F (+2.4°F)	64.1°F (+2.3°F)	77.9°F (+2.8°F)	92.0°F (+3.0°F)	104.5°F (+2.7°F)
Highest	55.8°F (+5.6°F)	65.7°F (+3.9°F)	79.2°F (+4.1°F)	94.5°F (+5.5°F)	107.5°F (+5.7°F)

At the hatchery site, mean annual air temperature is projected to rise by 2.5°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 (Table 3-2, Table 3-3, and Figure 3-2) and the highest temperature rises are projected to occur in the hottest days (Table 3-4 and Table 3-5). Days with maximum daytime temperatures representing the 75th percentile (i.e., the upper quartile of temperatures) are projected to warm by 3.4°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, 4.5°F, reaching 106.3°F. These projected temperatures represent potentially hazardous outdoor working conditions at the hatchery.

3.5 Fire Risk

Historical wildfires have been documented within the watershed perimeter, and less frequently in the local vicinity of the hatchery, as mapped in Figure 3-3. Most of the watershed area has not burned within the past century and therefore has relatively large amounts of fuel stores. While smaller, more frequent fires are more common in the watershed, large wildfires are possible and have occurred in the upper basin, including the 2021 Caldor Fire (Figure 3-3). Landcover in the basin consists primarily of evergreen forest with some grassland, with anticipated fuel recovery rates ranging from 2 to 5 years in grasslands to more than 10 years in the uplands (depending on the type).

Expressing wildfire risk as a percent chance of occurring at least once in a decade (Westerling, 2018), the projected wildfire risk at the hatchery site is approximately 6% through mid-century (Figure 3-3). Across the uplands, the projected fire risk is higher, with local zones increasing to 50% towards the end of this century.

The primary risks to the hatchery operations include infrastructure impacts from local fires, as well as reservoir impacts from fires in the upper basin. Because the hatchery relies on intake from Nimbus Dam, the hatchery is shielded from most flooding and debris that can impact hatcheries along running rivers, except for catastrophic dam failures. Wildfires can impact reservoirs by increasing runoff and turbidity along burn scars. Turbidity was listed as an existing maintenance concern, with dredging required around pipes. Watersheds are most sensitive to flooding and suspended sediment impacts in the first five to ten years after the fire, or the time it takes for new vegetation to mature. The largest risks to the hatchery are therefore increased turbidity following wildfires in the basin, as well as localized fire-related infrastructure hazards to the hatchery itself.

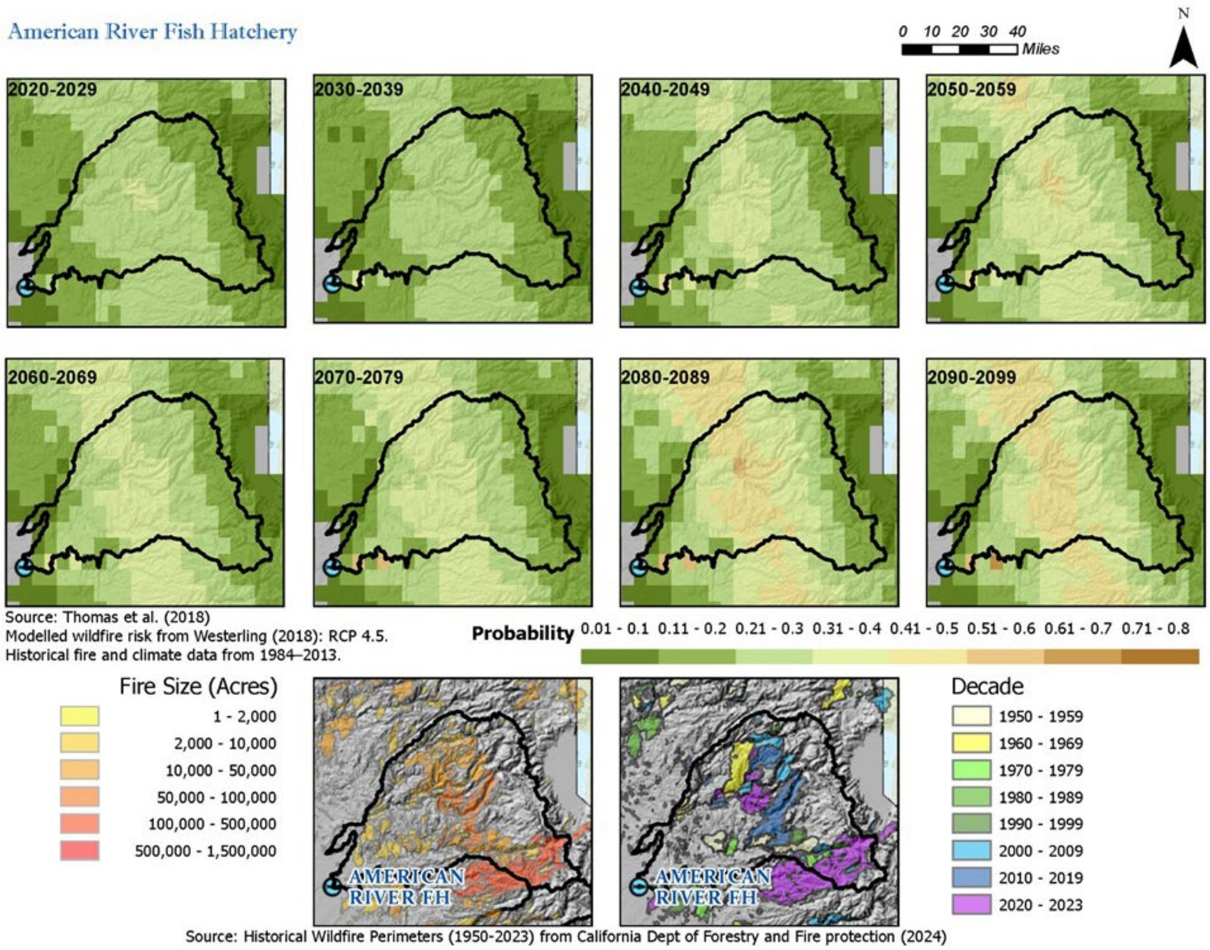

Figure 3-3. Wildfire Risks as Probability of Future Occurrence, and Known Historical Fire.

3.6 Conclusions

The climate change evaluation for the Hatchery location was restricted to projections of air temperature and wildfire risk, given instructions by CDFW that streamflow or water temperature evaluations were not requested for this hatchery.

The projected increases in seasonal means and extremes are among the highest of all California hatcheries studied. Mean annual air temperature is projected to rise by 2.5°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.

The distribution of daily air temperatures will change, and the upper end of this distribution is of most interest. Therefore, we looked at changes in the 75th and 97th percentiles of the daily temperature distribution and found that the 75th percentile will increase by 3.1°F and the 97th percentile will increase by 3.4°F in the next 20 years, relative to the reference period.

According to gridded air temperatures for the reference period (1984-2003), the 75th and 97th percentiles of peak daytime temperature (i.e., the temperature at the hottest time of day) were 89.0°F and 101.8°F. For the near-future period (2024-2043), these percentiles are projected to rise to 92.1°F and 105.2°F, respectively. Such an increase in the peak air daytime temperature requires adaptation measures for the protection of hatchery 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.

The hatchery is at moderate risk of wildfires. The projected chance of at least one wildfire occurring in a 10-year period at the hatchery site is estimated as 6% through mid-century. Most of the watershed has not burned in over a decade, meaning that fuel stores are relatively large in a watershed prone to wildfires. Post-fire conditions also pose risks to the hatchery, including scar-induced flooding, turbidity, and debris.

4.0 Existing Infrastructure Deficiencies

While the American River Hatchery is an operational facility, multiple 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 available to address specific deficiencies that would allow the hatchery to meet production goals and provide protection against climate change. The main areas of concern for the hatchery included a water supply system in a state of general disrepair with leaking structures and broken valving, high turbidity water supply during wintertime, insufficient rearing space for desired production, inadequate alarm systems, low dissolved oxygen (DO) in lower raceway sections, limited water diversion control in the raceways, inadequate predator exclusion, and a compromised effluent system. Biosecurity deficiencies and potential solutions for addressing these concerns were identified in Sections 3.0 and 3.2 of the Site Visit Report, respectively. The details of these deficiencies are further expanded upon in Sections 4.1 and 4.2.

4.1 Water Process Infrastructure

4.1.1 Water Supply and Conveyance System

ARTH has shared water intake infrastructure with the adjacent Nimbus Hatchery. The mitigator for the Nimbus Hatchery, the U.S. Bureau of Reclamation (USBR), is responsible for maintaining this infrastructure. The intake pipes are located at Nimbus Dam and are operating as intended, though regular maintenance and dredging around the pipes has not been performed recently. The terminal structure was recently upgraded and can now effectively regulate water levels to maintain constant head pressure to hatchery facilities. Previously, fluctuations of water levels in Lake Natoma would regularly result in the terminal structure overflowing and flooding adjacent areas, or reduced flow rates for hatchery systems when the water level would fall.

The valve yard contains a variety of valves that are used to divert water to specific rearing areas at Nimbus and ARTH facilities. Valve 13 (Site Visit Report, Figure 4-1) supplies the entire ARTH. Current operations require the valve to be kept partially open to limit flows into the facility to limit effluent water backing up into the raceways. Valve 13 is unable to be closed entirely, which prevents ARTH from completely drying out the facility. Valve 14 isolates the water main that supplies the hatchery buildings and intermediate rearing systems at ARTH; this valve is always open and has no operator to change its position. Valve 15 allows for water to be supplied to the ARTH directly from the terminal structure, though this is always in the closed position. Additionally, staff at ARTH have observed a fine, dark sediment that collects in their rearing tanks and elevated turbidity occurs during storm periods. It is suspected that this impacts the rearing environment quality for young fish in the early rearing areas of the hatchery.

4.1.2 Alarm Deficiencies

During the site visit, ARTH expressed the importance of the alarm system installed in Hatchery Building B which has saved an estimated millions of fish. However, there are no additional alarm systems for other rearing areas including the newly built round tank system adjacent to Hatchery Building B.

4.1.3 Chilled Water Capacity

As described in the Climate Evaluation section, California's Central Valley is expected to experience increasing air and water temperatures into the future. Dangerously high water temperatures at ARTH have already negatively impacted hatchery operations and overall production. Elevated water temperatures caused ARTH to evacuate fish in 2014, 2015, and 2021. These evacuations severely limited trout stocking in CDFW's region 2 during those years. Evacuations also affect the production cycles in the following years, since it typically takes two years for fish to reach a catchable size which make-up the majority of ARTH's production quotas.

In response to elevated water temperatures, the facility has added chilling capacity for all its indoor rearing. A chilling system treats water for Hatchery Building B and two large circular tanks; these systems are used for early rearing for all species and catchable LCT production, respectively. The chilling system uses a split-loop design to pre-chill incoming water with the chilled effluent. This design increases energy efficiency, but still operates as a flow-through system. In Hatchery Building A, the RAS modules operate with over 90% recirculation, significantly lowering the chilling demand but at the expense of additional pumping requirements. During the site visit, chilled water for Hatchery Building B was identified as a major cost and an obstacle to adding more chilled water for other rearing areas.

4.1.4 Oxygenation Equipment

Currently, water enters the raceway near saturation without any additional aeration or oxygenation included in the water supply. However, as densities and water temperatures increase, the hatchery can experience low dissolved oxygen levels as water leaves the raceways. To supplement oxygen, staff install floating aerators in the raceways to provide some mechanical aeration. Floating aerators are less efficient compared to technology that supplements pure oxygen into the rearing area.

According to CDFW hatchery staff, the American River and Nimbus Hatcheries have experienced seasonally low DO concentrations in incoming water supply, between July and November. While the USBR can bypass water from the Folsom Powerhouse to increase DO levels, this draws from a cold-water supply that must be reserved for October when it is needed for adult holding and Nimbus fall-run Chinook spawning operations.

4.2 Rearing Infrastructure

4.2.1 Rearing Capacity

From January through March, many of the rearing areas at the ARTH are in-use and near capacity; eggs begin to arrive, so the hatchery has small fish as well as catchable fish that have yet to be stocked out. The commissioning of a new round tank system has helped alleviate this. Delaying the ponding of juvenile fish into larger raceway systems allows for more control and high-quality care for early life stages. However, the hatchery still needs additional early rearing space because egg availability is limited to only a few months in the beginning of the year. Alternatively, expanding Rainbow Trout egg availability would provide more flexibility and better rearing conditions at the ARTH. Additionally, other CDFW hatcheries have experienced issues with emerging diseases, primarily Lactococcosis (causative agent *Lactococcus* spp.), which now requires fish to be vaccinated at specific sizes prior to being stocked into raceways. The CDFW Fish Pathology Department may expand vaccination to other hatcheries not yet affected by *Lactococcus* spp., such as ARTH, or climate change may result in the emergence of new diseases that require similar changes to fish care.

4.2.2 Raceway Deficiencies

The raceways at the ARTH have several issues preventing optimal production. The major deficiencies will each be discussed in their own section. Ultimately, these issues combined with the climate change impacts identified in Section 3.0 support removing the current raceways and rebuilding the production rearing system.

4.2.2.1 Valving

The raceways at ARTH share a common supply line and headbox structure that does not allow for isolation of individual raceways. Therefore, the system only functions with all raceways in operation, or none. This severely impacts the ability of ARTH to perform preventative or even reactionary maintenance, particularly because fish occupy at least some raceways year-round. Adding new valving to the raceways has been considered by CDFW, though because of the headbox design, only one raceway could be shut down at a time before water would begin to overflow due to a lack of available freeboard. To allow all raceways to be operated individually, the entire headbox and water conveyance system supplying it would have to be replaced.

4.2.2.2 Concrete and Asphalt Deterioration

The concrete along the top of each raceway wall is serviceable but deteriorates as it approaches the water line. There is significant pitting on the surface and exposed aggregate; this can affect fish health by increasing abrasion injuries and also makes surfaces more difficult for staff to clean. This could become a major problem if a new harmful pathogen is found at ARTH that requires extensive cleaning and disinfection. This could result in complete depopulation because of the inability for ARTH to operate raceways in isolation. Additionally, asphalt around the raceways is cracked and deteriorating in some areas. The asphalt is not a significant issue currently but is cause for concern because of major issues at the nearby Nimbus Hatchery which is experiencing major sinkholes requiring significant operational changes including early fish releases and limiting use of available raceways.

4.2.2.3 Predator Exclusion

Staff at ARTH noted that there is some predation in the outdoor raceways even though they are enclosed in chain-link fence and covered with bird netting. The total number of fish lost to predators impacts the overall production of the facility, but the potential for transmitting pathogens or aquatic invasive species (AIS) is a major cause for concern. Predators at ARTH include birds and animals that frequent the American River, which is positive for New Zealand mudsnail (NZMS; *Potamopyrgus antipodarum*). If NZMS were to be introduced into rearing areas at ARTH, it would significantly impact the potential waters that could be stocked with fish from the facility. As the only trout hatchery in CDFW’s North Central Region, ARTH’s contamination with NZMS would result in an increased burden on other CDFW hatcheries to stock trout waters in the region.

4.2.2.4 Effluent Drainage

A new effluent drain system for the raceways was installed in 2006/2007. The design of the effluent pipe used a maximum flow rate of 3.5 cfs per raceway, but more recent measurements with better equipment found that approximately 4.5 cfs of water was flowing through the raceways. This has resulted in an undersized pipe that backs water up into the raceways when flows to the facility are high enough, which occurs regularly. Staff at ARTH lose rearing space because of the effluent water in the lower sections of raceways.

As shown in Table 4-1 below, full pipe flows are ~3 cfs less than the open channel flow maximums for the same roughness coefficients. Additional head above full pipe is needed to regain/establish the previous open channel flow maximum, the amount varies by surface roughness. During short periods of time in which actual flows exceed the required flows (50 cfs), if the full pipe flow capacity is greater than the required flow then the pipe will return to open channel flow condition after the event. However, for the rougher pipes, above .012 this means that the open channel flow will not re-establish itself until the pipe flows drop to about 90% of the open channel maximum flow.

Table 4-1. Maximum Flow Estimates Dependent on Friction Coefficients.

Open Channel Maximum (94% Full) Coefficient	Open Channel Maximum (94% Full) Flow Rate (cfs)	Full Pipe Maximum (100% Full) Coefficient	Full Pipe Maximum (100% Full) Flow Rate (cfs)
0.011	57.20	0.011	53.17
0.012	52.43	0.012	48.74
0.013	48.40	0.013	44.99
0.014	44.94	0.014	41.78
0.015	41.95	0.015	38.99
0.016	39.32	0.016	36.56
0.017	37.01	0.017	34.41

The maximum discharge rate that would be required by the rearing ponds is approximately 50 cfs. To achieve this, assuming an optimized partial full channel (~94% full), the 42-inch reinforced concrete pipe (RCP) pipe would need to have a Manning roughness coefficient of approximately .0126. To add some context, a very smooth concrete finish is .011. The real coefficient is likely closer to the .016 – .017 range, as these are values for rough jointed concrete. It is possible that over time the walls have eroded causing their roughness coefficient to increase dropping the available rate of discharge through the pipe. Additionally, when rearing ponds are attempting to discharge so much water that the pipe is full, the additional friction losses decrease the capacity even further. It is a combination of too much being discharged at one time and deteriorating pipe wall surface that are the likely cause of the discharge pipe backing up.

4.2.3 Hatchery Building A

Hatchery Building A is exclusively used for the Heenan Lake LCT special release program. Fish are raised in three RAS modules which recently received upgraded biofilters and high efficiency pumps. However, the plumbing in the building is very old and showing signs of wear. The water supply and conveyance for the RAS modules should be upgraded. Additionally, there is only room for one RAS module inside the building; two are located outside in an open-air space covered by a metal roof and enclosed in chain-link fence. Fully enclosing this rearing area will increase protection for the fish and RAS equipment.

4.2.4 Old Round Tank System

There are two round tanks on a concrete pad under a metal awning. These are typically used to raise catchable LCT because the tanks are supplied with chilled water. The chilled water is tied to Hatchery Building B's chilled water supply and both systems are flow-through. During the site visit staff mentioned that the expense of chilling enough water for production limits their production of sensitive species such as LCT.

5.0 Alternative Selected

5.1 Alternative Description

During the site visit and through meetings with hatchery staff, several deficiencies were identified that currently limit the hatchery's ability to meet fish production goals. These deficiencies have been summarized in Section 4.0 of this report. Appendix E – Alternatives Development Technical Memorandum (TM) 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.

5.1.1 Intake System Upgrades

5.1.1.1 Intake Structure Investigation

To maintain the existing intake structures in the reservoir, we propose an investigation and cleaning or dredging of the intakes in the reservoir. Dive teams were typically used to clean out this area in the past, but this preventative maintenance and assessment has not been performed in recent years. The status of debris, silt, or sediment accumulating near the intake pipes is unknown. To ensure that all infrastructure will remain operational for the next 30 years, a more thorough investigation of the intakes is necessary and may require manual cleaning to remove sediment. This would improve water quality at the hatchery, providing better rearing conditions for fish.

5.1.1.2 42-Inch Intake Screening

An automatic traveling screen is proposed for the older 42-inch intake pipe to complete the redundancy of having multiple intake sources. The new 60-inch intake pipe is fitted with a traveling screen to reduce debris entering the hatchery. The entrance to the old 42-inch intake pipe used to be manually cleaned by a dive team, but this preventative maintenance does not occur now that the new 60-inch intake is regularly used. The ARTH operates the 42-inch intake to provide additional head pressure to drive the water supply to all ARTH systems. Adding a traveling screen would allow CDFW to use the old intake system without concern for introducing debris into the hatchery. This would provide flexibility to maintain the infrastructure associated with the 60-inch intake in the reservoir and valve yard, while maintaining a water supply free of large debris.

5.1.1.3 Valve Yard Improvements

The existing valve yard has knife gate valves that have had the leaf removed, along with others that do not work effectively or are unable to completely close. The supply piping is also aging causing corrosion and increased head losses to the hatcheries. The proposed alternative is meant to add operational control to water flow for the ARTH. The proposed alternative would separate the water supplies for ARTH and Nimbus. It would require a scheduled shutdown in which all the knife gate valves can be replaced (as shown in Appendix C, FIG 3). By strategically closing valves ARTH would be able to be supplied completely off the 42-inch intake pipe allowing for each hatchery to operate independently. This would bypass the terminal structure and all of the supply water will flow through the existing 30-inch and 32-inch welded steel pipe (WSP) to a new head tank distribution box near the PRAS systems (as shown in Appendix C, FIG 1).

5.1.1.4 Construct Headbox

The ARTH operates without a level control structure. The proposed improvements include constructing a headbox that would control water flow to all rearing areas through the hatchery. The headbox would be located south of the existing raceways, west of the existing Hatchery Building A. The entire water supply to the ARTH would be conveyed through this headbox. Water would be directed to one of 10 outfalls, each serving a production area with one overflow going straight to the effluent ponds.

5.1.2 Replace Raceways with Circular PRAS Tanks

The raceways will be replaced with PRAS modules enclosed with a solid roof structure and chain-link fencing for improved biosecurity. Each PRAS module will include a sump, pumps, mechanical chiller, filtration, UV disinfection, and oxygenation to maintain optimal water quality for rearing. Additionally, low-flow alarms would be installed for each module to avoid catastrophic losses associated with malfunctioning equipment. Each PRAS module will include eight (8) 20-foot-diameter tanks with wall heights of 7 feet and water depths of 6 feet with a rearing volume of 1,885 ft^3.

Required flows for each module are based on a hydraulic residence time (HRT) of 45 minutes, based on recommendations for large tanks (Timmons et al., 2018). A process flow rate of 325 gpm is required for each tank, or 2,600 gpm (5.8 cfs) for a module. It is recommended that CDFW begin operations with a 50% recirculation rate until staff familiarize themselves with the system and equipment; the recirculation rate may be operated up to 75% without requiring a biofilter to process nitrogen accumulation. At a 50% recirculation, the fresh make-up water requirement would be 1,300 gpm (2.9 cfs) for each module. At a 75% recirculation rate, the fresh make-up water requirement would be 650 gpm (1.5 cfs) for each module. The PRAS equipment would be sized to recirculate and recondition a flow rate of 1,950 gpm (4.3 cfs).

Ultimately, the preferred alternatives are to build seven (7) new identical PRAS modules, or 56 total tanks. Each module would be designed for a specific species production program to replace the production potential of the raceways and maintain the modeled production in Section 2.2.2. The total make-up flow requirement, while operating at a 75% recirculation rate, would be 10.5 cfs; operating at a 50% recirculation the make-up flow requirement would be 20.3 cfs.

All tanks would be accessible by a drive lane to allow fish stocking trucks direct access to each tank. The space allotted for PRAS equipment will also be designed to allow for expansion, including the potential addition of a biofilter or other equipment in the future. All oxygen would be generated on site for this improvement. During advanced design phases, bulk liquid oxygen (LOX) would be evaluated as a potential alternative to determine what, if any, cost savings may be available. Each PRAS module would include a 200-ton chiller, capable of reducing the water temperature by approximately 3.5°F at 50% reuse, and 7°F at 75% reuse.

5.1.2.1 Lahontan Cutthroat Trout System

The proposed alternative for LCT production requires a single PRAS module (8 tanks) to produce 250,000 sub-catchable fish modeled in Section 2.2.2.2. A single PRAS module provides 15,080 ft^3 of rearing volume, which would result in a DI below 0.3. The total freshwater make-up flow requirement for the module would be 1.5 cfs at a recirculation rate of 75% (2.9 cfs if operating at a recirculation rate of 50%).

5.1.2.2 Brown Trout System

The proposed alternative is for two PRAS modules for Brown Trout (16 tanks), providing 30,160 ft^3 of rearing volume. To produce the 152,000 Brown Trout modeled in Section 2.2.2.3, only nine (9) 20-foot-diameter circular tanks are required. Extra tanks are proposed to provide operational flexibility to produce more Brown, Rainbow, or LCT as desired. Maintaining identically sized PRAS modules for all systems also creates a simpler production system for the entire facility. Backup parts and equipment may be shared among the PRAS modules as needed, reducing the required storage space for unique parts only required for a single system. The freshwater make-up flow requirement for this system is 3 cfs at a recirculation rate of 75% (5.8 cfs if operating at a recirculation rate of 50%).

5.1.2.3 Rainbow Trout System

The proposed alternative includes four RAS modules for Rainbow Trout (32 tanks), providing 60,318 ft^3 of rearing volume to accommodate 304,000 catchable Rainbow Trout below a DI of 0.3. Based on the bioprogram in Section 2.2.2, two modules would be reserved for each pulse of Rainbow Trout. The total freshwater make-up flow requirement for the entire Rainbow Trout system (four modules) would be 6 cfs while operating at a recirculation rate of 75% (11.6 cfs if operating at a 50% recirculation rate).

5.1.2.4 Summary

A summary of the proposed rearing systems is shown in Table 5-1. The summary does not account for additional stocking of fingerling or sub-catchable allotments that may occur before or during the period fish are reared in the PRAS modules.

Table 5-1. Summary of Proposed Rearing Systems Using PRAS.

System	Number of Modules	Fresh Make-up Flow Requirement (cfs) 50% Recirculation Rate	Fresh Make-up Flow Requirement (cfs) 75% Recirculation Rate	Total System Capacity at Maximum DI of 0.3
Lahontan Cutthroat Trout	1	2.9	1.5	268,719 fish at 10 fpp (6.6 inches) 26,872 pounds
Brown Trout	2	5.8	3	175,888 fish at 2 fpp (10.8 inches) 87,944.5 pounds
Rainbow Trout	4	11.6	6	351,770 fish at 2 fpp (10.8 inches) 175,889 pounds
Total	**7**	**20.3**	**10.5**	**290,705.5 pounds (Variable sizes at release not shown)**

5.1.3 Viewing Raceways

To maintain public engagement at the hatchery, a smaller pair of raceways would be built as part of a public viewing area. More advanced design phases may include interpretive or information signs, feeding areas, a walking path to the public entrance of the facility, or other forms of engagement. The viewing raceways would provide a setting for the public to better understand CDFW hatchery operations, while maintaining a secure and controlled environment for the PRAS modules and production fish at the facility.

The raceways would be 100 feet long by 10 feet wide with a wall height of 4.5 feet, positioned side by side. The flow rate for the raceways will be determined during future design phases based on CDFW's preferences. The primary intent for these raceways is not additional intensive production, but CDFW may choose to operate them as they see fit to achieve the hatchery program goals. There is no water chilling equipment proposed for this production area.

5.1.4 Hatchery Building A Upgrades

As part of the raceway upgrades, the proposed alternative would relocate the three RAS modules used for Heenan Lake LCT special releases under a smaller covered structure near the proposed PRAS modules. The structure would include walls to isolate the Heenan Lake select group from other trout production and maintain biosecurity. The existing equipment would be reused and reassembled in the new production area as much as feasible. All plumbing would be inspected and upgraded for the new production area as required. Low-flow alarms would also be incorporated into this rearing system to avoid catastrophic losses for this important group of fish.

5.1.5 Hatchery Building B Effluent Upgrade

Water from Hatchery Building B could be filtered and used as partial make-up water for the new round tank system. This would efficiently reuse water that is already chilled and use for egg incubation and early rearing. The water reconditioning equipment would be associated with PRAS retrofit to the existing round tank system adjacent to Hatchery Building B, discussed in Section 5.1.6.

5.1.6 New Round Tank System PRAS Retrofit

The preferred alternative to improve operation of the new round tank system is to retrofit recirculation equipment to allow its operation as a PRAS. PRAS equipment would include pumps, chilling, degassing, and oxygenation. The tanks currently have filtration and UV disinfection equipment installed. The PRAS equipment would be designed to recirculate up to 75% of the process water for more efficient chilling capabilities. Currently, the system requires 900 gpm of water flow. PRAS equipment would be sized to recondition and recirculate up to 675 gpm (1.5 cfs) with a make-up water requirement of 225 gpm (0.5 cfs). Alternatively, the PRAS may operate at 50% reuse, with 450 gpm (1 cfs) of both make-up and recirculated water. Equipment would include a 75-ton chiller, capable of reducing water temperatures by 3.5°F at 50% reuse and by 7°F at 75% reuse.

5.1.7 Effluent System Upgrade

The existing pipe discussed above in Section 4.2.2.4 that conveys hatchery wastewater to the settling ponds will be removed and replaced as part of the raceway system upgrades. The new pipe would be sized large enough to allow for flow-through operation of the PRAS tanks (40.6 cfs) if necessary, even though water reuse will significantly decrease the amount of effluent water discharged from the rearing areas. The pipe will be sized to operate under open channel flow to prevent the pipe from being the control point for system flows.

5.2 Pros/Cons of Selected Alternative

Table 5-2 provides a high-level summary of the pros and cons for American River Hatchery's selected alternative.

Table 5-2. Pros/Cons of Selected Alternative – American River Hatchery.

Description	Pros	Cons
Investigate and clean or dredge the intake structure.	• Improves water supply redundancy. • Identifies other necessary improvements preemptively.	• May increase costs as there are unknown factors that may require major construction.
Add an automatic traveling screen to the 42-inch supply pipe intake.	• Reduces sediment and debris in water supply. • Improves water supply redundancy.	• Increases operating costs. • Requires regular inspection and maintenance.
Improve the valve yard.	• Increases flexibility of water conveyance significantly. • Repairs buried infrastructure, ensuring reliable operation for 30+ years. • Provides opportunity to assess and upgrade Nimbus Hatchery infrastructure as well.	• Increases capital cost. • May require dewatering of ARTH. • May disrupt operations at the Nimbus Hatchery.
Construct a headbox.	• Allows for constant head pressure throughout facility. • Provides flow control for each rearing area.	• Increases initial cost of construction.

Description	Pros	Cons
Replace raceways with circular PRAS tanks, includes a solid roof structure and chain-link fencing.	• Increases efficiency for water use. • Provides protection against predators and increases biosecurity. • Maintains optimal rearing conditions during environmental changes, which avoids fish evacuations.	• Increases energy demand and operating costs significantly. • Increases cost significantly due to construction. • Disrupts production during construction. • May need multiple backup generators to provide power to all proposed equipment. • May require staff training because of the more complex rearing systems.
Construct viewing raceways.	• Maintains public engagement. • Maintains biosecurity of other production systems.	• Increases construction cost. • Requires additional equipment that would not be used for PRASs.
Relocate Hatchery Building A production.	• Improves biosecurity by completely enclosing systems. • Provides structure that will last 40+ years of production.	• Increases construction costs slightly due to moving systems. • May disrupt production.
Retrofit the new round tank system to PRAS.	• Increases efficiency for water use. • Provides optimal rearing conditions during environmental changes, which avoids fish evacuations. • Takes advantage of chilled water in Hatchery Building B.	• Increases operating costs. • Has a limited space for equipment.
Upgrade the effluent system.	• Allows for facility's entire water right to be used. • Provides an opportunity for other proposed subgrade work to access discharge piping.	• Is a lower priority if other reuse technology is implemented.

5.3 Alternatives for Short-Term Improvements

In the event that funding is not available to construct the preferred alternative, the following short-term improvements are recommended for continued hatchery operation.

5.3.1 Raceway Upgrades

5.3.1.1 Valving Improvements

Currently, the raceways share a common headbox system which requires constant water flowing to supply the raceways. The existing design does not allow for each raceway, or each pair of raceways, to be isolated and dewatered. The proposed short-term improvement would add flow control structures and valving that water passes through to enter the raceway. This would allow CDFW to shut water off to individual raceways. The design of the head system would only allow a single raceway to be closed at a time; if multiple valves are closed there is a risk of overflowing the headbox and flooding the asphalt around the raceways.

5.3.1.2 Concrete Refurbishment for Raceways

The concrete in the raceways is showing signs of aging after 40 years of service. The underlying aggregate in the floor and walls of the raceways is exposed due to wear, which creates an abrasive surface that can be harmful to fish as well as a surface that promotes algae growth. The rough aggregate is difficult for hatchery staff to clean efficiently. Adding a skim coating to the concrete can help alleviate the present issues and reduce the rate at which the concrete surface deteriorates. Over the skim coat, additional products can be applied such as an epoxy-based paint resulting in a smooth surface further protecting the raceway and improving overall tank hygiene as excess feed and fish waste slide more easily toward the tail end of the raceway. Raceway coatings are typically epoxy, polyurethane, or mortar based, but they all serve the same general purpose. Prior to coating the raceways, they must be emptied, cleaned, and completely dried. Additionally, any large cracks or significant damage in the existing concrete will need to be repaired prior to coating. After applying, the coating will need to cure which can take anywhere from 1-14 days depending on the manufacturer's instructions and base component of the coat. Depending on factors such as weather and sun exposure, raceway coatings can last anywhere from 5-15 years. Applying a coat to the concrete creates a surface that is easier to clean, does not promote algae growth, and reduces sun and water exposure to the aging concrete underneath.

5.3.1.3 Add a Roof Structure to the Raceways

Covering the raceways with a roof eliminates direct sunlight and reduces the rate at which the water in the raceways warms, provides protection from avian predation, reduces risk of sunburn on the fish, and allows for a structure that is more easily enclosed to reduce predation. A photovoltaic system (solar panels) can also be incorporated above the shade structure to offset some of the power demands associated with new hatchery equipment.

5.3.1.4 PRAS Installation

The short-term alternative would be to install the PRAS equipment for 4 out of 10 raceways. Space around the raceways is limited due to necessary drive lanes for feeding and stocking operations. Outfitting the four southernmost raceways with PRAS equipment would include filtration, UV disinfection, oxygenation, and most importantly chilling. This alternative would provide the ARTH a means to maintain some fish on station when water temperatures are forecasted to rise above suitable levels for trout culture. Chilling all raceways as a flow-through system would incur unreasonable operational costs. With this proposed improvement, large fish would be released, and the hatchery would focus on maintaining sub-catchable stocks in the four chilled raceways. To avoid excessive operational costs, the PRAS would only be used when water temperatures are expected to increase to dangerous levels; during other periods, the raceways may operate in their existing flow-through state.

Each raceway receives a maximum of 5 cfs of water flow, or 20 cfs of total flow for four raceways. The PRAS equipment would be designed to operate during emergencies only when water temperatures become dangerously high for salmonids. It is assumed that raceway flows would be decreased to 4 cfs per raceway, for a total flow of 16 cfs. The PRAS equipment would be designed to recirculate and recondition 50% to 75% of the water flow. The chilling equipment would treat the fresh make-up water and would be sized to reduce the temperature of the incoming water by 3.5°F when operating on 50% reuse and by 7°F when operating on 75% reuse. This would provide chilling to account for periods when the source water temperature exceeds 70°F. This would require three (3) 200-ton chilling units to meet the chilling requirements. It is recommended that this is operated as a ‘life support’ system, to allow the hatchery to maintain some stocks of fish in which significant time and money have already been invested. Operating the raceway PRAS as a production system with high densities and feed rates while source water temperatures are elevated could lead to catastrophic losses if equipment were to malfunction or environmental conditions are altered (i.e., further warming of the source water).

5.3.1.5 Effluent Piping Upgrade

As part of the modifications to the raceway headbox and PRAS upgrade, the drainage piping for the raceways will also be modified. This could be accomplished by replacing the existing 42-inch pipe (as described in Section 5.1.7) or by installing an additional effluent pipe to convey wastewater more efficiently to the settling ponds.

5.3.2 Hatchery Building A Improvements

A proposed short-term alternative is to preventatively replace the plumbing in Hatchery Building A. Upgrading the existing PVC plumbing supply lines for the RAS modules would reduce the risk of catastrophic failure in the near future while ensuring the systems remains operational for another 15+ years.

5.4 Natural Environment Impacts

The proposed upgrades to the American River Hatchery 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 American River Hatchery will change the existing infrastructure and the number of rigid structures on site. This will increase the size of defensible areas that staff must maintain to protect infrastructure against potential fire danger. Future fire risk was not evaluated for this hatchery, but the urban setting suggests that wildfires would be relatively rare. However, the added complexity and pieces of equipment required to operate PRASs present more potential failure points if a fire were to encroach on the hatchery grounds. If fire risk increases due to the proximity of an active fire, special care should be taken to ensure the oxygen generation and/or distribution system is protected and free from leaks.

The Nimbus and American River Hatcheries were not included in the climate change evaluation per CDFW direction since the reservoirs along the American River are heavily managed and do not represent a natural system. Management of the water system will have a more direct impact on the conditions of the hatcheries' water supply relative to climate change. The American River Hatchery will continue to be at some level of risk of flooding in the future given their proximity to the American River and its upstream dams. The recommended changes will slightly increase the total impervious surface of the site, this will be addressed with an improved stormwater drain plan throughout the facility.

Additionally, upgrading the intake system, replacing valves and piping will provide the hatchery with better flow control into the facility. The hatchery staff will be able to manage flow and prevent flooding associated with the water intake and distribution infrastructure.

5.4.2 Effluent Discharge

The recommended changes to the hatchery do not include an overall increase in production goals at the American River Hatchery. This will ensure there will be no change to the NPDES permit requirements. The effluent system will be improved by installing a new pipe to carry effluent water from the production area to the settling ponds. The upsized pipe will prevent any backflow of effluent water to the production systems, reducing stagnant water in the pipe that could potentially promote growth of harmful microorganisms.

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 even a modest increase in waste load (fish biomass) due to increased rearing flexibility provided by 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

The production schedule will continue with multiple groups of Rainbow Trout being reared throughout the year. Brown Trout, Lahontan Cutthroat and kokanee production will continue to vary somewhat from year to year depending upon spawning timing and the resultant egg availability. The ability to chill water during the late summer and early fall will allow the hatchery to sustain fish production when water temperatures in Lake Natoma become dangerously high.

The deep tanks will continue to serve as the early rearing tanks for all fish species and the circular tanks will serve as an intermediate rearing area as space is limiting in the deep tanks. The hatchery will continue utilizing their current fish culture practices for early and intermediate rearing; however, as the circular tanks are converted to PRAS, fish culture practices will transition to those outlined in Sections 5.5.1 and 5.5.2.

As the fish transition into their final rearing tanks, each species (i.e., Rainbow Trout, Brown Trout, Lahontan Cutthroat) of fish will be transferred to their respective PRAS circular tanks to maintain biosecurity. Use of a small fish pump (e.g., 2.5-inch hose diameter) to transfer fish to the PRAS tanks will significantly reduce the handling stress and staff labor required. However, the distance to some grow-out tanks may require fish to be pumped into a truck for transport. If enumeration of the fish is desired, a fish counter may be utilized in conjunction with the fish pump. Once fish have been transferred to the circular tanks, they will be grown to their target release size at which time they will maximize the biomass and DI capacity of the system. Truck loading for fish release will basically continue as the hatchery has previously operated, using fish pumps and dewatering towers with a few minor adjustments unique to circular tanks relative to traditional raceways.

5.5.1 PRAS Circular Tank Operations

The final rearing tanks will operate as PRAS systems reusing 50 to 75% of their water flow. The hydraulic self-cleaning characteristics of the circular tanks will reduce labor associated with tank cleaning. Additional tank sweeper systems are also available and can further reduce staff labor associated with maintaining tank hygiene. Staff time will be required for monitoring PRAS components including routine water quality checks, flow adjustments, and monitoring LHO and CO_2 systems to ensure a high-quality rearing environment. Staff will make routine flow adjustments as fish grow to maintain a maximum velocity of approximately 2 body lengths/second (BL/s; or as required for fisheries management objectives). Seine nets, clamshell crowders or other crowder types can be used to concentrate fish for collection and handling.

Transfer of fish between tanks and for truck loading will utilize fish pumps and hosing to minimize handling and stress on the fish and decrease physical labor for staff transferring fish between tanks or loading trucks. For transferring fish into other rearing tanks requiring enumeration, a fish counter can be included at the receiving tank to obtain an accurate inventory of the fish. For fish being loaded onto a transport tanker for stocking, a dewatering tower will allow for the removal of the water through a screen prior to the fish entering the fish transport tanker. This is consistent with current hatchery practices as well as industry standards and practices and allows the hatchery to quantify fish biomass based on water displacement in the fish transport tanker. The return of the water from the dewatering tower to the PRAS module sump will be necessary to maintain the water balance within the PRAS module. Another option is to increase the fresh make-up water flow to compensate for this water loss in the module during the fish pumping process.

5.5.2 PRAS Equipment

The PRAS provides tremendous benefits in reducing the water flow requirements to produce large numbers/biomass of fish while maximizing water quality. However, these systems are more complex and require additional skillsets to monitor and maintain the equipment to ensure reliable system operations for successful fish production. As fish cohorts are cycled through PRAS modules, staff must schedule time for cleaning and disinfection as well as preventative and routine maintenance on the equipment. All PRASs should be programmed into the facilities maintenance and management system to schedule, perform, and document preventative and corrective maintenance.

5.5.3 Feeding

Early rearing feeding techniques in the deep tanks can continue using the hatchery's standard feeding practices. Hatchery staff will need to transition away from the blower style feeding systems typically used for linear raceways to a feeding system designed for circular tanks. Fish can be fed in circular tanks utilizing the simplest of methods ranging from hand-feeding to automated systems and the techniques may vary depending on the size of the circular tanks and staff preferences. In addition to staff preferences, there are pros and cons associated with the various feeding options. Hand-feeding requires more staff time compared to automated feeding systems as it is labor intensive but allows staff to observe fish feeding and overall behavior and health. Hand-feeding allows the staff to feed the fish to satiation and minimizes overfeeding reducing wasted feed and maximizing water quality. Automated systems require an initial cost for the purchase and installation of the system. The automated feeding systems provide feed intermittently throughout the day, including staff non-duty times, to maximize growth. Automatic feeder systems reduce staff labor but as a result reduce the mandatory time spent observing fish; feeders also require routine adjustment and maintenance to ensure the correct amount of feed is distributed and all feeders work as intended. It should be noted that hand and automatic feeding systems are not mutually exclusive. Even with automatic feeding systems, culture operations should still involve regular monitoring of fish and their feeding response throughout the day.

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 American River Hatchery reported several disease concerns at the facility. This included columnaris disease (causative agent *Flavobacterium columnare* and other *Flavobacterium* spp.), bacterial coldwater disease (causative agent *Flavobacterium psychrophilum*), Infectious Hematopoietic Necrosis Virus (IHNv), fungus (*Saprolegnia* spp.) and a variety of parasites associated with the surface water supply. The most likely pathways for pathogens to enter the American River Hatchery and spread through the facility is through the incoming water supply or environmental exposure within the hatchery.

5.6.1 Incoming Water Supply

The American River Hatchery currently has limited measures to prevent pathogens from entering the facility. However, the recommended alternatives improve biosecurity by extending the use of UV treated water to the grow-out PRASs as well as the hatchery building and intermediate round tank system. These additions would reduce the pathogen loads and potential for disease and/or parasite outbreaks at the hatchery.

5.6.2 Environmental Exposure/Bio Vectors

The existing facility has several areas that are potential pathways for pathogens due to environmental exposure. The existing concrete raceways are enclosed by perimeter fencing with bird wires overtop, but these structures are minimally effective in excluding otters, raccoons, and avian predators from accessing the raceways. The recommended alternatives reduce the risk of pathogens entering the rearing areas by reducing environmental exposure. Implementing PRAS in covered structures will limit potential pathogen vectors, such as birds, otters, etc., from entering the rearing vessels. Predators can be a significant source of stress and may transmit pathogens or aquatic invasive species into the production areas at the hatchery. The proposed upgrades will result in a much more secure rearing area capable to excluding nearly all predators.

5.7 Water Quality Impacts

The recommended alternatives will improve the water quality within the existing rearing vessels. Treatment of the incoming water will result in higher quality water at the start of the culture process, leading to cleaner water in the effluent relative to current conditions. The addition of chilling capability throughout the hatchery will provide water temperatures within a healthy range for the fish minimizing stress and the potential for fish health issues. Replacing the existing concrete raceways with dual-drain circular tanks can improve the water quality of the rearing environment. Dual-drain circular tanks provide a completely mixed environment as opposed to a raceway that has a gradient of high to low dissolved oxygen (DO) along its length. This characteristic of circular tanks makes the entire tank volume available to the fish, instead of fish crowding at a raceway's head end, thereby not using the entire raceway volume. The dual-drain system in circular tanks aids in waste removal, allowing for more effective removal of solid waste and uneaten feed. This can contribute to better overall water quality in the rearing vessels.

The other PRAS equipment will also improve the water quality within the system. The microscreen drum filters will remove the solids in the water. The LHOs will ensure the dissolved oxygen levels enter the tanks at saturation or higher. The carbon dioxide strippers will remove dissolved carbon dioxide as well as other undesirable gases, and the UV unit will reduce the pathogen load of the water that returns to the tanks. Additionally, installing a rigid roof structure with bird netting will reduce heat gain during the summer months and algae growth in the rearing tanks.

Each PRAS module will concentrate the fish waste into smaller flows prior to the water entering the settling ponds. This will reduce the volume of water the settling ponds are handling but increase the concentration of biological waste. Water will still percolate through the ground into the American River, but staff may have to increase the frequency of effluent pond cleanings in response to the more concentrated waste streams. Ultimately, the proposed upgrades should have little to no impact on the water quality discharged into the American River.

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 our 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. 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 the 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 a 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. 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.
- Site geotechnical properties have not been evaluated but are assumed to be good for construction of the hatchery.
- A facility condition assessment was performed for the American River Hatchery in 2022 by Terracon (Terracon Consultants, Inc., 2022). The assessment included an inventory of all facilities and equipment, code evaluations, and upgrades required to meet the assessment including the detailed replacement value. The cost of all work items generated was $820,741 in 2022 dollars. The work items identified in the Terracon facility condition assessment are not included in this report, costs, or evaluation of facilities. Some work items from the Terracon facility condition assessment may be resolved as part of the proposed upgrades at the American River Hatchery, while others may still need to be addressed. The upgrades in the Terracon reports may be included in future design efforts for each facility at CDFW direction.
- Additional division specific cost evaluation assumptions may be found in Appendix F.

6.4 LEED Assessment

RIM Architects (RIM) and STŌK have reviewed and assessed this 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 and/or square footage requirements in the proposed structures. There is insufficient scope to pursue LEED certification. Refer to Appendix H for more information.

6.5 Net Zero Energy Evaluation

The site faces significant challenges in achieving net zero energy status due to high energy consumption and limited available space. Even with the installation of large shading structures over existing equipment and two parking lots, the PV capacity achieved is only 31% of the total requirement. Additional space is severely constrained, and reaching net zero would likely necessitate utilizing the rooftops of existing buildings. To achieve net zero, 353,488 square feet of greenspace would need to be covered in PV panels.

6.6 Alternative Cost Estimate

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

Table 6-2. Alternative Cost Estimate.

Item	Estimate ($)
Division 01 - General Requirements	7,210,000
Division 02 - Existing Conditions	350,000
Division 03 - Concrete	2,638,000
Division 05 - Metals	170,000
Division 08 - Openings	24,000
Division 13 - Special Construction (Buildings and Tanks)	21,348,000
Division 23 - Mechanical & HVAC	270,000
Division 26 - Electrical	6,800,000
Division 31 - Earthwork	526,000
Division 32 - Exterior Improvements	203,000
Division 40 - Process Water Systems	3,724,000
2024 CONSTRUCTION COST	**43,263,000**
Construction Contingency	10,816,000
Overhead	2,596,000
Profit	3,461,000
Bond Rate	433,000
2024 CONSTRUCTION PRICE	**60,569,000**
Design, Permitting, and Construction Support	9,086,000
Geotechnical	25,000
Topographic survey ($1000/acre)	7,000
PROJECT TOTAL	**69,687,000**
Accuracy Range +50%	104,531,000
Accuracy Range -30%	48,781,000
Photovoltaic (Full kW Required)	25,164,000
Photovoltaic (Roof kW Available)	5,286,600

7.0 American River Hatchery 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 work near the existing intake structures, 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 to 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 (U.S. Fish and Wildlife Service [USFWS] Information for Planning and Consultation [IPaC] and California Biogeographic Information and Observation System [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, National Oceanic and Atmospheric Administration (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. Federal Anticipated 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. State Anticipated 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
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

Agency and Permit/Approval	Submittal / Document Type	Supporting Documentation	Anticipated Time Frame	Notes
Central Valley 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 US 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
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	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. Sacramento County Anticipated Permits and Approvals for Selected Location.

Agency and Permit/Approval	Submittal / Document Type	Supporting Documentation	Anticipated Time Frame	Notes
Sacramento County Building Services Department Construction Permits	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 American River Hatchery and Nimbus Hatchery share the same NPDES permit and, for that purpose, are collectively referred to as a single facility. The facility is classified as a cold water Concentrated Aquatic Animal Production (CAAP) facility and is eligible to operate under General Order R5-2019-0079 issued by the Regional Water Quality Control Board, Central Valley (Region 5), and NPDES Permit No. CAG135001.

Wastewater is discharged through the following outfalls:

- Outfall 001: Latitude: 38° 38' 07.00" N and Longitude: 121° 13' 13.27" W.
- Outfall 002: Latitude: 38° 38' 05.90" N; and Longitude: 121° 13' 35.29" W.
- Outfall 004N: Latitude: 38° 38' 01.47" N; and Longitude: 121° 13' 48.52" W.
- Outfall 004S: Latitude 38° 37' 59.70" N; and Longitude: 121° 13' 46.90" W.

The permit identifies formaldehyde and chlorine as potential pollutants from the hatchery. The following limitations for formaldehyde and chlorine effluent are specified:

- Formaldehyde: 0.65 mg/L (monthly average), 1.3 mg/L (daily maximum).
- Chlorine: 0.018 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 valuable information on the impacts that the American River Hatchery could experience as a result of climate change and provides modifications that can be made to increase the resiliency of the hatchery. Based on historic trends and the general climate impacts experienced throughout California's Central Valley, air and water temperatures are expected to increase.

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. Increased 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:

- Dredging and inspecting current intake structures, then installing an automatic traveling screen for the 42-inch intake to reduce debris in all water sources to the hatchery.
- Inspecting and replacing valves for the hatchery's water supply, improving flow control and isolation ability.
- Constructing a headbox to provide constant head pressure and improved flow control for all rearing areas at the hatchery.
- Replacing raceways with circular tank PRAS modules, including water chillers that reduce the risk of emergency evacuations during periods with increased water temperatures.
- Constructing viewing raceways to promote public engagement while maintaining biosecurity in the PRAS modules.
- Constructing new structure for Hatchery Building A's production, replacing aging plumbing, and creating a more biosecure area for Heenan Lake selects.
- Retrofitting existing round tank system with PRAS equipment, including water chilling, to reduce water demand and risk of high water temperatures affecting fish.
- Reconfiguring Hatchery Building B's effluent stream to allow for chilled water from Hatchery Building B to be treated and used as partial make-up water for the round tank PRAS retrofit.

- Constructing a new effluent discharge pipe to allow for the hatchery's full water right to be used without concern for effluent backing up into production areas.
- Installing solar panels atop new structures will offset some of the power demands associated with new hatchery equipment.

The proposed upgrades to the American River Hatchery 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 $69,687,000.

9.0 References

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