DRAFT ENVIRONMENTAL ASSESSMENT

Impacts of NOAA's National Marine Fisheries Service Proposed 4(d) Determination under Limit 5 for the Mad River Winter-run Steelhead Program

Prepared by the
National Marine Fisheries Service
West Coast Region, Northern California Office

March 2016

Cover Sheet

March 2016

Title of Environmental Review:	Impacts of NOAA's National Marine Fisheries Service Proposed 4(d) Determination under Limit 5 for the Mad River Winter-run Steelhead Hatchery Program
Evolutionarily Significant Units/ Distinct Population Segments:	Northern California Steelhead
Responsible Agency and Official:	William Stelle, Jr. Regional Administrator West Coast Region National Marine Fisheries Service 7600 Sand Point Way N.E., Building 1 Seattle, WA 98115
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Legal Mandate:	Endangered Species Act (ESA) of 1973, as amended and implemented – 50 CFR Part 223
Location of Proposed Activities:	Mad River watershed in Northern California
Activity Considered:	Operation of a hatchery program for the augmentation of steelhead fisheries. The operator is the California Department of Fish and Wildlife. The Federal action considered in this environmental assessment is the National Marine Fisheries Service's proposed 4(d) determination under Limit 5 for this hatchery program.

Table of Contents

1. PURPOSE OF AND NEED FOR THE PROPOSED ACTION I

1.1. Background i

1.2. Description of the Proposed Action i

1.3. Purpose of and Need for the Proposed Action 1-2

1.4. Project Area 1-2

1.5. Relationship to Other Plans and Policies 1-3

1.5.1. Clean Water Act 1-3

1.5.2. Bald Eagle and Golden Eagle Protection Act 1-4

1.5.3. Marine Mammal Protection Act 1-4

1.5.4. Executive Order 12898 Environmental Justice in Minority and Low-income Population 1-5

1.5.5. Executive Order 11988 Floodplain Management and 11990 Protection of Wetlands 1-5

1.5.6. Secretarial Order 3206 1-8

1.5.7. The Federal Trust Responsibility 1-8

1.5.8. California State Endangered, Threatened, and Sensitive Species Act 1-9

1.5.9. California Hatchery Scientific Review Project 1-9

1.5.10. Southern Oregon and Northern California Coho Recovery Plan 1-9

1.5.11. *EPIC v. Ayers et. al.* Lawsuit and Settlement Agreement 1-10

2. ALTERNATIVES INCLUDING THE PROPOSED ACTION 2-1

2.1. Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule 2-1

2.2. Alternative 2 (Proposed Action/Preferred Alternative) – Make a Determination that the Submitted HGMP Meets the Requirements of the 4(d) Rule 2-1

2.3. Alternative 3 (Reduced Production Alternative) – Make a Determination that Revised HGMP with Reduced Production Levels Meet the Requirements of the 4(d) Rule 2-1

2.4. Alternatives Considered But Not Analyzed in Detail 2-2

2.4.1. Use Hatchery Cohorts instead of Wild Fish for Broodstock 2-2

2.4.2. Alternative Approval Process 2-2

2.4.3. Additional Best Management Practices 2-2

3. AFFECTED ENVIRONMENT 3-1

3.1. Water Quantity and Quality 3-7
3.2. Salmon and Steelhead 3-16
3.2.1. Genetic Risks 3-20
3.2.2. Competition and Predation 3-21
3.2.3. Hatchery Facility Effects 3-23
3.2.4. Fisheries 3-24
3.2.5. Risk of Disease Transfer 3-26
3.2.6. Risk of "Mining" Natural-Origin Mad River Steelhead 3-26
3.3. Other Fish Species 3-27
3.4. Wildlife and Marine Mammals 3-28
3.5. Socioeconomics 3-32
3.6. Environmental Justice 3-33
4. ENVIRONMENTAL CONSEQUENCES 4-1
4.1. Water Quantity and Quality 4-1
4.1.1. Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule4-1
4.1.2. Alternative 2 (Proposed Action/Preferred Alternative) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule 4-2
4.1.3. Alternative 3 (Reduced Production Alternative) – Make a Determination that Revised HGMPs with Reduced Production Levels Meet the Requirements of the 4(d) Rule 4-6
4.2. Salmon and Steelhead 4-7
4.2.1. Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule4-7
4.2.2. Alternative 2 - Alternative 2 (Proposed Action/Preferred Alternative) – Make a Determination that the Submitted HGMP Meet the Requirements of the 4(d) Rule 4-8
4.2.3. Alternative 3 (Reduced Production Alternative) – Make a Determination that Revised HGMP with Released Production Levels Meet the Requirements of the 4(d) Rule 4-9
4.3. Other Fish Species 4-11
4.3.1. Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule . 4-11
4.3.2. Alternative 2 (Proposed Action/Preferred Alternative) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule 4-12

4.3.3. Alternative 3 (Reduced Production Alternative) – Make a Determination that Revised HGMPs with Released Production Levels Meet the Requirements of the 4(d) Rule 4-12
4.4. Wildlife and Marine Mammals 4-13
4.4.1. Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule . 4-13
4.4.2. Alternative 2 (Proposed Action/Preferred Alternative) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule 4-14
4.4.3. Alternative 3 (Reduced Production Alternative) – Make a Determination that Revised HGMPs with Released Production Levels Meet the Requirements of the 4(d) Rule 4-15
4.5. Socioeconomics 4-16
4.5.1. Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule . 4-16
4.5.2. Alternative 2 (Proposed Action/Preferred Alternative) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule 4-16
4.5.3. Alternative 3 (Reduced Production Alternative) – Make a Determination that Revised HGMPs with Released Production Levels Meet the Requirements of the 4(d) Rule 4-16
4.6. Environmental Justice 4-17
4.6.1. Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule . 4-17
4.6.2. Alternative 2 (Proposed Action/Preferred Alternative) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule 4-18
4.6.3. Alternative 3 (Reduced Production Alternative) – Make a Determination that Revised HGMPs with Released Production Levels Meet the Requirements of the 4(d) Rule 4-18
5. CUMULATIVE EFFECTS 5-1
5.1. Introduction 5-1
5.2. Past and Present Actions 5-5
5.2.1. Resource Extraction Actions 5-6
5.2.2. Mad River Water Management 5-8
5.2.3. Climate Change 5-11
5.2.4. Salmon and Steelhead Harvest 5-12

5.2.5. Fire Management Actions 5-12
5.2.6. Watershed and Aquatic Habitat Rehabilitation and Management Efforts 5-13
5.3. Existing Conditions 5-14
5.4. Future Actions and Conditions 5-15
5.5. Cumulative Effects by Resource 5-15
5.5.1. Water Quantity and Quality 5-16
5.5.2. Salmon and Steelhead 5-18
5.5.3. Other Fish Species 5-21
5.5.4. Wildlife and Marine Mammals 5-22
5.5.5. Socioeconomics 5-23
5.5.6. Environmental Justice 5-24
6. AGENCIES AND PERSONS CONSULTED (INCLUDING TRIBES) 6-1
7. LITERATURE CITED 7-1

List of Tables

Table 3-1. Water Quality Objectives for the Mad River (NCRWQCB 2011)..... 3-12

Table 3-2. Permitted Effluent discharges and timelines. 3-14

Table 3-3. Mad River water quality monthly monitoring data (https://ciwqs.waterboards.ca.gov/ciwqs). 3-15

Table 3-4. The scientific name, listing status under the ESA, Federal Register notice citation, and geographic distribution of the salmon and steelhead ESUs and DPS in the project area. . 3-17

Table 3-5. General mechanisms by which integrated hatchery programs may affect natural-origin salmon and steelhead populations. 3-19

Table 3-6. Ecological relationship between hatchery-origin steelhead and natural-origin salmon and steelhead in the analysis area (“X” indicates interaction). 3-21

Table 3-7. Number of natural- and hatchery-origin steelhead caught and released on the Mad River for years 2006-2011, as recorded on returned steelhead catch cards (CDFW 2015). It should be noted that this is likely only a fraction of the steelhead caught based on low angler reporting rates. 3-25

Table 3-8. Range and status of other fish species that may be affected by Mad River Hatchery winter-run steelhead. 3-27

Table 3-9. Wildlife and marine mammals that may interact with Mad River Hatchery steelhead as prey, predators, or competitors in freshwater, estuarine, or marine habitats. 3-30

Table 3-10. Humboldt County and California population levels, minority populations percentages, annual income, and percentage of persons living below poverty level (i.e., low income population). 3-35

List of Figures

Figure 1-1. Federal Emergency Management Agency's Federal Insurance Rate Map for the area surrounding the Mad River Hatchery. The Zone A (gray shaded area) near the hatchery was estimated by FEMA and does not use detailed topographic survey data or hydraulic flow modeling to define this boundary. 1-7

Figure 3-1. Map of the Mad River Watershed displaying the location of the Mad River Hatchery the potential fish passage barriers and Ruth Reservoir (Modified from CDFW 2014). 3-3

Figure 3-2. Flood frequency curve for Mad River near Arcata (USGS gage no. 11481000)..... 3-4

Figure 3-3. Aerial photo of the Mad River Hatchery and worker residences. 3-5

Figure 3-4. View looking down (a) and up (b) the fish ladder. 3-6

Figure 3-5. Rearing ponds or raceways. 3-6

Figure 3-6. Settling pond head works. 3-6

Figure 3-7. Outflow pipe and fishing access trail. 3-7

Figure 3-8. Schematic of the MRH water system (Modified from Will 1971). 3-10

Figure 3-9. Mad River flow duration curves for the USGS's Mad River near Arcata, California gage (No. 11481000). 3-16

Figure 4-1. Water year 2013 through 2015 hydrographs for the Mad River near Arcata, CA, USGS gaging station No. 11481000. 4-5

Figure 5-1. Humboldt Bay Municipal Water District's water usage (MGD). 5-9

Figure 5-2. Potential water management scenarios outlined by the Humboldt Bay Municipal Water District (HBMWD 2013). (a) The scenario with the lowest likelihood and lowest flow release. (b) The most likely scenario and similar to the current flow release schedule. (c) HBMWD's preferred alternative and max capacity—this scenario has a low to moderate likelihood. 5-10

1. PURPOSE OF AND NEED FOR THE PROPOSED ACTION

1.1. Background

NOAA's National Marine Fisheries Service (NMFS) is the lead agency responsible for administering the Endangered Species Act (ESA) as it relates to listed salmon and steelhead. Actions that may affect listed species are reviewed by NMFS under section 7, either to address incidental take by another Federal agency or pursuant to section 10 or section 4(d) of the ESA, the latter of which can be used to limit the application of take prohibitions described in section 9. NMFS issued a final rule pursuant to ESA section 4(d) (4(d) Rule), adopting regulations necessary and advisable to conserve threatened species (50 CFR 223.203). The 4(d) Rule applies the take prohibitions in section 9(a)(1) of the ESA to salmon and steelhead listed as threatened, and also sets forth specific circumstances when the prohibitions will not apply, known as 4(d) limits. With regard to hatchery programs described in Hatchery and Genetic Management Plans (HGMPs) submitted pursuant to the 4(d) Rule, NMFS declared under limit 5 of the 4(d) Rule that section 9 take prohibitions would not apply to activities carried out under those HGMPs when NMFS determines that the HGMPs meet the requirements of limit 5.

The California Department of Fish and Wildlife (CDFW) has provided NMFS with a Hatchery and Genetic Management Plan (HGMP) for the Mad River winter-run steelhead hatchery program and associated monitoring and evaluation actions. The HGMP provides the framework through which CDFW can manage hatchery operations, monitoring, and evaluation activities, while meeting requirements specified under the ESA. CDFW developed the HGMP and has provided the HGMP for review and determination by NMFS as to whether they address the criteria of limit 5 of the 4(d) Rule.

1.2. Description of the Proposed Action

Pursuant to the ESA, NMFS will review CDFW's Mad River winter-run steelhead HGMP to determine if the HGMP meets the requirements of limit 5 of the 4(d) Rule and whether limitation of the ESA section 9 take prohibitions will afford adequate protections for threatened steelhead in the Northern California Distinct Population Segment (DPS) (NC steelhead) (50 C.F.R. § 223.102(c)(18)). The Mad River contains winter-run and summer-run steelhead, which belong to the NC Distinct Population Segment; NC steelhead were listed as threatened under the ESA (65 Fed. Reg. 36074, June 7, 2000; 62 Fed. Reg. 834, February 6, 2006). This EA will evaluate how approval of the HGMP would affect the human environment (e.g., the river ecosystem, recreational fishing, and listed species).

In November 2014, the CDFW submitted a final HGMP pursuant to the 4(d) Rule for the Mad River Hatchery (MRH) winter-run steelhead program to NMFS's Northern California Office in Arcata, California. The CDFW requested final review and approval of the HGMP under the 4(d) Rule Limit 5. The Mad River HGMP outlined the winter-run NC steelhead supportive breeding and associated monitoring and evaluation actions that would occur in the lower Mad River watershed. The MRH is currently operating as per a court settlement agreement and releases winter-run NC steelhead into the lower Mad River. The proposed HGMP actions include:

1. Broodstock would be collected at MRH and throughout the Mad River watershed using seining, angling, volitional entry into the fish ladder, and weir collection methods. Broodstock would include both hatchery and natural fish. Natural broodstock would be incorporated into the spawning population in the same proportions as collected, such that 50-100 percent of the hatchery broodstock would be of natural origin. Collections will be made throughout the run. Since the MRH may take up to 100 percent of their broodstock from the natural population, the number of natural fish collected for broodstock will follow the same rules for spawning at the hatchery, which means they will be collected based on a bell-shaped curve so that it is representative of the natural run. Up to 250 adult steelhead or up to approximately 10 percent of the natural spawning population would be collected for broodstock. Spawning would occur at the Mad River Hatchery. The hatchery would release adult fish, of both natural and hatchery origin, not used in the broodstock process back into the Mad River. Additionally, natural-origin fish used for spawning would be rehabilitated and released to encourage survival and repeat spawning.
2. Egg incubation and juvenile fish would be reared at the MRH for approximately one year prior to being released.
3. The MRH would release up to 150,000 juvenile steelhead into the Mad River during March and April each year. Before they are released, all juvenile steelhead will have their adipose fin clipped off to mark them as hatchery fish. Clipping the adipose fin of 100 percent of the hatchery-origin juveniles prior to release would make these fish distinguishable from naturally produced fish, and provide options for management of fisheries that can selectively target hatchery-produced fish.
4. Monitoring and evaluation activities would assess the performance of the program in meeting conservation, harvest augmentation, and listed fish risk minimization objectives.
5. Based on a recommendation from the CDFW and NMFS technical-team meeting on August 25, 2009, the hatchery would be operated as an integrated hatchery program. The Proposed Action would also be consistent with the *Steelhead Restoration and Management Plan for California* (McEwan and Jackson 1996). MRH spawning protocol would use one male for each sub-lot (two lots per female) derived from two different

females. Mad River Hatchery would also incubate each lot separately to afford equalization (and documentation) of each family group contribution, if needed[1].

6. No construction would occur.

Pertinent operational elements of the Mad River HGMP (CDFW 2014) not listed above will be discussed and any effects analyzed in detail within the Affected Environment and Environmental Consequences (Subsections 3 and 4).

1.3. Purpose of and Need for the Proposed Action

NMFS's purpose of and need for the Proposed Action:

- Ensure the proposed hatchery program complies with requirements of the ESA
- Work collaboratively with CDFW to protect and conserve listed species

The CDFW's purpose of and need for the Proposed Action:

- Operate the Mad River program as an integrated hatchery program to produce winter-run steelhead that will help conserve at-risk salmon species.
- Provide recreational fishing opportunities for winter-run steelhead in the Mad River while reducing hatchery effects on the natural steelhead population. .
- Develop an HGMP and seek approval from NMFS pursuant to Limit 5 of the 4(d) Rule.

1.4. Project Area

The project area (or project area) is the geographic area where the Proposed Action would take place. The Project area includes the places where the proposed steelhead hatchery program would (1) collect broodstock; (2) spawn, incubate, and rear fish; (3) release fish; (4) remove surplus hatchery-origin adult steelhead that return to hatchery facilities; and (5) conduct monitoring and evaluation activities. The project area includes the lower Mad River Watershed from Matthews Dam (river mile 68) downstream to the Mad River's confluence with the Pacific Ocean (river mile 0). NMFS (2008) concluded that the entire Mad River watershed up to Matthews Dam is open to NC steelhead. Upstream steelhead migration is limited by several large boulder cascades between Bug Creek (river mile 50) and Deer Creek (river mile 53). There

[1] Culling options may require the participation of the NMFS Southwest Fisheries Science Center.

is generally consensus that during low to normal water years, the large boulder cascades limit anadromy to the Mad River mainstem and tributaries downstream of Bug Creek.

The analysis area for each resource will include the project area, at a minimum, but may vary in geographic size depending upon the range of potential effects. For some resources, the analysis area may be larger than the project area, since some of the effects of the alternatives may occur outside the project area. The Mad River watershed downstream of Bug Creek (river mile 50) will be the primary area of resource evaluation for the following reasons: First, there is a potential fish barrier in the vicinity of the Bug Creek confluence. Secondly, Sparkman (2002c) made a winter-run steelhead population estimate of 17,164 (95% C.I. = 11,478 – 26,077) upstream of the hatchery weir during the 2001/2002 season. Based on marked hatchery fish, an estimated 92% of this population estimate was hatchery-origin fish. Lastly, CDFW (Zuspan and Sparkman 2002) found a decreased incidence of straying with distance upstream from the hatchery. They found 18 of the 29 (62%) at the Cañon Creek Weir (river mile 19) and 2 of 8 (25%) at Big Bend weir (river mile 44.6) were of hatchery origin, based on marked and recovered steelhead.

The socio-economic effects evaluation area will include a larger area, Humboldt County, because the hatchery funds and fisherman expenditures are likely spent within the county.

1.5. Relationship to Other Plans and Policies

In addition to NEPA and ESA, other plans, regulations, agreements, treaties, laws, and Secretarial and Executive Orders also affect hatchery operations in the Mad River watershed. They are summarized below to provide additional context for the hatchery program and the proposed HGMP.

1.5.1. Clean Water Act

The Clean Water Act (33 USC 1251, 1977), administered by the U.S. Environmental Protection Agency and state water quality agencies, is the principal Federal legislation directed at protecting water quality. Each state implements and carries forth Federal provisions, as well as approves and reviews National Pollutant Discharge Elimination System applications, and establishes total maximum daily loads for rivers, lakes, and streams. The states are responsible for setting the water quality standards needed to support all beneficial uses, including protection of public health, recreational activities, aquatic life, and water supplies.

The North Coast Regional Water Quality Control Board is the agency responsible for carrying out the provisions of the Federal Clean Water Act within the Mad River Watershed. The agency is responsible for establishing water quality standards, making and enforcing water quality rules, and operating waste discharge permit programs. Hatchery operations are required to comply with

the Clean Water Act. More detail about the Clean Water Act regulatory process and the specific water quality requirements for the MRH will be discussed in the Water Quantity and Quality Subsection 3.1.

1.5.2. Bald Eagle and Golden Eagle Protection Act

The Bald Eagle and Golden Eagle Protection Act (16 USC. 668-668c), enacted in 1940, and amended several times since then, prohibits the taking of bald eagles, including their parts, nests, or eggs. The act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." The U.S. Fish and Wildlife Service, who is responsible for carrying out provisions of this Act, defines "disturb" to include "injury to an eagle; a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior; or nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior." Changes in hatchery production have the potential to affect eagle productivity through changes in its steelhead prey or other affected prey sources. Effects on eagles and other wildlife species are addressed in Subsection 4.4.

1.5.3. Marine Mammal Protection Act

The Marine Mammal Protection Act of 1972 (16 USC 1361), as amended, establishes a national policy designated to protect and conserve wild marine mammals and their habitats. This policy was established so as not to diminish such species or populations beyond the point at which they cease to be a significant functioning element in the ecosystem, nor to diminish such species below their optimum sustainable population. All marine mammals are protected under the Marine Mammal Protection Act.

The Marine Mammal Protection Act prohibits, with certain exceptions, the take of marine mammals in United States waters and by United States citizens on the high seas, and the importation of marine mammals and marine mammal products into the United States. The term "take," as defined by the Marine Mammal Protection Act, means to "harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." The Marine Mammal Protection Act further defines harassment as "any act of pursuit, torment, or annoyance, which (i) has the potential to injure a marine mammal or marine mammal stock in the wild; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing a disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild."

NMFS is responsible for reviewing Federal actions for compliance with the Marine Mammal Protection Act. Changes in fish production can indirectly affect marine mammals by altering the

number of available steelhead prey and other potentially affected prey sources. Effects on marine mammals and other wildlife species are addressed in Subsection 4.4.

1.5.4. Executive Order 12898 Environmental Justice in Minority and Low-income Population

The objectives of the Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority and Low-income Population,* include developing Federal agency implementation strategies, identifying minority and low-income populations where proposed Federal actions could have disproportionately high and adverse human health and environmental effects, and encouraging the participation of minority and low-income populations in the NEPA process. Changes in hatchery production have the potential to affect the extent of recreational harvest available for minority and low-income populations. Such communities in the analysis area are discussed in Subsection 3.6, and the potential impacts of the proposed action in Subsection 4.6.

1.5.5. Executive Order 11988 Floodplain Management and 11990 Protection of Wetlands

Executive Orders (E.O.) 11988 – Floodplain Management and 11990 – Protection of Wetlands require agencies to avoid or minimize impacts on/from floodplains and wetlands when conducting activities involving Federal lands, land use, or real property (e.g., leasing, habitat conservation, construction, research, etc.). Floodplains are defined as any "lowland and relatively flat areas adjoining inland and coastal waters including flood prone areas of offshore islands, including at a minimum, that area subject to a 1 percent or greater chance of flooding in any given year"—i.e., the 100-year recurrence interval flood. Wetlands are defined as "those areas that are inundated by surface or ground water with a frequency sufficient to support and under normal circumstances does or would support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction." There are no wetlands within the MRH property. However, the MRH borders the Mad River and is constructed on a Mad River terrace.

The Anadromous Fisheries Branch Administrative Report No. 73-12 (Will 1973) stated that all buildings and ponds are located above the peak flood of record (December 22, 1964) which measured 81,000 cubic feet per second (cfs) at the U.S. Geological Survey's Mad River near Arcata, California gaging station located just upstream of the Highway 299 Bridge. An examination of historical aerial photos showed that the terrace was substantially eroded during the 1964 flood but the photos do not show whether the terrace surface was overtopped or, if so, how deep it was inundated. When the Federal Emergency Management Agency's Federal Insurance Rate Map (last updated February 8, 1999), which estimates the 100-year recurrence interval floodway (Figure 1-1), was compared to a scaled Google Earth view (cover photo) and

historical aerial photos of the MRH, the majority of the MRH facilities appeared to be outside of Zone A; i.e., the 100-year flood recurrence interval flood inundation area. The 100-year flood while predicted to be approximately 83,000 cfs (See section), which is very similar to the 1964 flood, has a 95 percent confidence interval range of 69,000 to 104,700 cfs. Therefore, NMFS assumes that the MRH is likely within the 100-year flood inundation area and within the channel migration zone with the latter zone only being a concern if the riprap wall protecting the MRH was to fail.

The *NOAA Administrative Order 216-6 E.O. 11988/11990 Companion Manual, Implementing Procedures for Executive Order 11988, Floodplains Management and Executive Order 11990, Protection of Wetlands E.O. 11988/11990 Companion Manual* (NOAA 2011) provides the procedures and processes to implement NOAA policy contained in *NAO 216-6 Environmental Review Procedures for Implementing the National Environmental Policy Act*. This guidance enables NOAA to carry out its mission while minimizing and mitigating the effects of its activities in floodplains and wetlands.

- Requirements under the Executive Orders include identification of practicable alternatives, notification to the public, analysis of impacts, and identification/implementation of mitigation measures.
- Compliance should be achieved concurrently with the NEPA review process in accordance with NOAA's Companion Manual for NOAA Administrative Order 216-6 (NOAA 2011).

To evaluate the potential effects of the proposed project on the floodplain and achieve compliance with E.O. 11988, an analysis was completed following NOAA's (NOAA 2011) eight-step evaluation process to ensure NOAA avoids or minimizes adverse impacts on floodplains whenever there is a practicable alternative or proceed with the appropriate level of mitigation.

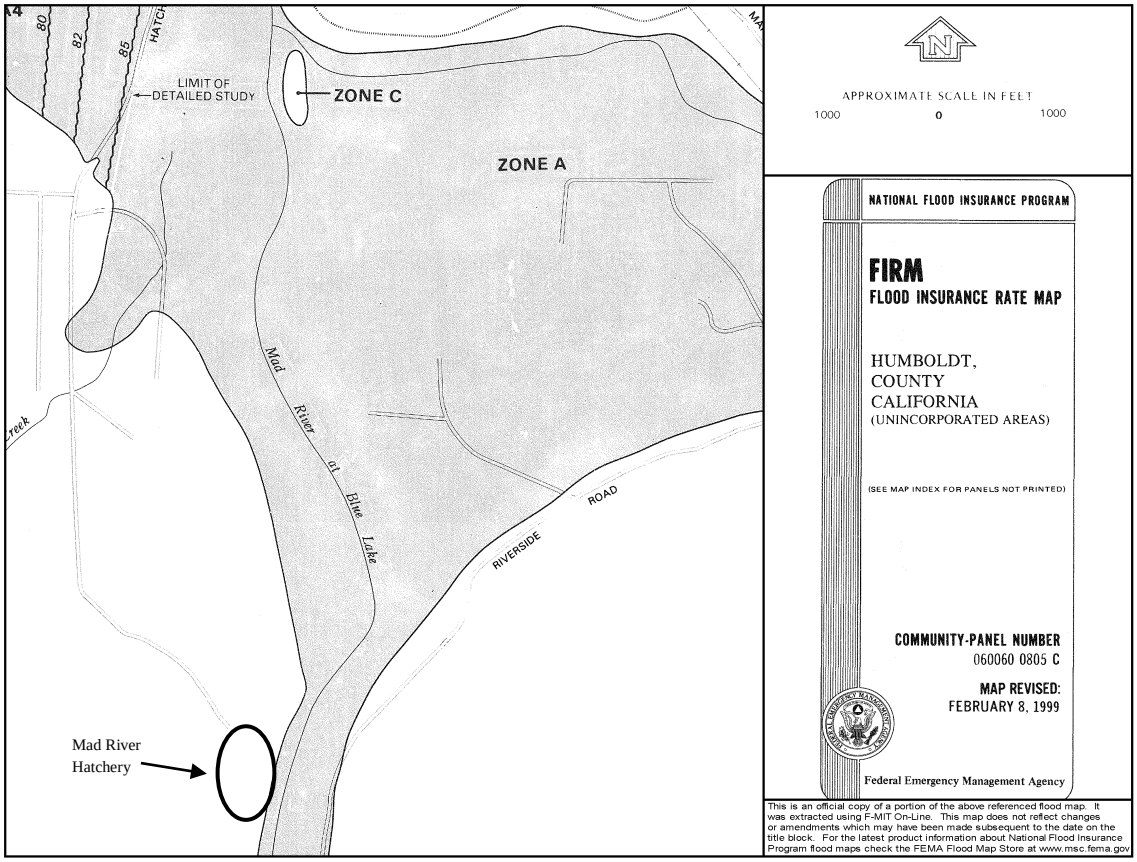

Figure 1-1. Federal Emergency Management Agency's Federal Insurance Rate Map for the area surrounding the Mad River Hatchery. The Zone A (gray shaded area) near the hatchery was estimated by FEMA and does not use detailed topographic survey data or hydraulic flow modeling to define this boundary.

1.5.6. Secretarial Order 3206

Secretarial Order 3206 (*American Indian Tribal Rights, Federal-Tribal Trust Responsibilities and the ESA*) issued by the secretaries of the Departments of Interior and Commerce, clarifies the responsibilities of the agencies, bureaus, and offices of the departments when actions taken under the ESA and its implementing regulations affect, or may affect, Indian lands, tribal trust resources, or the exercise of American Indian tribal rights as they are defined in the Order. Secretarial Order 3206 acknowledges the trust responsibility and treaty obligations of the United States toward tribes and tribal members, as well as its government-to-government relationship when corresponding with tribes. Under the Order, NMFS and the U.S. Fish and Wildlife Service (Services) "will carry out their responsibilities under the [ESA] in a manner that harmonizes the Federal trust responsibility to tribes, tribal sovereignty, and statutory missions of the [Services], and that strives to ensure that Indian tribes do not bear a disproportionate burden for the conservation of listed species, so as to avoid or minimize the potential for conflict and confrontation."

More specifically, the Services shall, among other things, do the following:

- Work directly with Indian tribes on a government-to-government basis to promote healthy ecosystems (Sec. 5, Principle 1)
- Recognize that Indian lands are not subject to the same controls as Federal public lands (Sect. 5, Principle 2)
- Assist Indian tribes in developing and expanding tribal programs so that healthy ecosystems are promoted and conservation restrictions are unnecessary (Sec. 5, Principle 3)
- Be sensitive to Indian culture, religion, and spirituality (Sec. 5, Principle 4)

Potential effects of the proposed action on Native American culture and rights are discussed in Subsection 4.6.

1.5.7. The Federal Trust Responsibility

The United States government has a trust or special relationship with Indian tribes. This unique and distinctive political relationship is defined by statutes, executive orders, judicial decisions, and agreements and differentiates tribes from other entities that deal with, or are affected by the Federal government. Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments*, states that the United States has recognized Indian tribes as domestic dependent nations under its protection. The Federal government has enacted numerous statutes and promulgated numerous regulations that establish and define a trust relationship with Indian

tribes. The relationship has been compared to one existing under common law trust, with the United States as trustee, the Indian tribes or individuals as beneficiaries, and the property and natural resources of the United States as the trust corpus (Cohen 2005; Newton et al. 2005). The trust responsibility has been interpreted to require Federal agencies to carry out their activities in a manner that is protective of Indian treaty rights. This policy is also reflected in the March 30, 1995, document, *Department of Commerce – American Indian and Alaska Native Policy* (U. S. Department of Commerce 1995).

1.5.8. California State Endangered, Threatened, and Sensitive Species Act

This EA will consider the effects of hatchery programs and harvest actions on state endangered, threatened, and sensitive species. The State of California listed species are identified on CDFW's website (*http://dfg.ca.gov/wildlife/nongame/t_e_spp/*). These species are managed by CDFW, as needed, to prevent them from becoming endangered, threatened, or sensitive or working to recover them once if they are listed. The criteria for listing and de-listing, and the requirements for recovery and management plans for these species are available on the latter webpage. Species listed under the state endangered, threatened, and sensitive species list are reviewed in this EA.

1.5.9. California Hatchery Scientific Review Project

Following successful reviews processes in Puget Sound, coastal Washington, and the Columbia River Basin, Congress authorized funds in 2010 to conduct a scientific review of hatchery programs in California, herein referred to as the California Hatchery Scientific Review Project (California Hatchery Scientific Review Group, CHSRG 2012). Unfortunately, time and resource constraints limited the reviews to the Klamath, Trinity, and Central Valley River hatcheries. The Mad River and Warm Springs Hatcheries were to be reviewed later. The objective of the Hatchery Scientific Review Group was to review the best available science and make consensus-based recommendations for improving hatchery operations to responsible policy makers. The California Hatchery Scientific Review Project's goals were to develop recommendations for hatchery operations that would help recover and conserve naturally spawning salmon and steelhead populations and support sustainable fisheries with as few as possible deleterious consequences to natural populations (CHSRG 2012).

1.5.10. Southern Oregon and Northern California Coho Recovery Plan

A Federal recovery plan is in place for the ESA-listed Southern Oregon and Northern California Coho (SONCC, NMFS 2014). Broad partnerships of Federal, state, local, and tribal governments and community organizations collaborated in the development of this recovery plan. In addition, the SONCC Recovery Plan (NMFS 2014) incorporates and dovetails with the State of California Recovery Strategy for the California Coho Salmon (CDFG 2004). The

comprehensive recovery plan includes conservation goals and proposed habitat, hatchery, and harvest actions needed to achieve the conservation goals for each watershed within the geographic boundaries of the listed ESUs.

1.5.11. *EPIC v. Ayers et. al.* Lawsuit and Settlement Agreement

The Environmental Protection Information Center (EPIC) and multiple conservation groups submitted a notice of intent to sue (Western Environmental Law Center 2012) against the U.S. Fish and Wildlife Service (USFWS, partial funding source) and CDFW claiming that the MRH operations were in violation of the ESA and releasing hatchery fish has harmful genetic effects on wild fish, altering the genes of their spawn and reducing the fitness and genetic variability of the native species. The notice stated that, CDFW was operating the MRH without an approved HGMP which results in the illegal take of "wild California Coastal Chinook, SONCC coho, and Northern California steelhead" (Western Environmental Law Center 2012).

On February 13, 2013, EPIC sued the USFWS (*EPIC v. Ayers et al.* 2013) in the U.S. District Court for the Northern District of California, San Francisco Division. A settlement agreement was reached on May 13, 2013, which stopped the collection of natural-origin steelhead broodstock and the release of hatchery fish until a HGMP could be completed and approved. The parties involved subsequently agreed to allow the program to continue operating while the HGMP was completed and progressed through NMFS's approval process. The U.S. District Court approved a stay order for a year and then extended the stay for another year until December 1, 2015. On November 14, 2014, CDFW submitted a request to NMFS for review and approval of the HGMP under Limit 5 of the 4(d) Rule. The stay order states that the plaintiff and defendants agree to require CDFW staff to collect natural-origin steelhead during January through March as long as each spawned pair includes at least one natural-origin steelhead and, if possible, two natural-origin steelhead.

In late July 2015, EPIC dropped the lawsuit for attorney fees and reassurances by the USFWS and CDFW that the HGMP evaluation process was making adequate process and will be completed this year. The USFWS and CDFW agreed to ensure that at least half of the MRH winter-run steelhead spawning pairs are hatchery spawned natural-origin and to match natural-origin steelhead with their natural counterparts whenever possible. On July 27, 2015, the U.S. District Court judge approved the stipulation and dismissal.

2. ALTERNATIVES INCLUDING THE PROPOSED ACTION

Three alternatives are considered in this EA: (1) NMFS would not make a determination under the 4(d) Rule (No Action); (2) NMFS would make a determination that the submitted HGMP meets the requirements of the 4(d) Rule (Proposed Action); (3) NMFS would make a determination that a revised HGMP with reduced production levels would meet the requirements of the 4(d) Rule.

2.1. Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule

Under this alternative, the HGMP would not be approved.

For analysis purposes, NMFS treats Alternative 1 as resulting in the termination of the winter-run steelhead hatchery program described in the HGMP. However, NMFS expects CDFW to continue to operate the MRH and produce trout and other none anadromous fish species following the California Hatchery Scientific Review Group (2012) recommendations.

2.2. Alternative 2 (Proposed Action/Preferred Alternative) – Make a Determination that the Submitted HGMP Meets the Requirements of the 4(d) Rule

Under this alternative, NMFS would make a determination that the submitted HGMP meets the requirements of the 4(d) Rule Limit 5, and the winter-run steelhead hatchery program would be implemented as described in the submitted HGMP (CDFW 2014). For the purpose of this analysis, NMFS treats the Proposed Action Alternative as resulting in the hatchery production of steelhead as described in the HGMP and summarized in Section 1.2, above.

2.3. Alternative 3 (Reduced Production Alternative) – Make a Determination that Revised HGMP with Reduced Production Levels Meet the Requirements of the 4(d) Rule

Under this alternative, CDFW would reduce the number of steelhead juveniles released from the hatchery by 50 percent (75,000 juveniles). All other operations would occur as described in the Proposed Action (Alternative 2). However, the hatchery would likely need less broodstock, water, feed, energy, and other resources to produce less fish than the Proposed Action. A revised HGMP would be submitted reflecting the reduced production level, and NMFS would make a determination that the revised HGMP meet the requirements of the Limit 5 of the 4(d) Rule.

This alternative enables NMFS to assess and obtain a thorough understanding of the potential effects from a reduction in the existing and proposed hatchery juvenile release levels. In drafting this alternative, NMFS set out to choose a point that differs meaningfully from the existing operations, Proposed Action, and the zero-hatchery alternative.

Note that NMFS's 4(d) regulations do not provide NMFS with the authority to order changes of this magnitude as a condition of approval of the HGMPs. NMFS's 4(d) regulations require NMFS to make a determination that the HGMPs *as proposed* either meet or do not meet the standards prescribed in the rule. Nonetheless, NMFS supports analysis of this alternative to assist with a full understanding of potential effects on the human environment under various management scenarios.

2.4. Alternatives Considered But Not Analyzed in Detail

The following alternatives were considered, but NMFS determined that they would not be measurably different from the alternatives already being considered, would likely have markedly increased adverse environmental effects relative to the Proposed Action, or would clearly not meet the purpose and need for action (Subsection 1.3, Purpose of and Need for the Proposed Action).

2.4.1. Use Hatchery Cohorts instead of Wild Fish for Broodstock

While initially considered, operating the hatchery as a segregated program, using hatchery cohorts instead of wild stocks, was dismissed based on the conclusions of the CDFW and NMFS technical team summit meeting on August 25, 2009, which included molecular scientists, fishery biologists, and policymakers. The team concluded that sufficient isolation of the MRH stock was not possible, and that, due to the inevitability of mixing natural-origin fish with hatchery fish, the availability of the hatchery program fish for potential future use as a "safety net" would be eroded. In addition, a weir or some other mechanism for segregating hatchery and natural fish would need to be developed. The genetic implications of the hatchery program with and without incorporating natural-origin adults into the broodstock will be part of the analysis of the Proposed Action Alternative.

2.4.2. Alternative Approval Process

CDFW would request that NMFS evaluate and determine if the proposed hatchery program, as described in the HGMP, meets the criteria for issuance of a section 10(a)(1)(A) permit, rather than being approved under the 4(d) Rule. Under this alternative, the only substantive change from the Proposed Action Alternative would be a difference in ESA authorization for the hatchery program. The analysis of impacts under this alternative would not differ from the analysis that would occur under the Proposed Action Alternative.

2.4.3. Additional Best Management Practices

Under this alternative, NMFS would approve the proposed hatchery program under limit 5 of the 4(d) Rule, and the hatchery program would be implemented as described in the 2014 HGMP. In addition, under this alternative, additional Best Management Practices (BMPs) would be applied

to further reduce potential adverse impacts of the HGMP on natural-origin steelhead populations. However, the proposed 2014 HGMP already includes BMPs considered necessary and appropriate and allows for the incorporation of additional BMPs if monitoring and evaluation feedback identify issues that can be addressed with new BMPs. Therefore, this alternative would not be meaningfully different from the Proposed Action and will not be evaluated in detail.

3. AFFECTED ENVIRONMENT

The Affected Environment section describes the relevant existing conditions of the biological, physical, and socioeconomic resources where the proposed action and alternatives would take place. Existing conditions include effects of the past and present operation of the winter-run steelhead program in the Mad River Watershed, and serves as a baseline to compare the effects of the alternatives (NOAA 2009). Each section in the affected environment chapter starts with a succinct description of the relevant potential effects that will be used assessed in the Environmental Consequences Chapter (4).

During internal scoping, the following resources were identified with the potential to be significantly impacted if the Proposed Action or alternatives were implemented:

- Water quantity and quality (Subsection 3.1)
- Salmon and steelhead and their habitats (Subsection 3.2)
- Other aquatic species and their habitats (Subsection 3.3)
- Wildlife and marine mammals (Subsection 3.4)
- Socioeconomics of the affected activities, including recreational fishing (Subsection 3.5)
- Cultural Resources
- Environmental justice (Subsection 3.6)

Mad River Watershed

The 466-square-mile Mad River watershed drains a relatively long and narrow section of the northern Coast Range Mountains in Humboldt and Trinity Counties, California (Figure 3-1). The Mad River watershed is predominantly composed of Mesozoic and Cenozoic age sedimentary and metamorphic rocks that were accreted off the coast, uplifted, faulted, and folded by the complex interactions between the North American, Pacific, and Gorda Plates. The relative plate motions drive the Cascadia Subduction Zone, the Mendocino Triple Junction, and the San Andreas tectonic regions, which in turn formed the northeast dipping thrust faults and asymmetric folds that form the Mad River watershed's long, northwest trending linear ridges and valleys. The MRH sits within the northwest trending thrust faults and folds of the Mad River Fault Zone.

The Mad River is commonly broken into three sections based on geomorphic regimes (GMA 2007; EPA 2007; Stillwater 2010): (1) Upper Mad River, the headwaters to Matthews Dam (120 square miles); (2) Middle Mad River, Matthews Dam downstream to Jack Shaw Road/Swinging Bridge (120 square miles); and (3) Lower Mad River, Jack Shaw Road/Swinging Bridge to the ocean (226 square miles). The Mad River headwaters reach elevations of 6,000 feet, and the Mad River flows through an alluvial valley above Ruth Reservoir. From Matthews Dam to the confluence with Pilot Creek, the Mad River flows through a relatively constant gradient canyon reach. From Pilot Creek to Jack Shaw Road, the Mad River flows through miles of boulder cascades, canyons, and steep hillslopes interspersed with large earthflows. Two of these large

boulder cascades are known to be partial fish passage barriers for steelhead (Figure 3-1). Below Jack Shaw Road, there are several miles of moderate gradient boulder cascades interspersed with bedrock pools and thin gravel bars and riffle. There are several small alluvial valleys in the lower reach above the MRH. Below the MRH, the lower Mad River flows through a large alluvial valley with an extensive floodplain and terrace deposits. Below Blue Lake, California, the river flows through a narrow bedrock-bounded area before flowing across a thick alluvial plain to the ocean. The Mad River turns north and flows along coastal bluffs for a couple of miles before flowing into the ocean. The last couple of miles are tidally influenced and make up the estuary.

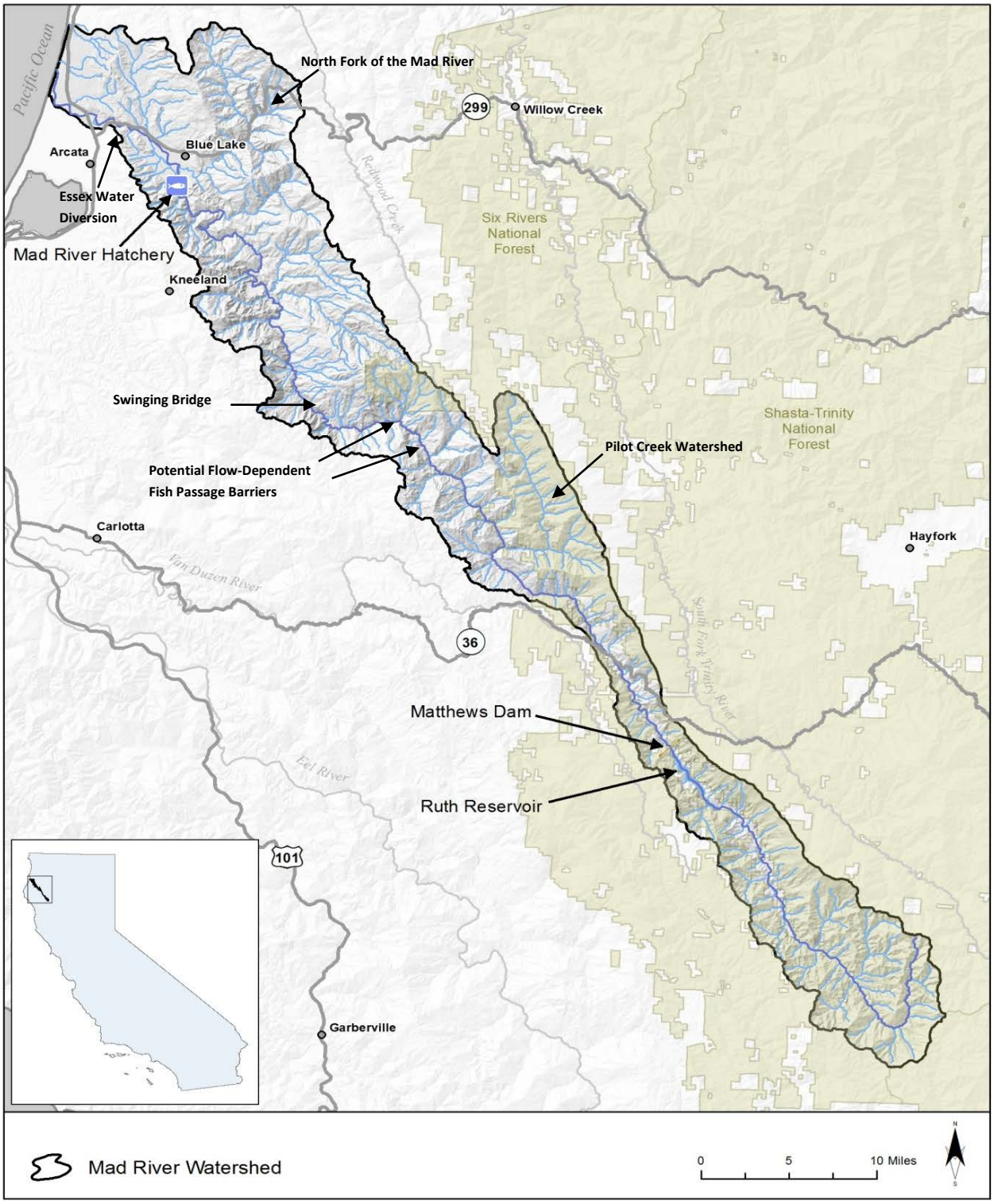

Figure 3-1. Map of the Mad River Watershed displaying the location of the Mad River Hatchery the potential fish passage barriers and Ruth Reservoir (Modified from CDFW 2014).

The majority of the Mad River watershed precipitation occurs during fall and winter storms. The magnitude and duration of the runoff events vary, but flows typically return to winter base flow levels within a week. The flood frequency curve (Figure 3) for the Mad River near Arcata, California (USGS gage 11481000), shows the wide range of flow events. The largest two events occurred on December 22, 1955 and 1964 at 80,000 and 81,000 cfs. Low flow information will be discussed in the Subsection 3.1 Water Quantity and Quality.

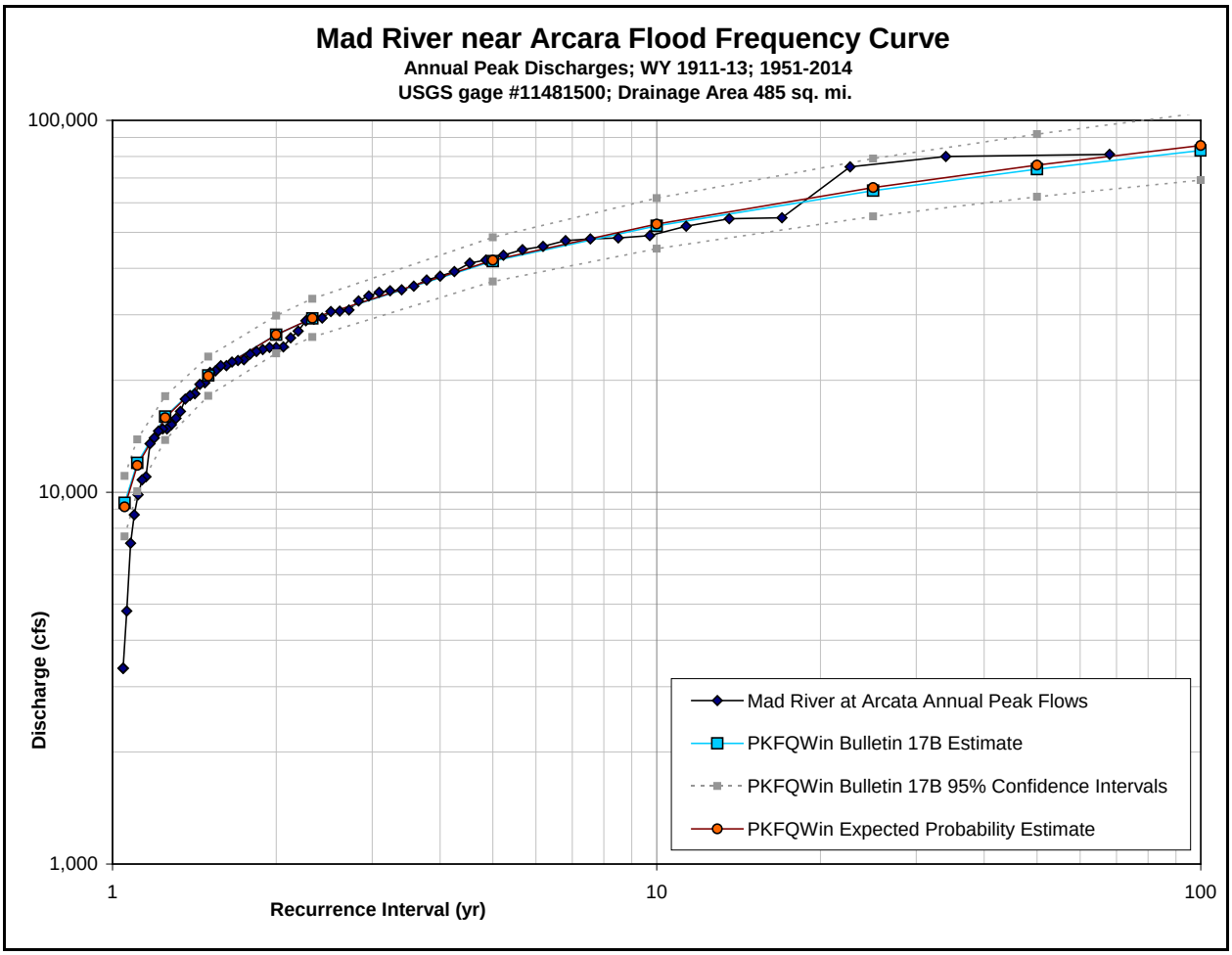

Figure 3-2. Flood frequency curve for Mad River near Arcata (USGS gage no. 11481000).

Mad River Hatchery Facilities Description

The following brief description of the Mad River Hatchery's (MRH) physical setting and facilities provides context for each resource's Affected Environment subsection and reduces redundancy. The MRH is located on the west side of the river approximately 2 miles (3.2 km) south of Blue Lake, California, and 10 miles (16.1 km) upstream from the mouth of the Mad River's confluence with the Pacific Ocean (Figure 3-1). The MRH is located on a fluvial terrace at the start of a broad alluvial valley (Figure 3-3). There are several tributaries located downstream of the MRH used by steelhead and salmon including the North Fork of the Mad River. The Mad River follows the general trace of the Mad River fault zone near the MRH.

Figure 3-3. Aerial photo of the Mad River Hatchery and worker residences.

The MRH has operated continuously since 1971, with the exception of the 2004/2005 season due to budget cuts. The MRH raised salmon and steelhead from around northern California and local resident trout. After the MRH reopened in 2005, operations focused solely on winter-run steelhead. The main hatchery facilities include: a well field, river pump station, a concrete weir (dismantled in 2012), a fish ladder (Figure 3-4), four adult holding ponds and a gathering tank, a spawning and incubation building, two aeration towers, a blower house, eight water filters, fish raceways (Figure 3-5), a diesel power generator, and several operation and residence buildings. There is a diesel generator to operate the wells and pumps in case of a power failure. This requires onsite diesel tanks to store up to 1,000 gallons which can provide backup power for approximately 70 hours (14 gallons per hour).

Figure 3-4. View looking down (a) and up (b) the fish ladder.

Figure 3-5. Rearing ponds or raceways.

Figure 3-6. Settling pond head works.

Figure 3-7. Outflow pipe and fishing access trail.

3.1. Water Quantity and Quality

Within the Mad River watershed streamflows are manipulated by the Humboldt Bay Municipal Water District's (HBMWD) operations and facilities including Matthews Dam and the Essex Diversion (Figure 3-1). Matthews Dam blocks approximately the upper 25 percent of the Mad River watershed. Typically, fall and early winter storm flows are captured in Ruth Reservoir and then released during the low flow season to supply municipal water supplies to the northern Humboldt County area. There are numerous private water diversions throughout the watershed that reduce tributary flows including an unknown number of illegal marijuana diversions.

The MRH operations (e.g., fish ladders, spawning, race ways, facilities cleaning, and residential homes use) use diverted Mad River water and groundwater from wells within the river terrace where the hatchery is located. After usage, the mix of water and waste effluent is discharged back to the river or into the ground. Although the diversion of Mad River water and extraction of groundwater and the return of waste water effluent occur within a small area (Figure 3-8), the water quantities and quality vary in magnitude, duration, frequency, and timing. In order to provide an informative affected environment description and environmental consequences assessment of the surface water and groundwater quantities used and returned to the river and water quality of the return water, a detailed but succinct description of the MRH's operations, flow pathways (Figure 3-8), methods and rates of surface water diversion and groundwater extraction, waste water filtration processes, Mad River flow quantities and quality, and the State of California water right permits, water quality standards, effluent discharge allowances, monitoring requirements, and the existing quantities and quality of MRH effluent discharges are presented. This information will be used to assess changes in pertinent water quality parameters and water quantities between water diversions and effluent discharges, and the how any changes in the water quantities and quality will affect the environment.

The primary components of the MRH (Figure 3-8) are the adult collection and spawning facilities (fish ladder, adult holding and spawning building), fish rearing facilities (incubation building and ten 100-foot long juvenile rearing ponds), and the water diversion, circulatory, and filtration systems (groundwater wells, Mad River diversion, aerators, filtration systems, settling ponds, wastewater return pipes, settling ponds, and associated plumbing). Under the current winter-run steelhead program, the MRH only requires two of the ten rearing ponds to raise fish.

The MRH draws water from a series of wells and the Mad River (Figure 3-8) to provide a continuous flow rate of approximately 11.6 cfs through the hatchery. At full production, the MRH used approximately 30 cfs (CDFW 2014). Groundwater is pumped into the system from a series of eighteen 12 inch diameter floodplain wells. The wells range in depth from 38 to 75 feet and each well's flow capacity ranges from 0.7 to 1.8 cfs. Currently, the MRH only uses water from four wells and the Mad River to run the winter-run steelhead program. The majority of the water is recirculated back through the rearing ponds after going through the biological filtration system. System water is continuously replaced at a 10 percent rate but flow replacement can increase to approximately 15 percent during pond and filter cleanings and fish treatment operations. Groundwater is primarily used for hatchery operations including broodstock holding, egg incubation, juvenile rearing, juvenile acclimation, adult passage into the facility, and general facility operations (e.g., cleaning). Well water is pumped into the main sump, aerator (No. 2), and the spawning and incubation building (Figure 3-8) by three pumps, each with a 10 cfs capacity. Water flows from the aerator (No. 2) to the head of the rearing ponds. Water that flows out of the rearing ponds can be diverted to supply the holding ponds or the fish ladder, discharged directly to the river, discharged to the setting ponds through the waste water line, and/or sent through the filtration system (Figure 3-8). Water can also be diverted at the midpoint of each rearing pond to aerator (No. 1) to re-oxygenate the water or discharge water to the settling basin or into the river (Figure 3-8). Fish wastes and wastewater generated during raceway cleaning and filter backwashing is discharged to settling ponds i.e., two evaporation/percolation ponds (Figure 3-8).

Diverted Mad River water is pumped (Figure 3-8) up to the adult holding and spawning facilities. The majority of the river water returns to the river through the fish ladder (Figure 3-8, discharge point 1) and the spawned fish return (Figure 3-8, discharge point 2). MRH runs 1.45 cfs of Mad River water down the 17-step fish ladder (Figure 3-8) to attract adult steelhead during the spawning season (generally January to March).

The MRH can reuse up to 84 percent of the rearing pond water by recycling up to 38 cfs of effluent water through ponds filled with four feet of crushed rock and oyster shells. The convoluted surfaces of the oyster shells provide habitat for bacteria that clean the water. The recycled water is then sterilized using ultraviolet light at the beginning of each raceway. The surplus rearing pond water flows into a settling basin and percolates through the gravel back into

the floodplain or flushes through a wash box and returned directly to the river. During the height of fish production, approximately 9.1 cfs is discharged from the rearing ponds into the settling basin. Currently, the filter beds are only being used to move water through to the settling ponds where the water is filtered as it settles through the substrate.

Wastewater is discharged directly to the Mad River at four locations and percolated into the groundwater at the settling ponds (Figure 3-8). Well water from the rearing ponds and Mad River water enter the holding ponds and then flow down the fish ladder into the river (Figure 3-8, discharge point 1). From December 1 to April 1, approximately 1.7 cfs of water from the rearing ponds is passed through the adult fish holding tanks and discharged down the fish ladder directly into the river.

Well water used in the spawning house to hold broodstock in small tanks, incubate eggs, and rinse the floor after spawning is discharged at an approximately 0.8 cfs directly into the Mad River (Figure 3-8, discharge point 2) during the period of December 1 through May 15. The floor rinse water contains egg incubator overflow water and floor wash water with small amounts of carbon dioxide (CO_2) and other drugs used to anesthetize steelhead before spawning.

The MRH can discharge 2.8 cfs from the rearing ponds to allow yearling steelhead to swim from MRH rearing ponds directly to the river (Figure 3-8, discharge point 3). This event occurs between March 15 and April 15.

Water overflowing aerator (No. 1) and flowing out of the wash box flows into the Mad River (Figure 3-8, discharge point 4). There are no estimates of the quantities of flow that occur during overflow spills.

Flows up to 9.1 cfs carry waste material from the rearing ponds and cleaning activities to the settling ponds (Figure 3-8). The settling ponds allow floodplain sediments to filter out the metabolic waste, unconsumed food, algae, silt and detritus.

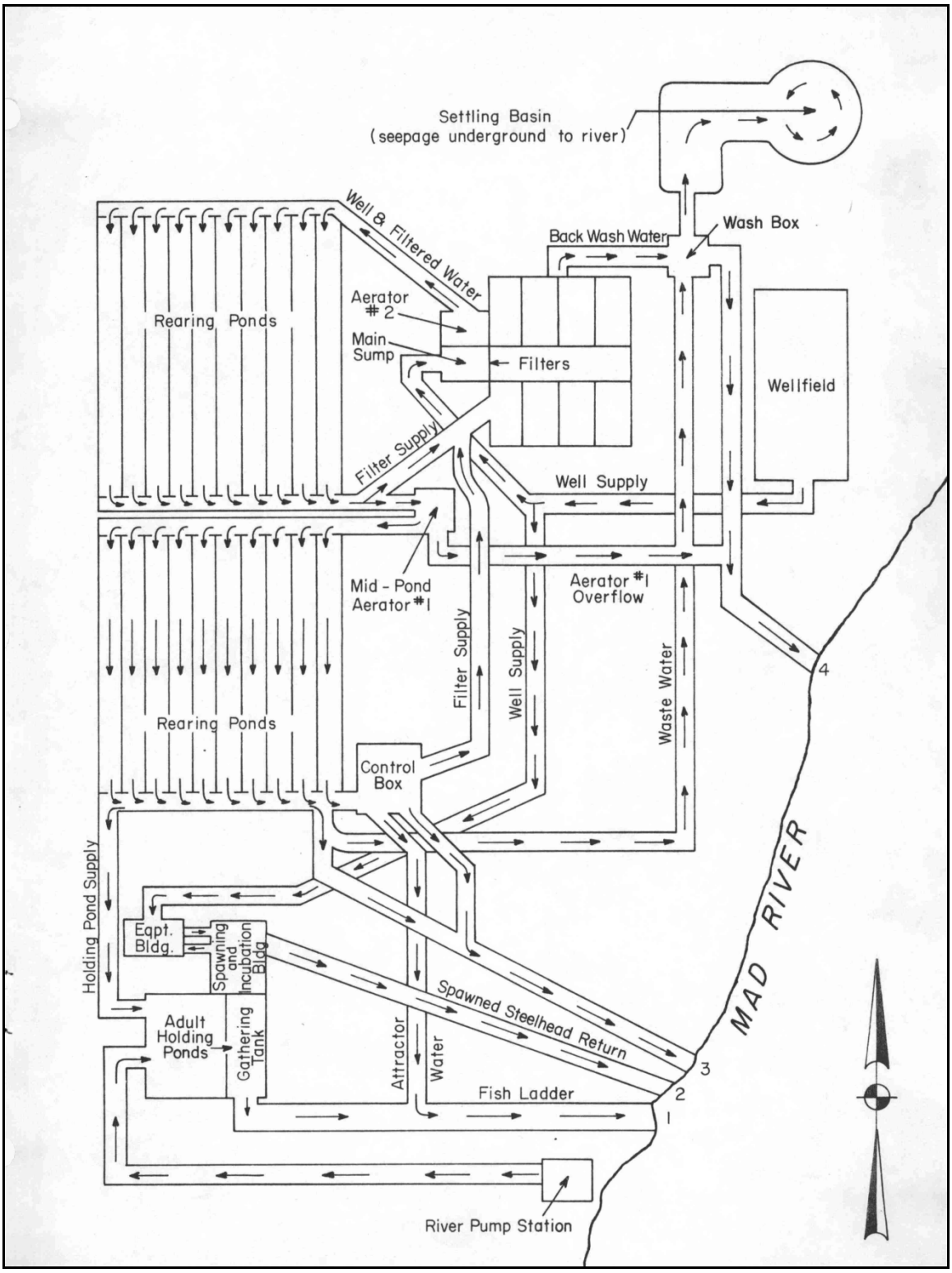

Figure 3-8. Schematic of the MRH water system (Modified from Will 1971).

The Federal Clean Water Act (CWA, 33 U.S.C. §1251 et seq. 1972), administered by the U.S. Environmental Protection Agency and state water quality agencies, establishes the structure for protecting surface water quality and regulating pollutant discharges. The basic structure consists of point source discharge regulation and the establishment and regulation of surface water quality standards including identification of waters not obtaining the standards and processes to obtain those standards. Each state implements and carries forth Clean Water Act provisions including: 1) establishing water quality standards necessary to support all beneficial uses, including protection of public health, recreational activities, aquatic life, and water supplies, 2) identifying waterbodies not meeting water quality standards or not supporting their beneficial uses after implementation of technology-based effluent limitations on point sources, 3) identify the pollutants or stressors causing impairment, 4) establish a water quality control plan and schedule to address the impairments, and 5) establishing total maximum daily load (TMDL) allocations for rivers, lakes, and streams with impairments, and 6) reviewing, approving, and monitoring compliance of National Pollutant Discharge Elimination System (NPDES) applications or permits.

The State Water Resources Control Board oversees the North Coast Regional Water Quality Control Board (NCRWQCB) which is responsible for carrying out the provisions of the Clean Water Act within the Mad River Watershed. The NCRWQCB is responsible for establishing water quality standards, making and enforcing water quality rules, and operating waste discharge permit programs.

The Clean Water Act water quality standards consist of four parts: designated uses, water quality criteria to protect the designated uses, an anti-degradation policy, and general policies (mixing zones, variance, and low flow policies). The State of California uses slightly different language for these first three water quality standards components, beneficial uses, water quality objectives, and a non-degradation policy. These standards protect the beneficial uses of the State's waters.

The Water Quality Control Plan for the North Coast Region (Basin Plan, NCRWQCB 2007), as amended (NCRWQCB 2011), provides a program of actions designed to preserve and enhance water quality and to protect beneficial uses of water in the North Coast Region. The Basin Plan establishes beneficial uses, water quality objectives for the Mad River, implementation plans for point source and nonpoint source discharges, prohibitions, statewide plans and policies, and water quality objectives. The pertinent beneficial uses and water quality objectives relative to the MRH are outlined in (NCRWQCB 2011). Of particular interest to the MRH is the cold freshwater habitat beneficial use which includes the "uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates" (NCRWQCB 2011).

Table 3-1. Water Quality Objectives for the Mad River (NCRWQCB 2011).

Parameter	Water Quality Objectives
Suspended Material	Waters shall not contain suspended material in concentrations that cause nuisance or adversely affects beneficial uses.
Settable Solids	Waters shall not contain substances in concentrations that result in deposition of material that causes nuisance or adversely affect beneficial uses.
Sediment	The suspended sediment load and suspended sediment discharge rate of surface water shall not be altered in such a manner as to cause nuisance or adversely affect beneficial uses.
Turbidity	Turbidity shall not be increased more than 20 percent above naturally occurring background levels. Allowable zones of dilution within which higher percentages can be tolerated may be defined for specific discharges upon the issuance of discharge permits or waiver thereof.
Temperature	

The NCRWQCB (2011) listed the Mad River under section 303(d) as impaired for sedimentation/siltation, temperature and turbidity. TMDLs establish the maximum pollutant quantity of a pollutant that can be discharge from all sources without exceeding a water quality standard and determine waste load allocations for point and nonpoint sources. The EPA (2007) established Mad River TMDL allocations for sediment and turbidity as no net increase greater than 20 percent over background (Table 3-2). Turbidity in the Mad River was found to be almost entirely derived from suspended sediment. Therefore, suspended sediment was used as a stand alone measure and as a surrogate for turbidity. The Mad River Sediment Source Assessment (GMA 2007) and the TMDL (EPA 2007) established background suspended sediment levels and concluded that the majority of the watershed's suspended sediment derived from diffuse, nonpoint sources. The TMDL (EPA 2007) identified the MRH as a point source and specified waste load allocations for total suspended solids (i.e., suspended sediment) of 0.0004994 pounds per cubic foot (8 mg/l) and for settleable solids of 0.0000062 pounds per cubic foot (0.1 mg/l) (Table 3-). Based on the "Severity of Ill Effects" concentration/ duration model (Newcombe and Jenson 1996; Bray 2000) commonly used by NMFS to assess baseline conditions and the effects of proposed actions to aquatic organisms and listed species and the assessment of Mad River existing conditions and severity of ill effects exceedences (GMA 2007), NMFS finds that these permitted suspended sediment concentrations are very low.

Table 3-2. Total Maximum Daily Loads for the Mad River (NCRWQCB 2007).

Parameter	Total Maximum Daily Loads
Sediment	120 percent of the natural sediment (bedload and suspended sediment) loading
Turbidity	120 percent of the natural suspended sediment loading or 90 percent of the sediment loading

Table 3-3. NPDES permit # CA0006670 standards for Mad River Hatchery effluent discharges.

Parameter	Unit	Monthly Average	Maximum
Suspended Solids	lbs/ft^3 (mg/l)	0.0004994 (8.0)	0.0009364 (15.0)
Suspended Solids	lb/day	138	259
Settleable Solids	lbs/ft^3 (mg/l)	0.0000062 (0.1)	0.0000125 (0.2)
Hydrogen Ion	pH	6.5 - 8.5	
Flow	cfs	11.6	--------

The principal mechanism the NCWRQCB uses to ensure the MRH meets the water quality standards (NCRWQCB 2011) and protects the beneficial uses is a NPDES permit. MRH is not a major discharger as defined in 40 CFR 122.2. The NPDES permits set wastewater limits necessary to meet the water quality standards outlined in the Basin Plan and TMDL allocations. The MRH currently operates under the NPDES permit No. CA0006670, Order No. R1-2005-0036 (NCRWQCB 2005a) and associated Monitoring and Reporting Program (https://ciwqs.waterboards.ca.gov/ciwqs). The NPDES permit wastewater discharge allowances are outlined in Table 3-3. The current NPDES permit requires that monthly MRH effluent discharges average 11.6 cfs or less from October 1 through May 15 (Table 3-2). In addition, the Basin Plan requires MRH waste discharges be less than or equal to 1 percent of the Mad River streamflow at the USGS Gage near Arcata, CA. (No. 11481000), and prohibits all wastewater discharge from May 15 through September 30 (NCRWQCB 2011). Although not clearly defined in the Basin Plan or the NPDES permit No. CA0006670 (NCRWQCB 2005b), NMFS assumes the NCRWQCB meant to compare the MRH waste discharges to the Mad River mean daily average streamflow.

In the future, the NCRWQCB proposes to permit the MRH under the draft General NPDES permit No. CAG131015, Order No. R1-2015-0009 (NCRWQCB 2015) for cold water concentrated aquatic animal production facility discharges to surface waters. The differences between the proposed NPDES permit and the existing will be discussed in the Environmental Consequences Chapter, Subsection Water Quantity and Quality, Alternative 2, Proposed Action/Preferred Alternative.

Table 3-2. Permitted Effluent discharges and timelines.

Effluent Discharge	**Monthly Average** (cfs)	**Maximum Discharge** (cfs)	**Permitted Timeline**
Fish Ladder (#1 Figure 3-X)	-	1.7	December 1 to April 1
Spawned Salmon Return (#2 Figure 3-X)	-	0.8	December 1 through May 15
Rearing Ponds Outflow (#3 Figure 3-X)	-	2.8 1.7	March 15 and April 15 December 1 to April 1
Settling Ponds Overflow (#4 Figure 3-X)	-	NA	NA
Total Effluent Discharge	11.6	1 percent of Mad River Flow	October 1 through May 15
Discharge Prohibition	0	0	May 15 through September 30

In addition to the NCRWQCB's water quality regulatory processes described above, the California Toxic Rule (CTR, 40 CFR Part 31) establishes numeric water quality criteria for priority toxic pollutants and other water quality standard provisions, and Division 4 Title 22 of the California Code of Regulations establishes maximum containment levels for various toxins to protect drinking water. The NCRWQCB requires the MRH to provide data on all CTR and Title 22 constituents so pertinent effluent regulations can be included in the NPDES permit.

Based on responses to a NCRWQCB Order (2013), hatcheries within the North Coast Region listed the following chemicals and aquaculture drugs used for the treatment and control of disease and anesthesia: oxytetracycline, penicillin G, florfenicol, amoxicillin trihydrate, erythromycin, Romet, formalin, PVP iodine, hydrogen peroxide, potassium permanganate, copper sulfate, sodium chloride, acetic acid, and chloramine-T, MS-222, sodium bicarbonate, carbon dioxide, and Aqui-S. The use of these chemicals and drugs within the hatchery could result in the release of antibiotics, fungicides, disinfectants, and other agents into the surface water and groundwater. The MRH is prohibited from discharging detectable levels of chemicals used for cleaning activities and the treatment and control of disease other than sodium chloride (NCRWQCB 2005).

CDFW monitors MRH water usage and effluent discharges and provides monthly NPDES reports to the NCRWQCB. CDFW currently monitors effluent for ammonia, organic nitrogen, total phosphorus, biological oxygen demand, pH, salts, and suspended and settable solids (https://ciwqs.waterboards.ca.gov/ciwqs). The NPDES Permit No. CA0006670 mandates continuous flow monitoring and daily temperature measurements at the four discharge locations, weekly flow measurements in the fish ladder, and spawning house effluent measurements during

floor cleaning operations for pH, turbidity, suspended solids (Table 3-3) , settle-able matter, and residue in solution. Furthermore, no more than 10 percent of critical life stage, chronic toxicity bioassay determinations can produce statistically significant deleterious effects on test organisms from undiluted effluent exposure, in any calendar year.

Table 3-3. Mad River water quality monthly monitoring data (https://ciwqs.waterboards.ca.gov/ciwqs).

Period of Record	Number of Monitoring Reports	Total Suspended Solids [a] (mg/l)	Net Turbidity [a] (NTU)	pH [b]
April 2007–November 2008	18	3.7	1.9	7.1

[a] Maximum value during period of the record. Value is waste water discharge minus receiving water.

[b] pH measured in the Mad River downstream of the hatchery.

The California State Water Resources Control Board oversees the surface water right permitting and licensing process. Groundwater extraction is unregulated in the State of California. A water right is a legal entitlement authorizing water to be diverted from a specified source and put to a beneficial, non-wasteful use. CDFW is permitted by the California State Water Resources Control Board to divert up to 30 cfs from the Mad River under permit No. S012962_01 (active) and 20 cfs under permit No. S015504_01 (inactive). Although CDFW is permitted to withdraw up to 30 cfs which could run the MRH at full capacity (all ten raceways), the MRH is only permitted under their NPDES permit to discharge a monthly average of 11.6 cfs of effluent. Therefore, based on the 10 to 15 percent replacement rate and well withdrawal rates presented earlier from the MRH HGMP (CDFW 2014), NMFS assumes on a monthly average that the MRH withdrawals approximately 5.0 cfs from the four wells and approximately 6.6 cfs from the Mad River. The total water withdrawal and well to river ratio will vary depending on operational needs and permitted quantities. In particular, the NCRWQCB (2007) requires that MRH's Mad River water withdrawal is less than 1 percent of the flow at the U.S. Geological Survey's (USGS) streamflow gaging station, Mad River near Arcata, CA (No. 11481000) during the permitted operation period, October 1 through May 15 (Table 4).

The period of record for the USGS's streamflow gaging station, Mad River near Arcata, CA (No. 11481000), extends from water year (October 1 to September 30) 1910 to 1913 and 1950 to present. Streamflow is regulated 68 miles upstream of the gaging station at Humboldt Municipal Water District's Mathews Dam. Water is captured in Ruth Reservoir during fall and winter storms and released during the low flow periods for municipal supply and industrial use in the Humboldt Bay area. Dam release water is diverted approximately 0.25 mile upstream of the USGS gaging station, and therefore 1.5 miles downstream of the MRH. The Humboldt Bay Municipal Water District releases the majority of water stored in Ruth Reservoir during the prohibited Mad River water withdrawal period, May 15 to September 30. A flow duration curve for the USGS's Mad River near Arcata gage (Figure 3-9) for the annual permitted effluent period

shows that the Mad River is less than 116 cfs and 53 cfs, 18.3 and 9.4 percent of the days during the gage's period of record. The first flow value (116 cfs) relates to the flow necessary for the MRH to release the total permitted effluent discharge of 11.6 cfs while meeting the 1 percent of the allowed total effluent discharge requirement (Table 3-2). The second value (53 cfs) represents the Mad River discharge necessary if the MRH discharges the maximum permitted effluent discharges outlined in Table 3-2 while meeting the 1 percent of the allowed total effluent discharge requirement. CDFW continuously monitors effluent discharges.

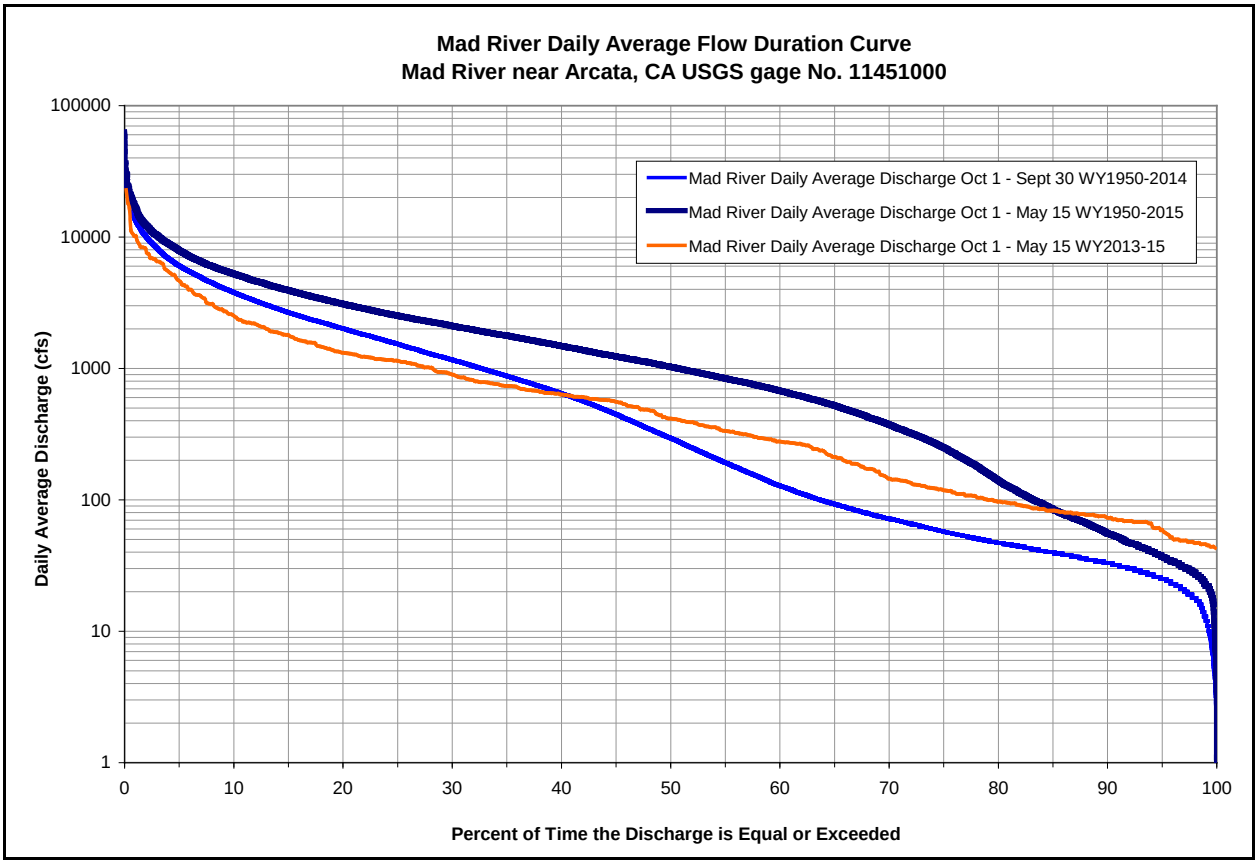

Figure 3-9. Mad River flow duration curves for the USGS's Mad River near Arcata, California gage (No. 11481000).

3.2. Salmon and Steelhead

Since 1999, NMFS has identified two salmon ESUs—Southern Oregon/Northern California Coast (SONCC) coho salmon and Coastal California (CC) Chinook salmon—and one DPS of steelhead (Northern California (NC) steelhead) in the analysis area that require protection under the ESA. No other salmon ESUs and steelhead DPS are found in the analysis area. Critical habitat for SONCC coho salmon, CC Chinook salmon, and NC steelhead is found in the analysis area. Table 3-4 summarizes which salmon and steelhead are in the analysis area.

Table 3-4. The scientific name, listing status under the ESA, Federal Register notice citation, and geographic distribution of the salmon and steelhead ESUs and DPS in the project area.

	SONCC Coho Salmon ESU	NC Steelhead DPS	CC Chinook Salmon ESU
Scientific Name	*Oncorhynchus* (*O.*) *kisutch*	*O. mykiss*	*O. tshawytscha*
Listing Status	Threatened	Threatened	Threatened
Federal Register Notice	June 28, 2005; 70 FR 37160	ESU listed on June 7, 2000 (65 FR 36074) Relisted as DPS January 5, 2006 (71 FR 834)	June 28, 2005; 70 FR 37160
Geographic Distribution	From Cape Blanco, Oregon, to Punta Gorda, California	From Redwood Creek (Humboldt County), southward to, but not including, the Russian River	From Redwood Creek (Humboldt County) south to, and including, the Russian River
Critical Habitat Designation	May 5, 1999; 64 FR 24049	September 2, 2005; 70 FR 52488	September 2, 2005 70 FR 52488

The MRH began operations in 1971, for the purpose of increasing recreational and commercial fishing for Chinook salmon, coho salmon, and steelhead (CDFW 2014). Neither the Chinook salmon or coho salmon programs were considered successful and were finally ended in 2000. The MRH winter steelhead program has been one of the most successful programs in California in terms of providing a viable recreational fishing opportunity. Adult return numbers to the MRH (Table 3-7) provide rough estimates of the hatchery-origin return numbers. The Mad River is consistently the most popular program in terms of the number of days anglers spend angling and the harvest rate of hatchery-origin steelhead CDFW 2014).

Table 3-7. Adult steelhead and Chinook and coho salmon return numbers to Mad River Hatchery for collection seasons 1971/1972 through 2013/2014 (modified from CDFW 2014).

Season	**Coho**	**Chinook**	**Steelhead***	**Season**	**Coho**	**Chinook**	**Steelhead***
1971/1972	337	323	42	1993/1994	39	11	5,591
1972/1973	466	1,036	52	1994/1995	74	67	11,118
1973/1974	327	495	2,872	1995/1996	12	56	11,520

1974/1975	160	231	2,138	1996/1997	259	64	8,713
1975/1976	2,103	278	190	1997/1998	40	7	1,807
1976/1977	1,193	661	658	1998/1999	13	40	2,364
1977/1978	648	250	1,317	1999/2000	20	50	3,085
1978/1979	577	246	2,190	2000/2001	17	11	1,399 (11)
1979/1980	352	145	1,411	2001/2002	13	52	5,893 (238)
1980/1981	503	86	730	2002/2003	9	11	4,519 (54)
1981/1982	135	251	442	2003/2004	No trapping		
1982/1983	622	900	1,087	2004/2005	0	1	1,880 (15)
1983/1984	87	437	838	2005/2006	0	1	1,671 (19)
1984/1985	24	82	1,015	2006/2007	0	0	1,528 (12)
1985/1986	45	275	753	2007/2008	1	0	3,005 (1)
1986/1987	324	299	13,833	2008/2009	0	0	305 (2)
1987/1988	953	846	4,303	2009/2010	0	0	2,441 (5)
1988/1989	845	242	2,529	2010/2011	0	0	4,846 (70)
1989/1990	256	46	1,027	2011/2012	0	0	3,948 (133)
1990/1991	92	1	915	2012/2013	0	0	3,118 (21)
1991/1992	37	10	3,463	2012/2013	0	0	3,192 (22)
1992/1993	67	27	7,497	2013/2014	0	0	1,841 (19)

*MRH fish had their adiposed fin clipped starting during the 1998/1999 season. The values with in the paraphrases represent unclipped adult steelhead numbers.

The origin of the broodstock for the MRH has been primarily the Mad River; however, eggs from the South Fork Eel River were also hatched, reared, and released into the Mad River during the first 3 years of the program (1971, 1972, and 1973) (CDFW 2014). In addition, Skamania-stock summer steelhead from the Washougal River were also released at MRH in 1971, 1973, and 1980 (CDFW 2014). The summer steelhead program was ended in 1996, because of poor returns (CDFW 2014).

The winter steelhead program at MRH is an integrated program (HRSG 2005, CHRSG 2012) that is intended to augment recreational fishing opportunities with a potential secondary benefit of providing a repository for steelhead in the case of a stochastic event that would dramatically decrease the size of the natural Mad River population. The program is integrated with the natural population in the Mad River because it is unfeasible to separate the hatchery and wild population. Since NC steelhead were listed under the ESA, the CDFW has implemented a number of measures to reduce the impacts of the MRH steelhead program on natural-origin steelhead. These include:

(1) Marking 100 percent of the hatchery steelhead with an adipose fin clip to allow the identification of hatchery fish in the fishery, at the hatchery, and on the spawning grounds;

(2) Reducing steelhead production from 250,000 smolts released to 150,000;
(3) Increasing the effective population size of the hatchery broodstock to reduce the risk of inbreeding depression by splitting the eggs from each female into two lots and fertilizing each lot with 1 male;
(4) Increasing the time of broodstock selection and spawning based on a bell-shaped curve that distributes the spawning throughout the complete run, and;
(5) Increasing the number of natural fish used for broodstock.

Hatchery programs have the potential to adversely affect natural-origin salmon and steelhead and their habitat through genetic risks, competition and predation, hatchery facility effects, incidental fishing effects, and disease transfer. The general mechanisms through which integrated hatchery programs can affect natural-origin salmon and steelhead populations are described in Table 3-5.

Table 3-5. General mechanisms by which integrated hatchery programs may affect natural-origin salmon and steelhead populations.

Effect Category	Description of Effect
Genetic Risks	• Interbreeding with hatchery-origin fish can adversely change the genetic character of the local steelhead populations. • Interbreeding with hatchery-origin fish may reduce the reproductive performance of the steelhead populations.
Competition and Predation	• Hatchery-origin fish can increase competition for food and space. • Hatchery-origin fish can increase predation on natural-origin salmon and steelhead.
Hatchery Facility Effects	• Hatchery facilities can reduce water quantity or quality in adjacent streams through water withdrawal and discharge. • Weirs for broodstock collection can have the following unintentional consequences[1]: • Limiting or slowing movement of migrating fish species, which may enable poaching or increase predation • Alteration of streambed and riparian habitat • Alteration of the distribution of spawning within a population • Increased mortality or stress due to capture and handling

Effect Category	Description of Effect
	• Impingement of downstream migrating fish • Forced downstream spawning by fish that do not pass through the weir
Incidental Fishing Effects	• Fisheries targeting hatchery-origin fish have incidental impacts on natural-origin fish.
Disease Transfer	• Hatcheries may have increased risk of disease because of crowded and stressful conditions. When hatchery-origin fish are released from the hatchery facilities, they may increase the disease risk to natural-origin salmon and steelhead.

[1] There is no weir at the MRH; however, weirs may be used in the future to collect broodstock in tributaries. There is no plan to use weirs at the present time, but this is included as an option if it becomes necessary to achieve broodstock goals or if monitoring information suggests the number of hatchery-origin fish on the spawning grounds should be controlled.

3.2.1. Genetic Risks

As described in section 3.3, CDFW operates the MRH as an integrated program. As such, there is a genetic risk to the natural-origin steelhead population if hatchery-origin fish spawn with natural-origin fish. The hatchery does not currently operate a weir to collect broodstock or otherwise manage adult numbers, so a substantial number of hatchery-origin steelhead have been observed on natural spawning grounds (Sparkman 2002, 2003). Prior to a reduction in the number of juveniles released (250,000) to the current 150,000, Zuspan and Sparkman (2002) observed that approximately 88% of the total steelhead population in the Mad River. They determined that approximately 62% of the steelhead entering Cañon Creek (5 miles upstream of the hatchery) on the Mad River were comprised of hatchery-origin fish and 25% of the steelhead observed at a weir upstream approximately 27 miles from the hatchery were hatchery-origin fish (Zuspan and Sparkman 2002). As such, the number of hatchery fish that are observed on spawning grounds apparently declines as the distance from the MRH increases. Recent monitoring of the proportion and number of hatchery-and natural-origin steelhead in the Mad River suggests a higher proportion of natural fish now make-up the total Mad River steelhead population (~60%) as compared to those earlier studies (~88%) (CDFW unpublished data, 2015). This may be a result of a reduction in the number of steelhead juveniles released from the hatchery, a slight increase in the number of natural-origin steelhead in the Mad River, or both.

Spence et al. (2008) suggested that the genetic risk to natural-origin steelhead from the Mad River Hatchery program was high given past use of steelhead from the Eel River for broodstock.

Busby et al. (1996) cited evidence that MRH steelhead clustered genetically closer to Eel River stocks than other nearby stocks near the Eel River (e.g., Humboldt Bay), suggesting that there may be remnant genetic effects (1971-1973) from those early broodstock transfers. However, Reneski (2011) demonstrated differences between contemporary hatchery-origin fish and contemporary natural-origin fish, historical hatchery-origin fish, and historical natural-origin fish and found little evidence that the historical Eel River integration was still genetically evident in the contemporary hatchery stock. In addition, Reneski (2011) determined that a significant divergence between the contemporary hatchery and natural stock exists despite significant numbers of hatchery-origin fish being found on the spawning grounds. This suggests that (1) the divergence between the hatchery and natural stock was likely a result of a low rate of natural fish incorporation into the hatchery broodstock and subsequent genetic drift of the hatchery stock from the natural stock and (2) low production of hatchery fish on the natural spawning grounds. Therefore, Reneski (2011) recommended increasing the use of natural fish into the hatchery broodstock to minimize divergence.

In 2004, the Hatchery Scientific Review Group (HSRG) released its recommendations for hatchery reform (HSRG 2004). While not addressing the MRH program specifically in their guidelines, the HSRG recommended that integrated hatchery programs affecting primary populations have a Proportionate Natural Influence (PNI) of 0.67 (HSRG 2009). In 2012, the California HRSG released its recommendations and recommended a PNI of 0.50 (CAHRSG 2012). Because the CDFW proposes a PNI goal of 0.67 and minimum PNI of 0.50, the proposed action would increase PNI to these levels. PNI has ranged from 0-50% over the last 10 years. Because of the decreasing influence of hatchery fish on the spawning grounds with increased distance from the hatchery, NMFS assumes that the genetic risk from the MRH program is low and will decrease over time because PNI is increasing. Salmon do not interbreed with steelhead so there is no genetic risk to salmon from the MRH steelhead program.

3.2.2. Competition and Predation

The MRH program releases steelhead at the yearling smolt stage, and they have the potential to compete with or prey on other salmon and steelhead (Table 3-6).

Table 3-6. Ecological relationship between hatchery-origin steelhead and natural-origin salmon and steelhead in the analysis area ("X" indicates interaction).

	Ecological Relationship with Hatchery-origin Steelhead			**Location of Ecological Interaction**		
Species	**Predator of Hatchery-Origin Steelhead**	**Competitor with Hatchery-Origin Steelhead**	**Prey of Hatchery-Origin Steelhead**	**Freshwater**	**Estuary**	**Marine**

Fall Chinook Salmon			X	X	X	Unknown, but also unlikely
Winter Steelhead		X		X	X	Unknown, but also unlikely
Summer Steelhead		X		X	X	Unknown, but also unlikely
Coho Salmon		X		X	X	Unknown, but also unlikely

Hatchery-origin steelhead smolts may compete with natural-origin steelhead, Chinook salmon, and coho salmon smolts in the freshwater and estuary areas because they are similar in size and would likely eat similar prey (Table 3-6). However, based on the discussion below which suggests hatchery steelhead residence time in freshwater is short and foraging opportunities are low because of high turbidities and flows during release, the competition between hatchery steelhead smolts and other salmon and natural steelhead in the river and estuary is likely low. Competition between hatchery-origin steelhead smolts and natural-origin salmon and steelhead smolts is not expected to occur in the marine areas because, once steelhead smolts enter the marine environment, the fish tend to move directly offshore into areas where steelhead are dispersed and not present in numbers that would contribute to density-dependent effects (Hartt and Dell 1986; Light et al. 1989).

Hatchery-origin steelhead smolts may prey upon juvenile Chinook salmon fry that are encountered in freshwater during downstream migration. However, the hatchery typically releases fish during higher than average flow events and turbidity so foraging ability of outmigrating steelhead is significantly reduced. Coho salmon and steelhead fry are not expected to be present when hatchery smolts are released in March and April because they have not yet emerged from redds. Some reports suggest that hatchery fish can prey on fish that are up to 1/2 their length (Pearsons and Fritts 1999; HSRG 2004), but other studies have concluded that salmonid predators prey on fish 1/3 or less their length (Horner 1978; Hillman and Mullan 1989; Beauchamp 1990; Cannamela 1992). Therefore, we expect that older juvenile coho salmon and steelhead will be larger than what steelhead could effectively prey upon. Hatchery steelhead that do not emigrate and instead take upstream residence near the point of release (residuals) have the potential to prey on rearing natural-origin juvenile fish over a more prolonged period (Tipping 1997). However, Sparkman (2002) determined that steelhead released from MRH rapidly emigrate from the Mad River. In that study, 205 steelhead smolts were immediately captured in

downstream migrant traps out of a release of 225,000. However, no hatchery fish were captured after four weeks post-release suggesting residualization was low.

Therefore, the risk of hatchery-origin steelhead predation on natural-origin juvenile fish in freshwater and the estuary is dependent upon three factors: (1) the hatchery fish and their potential natural-origin prey must overlap temporally; (2) the hatchery fish and their prey must overlap spatially; and (3) the prey should be less than 1/3 the length of the predatory fish. Based on comparative fish sizes and timings, steelhead smolts that would be released through the hatchery program would have spatial and temporal overlap in freshwater and the estuary with a portion of the smaller Chinook salmon fry population. When combined with occurrence overlap, the large average size of the early-winter steelhead smolts poses a risk for predator-prey interactions in freshwater and the estuary for Chinook salmon fry. It is unknown whether these predation risks continue after the species have emigrated and dispersed in marine areas. However, hatchery steelhead enter the ocean earlier (March, April, May) than most Chinook salmon (June, July) and Chinook salmon would have grown substantially in that short time. Additionally, steelhead have a much greater diversity and abundance of forage available in the ocean. Chinook salmon grow rapidly after ocean entry which likely makes them subject to predation for only a short time, if at all. Therefore, the risk of steelhead predation on Chinook salmon juveniles is likely to be low for the following reasons: (1) due to rapid growth, natural-origin salmon are better able to elude predators and are accessible to a smaller proportion of predators due to size alone; (2) because juvenile salmon disperse soon after entering seawater, they are present in low densities relative to other fish species and forage (e.g., juvenile herring, krill); and (3) there has either been learning or selection for some predator avoidance by Chinook salmon since their emergence from redds (Cardwell and Fresh 1979).

3.2.3. Hatchery Facility Effects

Operating hatchery facilities can impact instream fish habitat in the following ways: (1) reduction in available fish habitat from water withdrawals; (2) reduction of water quality from hatchery discharge, (3) operation of instream structures (e.g., water intake structures, fish ladders, and weirs), or (4) maintenance of instream structures (e.g., protecting banks from erosion or clearing debris from water intake structures).

Water withdrawals may affect instream fish habitat if they reduce the amount of water in a river between the hatchery's water intake and discharge structures. A full discussion of the effects of water withdrawal can be found in Subsection 3.1, Water Quantity. The effect of the MRH water withdrawal on instream habitat for salmon and steelhead in the Mad River is expected to be negligible.

Hatchery discharge may affect water quality for salmon and steelhead if it increases water temperature, reduces dissolved oxygen, or adds elements that are toxic to salmon and steelhead.

A full discussion of the effects of hatchery discharge can be found in Subsection 3.1, Water Quality.

The MRH steelhead program does not currently use a weir to collect broodstock and/or manage adult returns. However, weirs may be used in the future in tributary streams if all other natural broodstock collection methods do not provide adequate numbers of fish. NMFS assumes that any weir placed as part of the MRH program would be compliant with the most current NMFS criteria for fish passage. In addition, operation of any weir is expected to be of limited duration and not encompass the duration of the run timing. The weirs that would be used are expected to be portable and temporary pipe-type weirs that would require almost no modification of the streambed or riparian habitat for their placement. A weir is a barrier to fish movement. The biological risks associated with weirs include the following:

- Isolation of formerly connected populations
- Limiting or slowing movement of non-target fish species
- Alteration of stream flow
- Alteration of streambed and riparian habitat
- Alteration of the distribution of spawning within a population
- Increased mortality or stress due to capture and handling
- Impingement of downstream migrating fish
- Forced downstream spawning by fish that do not pass through the weir
- Increased straying due to either trapping adults that were not intending to spawn above the weir, or displacing adults into other tributaries

By blocking migration and concentrating salmon into a confined area, weirs may also increase predation efficiency of mammalian predators. However, any weirs used on tributaries to the Mad River are expected to be conducted upstream of seals and sea lions and operated with complete 24-hour coverage by CDFW personnel. Because of the limited temporal and spatial use of weirs, the types of weirs used, and their 24-hour coverage, the risk of the potential effects described above is expected to be negligible.

3.2.4. Fisheries

Implementation of mark-selective fishing rules for steelhead began in California in the 1990s. Under selective fishing rules, anglers in the Mad River have only been able to retain steelhead with a clipped adipose fin. One hundred percent of the MRH-origin fish are adipose-clipped. The fisheries targeting hatchery-origin steelhead generally start in November and end by late

March. Cool water temperatures during those months minimize incidental mortality on listed natural-origin steelhead that are caught and released[2].

Prior to the 1990s, hatchery-origin steelhead were not mass-marked with an adipose fin clip. Therefore, anglers could not easily differentiate between natural-origin and hatchery-origin steelhead. However, since the MRH is located in the lower Mad River where access is easiest and fishing is focused nearest the hatchery where hatchery steelhead tend to congregate before entering the hatchery, more hatchery steelhead are hooked as compared to natural steelhead (CDFW 2015).

Table 3-7 shows incomplete catch data from the CDFW Steelhead Report Card for the years 2006-2011, but these data are incomplete because the angler rate of return of cards is poor. This has recently been addressed through implementation of mandatory reporting and restrictions on fishing and issuing of fines if cards are not returned each year. It should be noted that the CDFW Steelhead Report Card annually funds steelhead-focused restoration, monitoring, and education projects in California (CDFW 2015). Sixty-four projects totaling $1,434,089 were funded with money generated from the sale of report cards.

Table 3-7. Number of natural- and hatchery-origin steelhead caught and released on the Mad River for years 2006-2011, as recorded on returned steelhead catch cards (CDFW 2015). It should be noted that this is likely only a fraction of the steelhead caught based on low angler reporting rates.

Year	Natural kept	Natural released	Hatch kept	Hatch released
2006	1	177	369	362
2007	34	376	425	375
2008	19	250	389	509
2009	7	324	285	190
2010	10	325	645	572
2011	0	685	1027	1265
Total	71	2137	3140	3273

[2] Nelson et al. (2005) showed mortalities associated with catch and subsequent release of adult steelhead to be 1.4% and 5.8% in 1999 and 2000, respectively, on steelhead caught in recreational fisheries on the Chilliwack River in British Columbia. This study also showed no indication of increased mortality on fish that had been caught and released multiple times. A hook-and-line mortality study conducted in the Samish River on winter-run steelhead also showed similar results, although it indicated that there may be a negative relationship between a fish being caught in a sport fishery and their survival to out-migration as kelts (Ashbrook et al. in press). Taylor and Barnhart (1999) determined that summer steelhead caught and released in the Mad and Trinity Rivers of California had a 9.5% mortality rate, with 83% of the mortalities occurring at water temperatures of 21°C or greater. However, water temperatures during winter steelhead fishing for MRH fish are cold, so the lower range of mortality rates is expected. Based on best available information, hooking mortality associated with recreational harvest is generally believed to be less than 10% of fish hooked and released.

3.2.5. Risk of Disease Transfer

Interactions between hatchery-origin fish and natural-origin fish in the environment may result in the transmission of pathogens if either the hatchery-origin or the natural-origin fish are harboring fish disease. This impact may occur where hatchery-origin fish are released and throughout the migration corridor where hatchery-origin and natural-origin fish may interact. As the pathogens responsible for fish diseases are present in both hatchery-origin and natural-origin populations, there is some uncertainty associated with determining the source of the pathogen (Williams and Amend 1976; Hastein and Lindstad 1991). Hatchery-origin fish may have an increased risk of carrying fish disease pathogens because of relatively high rearing densities that increase stress and can lead to greater manifestation and spread of disease within the hatchery-origin population. Consequently, it is possible that the release of hatchery-origin steelhead may lead to an increase of disease in natural-origin salmon and steelhead populations.

The MRH is operated in compliance with all applicable fish health guidelines (i.e., American Fisheries Society *Bluebook: Suggested Procedures for the Detection and Identification of Certain Finfish and Shellfish Pathogens*, 2012 edition). These fish health guidelines ensure that fish health is monitored, sanitation practices are applied, and hatchery-origin fish are reared and released in healthy conditions. CDFW fish pathologists monitor hatchery programs monthly and conduct pre-release examinations of fish. Exams performed at each life stage may include tests for virus, bacteria, parasites, or pathological changes. In addition, the MRH uses ultraviolet water treatment prior to use of water for fish culture purposes.

3.2.6. Risk of "Mining" Natural-Origin Mad River Steelhead

Incorporating natural-origin fish into a hatchery broodstock can reduce the abundance and spatial structure of the natural-origin population through the action of removing natural-origin spawners from the natural environment, commonly referred to as "mining." Returning adult hatchery fish can be released (or allowed to remain) in the river to backfill the numbers of natural fish removed, though this is often subject to adult (genetic) management criteria. The MRH steelhead program is an integrated program and, therefore, is expected to both remove natural-origin adults from the river and result in some spawning of hatchery fish in the natural environment.

To address the problem of reducing hatchery and natural fish mating in the river, it is recommended that the hatchery fish do not diverge genetically from the natural fish. Therefore, natural fish must be incorporated into the hatchery broodstock to reduce the divergence potential. Both the HRSG (2019) and the California HRSG (2012) address incorporating natural broodstock into the hatchery broodstock. Then California HRSG (2012) recommended a PNI of 0.67. That is, 67% of the broodstock should be made up of natural fish. The MRH is targeting a PNI of 0.67 with a minimum of 0.5 (CDFW 2014). This should both bring the existing

broodstock genetically closer to the natural population (see Reneski 2011) and reduce the risk of future divergence of the population. Bringing the hatchery broodstock closer to the natural population and maintaining this condition over time is expected to increase the productivity of hatchery x natural matings as compared to the historical condition (e.g., Reisenbichler and Rubin 1999; Araki et al. 2007). The MRH is a relatively small program and would require at least 125 natural steelhead to meet current program goals (CDFW 2014) of a 0.5 to 0.67 PNI and production goal of 150,000 smolts. Information regarding the population of natural steelhead in the Mad River is limited. However, in 2001-2002, Zuspan and Sparkman (2002) estimated the natural steelhead population at 1,491. In 2014, Sparkman (2015; CDFW unpublished data) estimated the natural steelhead population at 2,652. These are the only two contemporary data points available regarding the Mad River natural steelhead population. However, using these data we can estimate that the MRH steelhead program would remove less than 10% (5-8%) of the natural steelhead run for broodstock purposes. Some of these would be males and, therefore, immediately returned to the river where it is possible, but unlikely, that they could spawn naturally. Hatchery fish that don't enter the hatchery will more than make up for this reduction in 10% or less of the natural run for broodstock.

3.3. Other Fish Species

MRH steelhead may be prey, predators, or competitors for food and space with or for other fish species in the Mad River and adjacent nearshore marine areas. The prey, predator, and competitive behavior depends on the relative life stages and range overlap of the steelhead and other fish. Table 10 lists the known native fish species that occupy the same range as the steelhead, their listing status, if any, and their prey, predator, and/or competitive relationships with steelhead. There are also several non-native fish species including brown bullhead, channel catfish, Sacramento sucker, largemouth bass, crappie, and bluegills that may overlap with MRH steelhead. The non-native fish are primarily competitors with and predators for MRH steelhead.

Table 3-8. Range and status of other fish species that may be affected by Mad River Hatchery winter-run steelhead.

Species	Federal/State Listing Status	Type of Interaction with salmon and steelhead
Pacific lamprey *Entosphenus tridentatus* River lamprey *Lampetra ayresi*	Federal species of concern; California watch list species	• Potential prey item for adult salmon and steelhead • May compete with salmon and steelhead for food and space • May be a parasite on salmon and steelhead while in marine waters • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
ACIPENSERIDAE (sturgeon)		•

Species	Federal/State Listing Status	Type of Interaction with salmon and steelhead
Green sturgeon *Acipenser medirostris*	Southern DPS is Federally listed as threatened; California listed as threatened; NMFS species of Concern; CDFW species of Special Concern	• May compete with salmon and steelhead for food • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
White sturgeon *Acipenser trensmontanus*	Not listed	• May compete with salmon and steelhead for food • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
SALMONIDAE (trout & salmon) (salmon were discussed in the previous subsection)		
Coastal cutthroat trout *Oncorhynchus clarki clarki*	California Species of Concern	• Predator of salmon and steelhead eggs and fry • Potential prey item for adult salmon and steelhead • May compete with salmon and steelhead for food and space • May interbreed with steelhead • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
Other predatory fish (e.g., rockfish, halibut, and sharks)	Several species are federally listed as threatened and/or have State Candidate listing status	• Predators of juvenile salmon and steelhead • Juveniles are prey for juvenile and adult salmon • May compete with salmon and steelhead for food
OSMERIDAE (smelt)		• **Forage fish**
Longfin smelt *Spirinchus thaleichthy*	California Listed - Threatened	• Prey for juvenile and adult salmon and steelhead • May compete with salmon and steelhead for food • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
Eulachon *Thaleichthys pacificus*	Federal Listed – Threatened (Southern DPS) California Species of Special Concern	• Prey for juvenile and adult salmon and steelhead • May compete with salmon and steelhead for food • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
		•

3.4. Wildlife and Marine Mammals

The analysis area supports a variety of birds, large and small mammals, amphibians, and invertebrates (Table 3-9) that may be prey, predators, or competitors with steelhead during different portions of their life stages. For example, steelhead eat invertebrates and amphibians such as insects and frogs. Steelhead predators include several species of marine mammals, birds,

black bear, river otter, mink, weasels, mountain lions, and some amphibians. Bird species such as bald eagle and cormorants, scavenge on steelhead carcasses, as do minks, weasels, and several invertebrate species. Some wildlife species such as river otters, seals, and cormorants compete with steelhead for food or habitat. Table 11 lists the known wildlife and marine mammals that occupy the same habitats as the steelhead, their listing status, if any, and their prey, predator, and/or competitive relationships with steelhead. Steelhead are not the only species consumed by wildlife and marine mammals; however, steelhead may be a larger proportion of diet during the MRH juvenile release and the adult winter-run steelhead return period. Most of these species and steelhead have ranges or life cycles where they overlap for at least short periods of time.

Changes in the MRH steelhead production and release levels could alter the survival and productivity of wildlife and marine mammals. The current MRH juvenile release levels are approximately 150,000 fish while the 1998 to 2009 average was approximately 250,000 and the 1970 to 1998 levels ranged from approximately 250,000 to 1,500,000 fish. The MRH began operating in 1970 to submit the significant declines in steelhead and salmon in the Mad River and other North Coast creeks and rivers. The downward trend in natural-origin levels began following Euro-American development of the area (See Subsection 3.2 Salmon and Steelhead). Most of the populations of species listed in Table 11 have also declined during the same time period as the natural-origin steelhead. Unfortunately, there is very little population data on the wildlife, marine mammals, and steelhead and salmon to make inferences about how the MRH steelhead (and historical salmon) population changes affect the various species listed in Table 11. NMFS assumes that the current production levels (150,000 juvenile MRH steelhead) and adult return levels are proportionate with existing wildlife and marine mammal population levels. However, the majority of wildlife and marine mammal species population levels are likely lower than historical levels, as are salmon and steelhead populations, and several wildlife are extirpated, including wolves and grizzly bears.

MRH operations also affect wildlife and marine mammals (Table 11) through adult steelhead collection methods (weirs which could block or entrap wildlife, or conversely, make salmon and steelhead easier to catch through their corralling effect), predator control programs (which may harass or kill wildlife preying on juvenile salmon at hatchery facilities), and transfer toxic contaminants directly into the water or through hatchery fish. The MRH implies varies actions and Best Management Practices to limit wildlife from entering the MRH to prey on fish. For example, the MRH has high fences to prevent animals from getting into the hatchery, but there are no overhead nets to prevent birds from flying into the hatchery's rearing ponds. The limited number of fish taken out of the rearing ponds and from the spawning holding ponds (river otter occasionally sneak into the holding tanks through the fish ladder) does not appear to significantly affect hatchery production numbers or contribute significantly to the predators' food base.

Table 3-9. Wildlife and marine mammals that may interact with Mad River Hatchery steelhead as prey, predators, or competitors in freshwater, estuarine, or marine habitats.

Animal (ORDER/FAMILY and Genius Species)	Federal and State Listing Status*	Type of Habitat	Type of Interaction with salmon and steelhead
ACCIPITRIDAE (hawks, kites, harriers, & eagles)			
Bald Eagle *Haliaeetus leucocephalus*	ESA – Delisted CESA - Endangered CDFW – Fully protected CDF – Sensitive	• Freshwater, estuary, and marine	• Prey, Scavenger
Golden Eagle *Aquila chrysaetos*	CDFW - Fully protected; watch list CDF – Sensitive	• Freshwater, estuary, and marine	• Prey, Scavenger
Northern goshawk *Accipiter gentilis*	CDFW – Species of special concern CDF - Sensitive	• Freshwater and estuary	• Prey, Scavenger
Osprey *Pandion haliaetus*	CDFW – Watch list CDF – Sensitive	• Freshwater, estuary, and marine	• Prey, Scavenger
PHALACROCORACIDAE (cormorants)			
Double-crested cormorant *Phalacrocorax auritus*		• Freshwater, estuary, and marine	• Prey
ARDEIDAE (herons, egrets, and bitterns)			
Great blue heron *Ardea herodias*	CDF – sensitive	• Freshwater, estuary	• Prey
PELECANIIDAE (pelicans)			
American white pelican *Pelecanus erythrorhynchos*		• Marine	• Prey
California brown pelican *Pelecanus occidentalis californicus*	ESA - Delisted CESA - Delisted CDFW – Fully protected CDF - SSP	• Marine	• Prey
STRIGIDAE (owls)			
Northern spotted owl *Strix occidentalis caurina*	ESA - Threatened CESA – Candidate Threatened CDFW – Species of special concern CDF - Sensitive	• Freshwater	• Prey
MUSTELIDAE (weasels and relatives)			
River otter *Lontra canadensis*		• Freshwater, estuary, and marine	• Prey; scavenger

Animal (ORDER/FAMILY and Genius Species)	Federal and State Listing Status*	Type of Habitat	Type of Interaction with salmon and steelhead
Humboldt marten *Martes caurina humboldtensis*	CDFW - Species of special concern	• Freshwater	• Prey; scavenger
Pacific marten *Martes caurina*		•	•
Fisher - West Coast DPS *Pekania pennanti*	ESA – Proposed Threatened CESA – Candidate Threatened CDFW – Species of special concern	• Freshwater	• Prey; scavenger
LARIDAE (gulls and terns)	See CDFW 2015	• Freshwater, estuary, and marine	• Prey
ANSERIFORMES (ducks, geese, and swans)	See CDFW 2015	• Freshwater, estuary, and marine	• Prey
ALCIDAE (auklets, puffins, and relatives)			
Marbled Murrelet *Brachyramphus marmoratus*	ESA - Threatened CESA – Endangered CDF – Sensitive	• Estuary and marine	• Prey
		•	•
PINNIPEDS (*phocids* (seals), *otariids* (sea lions) and *odobenids* (walruses)) **Protected under the Marine Mammal Protection Act**			
California sea lion *Zalophus californianus*		• Estuary and marine	• Predator
Harbor Seal *Phoca vitulina*		• Estuary and marine	• Predator
CETACEANS (dolphins, porposes, and whales) Protected under the Marine Mammal Protection Act			
Harbor porpoise *Phocoena phocoena*		• Marine	• Predator
Pacific white-sided dolphin *Lagenorhynchus obliquidens*		• Marine	• Predator
Southern Killer Whale *Orcinus orca*		• Marine	• Predator
Marine invertebrates (e.g., zooplankton; crab)	See CDFW 2015	• Marine	• Prey

Animal (ORDER/FAMILY and Genius Species)	Federal and State Listing Status*	Type of Habitat	Type of Interaction with salmon and steelhead
Amphibians (e.g., salamanders and frogs)	Northern red legged and yellow legged frog, torrent salamander, and tailed frog are Sensitive See CDFW 2015 for other species	• Freshwater	• Prey, predator, and competition
Mountain yellow-legged frog *Rana muscosa*	The northern California DPS is Federally and California listed as Endangered	• Freshwater	• Prey, predator, and competition
Reptiles (e.g., lizards, snakes, and turtles)	See CDFW 2015 for other species	• Freshwater	• Prey, predator, and competition
Western pond turtle *Emys marmorata*	CDFW species of special concern	• Freshwater	• Prey, predator, and competition
Large Mammals			
North American Beaver *Castor canadensis*	CDFW native nuisance species	• Freshwater	• Predator
Mountain Lion *Puma concolor*		• Freshwater	• Predator
American Black Bear *Ursus americanus*		• Freshwater	• Predator

*Endangered Species Act (ESA), California Endangered Species Act (CESA), California Department of Fish and Wildlife (CDFW), and California Department of Forestry (CDF).
Sources: NOAA's species webpage. Available at http://www.fisheries.noaa.gov/pr/species/index.htm
California Department of Fish and Wildlife, California Natural Diversity Database, Special Animal List, July 2015. Available at http://www.dfg.ca.gov/biogeodata/cnddb/

3.5. Socioeconomics

Socioeconomics is defined as the study of the relationship between economics and social interactions with affected regions, communities, and user groups. The MRH generates economic activity (personal income and jobs) by providing limited hatchery employment opportunities and through commercial services and goods necessary to support the recreational fishery. The MRH employs one Fish Hatchery Manager and three Fish and Wildlife Technicians. Additional help with fisheries monitoring, spawning, fish marking, and Quality Assurance and Quality Control is provided by volunteers and staff from CDFW's Anadromous Fisheries Resource Assessment and Monitoring Program (CDFW 2014). The recreational fishery contributes to local economies through the purchase of supplies such as fishing gear, camping equipment, consumables, and fuel at local businesses.

The MRH has generated recreational steelhead fishing opportunities for California licensed anglers which is rather limited within the more populated areas of northern coastal California.

The Mad River is the only recreational steelhead fishing opportunity within a short drive of Eureka, Arcata, Blue Lake, Fortuna, and McKinleyville, California, in which a fisherman can expect to semi-reliably catch a fish (Table 3-12). The next closest opportunities are the Trinity and Smith Rivers, which are approximately two hours' drive away. Jackson (2007) reported that the number of Mad River steelhead caught per trip between 1993 and1998 was 0.8 and between 1999 and 2005 was 1.75. Hatchery-produced steelhead comprised approximately 86 percent and 79 percent of the catches, respectively.

Table 3-12. Annual average number of steelhead fishing trips and catch in NC DPS (2003-2005).

Stream Location	Number of Trips	Wild		Hatchery	
		Kept	Released	Kept	Released
Klamath to Mad River	190	2	219	13	23
Mad River	**1,244**	**9**	**248**	**650**	**1,320**
Mad to Eel River	23	0	5	9	31
Eel River	111	3	130	5	31
Van Duzen River	74	1	67	1	6
South Fork Eel River	250	4	265	2	30
Middle Fork Eel River	20	1	23	1	1
Eel to Mattole River	10	0	15	0	0
Mattole River	132	10	173	1	4
Mattole to Noyo River	65	0	42	1	1
Noyo River	12	0	9	0	0
Noyo to Navarro River	14	0	14	1	2
Navarro River	104	0	105	0	9
Navarro to Gualala River	164	2	195	1	9
Gualala River	316	2	231	4	13
Gualala to Russian River	17	0	2	3	2
Russian River	1,089	4	115	249	204

Source: Jackson (2007)

The recreational steelhead fishery has also been an economical benefit for local businesses. Mad River angling accounts for approximately 32 percent on average, of all statewide steelhead trips (Jackson 2007). During the 1999/2000 and 2000/2001 fishing seasons, Sparkman (2000, 2002) found that Mad River anglers caught approximately 7,000 steelhead each season.

3.6. Environmental Justice

The Presidential Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (EO 12898, 59 FR 7629, February 16, 1994),

dated February 11, 1994, and Title VI of the Civil Rights Act of 1964. Executive Order 12898 states that Federal agencies shall identify and address, as appropriate "…disproportionately high and adverse human health or environmental effects of [their] programs, policies and activities on minority populations and low-income populations…." While there are many economic, social, and cultural elements that influence the viability and location of such populations and their communities, certainly the development, implementation and enforcement of environmental laws, regulations and policies can have impacts. Therefore, federal agencies, including NMFS, must ensure fair treatment, equal protection, and meaningful involvement for minority populations and low-income populations as they administer the law and develop programs under their jurisdiction.

Executive Order 12898 and Title VI address persons belonging to the following target populations:

- Minority – all people of the following origins: Black, Asian, American Indian and Alaskan Native, Native Hawaiian or Other Pacific Islander, and Hispanic[3]
- Low income – persons whose household income is at or below the U.S. Department of Health and Human Services poverty guidelines

Definitions of minority and low income areas were established on the basis of the Council on Environmental Quality's (CEQ's) *Environmental Justice Guidance under the National Environmental Policy Act* of December 10, 1997 (CEQ 1997). CEQ's *Guidance* states that "minority populations should be identified where either (a) the minority population of the affected area exceeds 50 percent or (b) the population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographical analysis." The CEQ further adds that "[t]he selection of the appropriate unit of geographical analysis may be a governing body's jurisdiction, a neighborhood, a census tract, or other similar unit that is chosen so as not to artificially dilute or inflate the affected minority population."

The CEQ guidelines do not specifically state the percentage considered meaningful in the case of low-income populations. For this EA, the assumptions set forth in the CEQ guidelines for identifying and evaluating impacts on minority populations are used to identify and evaluate impacts on low-income populations. More specifically, potential environmental justice impacts are assumed to occur in an area if the percentage of minority, per capita income, and percentage of low income persons are markedly greater than the percentage of minority, per capita income, and percentage low income persons in California.

While Humboldt County's minority population is less than California's minority population (Table 3-10), Humboldt County's Native American population (6.2 percent) is 3.6 times greater

[3] Hispanic is an ethnic and cultural identity and is not the same as race.

than California's Native American population (1.7 percent). Therefore, Humboldt County is an environmental justice community of concern for Native Americans, but not with respect to the minority population. Additionally, Humboldt County's low income population (20.4 percent) meaningfully exceeds the low income population of the state as a whole (15.9 percent) (Table 3-10).

Table 3-10. Humboldt County and California population levels, minority populations percentages, annual income, and percentage of persons living below poverty level (i.e., low income population).

Population	Humboldt County	State of California
Population (2014)	134,809	38,802,500
Black or African American (2013)	1.3%	6.6%
American Indian/Alaskan Native (2013)	6.2%	1.7%
Asian (2013)	2.5%	14.1%
Native Hawaiian and Other Pacific Islander (2013)	0.3%	0.5%
Hispanic or Latino (2013)	10.5%	38.4%
Per Capita Income (2009-2013)	$23,540	$29,527
Median Household Income (2009-2013)	$41,426	$61,094
Persons below Poverty Level/Low Income (2009-2013)	20.4%	15.9%

Economic statistics: U.S. Bureau of Census. 2015. State/County QuickFacts. Available at: http://quickfacts.census.gov/qfd/states/53/53009.html

The EPA guidance regarding environmental justice extends beyond statistical threshold analyses to consider explicit environmental justice effects on Native American tribes (EPA 1998). Federal duties under the Environmental Justice Executive Order, the presidential directive on government-to-government relations, and the trust responsibility to Indian tribes may merge when the action proposed by another federal agency or the EPA potentially affects the natural or physical environment of a tribe. The natural or physical environment of a tribe may include resources reserved by treaty or lands held in trust; native species (e.g., salmon and steelhead);

sites of special cultural, religious, or archaeological importance, such as sites protected under the National Historic Preservation Act or the Native American Graves Protection and Repatriation Act; and other areas reserved for hunting, fishing, and gathering (*usual and accustomed* areas, which may include "ceded" lands that are not within reservation boundaries). Potential effects of concern may include ecological, cultural, human health, economic, or social impacts when those impacts are interrelated to impacts on the natural or physical environment (EPA 1998).

The Wiyot, Whilkut, Nogatl, and Lassik native peoples occupied the Mad River watershed prior to Euro-American settlement. The Wiyot occupied the lower watershed from approximately the MRH to the river mouth. The Wiyot are the only surviving native peoples of the four bands. As described in Subsection 3.6, Socioeconomics, steelhead and salmon fishing has been a focus for tribal economies, cultures, lifestyles, and identities for thousands of years. These activities continue to be important for subsistence and ceremonial purposes.

4. ENVIRONMENTAL CONSEQUENCES

In Chapter 4, Environmental Consequences, the potential effects of the three alternatives are evaluated on the biological, physical, and socioeconomic resources described in Chapter 3, Affected Environment. A goal of this EA is to determine if any alternatives effects are likely to be significant (NOAA 2009). An effects' significance is determined by the degree to which the actions adversely or beneficially affect the affected environment resources. If there are no significant effects, the decision maker will finalize a Finding of No Significant Impact (FONSI) documenting the alternative selection. Mitigation, if any, should reduce the magnitude, duration, and/or likelihood of occurrence. Selection of an alternative that requires mitigation to reduce the effects below the level of significance requires a mitigated FONSI.

Evaluation of the alternatives' potential environmental consequences on the affected environment requires placing the actions and effects in context (i.e., Affected Environment) and an estimation of the probability of occurrence, magnitude or intensity, and duration of the effects. Where applicable, the relative magnitude and duration of effects are described using the following terms:

Undetectable:	The effects would not be detectable.
Negligible:	Beneficial or adverse effects would be at the lower levels of detection.
Low:	Beneficial or adverse effects would be slight, but detectable.
Moderate:	Beneficial or adverse effects would be readily apparent and of moderate degree. Depending on the context the effects may be significant.
High:	The effects would highly beneficial or severe i.e., significant.

Under Alternative 1, NMFS will not make a 4(d) Rule determination, and the winter-run steelhead hatchery program will be terminated and serve as a baseline environmental condition for comparison purposes to the proposed action (Alternative 2) and the reduced production level (Alternative 3) alternatives. CDFW is currently operating the MRH very similarly to the proposed action. The existing or baseline environmental conditions and the existing MRH operations and production levels are described in Chapter 3, Affected Environment. Lastly, the effects of the three Alternatives are compared to each other in a summary comparison subsection.

4.1. Water Quantity and Quality

4.1.1. Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule

Under Alternative 1, NMFS would not make a determination under the 4(d) Rule and the MRH winter-run steelhead program would likely terminate (Subsection 2.1, Alternative 1). For analysis purposes, NMFS treats Alternative 1 as resulting in the termination of the winter-run

steelhead hatchery program described in the HGMP. However, NMFS assumes the hatchery would not be closed or be decommissioned because CDFW rears fish at the MRH for other CDFW programs that are not part of the proposed action.

Under Alternative 1, the MRH would pump less groundwater, divert less Mad River water, and discharge less effluent into the settling basin (groundwater return) and the Mad River; therefore, Mad River water and groundwater quantity and quality would likely have a low to negligible beneficial effect compared to the existing conditions. CDFW will still require the NCRWQCB general NPDES permit and California water rights to continue operating. Alternative 1 would not be expected to change the 303(d) listings for total sediment load and turbidity/suspended sediment load because the contributions from the MRH are extremely small relative to the non-point source contributions within the Mad River watershed that led to the listings.

4.1.2. Alternative 2 (Proposed Action/Preferred Alternative) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule

Under Alternative 2, NMFS would make the determination that CDFW's proposed MRH winter-run steelhead HGMP meets the requirements of the 4(d) Rule, and CDFW would implement the HGMP (CDFW 2014). CDFW would pump groundwater and diverted Mad River water to produce winter-run steelhead in the MRH. The proposed HGMP (CDFW 2014) would require approximately 11.6 cfs circulating through the MRH. Approximately 85 to 90 percent of this flow can be recycled back through the MRH requiring a 10 to 15 percent replenishment rate depending on the various activities (e.g., juvenile outmigration, cleaning, and spawning). Effluent discharges would occur at four locations (Table 3-2) as described in the Affected Environment Subsection 3.1. The total effluent discharge would be less than 11.6 cfs and typically much less. The effluent discharge would contain some physical, chemical, and biological constituent waste. Water use and effluent discharge quantities and quality would be approximately the same as existing conditions (Subsection 3.1, Water Quantity and Quality). The MRH would be prohibited from discharging effluent or diverting water from May 16 to September 30 (NCRWQCB 2015).

MRH effluent discharges would continue to contain low levels of ammonia, nutrients (e.g., nitrogen), biological oxygen demand, pH, suspended solids levels, antibiotics, fungicides, disinfectants, steroid hormones, pathogens, anesthetics, pesticides, herbicides, and food and fish wastes. In addition, the MRH will likely continue using and discharging chemicals and aquaculture drugs for the treatment and control of disease including oxytetracycline, penicillin G, florfenicol, amoxicillin trihydrate, erythromycin, Romet, formalin, PVP iodine, hydrogen peroxide, potassium permanganate, copper sulfate, sodium chloride, acetic acid, and chloramine-T, and for anesthesia including MS-222, sodium bicarbonate, carbon dioxide, and Aqui-S at low levels (NCRWQCB 2015).

The Mad River water diversion quantities and effluent discharge quantities and water quality are regulated by the State of California as described in the Affected Environment. CDFW is operating the MRH and proposes to operate the MRH under the HGMP (CDFW 2014) as outlined in the 2005 NPDES Permit No. CA0006670 (NCRWQCB 2005). However, the NCRWQCB will be regulating the effluent discharge quantities and quality under the proposed general NPDES permit No. CAG131015, Order No. R1-2015-0009 (NCRWQCB 2015) for Waste Water Discharge Requirements for Cold Water Concentrated Aquatic Animal Production Facility Discharges to Surface Waters. The permit will likely become effective on October 1, 2015, and expire on September 30, 2020. Therefore, the differences between the two permits are briefly discussed.

The 2005 NPDES Permit No. CA0006670 requirements are described in detail in the Affected Environment Subsection 3.1. CDFW (2014) proposes to follow this permit's prohibitions and monitor flow at the four effluent discharge locations (Figure 3-8), daily temperature measurements, weekly testing of fish ladder discharge and spawning house effluent during floor cleaning operations for pH, turbidity, settle-able matter, suspended solids and residue in solution. The permit is designed to meet the TMDL allocations, Basin Plan water quality standards, and protect beneficial uses. For example, effluent discharge cannot alter the temperature or turbidity of the Mad River and monitoring must show that no more than 10 percent of critical life stage chronic toxicity bioassay determinations, in any calendar year, can produce statistically significant deleterious effects on test organisms from undiluted effluent exposure.

The proposed general NPDES permit (NCRWQCB 2015), Waste Water Discharge Requirements for Cold Water Concentrated Aquatic Animal Production Facility Discharges to Surface Waters, takes a slightly different approach than the 2005 NPDES permit (NCRWQCB 2005) in that it lists eighteen receiving water limitations that are based on the Basin Plan's water quality objectives (NCRWQCB 2011), uses general restrictions for the physical, chemical, and biological constituents in authorized effluent discharges, and requires receiving waters monitoring for dissolved oxygen, pH, temperature, turbidity, and hardness. Essentially, the general NPDES permit (NCRWQCB 2015) uses less specific numeric criteria and requires that the MRH "shall not cause receiving waters" and connected groundwater to contain any physical, chemical, or biological constituents that will affect the water quality standards, beneficial uses, or exceed limits set forth in the Basin Plan (NCRWQCB 2011) and the Mad River TMDL (EPA 2007). The proposed permit prohibits the discharge of cleaning waste and detectable levels of chemicals used for disease control and treatment other than salt. The permit also limits the total effluent concentration of total suspended solids and setttleable solids to the same values as the existing permit (Table 5). The effluent discharges must remain between 6.5 and 8.5 pH and not change the receiving waters by 0.5 within this range. The proposed permit also reiterates the Basin Plan (NCRWQCB 2011) objectives for dissolved oxygen concentration (effluent will not

reduce receiving waters below 7.0 mg/l at anytime and 9.0 mg/l during critical spawning or egg incubation periods), specific conductance, hardness, and boron. Additionally, the MRH will be prohibited from discharging substances that affect the taste or odor of edible aquatic products or create floating material (e.g., foams) or discoloration of the receiving waters that cause nuisances or adversely affect beneficial uses. The proposed permit also requires MRH to develop a pollutant minimization program and best management practices to control chemicals and solids. The latter elements are outlined in the proposed HGMP (2014). For additional requirements and prohibitions see the draft general NPDES permit No. CAG131015, Order No. R1-2015-0009 (NCRWQCB 2015) and the Basin Plan (NCRWQCB 2011). While there are some basic differences in the approaches in the two NPDES permits to ensuring attainment of the water quality standards, the effects on water quantity and quality are expected to be minor and undetectable.

Alternative 2 will result in relatively small quantities of surface water diverted from Mad River and pumped from the groundwater table. The MRH is only allowed to divert 1 percent of the Mad River during the operational period, October 1 to May 15, under the Basin Plan (NCRWQCB 2011). The effects of diverting 1 percent or less of the Mad River flow during October 1 to April 15 are considered negligible and would not result in adverse effects to the Mad River environment because flows during this time period are rarely below 100 cfs or 50 cfs (83 and 91 percent exceedance, (Figure 3-9) even during the last three drought years (79 and 96 percent exceedance, Figure 4-1). Mad River hydrographs for the last three drought years show that the flows rarely drop below 50 cfs during the operational period (Figure 4-1). Additionally, the effluent and fish ladder flows will be returned within a very short distance (Figure 3-8). Groundwater extraction is currently unregulated but the quantities proposed in the HGMP (CDFW 2014) are relatively minor and returned through a settling basin within a short distance from the extraction wells (Figure 3-8).

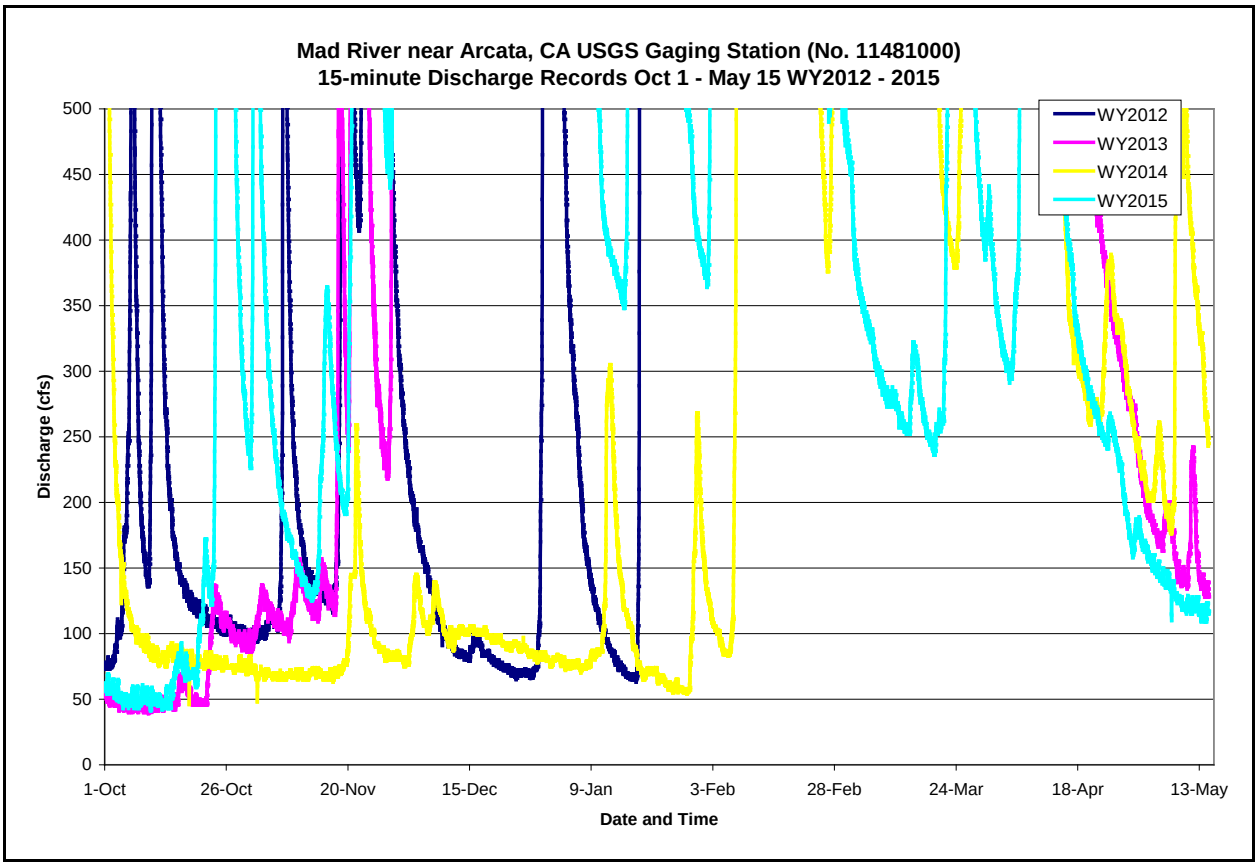

Figure 4-1. Water year 2013 through 2015 hydrographs for the Mad River near Arcata, CA, USGS gaging station No. 11481000.

Water quantity and quality effects would likely occur but the adverse effects would be negligible to low in magnitude and duration because (1) the majority of hatchery effluent would be passed through the pollution abatement system (e.g., settling basin will remove uneaten food and fish wastes) before being discharged into receiving waters, (2) multiple effluent prohibitions exist and/or are proposed under the proposed general NPDES permit (NCRWQCB 2011; 2015), and (3) all effluent will be monitored for pertinent physical, chemical, and biological constituents (Subsection3.1, Water Quantity and Quality) that could adversely affect the water quality standards and beneficial uses.

Discharge prohibitions examples include the discharge of detectable levels of chemicals used for the treatment and control of disease, other than sodium chloride, and the discharge of waste resulting from cleaning activities. Compliance and monitoring requirement examples include the Basin Plan's (NCRWQCB 2011) narrative objective/standard for toxicity that requires all waters shall be free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population

density, growth anomalies, bioassay of appropriate duration or other appropriate methods as specified by the Regional Water Board.

Based on the prohibition, effluent, and monitoring and reporting requirements in the proposed general NPDES permit (NCRWQCB 2015), the TMDL (EPA 2007), and the Basin Plan (NCRWQCB 2011), and the best management practices outlined in the proposed HGMP, NMFS believes there would be negligible to low, localized adverse effects on water quantity and quality relative to Alternative 1. As under Alternative 1, Alternative 2 would not be expected to change any of the 303(d) listings because the effects of the suspended sediment contributions from the MRH would be potentially adverse, but undetectable within the receiving water. Therefore, no significant impacts on water quantity and quality are expected to occur under the Proposed Action.

4.1.3. Alternative 3 (Reduced Production Alternative) – Make a Determination that Revised HGMPs with Reduced Production Levels Meet the Requirements of the 4(d) Rule

Under Alternative 3, CDFW would reduce MRH steelhead production levels by 50 percent, and water use would be reduced proportionately. Therefore, adverse effects on water quantity and quality would be proportionately smaller than under existing conditions and under Alternative 2, but more than Alternative 1 where no water will be used or effluent generated. CDFW would still be required to adhere to the state surface water permit quantities and the proposed NPDES permit (NCRWQCB 2015) and Basin Plan ((NCRWQCB 2011) requirements as described in the previous subsection.

Water quantity and quality adverse effects would likely occur, but would be negligible in magnitude and duration because (1) the majority of hatchery effluent would be passed through the pollution abatement system (e.g., settling basin will remove uneaten food and fish wastes) before being discharged into receiving waters, (2) multiple effluent prohibitions exist and/or are proposed under the proposed general NPDES permit (NCRWQCB 2011; 2015), and (3) all effluent will be monitored for pertinent physical, chemical, and biological constituents (Subsection 3.1, Water Quantity and Quality) that could adversely affect the water quality standards and beneficial uses.

There would be a reduction in the discharge of physical, chemical, and biological constituents such as ammonia, nutrients (e.g., nitrogen), biological oxygen demand, pH, suspended solids levels, antibiotics, fungicides, disinfectants, steroid hormones, pathogens, anesthetics, pesticides, and herbicides into the Mad River relative to existing conditions and Alternative 2. A reduction in the discharge of these substances would be low in the immediate vicinity of the hatchery discharge structures, but, downstream from the hatchery, dilution effects would make the reduction undetectable. Overall, Alternative 3 would provide low to negligible, localized

beneficial impacts on water quality relative to Alternative 2 and would have low beneficial effects relative to Alternative 1.

4.2. Salmon and Steelhead

4.2.1. Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule

Under this alternative, the HGMP would not be approved. For analysis purposes, NMFS treats Alternative 1 as resulting in the termination of the winter-run steelhead hatchery program described in the HGMP. However, NMFS assumes the hatchery would not be closed or decommissioned because CDFW rears fish at the MRH for other CDFW programs that are not part of the proposed action.

Because the winter-run steelhead program would terminate, all risks to ESUs, DPSs, non-listed salmon species, and designated critical habitat associated with the steelhead hatchery program would be eliminated (Subsection 3.3, Salmon and Steelhead). Relative to baseline conditions, Alternative 1 would result in the following effects:

1. **Genetic Risks –** Gene flow from the hatchery to the natural steelhead population would decrease to zero as all cohorts and the progeny from hatchery cohorts spawning in the natural environment stopped returning to the Mad River. This is expected to have a low, beneficial genetic effect on the Mad River steelhead population.
2. **Predation –** The risk of predation on juvenile fall Chinook salmon by MRH-origin steelhead would be eliminated, and therefore overall predation on Chinook salmon in the river would be reduced (Subsection 3.2.2, Competition and Predation), which would result in a low, beneficial effect on Chinook salmon populations.
3. **Competition** – The risk of competition between hatchery-origin steelhead and natural-origin steelhead, Chinook salmon, and coho salmon would be reduced (Subsection 3.2.2, Competition and Predation), which would result in a low, beneficial effect on natural-origin steelhead, Chinook salmon, and coho salmon populations.
4. **Hatchery Facility Effects** – Hatchery facility risks would decrease to zero and would have a low, beneficial effect on salmon and steelhead in the Mad River.
5. **Risk of Disease Transfer –** The risk of disease transfer is expected to be reduced if no fish were reared and released from the MRH which would result in a low to moderate beneficial effect on the natural salmon and steelhead population relative to current conditions.
6. **Risk of "Mining" Natural-Origin Mad River Steelhead –** There would be a slight decrease in the risk of "mining" the natural steelhead population because natural steelhead would no longer be collected for broodstock. However, there would also be a decrease in the number of steelhead that return and spawn in the Mad River. A substantial number of hatchery steelhead return and spawn in the Mad River so this effect

could be important. These hatchery-origin fish likely contribute less to the population than their natural cohorts. However, their contribution is expected to be measurable and slightly beneficial. It is expected that the natural steelhead population abundance in the Mad River would not decrease in the absence of hatchery production. However, there may be greater fluctuations in the number of steelhead spawning in the Mad River because bottlenecks in natural juvenile survival during some years would not be dampened by the presence of hatchery-origin spawners. A negligible, negative effect to steelhead abundance in the Mad River is expected under this alternative. There will be no effects to other salmonids from this alternative.

7. **Fisheries Effects –** Catch and release steelhead fishing on the Mad River is expected to remain open despite the hatchery closing. Angler effort would undoubtedly decrease; however, fishing would be expected to spread farther into the watershed instead of being concentrated in the river below the hatchery. A negligible, beneficial increase to natural steelhead is expected under this alternative from the reduction in fishing effort.

4.2.2. Alternative 2 - Alternative 2 (Proposed Action/Preferred Alternative) – Make a Determination that the Submitted HGMP Meet the Requirements of the 4(d) Rule

Under this alternative, NMFS would make a determination that the submitted HGMPs meet the requirements of the 4(d) Rule Limit 5, and the MRH steelhead program would be implemented as described in the submitted HGMP (CDFW 2014). For the purpose of this analysis, NMFS treats the Proposed Action Alternative as resulting in the hatchery production of steelhead as described in the HGMP and summarized in Section 1.2, above. Alternative 2 is very similar to the existing conditions and hatchery operations described under the Affected Environment Section 3.2.

1. **Genetic Risks -** Gene flow from the MRH to the natural environment would remain the same as existing conditions because the number of broodstock spawned would be the same. The risks would remain approximately the same as described in the Affected Environment, a low to moderate adverse risk. Alternative 2 will increase the number of hatchery fish spawning in the wild and increased risk of hatchery and wild matings. This would lead to a moderate, but not significant adverse effect compared to Alternative 1 because while the hatchery introduces natural fish into the hatchery broodstock to counteract the effects of domestication, there is likely to be some low to moderate level of adverse effects due to the potential genetic differences between hatchery fish and natural fish.
2. **Predation** The risk of predation on juvenile fall Chinook salmon would be the same as compared to existing conditions (Subsection 3.2.2, Competition and Predation), which

would result in a negligible, adverse effect on Chinook salmon populations as compared to Alternative 1.

3. **Competition** -The risk of competition between hatchery-origin steelhead and natural-origin steelhead, Chinook salmon, and coho salmon would be the same as existing conditions (Subsection 3.2.2, Competition and Predation), which would result in a negligible, adverse effect on natural-origin steelhead, Chinook salmon, and coho salmon populations. Compared to Alternative 1, this alternative would increase competition leading to a negligible adverse effect.
4. **Hatchery Facility Effects** – There is a negligible, adverse effect to natural-origin salmonids in the Mad River expected from this alternative. This alternative is the same as the existing condition which, as described previously (section 4.1.2), is expected to have a negligible adverse effect due to the small surface water diversion and the very low level of hatchery effluent that is discharged to the Mad River.
5. **Risk of Disease Transfer** - Despite recent improvements in hatchery management, diseases continue to infect salmonids in hatchery facilities. The risk of disease transfer to natural salmon and steelhead populations would depend on the number of affected fish, pathogen or parasite movement patterns, and whether the wild fish interact with infected hatchery fish. Alterative 2 would be the same as existing conditions, which is a negligible adverse risk of disease transfer to natural salmon and steelhead as compared to Alternative 1.
6. **Risk of "Mining" Natural-Origin Mad River Steelhead –**The risk of mining under Alternative 2 would be the same as the existing conditions which is a moderate increase in the risk of mining and a significantly greater risk than Alternative 1. A substantial number of hatchery steelhead return and spawn in the Mad River, but they likely contribute less to the population than their natural cohorts. However, their contribution on the spawning grounds is still expected to be measurable and negligibly beneficial because of their numbers.
7. **Fisheries Effects –** Angler effort would likely remain similar to existing conditions. This would result in a low to moderate, adverse effect of incidental fishing of natural steelhead compared to Alternative 1. Fishing opportunities are expected to be the same as under existing conditions, but more than under Alternative 1 (see Subsection 4.5, Socioeconomics, below).

4.2.3. Alternative 3 (Reduced Production Alternative) – Make a Determination that Revised HGMP with Released Production Levels Meet the Requirements of the 4(d) Rule

Under this alternative, CDFW would reduce the number of steelhead juveniles released from the hatchery by 50 percent (75,000 juveniles). All other operations would occur as described in the Proposed Action (Alternative 2). However, the hatchery would likely need less broodstock, water, feed, energy, and other resources to produce less fish than the Proposed Action. A revised

HGMP would be submitted reflecting the reduced production level, and NMFS would make a determination that the revised HGMP meet the requirements of the Limit 5 of the 4(d) Rule. The following effects would be expected:

1. **Genetic Risks -** Gene flow from the MRH to the natural environment would be reduced compared to existing conditions and Alternative 2 because fewer fish would be expected to return. This would lead to a low beneficial effect over the existing conditions and Alternative 2 but would be a low adverse effect compared to Alternative 1. Alternative 3 would increase the risk of inbreeding in the MRH because there would be a reduction in the number of broodstock spawned, approximately 126 fish. This is a substantially smaller effective population size than the natural population. In addition, a smaller gene pool of hatchery fish could lead to inbreeding within the natural population because hatchery origin returning adults spawn with natural fish.
2. **Predation** The risk of predation on juvenile fall Chinook salmon would be reduced compared to existing conditions and Alternative 2 (Subsection 3.2.2, Competition and Predation), which would result in a low, beneficial effect on Chinook salmon populations. However, when compared to Alternative 1 this alternative would lead to a negligible adverse effect.
3. **Competition** -The risk of competition between hatchery-origin steelhead and natural-origin steelhead, Chinook salmon, and coho salmon would be reduced compared to existing conditions and Alternative 2 (Subsection 3.2.2, Competition and Predation), which would result in a low, beneficial effect on natural-origin steelhead, Chinook salmon, and coho salmon populations. Compared to Alternative 1, this alternative would increase competition leading to a negligible adverse effect. The amount of reduced competition is not precisely predictable, but is likely to be 50 percent of existing and Alternative.
4. **Hatchery Facility Risks** - Hatchery facility risks would decrease a small amount because water use and discharge would decrease and, therefore, would have a low, beneficial effect on salmon and steelhead in the Mad River.
5. **Risk of Disease Transfer** - Despite recent improvements in hatchery management, diseases continue to infect salmonids in hatchery facilities. The risk of disease transfer to natural salmon and steelhead population would depend on the number of affected fish, pathogen or parasite movement patterns, and whether the wild fish interact with infected hatchery fish. Alterative 3 would create a low adverse risk of disease transfer to natural steelhead. However, Alternative 3 would provide a negligible beneficial reduction in the risk relative to existing conditions and Alternative 2.
6. **Risk of "Mining" Natural-Origin Mad River Steelhead -** There would likely be an approximate 50 percent reduction in the number of hatchery-origin steelhead that return and spawn in the Mad River. A substantial number of hatchery steelhead return and spawn in the Mad River, but they likely contribute less to the population than their

natural cohorts. However, their contribution on the spawning grounds is still expected to be measurable and beneficial because of their numbers. Compared to the existing conditions and Alternative 2, there would be a negligible beneficial reduction in the risk of "mining" the natural steelhead population because fewer natural steelhead would be collected for broodstock. This alternative would create a low adverse effect for natural-origin steelhead compared to Alternative 1 because some natural steelhead would be prevented from spawning in the river.

7. **Fisheries Effects –** NMFS assumes that steelhead fishing on the Mad River would remain open despite the reduction in hatchery production. Angler effort would likely decrease compared to existing conditions and Alternative 2 because there would be fewer hatchery-origin steelhead available to catch. However, fishing may spread farther up into the watershed instead of being concentrated in the river below the hatchery as anglers seek out natural fish to replace reduced numbers of hatchery fish. This would likely lead to a negligible to low, adverse increase in incidental fishing of natural steelhead compared to Alternative 1. A decrease in fishing effort would be expected to result in a decrease in total number of hatchery fish harvest; however, catch and release of natural fish would potentially increase. Therefore, fishing opportunities would likely remain roughly constant (see Subsection 4.5, Socioeconomics, below).

4.3. Other Fish Species

4.3.1. Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule

Under Alternative 1, the MRH steelhead program would be terminated immediately, and 150,000 steelhead would not be produced by the MRH and released in the Mad River that, under current conditions, would have been. Therefore, there would be a short- and long-term reduction in competition for space and food among freshwater species relative to baseline conditions. There would also be a reduction in predation risk by steelhead on other fish species, a reduction in the number of prey eaten by steelhead in the Pacific Ocean, and a reduction in the number of steelhead available as prey for other species. However, because (1) the analysis area is only a small portion of each species range and (2) steelhead are not exclusive predators or prey for any of the fish species, Alternative 1 would be expected to have a negligible effect on other fish species (beneficial for some species (steelhead prey) and adverse for others (steelhead predators) relative to baseline conditions. Consequently, Alternative 1 would not be expected to change any State or Federal species designations relative to baseline conditions (Subsection 3.3, Other Fish Species).

4.3.2. Alternative 2 (Proposed Action/Preferred Alternative) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule

Under Alternative 2, the MRH steelhead program would operate as proposed in the submitted HGMP (Subsection 2.2, Alternative 2). Alternative 2 would continue the production and release of 150,000 steelhead smolts, which is 150,000 more smolts in the Mad River than under Alternative 1. Therefore, there would be a short- and long-term increase in risk of competition for space and food among freshwater species relative to Alternative 1. There would also be an increase in the risk of predation by steelhead on other fish species, and an increase in the number of prey eaten by steelhead in the Pacific Ocean relative to Alternative 1. However, because (1) the analysis area is only a small portion of each species' range, and (2) steelhead are not exclusive predators or prey for any of the fish species, Alternative 2 would be expected to have negligible effects (positive for fish that eat steelhead and negative for fish that are eaten by steelhead) relative to Alternative 1. Consequently, Alternative 2 would not be expected to change any State or Federal species designations relative to baseline conditions (Subsection 3.3, Other Fish Species).

The HGMP proposes to ensure that at least half of the MRH steelhead spawning pairs are hatchery spawned natural-origin and to match natural-origin steelhead with their natural counter parts whenever possible. Therefore, Alternative 2 should assist with recovery of the natural-origin steelhead.

4.3.3. Alternative 3 (Reduced Production Alternative) – Make a Determination that Revised HGMPs with Released Production Levels Meet the Requirements of the 4(d) Rule

Under Alternative 3, the MRH steelhead program would be reduced by 50 percent relative to the proposed hatchery programs. Relative to Alternative 1 under which the hatchery programs would be terminated, Alternative 3 would increase the number of juvenile steelhead released into the Dungeness, Nooksack, and Stillaguamish River Basins by 75,000 smolts, which would lead to a negligible short- and long-term increase in the risk of competition for space and food among freshwater species relative to Alternative 1. There would also be a slight increase in the risk of predation by steelhead on other fish species, an increase in the number of prey eaten by steelhead in the Pacific Ocean relative to Alternative 1, and an increase in number of steelhead available as prey for other species. However, because (1) the analysis area is only a small portion of each species range, and (2) steelhead are not exclusive predators or prey for any of the fish species, Alternative 3 would be expected to have negligible effects (positive for fish that eat steelhead and negative for fish that are eaten by steelhead) relative to Alternative 1. Consequently, Alternative 3 would not be expected to change any State or Federal species designations relative to Alternative 1 (Subsection 3.3, Other Fish Species).

Relative to the Alternative 2 (Proposed Action/Preferred Alternative), Alternative 3 would release 75,000 fewer steelhead into the Mad River, which would lead to a negligible short- and long-term reduction in the risk of competition for space and food among freshwater species relative to Alternative 2. There would also be a slight reduction in the risk of predation by steelhead on other fish species, a potentially measurable reduction in the number of prey eaten by steelhead in the Pacific Ocean, and a reduction in the number of steelhead available as prey for other species, relative to Alternative 2. However, because (1) the analysis area is only a small portion of each species range, and (2) steelhead are not exclusive predators or prey for any of the fish species, Alternative 3 would be expected to have a negligible effect on other fish species (positive for fish that are eaten by steelhead and negative for fish the eat steelhead) relative to Alternative 2. Consequently, Alternative 3 would not be expected to change any State or Federal species designations relative to Alternative 2 (Subsection 3.3, Other Fish Species), or measurably contribute to an increase or decrease in fitness of such species.

4.4. Wildlife and Marine Mammals

4.4.1. Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule

Under Alternative 1, the MRH winter-run steelhead program would be terminated (Subsection 2.1, Alternative 1), and fewer juvenile and adult steelhead would be available as prey, predators, and competitors with wildlife and marine mammals (Table 3-9) than existing conditions and the proposed action. The number of juvenile steelhead currently being released and proposed in Alternative 2 would be approximately 150,000 fish. Based on data reported by CDFW and estimated recreational steelhead fishing catches, NMFS conservatively estimates that the total number of adult hatchery-origin steelhead returning to the Mad River could range from approximately 5,000 to 15,000 fish. A moderate number of the returning adult MRH steelhead are being harvested in-river by recreational fishermen (Table 3-12), a small portion return to the MRH (Table 3-7), and a another small but unknown portion spawn in the river.

The following estimates of the number of natural-origin steelhead and salmon are provided to determine the overall effect on wildlife and marine mammals. The number of juvenile natural-origin steelhead in the Mad River was estimated at approximately 1,000,000 fish (CDFW 2014). There are no separate estimates for summer-and winter-run juvenile populations. Spencer et al. (2008) estimated that the adult winter-run steelhead spawners likely ranged somewhere between the high and low risk of extinction threshold numbers, 352 and 7,000. The summer-run natural-origin steelhead adult population estimates are based on summer snorkel surveys from 1994-2005 which found that the number of spawners ranged between 80 and 617, with a geometric mean for that time period of 250 spawners. Spencer et al. (2008) determined that the summer-run steelhead were likely at a moderate risk of extinction.

There is very little data on the SONCC coho (NMFS 2014) population in the Mad River watershed. However, NMFS's SONCC coho recovery plan (NMFS 2014) determined that the population was likely below the depensation threshold of approximately 150 spawners (William et al. 2008).

NMFS estimated that the CC Chinook salmon abundance in the Mad River likely ranges somewhere in the middle of Spencer et al.'s (2008) high extinction risk threshold of 94 spawners and less than the low extinction risk threshold of 3,000 spawners. The only estimate for juvenile Chinook salmon, approximately 950,000 plus or minus 100,000, was developed by Sparkman (2002) during the 2001 spring outmigration trap near the MRH.

While the data on the number of juvenile and adult natural-origin salmon and steelhead within the Mad River are limited, the latter estimates allow the relative effects of each alternative to be approximated. Although none of the predatory wildlife and marine mammal species (Table 3-9) feed exclusively on steelhead, salmon and steelhead likely provide a large portion of their diets during the juvenile and adult steelhead migration periods. Based on the latter salmon and steelhead estimates, NMFS conservatively estimates the total number of juvenile natural-origin salmon and steelhead in the Mad River as roughly 2,000,000 plus or minus 500,000 while there are 150,000 juvenile hatchery steelhead released. As discussed in the previous paragraphs, the limited adult return estimates show a wide range of variation but the hatchery to natural-origin ratios after human harvest seem similar to the juvenile ratios. Therefore, the reductions proposed in Alternative 1 would have a low to moderate adverse effect on the diet, survival, or distribution of some of the wildlife and marine mammals relative to existing conditions and alternative 2.

While competitive behavior and the rates of predation depend on the species, migration rate, relative sizes, release location, and spatial overlap between species among other conditions, Alternative 1 would eliminate any potential issues associated with hatchery steelhead. Overall, the reduction in steelhead under Alternative 1 would have a low adverse effect on wildlife and marine mammal predators because the number of hatchery-origin juvenile and adult steelhead comprise a small portion of the total number of salmon and steelhead (anadromous and resident) in the Mad River watershed.

4.4.2. Alternative 2 (Proposed Action/Preferred Alternative) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule

Under Alternative 2, the MRH winter-run steelhead program would operate as proposed in CDFW's HGMP (Subsection 2.2, Alternative 2) and very similar to existing MRH operations. This alternative would provide the same number of juvenile steelhead as currently are being supplied to the Mad River (150,000) and very likely a similar range of adult steelhead would return to the MRH (approximately 5,000 to 15,000). Compared to the total number of salmon

and steelhead (anadromous and resident) in the Mad River watershed (See Alternative 1), this alternative provides a low increase. These fish would be available as prey, competitors, and predators for wildlife and marine mammals including federally- and state-listed species (Subsection 3.4, Wildlife and Marine Mammals). None of the predatory wildlife and marine mammal species (Table 3-9) feed exclusively on steelhead; however, MRH steelhead might make up a small portion of their diet during the juvenile release and adult return periods. MRH steelhead are expected to be a small source of prey for, predation on, or competition with the wildlife and marine mammals in Table 3-9, throughout the distribution and range of habitats found in the Mad River. Therefore, Alternative 2 would not be expected to substantially contribute to the diet, survival, or distribution of any of these species relative to existing conditions or Alternative 1. MRH adult steelhead would also continue to return marine-derived nutrients to the Mad River. The return of hatchery-produced adult steelhead would provide a negligible to low level of marine-derived nutrients.

CDFW has several wildlife deterrent structures in place, such as high fences around the rearing ponds, to exclude wildlife from eating juvenile steelhead at the hatchery. This method of passively excluding potential predators likely has a negligible adverse effect on wildlife species compared to Alternative 1.

4.4.3. Alternative 3 (Reduced Production Alternative) – Make a Determination that Revised HGMPs with Released Production Levels Meet the Requirements of the 4(d) Rule

Under Alternative 3, the MRH winter-run steelhead program would release 50 percent less juvenile fish (75,000) than CDFW's proposed HGMP (Subsection 2.3, Alternative 3). All other aspects of the Alternative 3 would be essentially the same as proposed in the HGMP. Relative to Alternative 1 under which the hatchery program would be terminated, Alternative 3 would increase the number of juvenile and returning adult steelhead in the Mad River. These fish would be prey, predators, and competitors to the species listed in Table 3-9 (Subsection 3.4, Wildlife and Marine Mammals). Given the relatively low numbers of other salmon and steelhead in the project area compared to historical populations (prior to European settlement) and the Alternative 3 50 % reduction in MRH steelhead numbers compared to exiting conditions and Alternative 2, Alternative 3 would have a moderate probability of a low beneficial effect on wildlife and marine mammals as prey and a low adverse effect as predators and competitors. Compared to existing conditions and Alternative 2, Alternative 3 could have a minor change in the diet, survival, and distribution of wildlife and marine mammal species during the adult return and the juvenile outmigration periods. None of the wildlife and marine mammal species feed exclusively on steelhead; therefore Alternative 3 would most likely only have a negligible adverse effect on the diet, survival, and distribution of these species relative to Alternative 1 or 2.

4.5. Socioeconomics

4.5.1. Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule

Under Alternative 1, the MRH winter-run steelhead program would terminate (Subsection 2.1, Alternative 1). CDFW could transfer some MRH employees to other jobs or facilities and/or not hire seasonal employees to mitigate for the loss of the winter-run program; however, this is unlikely, given the relatively small number of facilities in the state, and none of these replacement jobs would be in the analysis area. Additionally, the volunteers and staff from CDFW's Anadromous Fisheries Resource Assessment and Monitoring Program would lose their opportunities to participate in hatchery operations. The MRH would procure less local goods and services, which contribute to some personal income and/or jobs in the regional economy. Finally, the economic contributions to the community associated with steelhead fishermen would be moderately adversely affected under Alternative 1. However, within the socioeconomic context of Humboldt County these effects would not expected to be significant . This would also likely lead fishers, with the economic ability to do so, to fish other regional steelhead rivers such as the Trinity and Smith rivers.

4.5.2. Alternative 2 (Proposed Action/Preferred Alternative) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule

Under Alternative 2, the MRH winter-run steelhead program would operate as proposed in the submitted HGMP. Relative to Alternative 1, Alternative 2 would continue to provide full-time and seasonal jobs and the local procurement of goods and services to the current level which would contribute to personal income or jobs in the regional economy. The hatchery's primary beneficial effect will be to continue generating steelhead recreational fishing opportunities for California licensed anglers, which is rather limited in northern California.

Alternative 2 would provide the same level of economic benefit to the local communities and CDFW employees as the existing condition and likely a low to moderate beneficial increase over Alternative 1.

4.5.3. Alternative 3 (Reduced Production Alternative) – Make a Determination that Revised HGMPs with Released Production Levels Meet the Requirements of the 4(d) Rule

Under Alternative 3, the MRH would reduce the number of juvenile steelhead released by 50 percent relative to Alternative 2, but would still produce 75,000 steelhead smolts. Alternative 3 would continue to provide for recreational fishing opportunities on returning hatchery-origin

adult steelhead, though likely at lower levels. There would likely be some shift by steelhead fishers to other regional rivers.

Alternative 3 would also allow MRH employees associated with the winter-run steelhead program to continue working, and would allow the MRH to continue to receive help from volunteers and staff from CDFW's Anadromous Fisheries Resource Assessment and Monitoring Program. Additionally, the MRH and steelhead fishermen would procure some local goods and services which would have a low beneficial effect compared to Alternative 1. However, these benefits would be negligibly reduced relative to Alternative 2 which is similar to the current employment and revenue into local businesses.

4.6. Environmental Justice

4.6.1. Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule

Under Alternative 1, NMFS would not make a determination under the 4(d) Rule and the MRH winter-run steelhead program would be terminated. The No Action Alternative would essentially eliminate steelhead fishing opportunities on the Mad River because CDFW regulations only allow the harvest of hatchery-origin fish, specifically adipose fin-clipped fish.

Humboldt County is not an environmental justice community of concern for minorities as defined by Executive Order 12898 (59 FR 7629, February 16, 1994) and Title VI of the Civil Rights Act of 1964 (See Affected Environment, Subsection Environmental Justice). Specifically, the total number of minorities in Humboldt County is not meaningfully greater than in the State of California overall. However, the population of Native Americans in Humboldt County, 6.2 percent, is meaningfully greater than California as a whole (1.7 percent; Table 3-10); therefore, NMFS considers Humboldt County as an environmental justice community of concern for Native Americans. In addition, any reduction in harvest opportunity poses a disproportionate effect on Native American tribes because of the unique connection of Native American tribes to salmon and steelhead. While there is no Tribal fishery on the Mad River, any Native American can currently fish for winter-run steelhead if they can afford equipment, a license, and transport to and from the Mad River to recreational fish. Therefore, Alternative 1 would have low to moderate adverse impacts on regional Native Americans that recreationally fish the Mad River, by reducing the availability of steelhead and/or requiring them to shift efforts to other species or other recreational steelhead fisheries.

Humboldt County is also an environmental justice community of concern for the low income population (i.e., persons living below the poverty line) because this population is 20.4 percent of the counties' population compared to 15.9 percent of California's population (Table 3-10). Therefore, Alternative 1 would likely have a low adverse impact on the County's low income

population that can afford equipment, a license, and transport to and from the Mad River to recreational fish, but not able to travel to other regional steelhead rivers.

4.6.2. Alternative 2 (Proposed Action/Preferred Alternative) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule

Under Alternative 2, the MRH winter-run steelhead program would operate as proposed in the submitted HGMP (Subsection 2.2, Alternative 2). Relative to Alternative 1, Alternative 2 would moderately increase recreational fishing opportunities in the Mad River. However, these increases in fishing opportunities would be approximately the same as under existing conditions. Alternative 2 would maintain the recreational fishing opportunities at current levels for all persons able to afford equipment, a license, and transport to and from the Mad River.

Humboldt County is an environmental justice community of concern for Native Americans and persons living below poverty because their numbers meaningfully exceed the same sub-populations in California (Table 12). These communities would continue to have opportunities to fish for returning Mad River winter-run steelhead adults provided they can afford equipment, a license, and transport to and from the Mad River. The fishing opportunities would be approximately the same as under existing conditions.

4.6.3. Alternative 3 (Reduced Production Alternative) – Make a Determination that Revised HGMPs with Released Production Levels Meet the Requirements of the 4(d) Rule

Under Alternative 3, the number of juvenile steelhead released would be reduced by 50 percent relative to the proposed HGMP (Subsection 2.3, Alternative 2). How the 50 percent reduction in juveniles released translates to adult returns is not a direct relationship but there will be some reduction. Recreation fishing opportunities under Alternative 3 would likely be low to moderately greater than under Alternative 1, and would provide opportunities to harvest hatchery-origin steelhead. Fishing opportunity under Alternative 3 would be reduced and have a low adverse effect compared to Alternative 2, and might require fishing in different (potentially more different) areas and for different species.

5. CUMULATIVE EFFECTS

5.1. Introduction

The National Environmental Policy Act defines cumulative effects as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7). Council on Environmental Quality (CEQ) guidelines recognize that it is not practical to analyze the cumulative effects of an action from every conceivable perspective, but rather, the intent is to focus on those effects that are truly meaningful. In other words, if several separate actions have been taken or are intended to be taken within the same geographic area, all of the relevant actions together (cumulatively) need to be reviewed, to determine whether the actions *together* could have a significant impact on the human environment. Past, present, and reasonably foreseeable future actions include those that are Federal and non-Federal. For this EA analysis, they also include those that are hatchery-related (e.g., hatchery production levels) and non-hatchery related (e.g., human development).

The cumulative effects of a Proposed Action can be represented as an equation:

Proposed Action + Past Actions + Present Actions + Reasonably Foreseeable Future Actions = Cumulative Effects

The CEQ provides an 11-step process for cumulative effects analyses that is woven into the larger NEPA process and into documents supporting a Federal action (CEQ 1997) (Table 5.1). Other subsections of this EA are relevant as support for this cumulative effects analysis.

Chapter 3, Affected Environment, describes the existing conditions for each resource and reflects the effects of past actions and present condition. Chapter 4, Environmental Consequences, evaluates the direct and indirect effects of the alternatives on each resource's existing conditions. This chapter considers the cumulative effects of each alternative in the context of past actions, present conditions, and reasonably foreseeable future actions and conditions.

Table 5-1. CEQ cumulative effects analysis process and documentation within this EA.

		Steps in the Cumulative Effects Analysis Process	Location within this EA
Scoping	1	Identify the potentially significant cumulative effects issues associated with the proposed action and define the assessment goals	Subsections 1.1, 5.1.1, 5.2, and 5.4
	2	Establish the geographic scope for the analysis	Subsections 5.1.1
	3	Establish the time frame for the analysis	Subsections 5.2 and 5.4
	4	Identify other actions affecting the resources, ecosystems, and human communities of concern	Chapter 3, Chapter 4, and Subsections 5.2
Describing the Affected Environment	5	Characterize the resources, ecosystems, and human communities identified in scoping in terms of their response to change and capacity to withstand stresses	Chapters 3, 4, and 5
	6	Characterize the stresses affecting these resources, ecosystems, and human communities and relations to regulatory thresholds	
	7	Define a baseline condition for the resources, ecosystems and human communities	
Determining the Environmental Consequences	8	Identify the important cause-and-effect relationships between human activities and resources, ecosystems, and human communities	Chapter 3, Chapter 4, and Subsections 5.2, 5.3, 5.4, and 5.5
	9	Determine the magnitude and significance of cumulative effects	Subsections 5.2, 5.3, 5.4, and 5.5
	10	Modify or add alternatives to avoid, minimize, or mitigate significant cumulative effects	Chapter 2
	11	Monitor the cumulative impacts of the selected alternatives and apply adaptive management	Subsection 1.2

5.1.1 Geographic and Temporal Scales

The cumulative effects assessment area is the entire Mad River watershed including the near shore area along the Mad River spit for all potentially affected resources except socioeconomics and environmental justice which will be assessed using the Humboldt County jurisdictional boundary (Subsection 1.4 Project area). The scope of the action considered here includes the rearing and release of hatchery steelhead in the Mad River (Subsection 1.5, Scope). The direct,

indirect, and cumulative reviews address potential effects in the entire analysis area, although adult collection, rearing, and release activities would occur in localized areas only. The HGMP would be in effect after the associated ESA 4(d) determination is signed, and would remain in effect until CDFW replaces or retracts it, or until NMFS determines that the HGMP is no longer effective. There would be periodic reviews of the HGMP by NMFS every 5 years, and the plan would be modified as warranted by NMFS, as would be specified in the approval of the plans pursuant to Limit 5 of the 4(d) Rule.

Available knowledge and research abilities are insufficient to discern the role and contribution of the Proposed Action to density dependent interactions affecting salmon and steelhead growth and survival in the mainstem Mad River, the Mad River estuary, and the Pacific Ocean. NMFS' general conclusion is that the influence of density dependent interactions on growth and survival are likely small compared with the effects of large scale and regional environmental conditions. While there is evidence that hatchery production, on a scale many times larger than the Proposed Action, can impact salmon survival at sea, the degree of impact or level of influence is not yet understood or predictable, nor is there any evidence that programs of this size have effects in the ocean. Thus, direct, indirect, and cumulative impacts of the programs on the human environment outside the Mad River Basin are not expected.

Only the known past, present, and foreseeable future actions that could affect the same resources as the proposed action within the cumulative effects assessment area(s) are discussed. Therefore, the effects of the actions (Table 5-1) such as the construction and removal of Sweazey Dam, overfishing, historical gravel mining, and channelization of the lower Mad River will only be briefly discussed because these effects are not intrinsically connected to the proposed action's affected environment/resources even though they have a large role in the existing watershed conditions. The main past, present, and foreseeable future action categories that occur in the assessment area include resource extraction activities (e.g., timber harvest, gravel mining, marijuana cultivation, ocean and river fishing), Matthews Dam water impoundment and annual flow release schedules, climate change, ocean fish harvest, fire management actions, and watershed rehabilitation activities. Only the specific portions of these actions that would affect the affected resources will be assessed. The magnitude, duration, frequency, and timing of these actions have and will vary as economic, social, and regulatory aspects continue to change. For example, multiple agencies, local Tribes, private companies, and organizations have worked to change resource extraction management plans, practices, regulations, and laws (e.g., Basin Plan, U.S. Forest Service's Northwest Forest Plan, California Forest Practice Rules, Humboldt Bay Municipal Water District Habitat Conservation Plan, NMFS' Mad River Gravel Mining Biological Opinion, Six Rivers National Forest's Watershed Rehabilitation Plan, and Green Diamond Resource Company's Habitat Conservation Plan) in an effort to reduce the effects of resource extraction, to rehabilitate the watershed, river corridor, and estuary, and protect and recover listed species and their habitats. Although the data to determine the effects from climate

change, extraction industries, and watershed rehabilitation actions in combination with the proposed action vary in scope and parameters, the following subsections provide a reasonable means for determining whether there will be significant cumulative effects. The approach will use the language outlined in the introduction to the Environmental Consequences Chapter to describe the cumulative effect's magnitude, duration, and likelihood of occurrence.

Although this cumulative effects assessment only focuses on the past, present, and future action effect pathways that are also affected by the proposed action, NMFS recognizes that all past actions in the Mad River watershed resulted in substantially altered watershed conditions (e.g., Redwood Community Action Agency 2009; Stillwater Sciences 2010) degraded habitats (e.g., NMFS 2014), and depressed wildlife and fish populations (e.g., NMFS 2014). These cumulative effects led to salmon and steelhead population declines and the construction of the MRH to supplement the declines. This conclusion is strongly supported in a variety of literature including Mad River watershed assessments (e.g., Redwood Community Action Agency 2009; Stillwater Sciences 2010), sediment budgets and sediment erosion and transport studies (e.g., GMA 2007; EPA 2007), wildlife listings (Table 3-10), the proposed action's purpose and need statement, the original hatchery's purpose (Will 1973), the NC steelhead listing, SONNC coho listing the current NC steelhead status assessment (NMFS 20XX), and the California and SONNC coho salmon recovery plans (CDFW 2004; NMFS 2014). The adverse watershed and in-river effects seem to have peaked during the 1950s through 1980s when the highest rates of landscape extraction activities (e.g., timber harvesting and gravel mining) occurred in conjunction with a wetter climate period that produced several of the largest floods on record (e.g., 1955, 1964, and 1975). Additionally, wildlife and fish populations were declining prior to this time period from over harvesting and degraded habitats, but the continued loss of habitat and shifting baseline conditions continued to suppress populations with some species reaching critically low or depensation levels (e.g., coho).

Subsection 5.2, summarizes the past and present actions that affected the cumulative effects analysis area; Subsection 5.3, Current Conditions, summarizes the existing environmental conditions for the area; and Subsection 5.4, Future Actions, describes the projected actions and estimated associated effects on the affected resources. Large natural events (e.g., 1964 flood or the 2015 fires) are included for context and to describe how human actions compound the effects. Finally, Subsection 5.5, Cumulative Effects by Resource, describes how these past, present, and future actions would affect each resource evaluated in the Environmental Consequences chapter. Given the scale and scope the past, present, and future actions, this assessment will not be able to distinguish the differences between Alternative 2 (Proposed Action/Preferred Alternative) and 3 (50 percent reduction in production), or conduct a detailed cumulative effects assessment of all project-level activities that have occurred, are occurring, or are planned in the future. Therefore, this assessment will qualitatively assesses whether the

Preferred Action's effects in combination with the past, present, and reasonably foreseeable future action effects will degrade or led to declining resource conditions compared to No Action.

5.2. Past and Present Actions

In the cumulative effects area, the temporal boundary between past and present actions is more of a range due to the recurrent and stochastic but relatively predictable nature of the primary management actions (resource extraction, water management, climate change, ocean salmon and steelhead harvest, fire management, and watershed and aquatic habitat rehabilitation) and natural events (e.g., flood and fire). In addition, regulatory actions such as changes in the California Forest Practice Rules and pursuant to the development of Habitat Conservation Plans and issuance of incidental take permits occur at different times for different resources. NMFS defines past actions as having been completed, present actions as ongoing or reoccurring, and future as reasonable foreseeable. However, a defined boundary is less important than the identification of the actions and their effects on the resources.

In the cumulative effects area, the major human-driven actions are best defined by the magnitude, duration, frequency, and timing of the action or in some cases the environmental response to the actions (e.g., larger floods and sediment erosion). All the major human-driven actions that potentially affect the same recourses as the proposed action fit under the following categories: resource extraction, water management, climate change, ocean salmon and steelhead harvest, fire management, and watershed and aquatic habitat rehabilitation. Prior to assessment of the effects generated by the five action categories, the following brief historical description will provide context of the numerous other past and present actions that affect other resources than the proposed action will.

Before Europeans arrived, the indigenous inhabitants occupied the Mad River watershed and Humboldt County area for thousands of years. They were primarily hunter-gatherers and steelhead and salmon were a vital food source. They harvested various resources (e.g., fish, wildlife, and trees) and used fire as a land management tool to maintain certain vegetation and wildlife habitats. In general, their harvest methods and population sizes limited their effects.

Shortly after the arrival of Europeans, resource extraction including wildlife hunting and trapping, salmon, steelhead, and other fish harvest (e.g., canneries), and logging were carried out at a large scale throughout Northern California. As natural resource extraction and the number of people in the area increased, the quantity and quality of the recourses of the Mad River watershed and adjoining areas declined. Most of the old-growth forest was harvested, and the majority of the fertile bottom lands were converted to agricultural and urban uses. The quantity and availability of tidally influenced and freshwater estuarine areas declined, floodplains were altered, the lower mainstem Mad River and tributary creeks were channelized and/or modified, dams were built in the middle (later removed) and upper Mad River, water quality declined,

pollution increased, and species and habitat were lost. As a result, the number of species at risk increased (Table 3-4, Table 3-8, Table 3-9), as did the presence of non-native invasive species. Table 5-2 outlines the major events since Europeans came into the assessment area.

5.2.1. Resource Extraction Actions

Resource extraction actions have in the past and present affected numerous aspects of the environment and provided wood, gravel, water, and salmon and steelhead for human use (Table 5-1). The following resource extraction action descriptions will briefly discuss all the major effects, but the focus will be on the effects to resources affected by the proposed action such as changes in water quantity and quality and socioeconomics.

Timber harvest, road systems, and other similar land disturbances within the Mad River watershed decreased large wood sources, recruitment, and in-channel large wood; altered riparian corridors; altered hydrologic pathways; decreased soil productivity; increased surface erosion and landsliding, and the quantities of sediment entering and transporting down river (GMA 2007; EPA 2007). Although timber harvest and road management practices have improved in recent decades with changes in regulations and reductions in older trees, the major legacy effects have left lasting impacts, and as in any managed watershed, elevated and prolonged suspended sediment and turbidity during runoff events (GMA 2007; EPA 2007). As discussed in the Affected Environment chapter, the EPA established a TMDL for addressing sediment/turbidity and temperature exceedances. The TMDL limited the MRH effluent discharges using the Basin Plan and NPDES permit to ensure that actions within the watershed would not exceed water quality standards that support beneficial uses.

Gravel mining actions have altered the lower Mad River corridor including riparian and floodplain areas and changed the channel morphology which alter river wood resources and water quality (e.g., temperature and turbidity). These effects primarily occurred in the reach downstream of the MRH. These effects are conflated with the effects from timber harvest actions and large floods.

Marijuana cultivation occurs throughout the Mad River Watershed, and diverts water from the Mad River and its tributaries, dumps chemicals and waste into the environment, damages stream channels (e.g., streambank and channel alterations), and disturbs soil and forest resources (Bauer et al. 2015). Marijuana cultivation reduces stream flows, increases chemical pollution, and potentially increases stream temperatures (Bauer et al. 2015).

Table 5-2. Land Management and Major Natural Events Timeline for the Mad River Watershed (modified from Stillwater 2010).

1854 – Humboldt Bay and Mad River Canal Company formed

1854-1900 – Some flow diverted into Humboldt Bay via Mad River Canal used for log transport

Feb. 1, 1905 – U.S. Forest Service established

April 1905 – Trinity National Forest est. (encompassed Mad River Ranger District at the time)

1908 – Small parcel at Blue Lake designated as a "land for homeless Indians" under Executive Order

1910 – Gaging stations constructed to study Mad River flows

1933 – Mad River water first diverted to City of Eureka

1938 – Sweasey Dam constructed

1947 – Six Rivers National Forest est. by President Truman (includes Mad River Ranger District)

1954 – Blue Lake Rancheria wrongfully terminated under Public Law 85-671 with trust lands dissolved

1955 – Major flood event

1956 – Humboldt Bay Municipal Water District formed

1960s – Sweasey Dam filled and no longer functional

2010 – Mad River Gravel Mining Biological Opinion

1961- Matthews Dam and Ruth Reservoir constructed

1964 – Major flood event (Ruth Reservoir overflowed spillway)

August 1970 – Sweasey Dam removed by dynamiting

1970s – Butler Valley Dam proposed and reviewed

February 1971 – Mad River Fish Hatchery facilities completed

1972 – Forest Practice Rules (FPR) introduced

1972 – Major storm events

1976-1977 - Drought

1983 – Blue Lake Rancheria federally re-recognized with settlement of Tillie-Harwick Lawsuit

1989 – Blue Lake Rancheria tribal government organized under IRA Constitution approved by the Secretary of the Interior

1992 – Major upgrade to FPRs

1994 – Mad River PEIR for gravel mining

1995 – Six Rivers Nat'l Forest Land and Resource Management Plan

1995 – Major storm event

1996 – Final EIS for Pilot Creek published

2014 – SONNC Coho Recovery Plan

1996 – Corps of Engineers Letter of Permission (LOP) of instream gravel extraction operations

1997 – Major storm events

1997 – Coho salmon federally ESA listed as Threatened in the Mad River

1998 – Upper Mad River Watershed Assessment

1999 – Chinook salmon federally ESA listed as Threatened in the Mad River

2000 – Steelhead trout federally ESA listed as Threatened in the Mad River

2000 – Threatened and impaired FPRs introduced.

2004 – Humboldt Bay Municipal Water District Habitat Conservation Plan

2004 – New LOP and Individual Clean Water Act 404 Permits, NMFS Biological Opinions, and adaptive management strategies for instream gravel extraction operations

2004 – CDFG Recovery Strategy for California Coho Salmon published

2005 – Coho salmon state-listed as Threatened under CESA

2007 – Green Diamond Resource Company Aquatic Habitat Conservation Plan published

2008 – Mad River TMDL established for sediment impairment

2014 – HBMWD Water Planning Process

The construction of Matthews Dam and municipal use of water stored in Ruth Reservoir changed the annual hydrograph by reducing fall and early winter storm runoff and increasing summer and early fall low flows. Additionally, climate change has reduced the winter snowpack, the timing of the snowmelt runoff, and seems to have reduced the number of fall rain storms from historical levels. Given our short precipitation and streamflow gaging records, climate change effects are difficult to separate from the multi-decade wetter and drier period shifts. However, there is strong evidence that the ocean and climate are warming and weather patterns are changing leading to dynamic shifts in precipitation and runoff patterns.

Resource extraction actions including marijuana cultivation, HBMWD's operations of Matthews Dam for water supplies, ocean fish harvest, fire management actions, and watershed rehabilitation activities all have strong socioeconomic effects on Humboldt County and its residents. For example, timber harvest, gravel mining, ocean fishing, and watershed rehabilitation related activities provide tax dollars to the county, jobs for residents, and local business revenue for equipment, fuel, and operational expenditures.

The proposed action's economic impacts are rather small compared to all of the resource extraction activities, likely less than a couple of percent of the total from all other resource extraction revenue.

5.2.2. Mad River Water Management

The Humboldt Bay Municipal Water District (HBMWD) constructed Matthews Dam and water diversion infrastructure in 1961 to store and supply water for the cities and industries surrounding Humboldt Bay including two local pulp mills. The HBMWD holds appropriative water rights to store 48,030 acre-feet of water in Ruth Lake behind Matthews Dam and divert up to 75 million gallons per day of water at the HBMWD's pumping facilities on the Mad River at Essex, located between Arcata and Blue Lake. The HBMWD fills Ruth Reservoir during fall and winter storms and augments low flow periods to supply water costumers. These shifts have positive and negative effects on downstream fish, marine mammals, and wildlife and their habitats. For example, higher flows in late summer cool portions of the river, benefiting coho and steelhead, but likely prevent the sand spit from closing the mouth periodically. The longer the mouth remains open and passable, the more easily marine mammals can feed on coho or steelhead juveniles in the estuary.

Water use has changed since construction of the Mad River dam and diversion infrastructure. Changes in the global pulp market economics led to the closure of the mills and a reduction in water demand (Figure 5-1) and revenue for the HBMWD. The HBMWD developed and submitted a Habitat Conservation Plan (HBMWD 2004) for approval to NMFS, who provided an incidental take permit (NMFS 2005). The HBMWD recently conducted a Mad River water resource planning process and proposed several flow release and diversion alternatives (Figure

5-2) to address the loss of revenue and operational costs following the closure of the two local pulp mills (HBMWD 2014). At the end of the planning process, the HBMWD selected three broad approaches to addressing the issues: (1) use the water locally, (2) transfer water to a northern or central coast public agency, or (3) obtain an instream flow right for environmental benefit (HBMWD 2014). Figure 5-2 highlights the full range of potential flow releases possible for the Mad River. The MRH is located approximately 2 miles upstream of the Essex surface water diversion and the Rainey wells. HBMWD maintains a streamflow necessary to meet the diversion requirements at Essex and instream flow requirements below the Essex Diversion. Therefore, under the current usage regime (Figure 5-1), the MRH water diversion quantities do not create adverse effects to downstream resources.

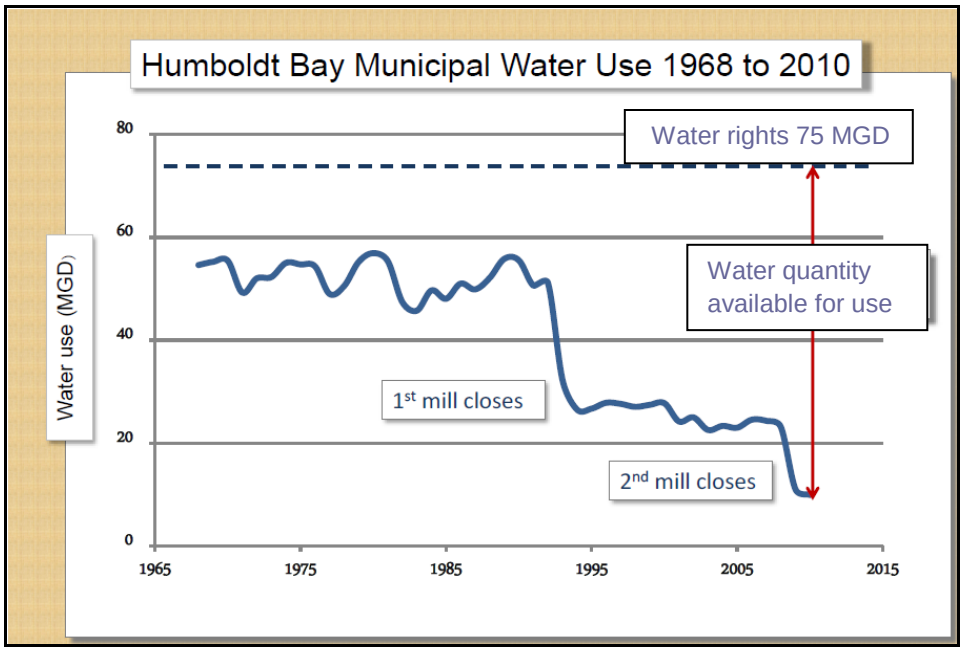

Figure 5-1. Humboldt Bay Municipal Water District's water usage (MGD).

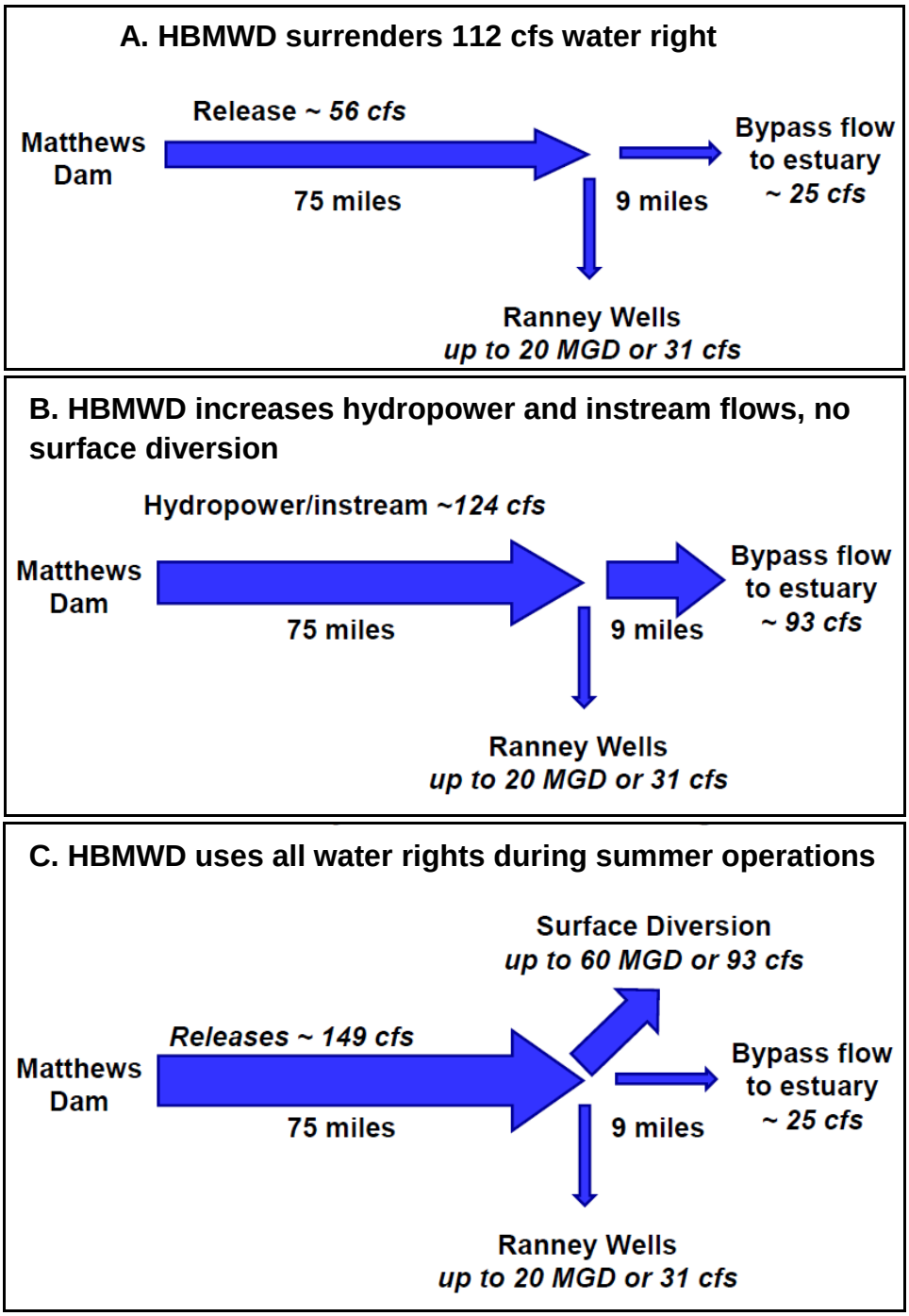

Figure 5-2. Potential water management scenarios outlined by the Humboldt Bay Municipal Water District (HBMWD 2013). (a) The scenario with the lowest likelihood and lowest flow release. (b) The most likely scenario and similar to the current flow release schedule. (c) HBMWD's preferred alternative and max capacity—this scenario has a low to moderate likelihood.

5.2.3. Climate Change

Anthropomorphic climate disruption or climate change driven by human-produced greenhouse gases is occurring and the changes are beginning to accelerate (e.g., NOAA's climate webpage; IPCC reports). While the effects of climate change vary across the globe, the following changes will and are affecting resources (e.g., District 1 Climate Change Vulnerability Assessment and Pilot Studies, FHWA Climate Resilience Pilot Final Report) within the cumulative effects area including (the likelihood of occurrence is in parentheses):

- Increasing air and water temperatures (high likelihood)
- Changing precipitation patterns (moderate likelihood)
- Reduced winter and spring snowpack (high likelihood)
- Earlier spring peak flow (high likelihood)
- Reduced summer stream flow into the Mad River (high likelihood)
- Changing flood frequency (moderate likelihood)
- Higher air and water temperatures (moderate likelihood)
- Warmer ocean temperatures (high likelihood)
- Rising sea level (high likelihood)
- Increased ocean acidity (high likelihood)
- Shifting offshore upwelling patterns (moderate likelihood)

These changes will and are having effects on the environmental resources including:

- Adjustments in the Mad River spit and estuary as sea level rises
- Increased variation in vegetation growth and water quality with warming air and water temperatures
- Warmer oceans and summer air temperatures combined with extensive fire suppression and timber management may lead to increasing fires frequency and post-fire sediment influxes (e.g., debris flows)
- Changes in plant, fish, and wildlife species' distributions and increased potential for invasive species

- Changes in streamflow runoff and river and ocean temperatures may shift the timing of life history events, changes in growth and development rates, and changes in habitat availability
- Less spring runoff and changes in HBMWD operations with less snowpack

5.2.4. Salmon and Steelhead Harvest

Salmon and steelhead are harvested in the Pacific Ocean offshore from the Mad River and there is a recreational MRH winter-run steelhead fishery in the river. The effects of the fisheries are managed by NMFS and the Pacific Fishery Management Council (PFMC) and CDFW. The PFMC was established by the Magnuson-Stevens Fishery Conservation and Management Act of 1976 and has jurisdiction over the 317,690 square mile exclusive economic zone off Washington, Oregon, and California. Management measures developed by the Council are recommended to the Secretary of Commerce through the NMFS. The Council's Salmon Fishery Management Plan describes the goals and methods for salmon management. Management tools such as season length, quotas, and bag limits vary depending on how many salmon are present. There are two central parts of the Plan: conservation objectives, which are annual goals for the number of spawners of the major salmon stocks ("spawner escapement goals"), and allocation provisions of the harvest among different groups of fishers (commercial, recreational, tribal, various ports, ocean, and inland). California State regulations, which may differ from Federal regulations, are in effect in State territorial waters (0-3 nautical miles off shore).

The PFMC proposes the salmon and steelhead harvest and NMFS reviews and implements the harvest levels. CDFW also solicits comments on their fishery recommendations. NMFS and CDFW have a complex system of data gathering and monitoring of salmon and steelhead to maintain sustainable and viable fisheries. Therefore, NMFS expects that the effects from harvest upon the sustainability and recovery of salmon and steelhead will be taken into account during the harvest recommendation process to ensure the survival and recovery of salmon and steelhead within the Mad River watershed.

5.2.5. Fire Management Actions

The State of California, Federal agencies, and private landowners implement a range of fire management actions ranging from total suppression to an integrated approach using prescribed fire, fuels treatments, and wildfire emergency response (i.e., suppression). In general, fire management actions consist of vegetation and ground disturbance that can reduce ground cover, and increase water runoff and sediment erosion as well as Mad River suspended sediment and turbidity levels. Changes in water quantity and quality may interact with MRH withdrawals or effluent discharges. The State and Federal agencies have numerous Best Management Practices and post-fire rehab efforts to reduce ground disturbances and sedimenterosion. For example, the

USFS's Burned Area Emergency Rehabilitation teams develop post-fire actions such as enlarging stream crossing culverts, outsloping roads, and dipping and rocking road crossings.

Burned areas are more susceptible to sediment erosion and can induce pulses of sediment that can affect fish survival by increasing the magnitude and duration of suspended sediment and turbidity events leading to increased severity of ill effects (Newcombe and Jenson 1996). Fire suppression efforts and climate change have increased the likelihood of larger fires and thus, sediment runoff pulses within the Mad River watershed. Many factors (e.g., four-year drought and fire suppression efforts) helped create the 2015 fires within the Mad River watershed including several completely surrounding Ruth Reservoir. These fires and recently proposed post-fire actions (i.e., hazard tree, fuels reduction treatments, and salvage logging) will likely increase sediment runoff.

5.2.6. Watershed and Aquatic Habitat Rehabilitation and Management Efforts

Habitat loss has been identified (e.g., CDFW 2004; NOAA 2014) as a key reason for the decline of salmon and steelhead populations in the Mad River. Improvements to and increases in habitat will benefit natural-origin steelhead and their prey, which in turn should increase the number and distribution of natural-origin steelhead. An increase in natural-origin steelhead would beneficially shift the PNI, and shifts in the habitat distribution could reduce competition with hatchery steelhead. Additionally, rehabilitation efforts would in the short-term (1 to 5 years) increase sediment runoff but lead to reductions in the longer-term (>5 years).

Numerous efforts have and are working toward improving watershed and aquatic habitat rehabilitation and management. The state of California and Federal agencies, local Tribes, and private companies and organizations have worked to change management policies and actions to rehabilitate the watershed, tributaries, and estuary and recover listed species and their habitats. The following examples highlight the larger improvements that have occurred in the Mad River watershed in recent decades that have led to improving watershed conditions. The Six Rivers National Forest (SRNF) has reduced timber harvest and roading and significantly changed their land management policies over the last 20 years with implementation of the Northwest Forest Plan (USFS 1993) and development of a restorative approach to watershed management (Six River National Forest 2014). The State of California and the primary private timber landowner, Green Diamond Resource Company (GDRC) have also improved their timber management activities (e.g., streamside buffers, improved roads, and stream crossings) with implementation of the California forest Practices Rules (California Department of Forestry) and the GDRC lands Habitat Conservation Plan (GDRC 2006).

The State of California's Recovery Strategy for California Coho Salmon (CDFG 2004) and the Steelhead Restoration and Management Plan for California (CDFG 1996) and NMFS's Recovery Plan for the Southern Oregon Northern California Coast Evolutionarily Significant Unit of Coho

Salmon (NMFS 2014) provide action plans and lists of specific rehabilitation projects and management actions that will aid in rehabilitating aquatic habitats and recovering coho, steelhead, and other aquatic species. Priorities for recovering the Mad River watershed include reducing land development pressure on ecologically important and sensitive areas, protecting and restoring floodplain function, and protecting and recovering salmon and freshwater resources. In marine and freshwater areas, development will continue to be encouraged away from ecologically important and sensitive nearshore areas and estuaries, and efforts will be made to reduce sources of pollution. Approaches will be used to help preserve the natural functions of the ecosystem and support sustainable economic growth. Local community efforts, such as smaller community habitat restoration and protection efforts, will help protect sensitive areas in the Mad River watershed.

There are multiple State and Federal grant programs that fund the restoration actions including the Fisheries Restoration Grant Program (FRGP) which uses these recovery plans to restore anadromous salmonid habitat with the goal of ensuring species survival and protection. Over the past 30 years, the FRGP has funded projects throughout coastal California with multiple projects within the assessment area. It is expected that California State and Federal Agencies will continue to support habitat-based recovery actions similar to recent support efforts. California State created the Salmon Recovery Funding Board, which administers Federal and California State funds to protect and restore salmon and steelhead habitat. Federal agencies and organizations are expected to continue to support habitat protection and restoration initiatives/processes including projects such as the Six Rivers National Forest's draft watershed restoration action plan (SRNF 2015).

In summary, the Federal, state, corporate, and private watershed and aquatic habitat rehabilitation and management actions are helping, and will continue to help, restore degraded habitat conditions in the cumulative effects analysis area. Collectively, these programs will help to counterbalance habitat degradation and long-term detrimental cumulative impacts on natural resources in the cumulative effects analysis area, which have previously contributed to Federal and state listings of fish and wildlife species (Subsection 3.3, Salmon and Steelhead; Subsection 3.4, Other Fish Species; and Subsection 3.5, Wildlife).

5.3. Existing Conditions

Multiple watershed and aquatic habitat assessments (e.g., GMA 2007, Stillwater Sciences 2009) and action and recovery plans (e.g., NOAA 2014; CDFW 2004) have described the existing conditions and substantial changes within the cumulative effects analysis area that have occurred since the arrival of Europeans. The area has a relatively low population and the highest rates of resource extraction have passed because the need for gravel has slowed, and the large trees and large fish runs are no longer available. In addition, water usage from the HBMWD's Ruth Reservoir has dropped off significantly because the pulp mills closed when the industry moved

on to foreign markets. However, the cumulative effects area still provides moderate quantities of gravel and timber and the majority of municipal and industrial water which continues to have effects on water quality and quality, aquatic habitats, and socioeconomics.

The Mad River watershed is relatively resilient and continues to adjust following the extensive human induced changes described previously. The relatively diverse and long, narrow Mad River watershed cuts across several environments including the fog belt coastal area, redwood forests, grass prairies, steep forest hillslopes, large earthflows, and headwater areas that receive snow. However, the Mad River has rather limited in-river habitat available for salmon and steelhead given the fish barriers (steep boulder "roughs") on the mainstem and North Fork Mad River (Figure 3-1) and the substantial human induced alterations with the loss of large wood and increased sediment supply. The limited habitat range, existing conditions, and adjusting climate may limit the ability for salmon and steelhead to recover and adapt to short-term and long-term changes in their environment over time. However, numerous efforts have and are being made to limit human impacts and rehabilitate the river, hillslopes, and habitats as described in Subsection 5.2.6, Watershed and Aquatic Habitat Rehabilitation and Management Efforts.

5.4. Future Actions and Conditions

Reasonably foreseeable future actions include all the previously discussed resource extraction actions, climate change, fire management activities, ocean steelhead and salmon fishing, Mad River water management, and watershed and aquatic habitat rehabilitation and management actions. All of these actions have occurred in the past, are currently occurring, and are expected to continue into the foreseeable future. Most of these actions are expected to continue as discussed previously but with some improvements based on new science, information, and adjustments in management and regulation. Therefore, the environmental conditions are expected to slowly improve. In particular, marijuana cultivation water use and land disturbance is expected to improve as regulation and compliance issues are addressed in the future through legalization or other efforts. Climate change is expected to continue shifting fire, precipitation, and sediment erosion regimes, increasing ocean, air, and stream temperatures, and raising sea levels. These changes will make oceanic (e.g., warmers waters and more southern winds reduce upwelling and primary/plankton production) and in-river (e.g., reduced snowpack and warmer tributary flows reduce habitat availability) conditions more difficult for steelhead. However, Mad River water management at Matthews Dam may buffer stream temperature and low flow effects within the mainstem river.

5.5. Cumulative Effects by Resource

The following provides an assessment of the cumulative effects of the no action and the proposed action/preferred alternative alternatives, in combination with the past, present, and foreseeable resource extraction, HBMWD's Mad River water management, climate change,

steelhead and salmon fishing, fire management, and watershed and aquatic habitat rehabilitation and management actions on each resource analyzed in this EA: water quantity and quality, salmon and steelhead, other fish species, wildlife, socioeconomics, and environmental justice. The effects of the past and present management action categories formed the affected resource's existing conditions and all the actions will continue as the foreseeable future actions. If there are no anticipated effects from one of the management action categories then there will be no mention of that action category.

5.5.1. Water Quantity and Quality

This subsection considers the effects that may occur as a result of the alternatives being implemented at the same time as the past, present, and reasonably foreseeable future actions on the existing water quantity and quality.

The MRH existing operations (Subsection 3.1, Water Quantity and Quality) closely mimic the Proposed Action. The existing surface water rights allow the diversion of enough Mad River to operate the MRH at full historical capacity (30 cfs). However, the MRHs primarily uses groundwater and some surface water to run the existing and proposed operations which commonly require 11.7 cfs (CDFW 2014). The Basin Plan (NCRWQB 2011) has surface water diversion prohibitions that only allow the MRH to divert 1 percent or less of the Mad River flow as measured at the USGS's Mad River near Arcata, California, gaging station. This gage is located just downstream of the HBMWD's extraction locations, the Essex diversion and Rainey Wells (Figure 5-2) which ensures the existing MRH diversion and as proposed under Alternative 2 in combination with HBMWD's dam releases and extractions would have a negligible to low adverse effect on water quantity in the lower river and estuary.

As discussed in the Affected Environment, Mad River water quality is impaired for sediment and temperature (EPA 2007). To address these issues, the EPA (2007) developed TMDL allocations to ensure water quality standards are met. In addition, the NCRWQCB's NPDES permit and the Basin Plan requirements (See Subsection 3.1, Water Quantity and Quality) address these and other potential water quality issues and monitoring associated with hatchery effluent discharges. The MRH can treat and recycle approximately 84 percent of the water. The majority of the effluent discharges are sent to the settling basin and unaffected surface water is returned to the river through the fish ladder within 500 feet of its removal. CDFW follows the strong diversion and effluent discharge monitoring requirements established by the NCRWQCB. The effluent discharge is also severely limited to ensure water quality standards and beneficial uses are protected under the NCRWQCB's (2011) Basin Plan and NPDES permit limits. There would be negligible cumulative adverse effects with implementation of Alternative 2 in combination with the resource actions on water quality or other downstream resources given the upstream flow manipulation and the limited MRH diversion and effluent quantities.

The following effects are anticipated from the ongoing and future actions discussed above on existing water quantities and quality, which developed as the past and present actions shaped the landscape. Resource extraction actions such as timber harvest and gravel mining use water in a variety of operations (e.g., road dust abatement, growing trees, and washing sediments). The majority of these actions require water rights and/or effluent discharge permits which fall under purview of the State Water Resources Control Board and/or the NCRWQCB. Marijuana cultivation uses an unknown but was recently estimated as substantial quantity of water (Bauer et al. 2015) within the Redwood Creek watershed, a very similar watershed adjacent to the Mad River watershed. Unfortunately, the effects on water quality have not been quantitatively assessed but recent Lost Coast Outpost (See lostcoastoutpost.com) and North Coast Journal (See northcoastjournal.com) news articles documenting recent field reviews by CDFW and law enforcement have revealed water contamination from pesticides, herbicides, and fuels. The effects of marijuana cultivation are expected to continue until legalization and/or proper enforcement, permitting, and oversight can be obtained.

Based on the expected water use scenarios in Subsection 5.2.1 (Figure 5-2), HBMWD's Mad River water management has a high likelihood of increasing low flows in the Mad River, especially in the summer and fall. However, when any of the scenarios are combined with the MRH's season of operation, October 1 through May 15, and the 1 percent or less surface water diversion as measured at the USGS's gaging station at Highway 299 prohibitions, the adverse effects are expected to be negligible to low. Additionally, the increased flows during the low flow period will provide a diluting effect which will have a high likelihood of improving water quality in the Mad River. This will have a low beneficial effect during the permitted MRH operating period.

Fire management will likely have a negligible to low adverse long-term effect on Mad River water quantity or quality because suppression actions are typically mitigated through post-fire BAER and other rehab work. In addition, prescribed fire and fuel treatments will likely have a short-term low adverse effect if all the best management practices and Forest Plan standards and guidelines are followed. Smoke and air borne particulates from fires have a short-term cooling effect on air and water temperatures which can have a low beneficial effect. Moderate and high burn severity areas have a high likelihood of increasing sediment runoff in the first three to five years after fires because of the loss of ground cover vegetation, increased soil disturbance, and declining root cohesion. The short-term increases in suspended sediment runoff can lead to moderate adverse effects to water quality; however, these effects are usually short-duration and the suspended sediment and turbidity effects are diluted by the watershed area above the MRH.

Climate change is expected to continue increasing air and water temperatures leading to such effects as reduced snowpack quantities and shifting precipitation regimes. Given the proximity of the Mad River watershed between the Pacific Northwest and the southern storm tracks there is a

moderate probability that the annual average precipitation quantities will remain relatively similar for decades but with less snow and more rain and a wider range of total annual precipitation. The changes in precipitation from climate change during the foreseeable future are expected to have a low adverse effect on the Mad River water qualities because the Ruth Reservoir has a relatively small storage capacity and has filled during each of the last three drought years. Therefore, HBMWD downstream releases will continue to meet downstream low flow requirements.

There is a moderate likelihood that HBMWD's Mad River water management will buffer (i.e., benefit) some of the climate change effects and some of the MRH diversions because and the current surplus of water for downstream release during low flows. The releases result in higher and cooler summer flows than would normally occur.

Watershed and aquatic rehabilitation and management actions will likely help improve water quantities and quality by reducing sediment erosion (e.g., further disconnecting the road system from the stream system) and improving wood loading. These effects are expected to have a low beneficial effect on the water quantities and quality unless these actions can help address marijuana cultivation issues and encroachment of the river from levees and infrastructure. Watershed rehabilitation activities have a variety of effects including short-term increases in sediment runoff following disturbance and the potential to rehabilitate various watershed and river attributes over the long-term. For example, watershed rehabilitation efforts to reconnect tributaries and improve habitat can increase the number of natural-origin steelhead and improve water quality.

In summary, there is a high likelihood that there will be low, cumulative adverse effects on water quantity and quality from the various action categories in combination with either the No Action or the Proposed Action alternative effects.

5.5.2. Salmon and Steelhead

Subsection 3.2, describes existing conditions for salmon and steelhead and their listing status. These conditions represent the effects of past and present actions. The expected direct and indirect effects of the alternatives on salmon and steelhead are described in Subsection 4.2. This subsection considers potential effects that may occur as a result of implementing the No Action and Proposed Action alternatives at the same time as anticipated future actions: resource extraction, Mad River water management, climate change, salmon and steelhead harvest, fire management, and watershed and aquatic rehabilitation and management.

Salmon and steelhead abundance naturally alternates between high and low levels on large temporal and spatial patterns that may last centuries and on more complex ecological scales than can be easily observed (Rogers et al. 2013). Current run sizes of salmon and steelhead in the

cumulative effects analysis area are depressed and Chinook and coho salmon and steelhead are listed. This subsection provides brief overviews of the anticipated future action's effects on salmon and steelhead.

The effects of climate change on salmon and steelhead are described in general in ISAB (2007), and would vary among species and among species' life history stages. Cumulative effects from climate change, particularly changes in air and water temperatures, would likely impact hatchery-origin and natural-origin salmon and steelhead life stages in various ways as described below and shown in Table 5-3. Under the No Action and proposed action/preferred alternative, the low level adverse impacts on salmon and steelhead from climate change are expected to be similar, because climate change would impact fish habitat under each alternative in the same manner.

Table 5-3. Examples of potential impacts of climate change by salmon and steelhead life stage under all alternatives.

Life Stage	Effects
Egg	1) Increased water temperatures and decreased flows during spawning migrations for some species would increase pre-spawning mortality and reduce egg deposition. 2) Increased maintenance metabolism would lead to smaller fry. 3) Lower disease resistance may lead to lower survival. 4) Changed thermal regime during incubation may lead to lower survival. 5) Faster embryonic development would lead to earlier hatching.
Spring and Summer Rearing	1) Faster yolk utilization may lead to early emergence. 2) Smaller fry are expected to have lower survival rates. 3) Higher maintenance metabolism would lead to greater food demand. 4) Growth rates would be slower if food is limited or if temperature increases exceed optimal levels; growth could be enhanced where food is available, and temperatures do not reach stressful levels. 5) Predation risk would increase if temperatures exceed optimal levels. 6) Lower flows would decrease rearing habitat capacity.
Overwinter Rearing	1) Smaller size at start of winter is expected to result in lower winter survival. 2) Mortality would increase because of more frequent flood flows as snow level rises. 3) Warmer winter temperatures would lead to higher metabolic demands, which may also contribute to lower winter survival if food is limited, or higher winter survival if growth and size are enhanced.

Sources: ISAB (2007), Glick et al. (2007), Beamish et al. (2009), and Beechie et al. (2013).

The ongoing effects of resource extraction described in Subsection 5.2.1 continue to affect aquatic habitat used by salmon and steelhead. Although regulatory changes for increased environmental protection such as new California forest practice rules, monitoring, and enforcement have helped reduce the effects of resource extraction on salmon and steelhead in fresh and marine waters, resource extraction continues to have low to moderate adverse effects to salmon and steelhead habitat, to water quality, and contribute to salmon and steelhead mortality. These developments result in environmental effects such as sediment erosion, sedimentation, changes in stream flow because of increased consumptive uses, barriers to fish passage, and other types of environmental changes that would continue to affect hatchery-origin and natural-origin salmon and steelhead. Resource extraction actions would more likely affect species that reside in the lower river and estuary because the effects are accumulated along the river and

compounded by development in the lower reaches. Effects from resource extraction are expected to have a low to moderate adverse effect on salmon and steelhead under all alternatives.

Mad River water management actions may provide some low moderate beneficial effects including increased habitat with higher summer and early fall flows and cooler temperatures and some buffering effects from the increasing air and water temperatures associated with climate change. While the community responses to HBMWD's water planning process emphasize the need and desire to support instream flows for fish, economics will ultimately drive the HBMWD's water management scenario selection (Figure 5-2). Rehabilitation water management actions may not fully mitigate for the adverse impacts of climate change and resource extraction actions on salmon and steelhead and their associated habitats.

Rehabilitation of habitat in the cumulative effects analysis area will improve salmon and steelhead habitat under all alternatives, with particular benefits to freshwater and estuarine environments considered to be important for the survival and reproduction of fish. However, the low beneficial effects from watershed and habitat rehabilitation will not substantially increase survival and abundance of salmon and steelhead without other improvements. In addition, rehabilitation is dependent on continued funding, which is difficult to predict over time. Benefits from watershed and habitat rehabilitation are expected to affect salmon and steelhead survival similarly under all alternatives.

In summary, the management actions may maintain or continue to improve salmon and steelhead habitat over time under all alternatives, which may have a negligible or low beneficial cumulative effect on the abundance and productivity of natural-origin salmon and steelhead and hatchery-origin populations. Although none of the alternatives would affect the overall trend in cumulative effects on salmon and steelhead, the Proposed Action could help mitigate some adverse effects on steelhead. That is, because this alternative would use a local, native broodstock the hatchery programs could be used to reduce the extinction risk of natural-origin populations resulting from cumulative effects such as habitat degradation.

5.5.3. Other Fish Species

Subsection 3.3, lists the other Fish Species with a predator, prey, and/or competitive relationship to steelhead in the assessment area and their listing status. These conditions represent the effects of past and present actions. The effects of the alternatives on other fishes are described in Subsection 4.3. This subsection considers potential effects that may occur as a result of implementing the No Action and Proposed Action alternatives at the same time as anticipated past, present, and reasonably foreseeable future actions.

Other fish species that have a relationship to NC steelhead include coastal cutthroat trout, sturgeon and lamprey, forage fish, and resident freshwater fish (Table 3-10). Similar to steelhead

species, these fish species require and use a diversity of habitats. However, similar to the effects described above for salmon and steelhead, these other fish species may also be affected by resource extraction, Mad River water management, climate change, ocean fisheries harvest, fire management, watershed and aquatic rehabilitation and management actions because of the overall potential for loss or degradation of aquatic habitat or the inability to adapt to shifting climatic conditions. The extent to which Mad River water management and watershed and aquatic rehabilitation actions may mitigate the impacts from resource extraction and climate change are difficult to predict but have a moderate likelihood of mitigating the relative low adverse effects in the short-term.

In summary, the cumulative effects of the various future actions under the three alternatives would have negligible adverse and/or beneficial cumulative effects on the abundance on fish species that compete, prey on, or are prey items for steelhead. None of the alternatives would affect the overall trend in cumulative effects on other fish species because the production levels under the No Action and Proposed Action (zero or 150,000 steelhead smolts) would be a small fraction of the total salmon and steelhead in the analysis area that these other fish species could compete with, prey on, or be prey items for.

5.5.4. Wildlife and Marine Mammals

Subsection 3.4, lists the wildlife with a potential relationship to steelhead in the assessment area and their listing status. These conditions represent the effects of past and present actions. The effects of the alternatives on wildlife are described in Subsection 4.4. This subsection considers potential effects that may occur as a result of implementing the No Action and Proposed Action alternatives at the same time as past, present, and reasonably foreseeable future actions.

As described in Subsection 5.5.2, Salmon and Steelhead, resource extraction, climate change, and ocean salmon and steelhead harvest may reduce the abundance and productivity of natural-origin salmon and steelhead and hatchery-origin steelhead populations. Consequently, the total number of salmon and steelhead available as prey to wildlife may be lower than that considered in Subsection 4.5, Wildlife. Effects would be greatest on wildlife species that have a strong relationship with salmon and steelhead, including seals, sea lions, common merganser, bald eagle, and osprey. Effects on these species may include changes in distribution in response to changes in the distribution of their food supply, decreases in abundance, and decreases in reproductive success compared to that described in Subsection 4.5, Wildlife. Effects on other wildlife species that have a recurring relationship with salmon and steelhead may also occur depending on how their overall aquatic prey base responds to future climate change, resource extraction, Mad River water management, watershed and aquatic rehabilitation and management actions.

In summary, the reasonably foreseeable future actions: Mad River water management, climate change, ocean salmon and steelhead harvest, and watershed and aquatic habitat rehabilitation and management actions would lead to negligible to low adverse and beneficial effects on wildlife species with strong predator, competitor, and/or prey relationships with salmon and steelhead. The various actions have different effects but during the proposed implementation of the HGMP the cumulative effects are not expected to be significant because the range of production levels under the No Action and Proposed Action (zero or 150,000 steelhead smolts) would be a small fraction of the total number of salmon, steelhead, and other prey items for wildlife in the analysis area (See Wildlife and Marine Mammals Affected Environment Environmental Consequences Sections).

5.5.5. Socioeconomics

This subsection assesses the incremental impacts of the alternatives in addition to past, present, and reasonably foreseeable future actions on socioeconomic resources. Subsection 3.5, describes the baseline conditions for socioeconomics. These conditions represent the existing conditions and the effects of the past and present actions. The expected effects of the alternatives on socioeconomics are described in Subsection 4.5.

The socioeconomic effects from either ending the MRH's winter-run steelhead program (No Action Alternative) or approving the HGMP (Proposed Action/Preferred Alternative) are likely undetectable to negligible beneficial effects compared to the low to moderate beneficial and adverse socioeconomic effects from resource extraction, Mad River water management, fire management, and watershed and aquatic rehabilitation and management actions; which provide highly beneficial social and economic effects on Humboldt County through jobs, taxes, community, and a general improvement in the environment. The chronic press condition imposed on the Mad River watershed resources from resource extraction, flow alterations, and climate change will continue to have moderate adverse effects by limiting various watershed goods such as aquatic habitat, fish populations, tree growth, large wood inputs to the river, and aquatic and terrestrial habitat, and would lead to elevated sediment erosion. Overall, the cumulative effect will likely be moderate beneficial effect to Humboldt County's socioeconomics.

In summary, there is low likelihood that the effects from resource extraction and climate change in combination with the Proposed Action would decrease the number of fish available for harvest, angler expenditure, and economic output relative to conditions considered in Subsection 4.6. However, none of the alternatives would affect the overall trend in effects on socioeconomics because the range of production levels under the alternatives (150,000 steelhead smolts) would result in continuing, reducing, or eliminating only a small fraction of the total harvestable salmon and steelhead in the analysis area (including the rivers and Pacific Ocean within and bordering Humboldt County), and therefore, a small fraction of the overall economic

benefits derived from salmon harvest in the analysis area. Regardless of the past, present, and reasonably foreseeable future action effects trajectory and the undetectable to negligible beneficial effects the Proposed Action or the No Action will or will not provide, the societal and physiological effects of having a recreational steelhead fishery where fish can be harvested provide an economic inflow into local businesses, and provide food and sport to locals.

5.5.6. Environmental Justice

This subsection considers potential effects that may occur as a result of implementing any one of the alternatives at the same time as other anticipated actions. This subsection discusses the incremental impacts of the alternatives in addition to past, present, and reasonably foreseeable future actions on environmental justice user groups and communities of concern. Environmental justice user groups and communities of concern within the cumulative effects analysis area include Indian tribes and low income or minority communities that fish for steelhead. The expected effects of the alternatives on environmental justice are described in Subsection 4.6, Environmental Justice.

Regardless of the effects of resource extraction, Mad River water management, climate change, ocean fish harvest, fire management, and watershed and aquatic rehabilitation and management actions, the No Action alternative would in all likelihood eliminate the Mad River winter-run recreational river fishery. This would have a high likelihood of moderately adversely affecting any environmental justice user groups and communities of concern within the cumulative effects analysis area that have the economic ability to purchase a fishing license, gear, and to travel to other locations to fish for steelhead. Therefore, selection of the Proposed Action would still provide environmental justice user groups and communities of concern within the cumulative effects analysis area the ability to fish and harvest MRH winter-run steelhead, but cumulative effects are not expected to be significant.

5.6. Cumulative Effects Summary

NMFS recognizes that the Mad River watershed has experienced substantial effects from a wide array of human-related activities since European settlement, which led to degraded watershed conditions, degraded habitats, local fish, wildlife, and marine mammal species extinction (e.g., wolves and grizzly bears) and population reductions, depressed steelhead and salmon populations (e.g., NMFS 2014), and multiple ESA-listed species. This conclusion is strongly supported by the references listed throughout this document and all recent regulatory actions (e.g., ESA listings, recovery plans, TMDLs, gravel permits, and timber harvest HCPs), the proposed action's need statement, the original hatchery's purpose and need (Will 1973), the NC steelhead listing (65 Fed. Reg. 36074, June 7, 2000; 62 Fed. Reg. 834, February 6, 2006), the current NC steelhead status assessment (NMFS 2000), and the SONCC coho salmon recovery plan (NMFS 2014). These past and current effects help lead to the construction of the MRH to

supplement the declining salmon and steelhead populations and the proposed continued use of the MRH to raise the NC winter-run steelhead. However, this assessment found that there are regulations and processes in place to mitigate and limit most of the adverse effects to affected resources. For example, the Mad River TMDL (EPA 2007) sets limits on the quantities of management-related sediment erosion for various management actions in particular watersheds. The eroded sediment produces suspended sediment and turbidity, which can degrade fish habitat and other beneficial uses. An additional example is the SONCC coho recovery plan (NMFS 2014), which outlines specific actions that need to be addressed to facilitate recovery of coho salmon and other aquatic species. In addition, the multiple agencies, local tribes, and private companies and organizations have worked to change management policies and actions to rehabilitate the watershed, river corridor, and estuary and to recover listed species and their habitats. While all the beneficial actions may not fully mitigate the impacts of climate change and other management actions, this assessment finds that the direct and indirect effects by the Proposed Action on the affected resources, in combination with effects from past, present, and foreseeable future actions on the same affected resources are not expected to be significant.

6. AGENCIES AND PERSONS CONSULTED (INCLUDING TRIBES)

Bear River Rancheria
Blue Lake Rancheria
Trinidad Rancheria
Yurok Tribe
Wiyot Tribe

California Department of Fish and Wildlife

7. LITERATURE CITED

Bauer, S., J. Olson, A. Cockrill, M. van Hattem, L. Miller, and M. Tauzer. 2015. Impacts of Surface Water Diversions for Marijuana Cultivation on Aquatic Habitat in Four Northwestern California Watersheds. PLoS ONE 10(3): e0120016. doi:10.1371/journal.pone.0120016

Bray, B. S. 2000. Quantitative Assessment of Suspended Sediment Concentration on Coho Salmon in Freshwater Creek. A Senior Project presented to the Department of Environmental Resources Engineering, Humboldt State University.

California Department of Fish and Wildlife, Natural Diversity Database. July 2015. Special Animals List. Periodic publication. 51 pp.

California HSRG (California Hatchery Scientific Review Group). 2012. California Hatchery Review Statewide Report. Prepared for the US Fish and Wildlife Servie and Pacific States Marine Fisheries Commission. April 2012. 100 pp.

CEQ (Council on Environmental Quality). 1997. Considering Cumulative Effects Under the National Environmental Policy Act. 64 pp.

California State Water Resources Control Board. 2015 California Department of Fish and Wildlife monitoring reports. https://ciwqs.waterboards.ca.gov/ciwqs Accessed wildlife and marine mammal listings, June 15, 2015.

Cohen, F. 2005. Cohen's Handbook of Federal Indian Law. LexisNexis. Newark, NJ. 647p.

EPIC v. Ayers et al. 2013. Plaintiff's and State Defendant's Stipulation Amending Existing Stay Order and [Proposed] Order Approving Amended Stay Order. Case No. C-13-00656-MMC-NJV

Flynn, K.M., Kirby, W.H., and Hummel, P.R., 2006, User's Manual for Program PeakFQ Annual Flood-Frequency Analysis Using Bulletin 17B Guidelines: U.S. Geological Survey, Techniques and Methods Book 4, Chapter B4; 42 pgs.

Graham Mathews & Associates. 2007. Mad River Sediment Sources Analysis. Prepared for Tetra Tech, Inc. 130 pp.

Humboldt Bay Municipal Water District. 2004. Habiotat Conservation Plan for its Mad River Operations. Final Approved HCP. Prepared by Trinity Associates and Humboldt Bay Municipal Water District.

Humboldt Bay Municipal Water District. 2013. Update Report on HBMWD's Water Resources Planning. December 2013. Eureka, California.

Newton, N.J., R.T. Anderson, C.E. Goldberg, J.P. La Velle, J.V. Royster, J.W. Singer, R. Strickland, and B.R. Berger. 2005. Cohen's Handbook of Federal Indian Law, 2005 edition. LexisNexis Matthew Bender Publications, San Francisco, California.

NOAA (National Oceanic and Atmospheric Administration). 2011. The *NOAA Administrative Order 216-6 E.O. 11988/11990 Companion Manual, Implementing Procedures for Executive Order 11988, Floodplains Management and Executive Order 11990, Protection of Wetlands E.O. 11988/11990 Companion Manual*

NOAA. 2009 National Environmental Policy Act Handbook. Devloped by NOAA Program Planning and Integration. Version 2.3, May 2009.

NPDES (National Pollutant Discharge Elimination System). Permit No. CA006670. 2000. Waste Discharge Requirement & Monitoring and Reporting Program Order No. R1-2000-33 for the State of California, Department of Fish and Game: Mad River Hatchery, Humboldt County. 17 pp.

NCRWQCB (North Coast Regional Water Quality Control Board). 2000.National Pollutant Discharge Elimination System (NPDES) Permit No. CA006670. Waste Discharge Requirement & Monitoring and Reporting Program Order No. R1-2000-33 for the State of California, Department of Fish and Game: Mad River Hatchery, Humboldt County. 17 pp.

NMFS (National Marine Fisheries Service). 2005. Section 10(a)(1)(B) Incidental Take Permit. Unpublished letter dated June 9, 2005. NMFS, Southwest Region, Long Beach, CA.

NMFS. 2007. Magnuson-Stevens Fishery Conservation and Management Act, As Amended Through January 12, 2007. January, 2007, Silver Spring, MD.

NMFS (National Marine Fisheries Service). 2008. Review of California Department of Fish and Game’s Hatchery and Genetic Management Plan for Mad River Winter-run Steelhead. Memorandum from F/SWRS Shirley Witalis to Irma Lagomarsino F/SWR3. 9 pp.

Newcombe, C.P. and J.O.T. Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. *North American Journal of Fisheries Management* 16: 693-727.

Sparkman, M. D. 2000. Recreational Angler Use and Catch in the Mad River, Humboldt County, California, November 1999-March 2000. Project 1g2. Steelhead Research and

Monitoring Program. California Department of Fish and Game. Northern Region. December 19, 2000. 16 pp.

Sparkman, M. D. 2002a. Recreational Angler Use and Catch in the Mad River, Humboldt County, California, November 2001-March 2002. Project 1g2. Steelhead Research and Monitoring Program. California Department of Fish and Game. Northern Region. November 2002. 26 pp.

Sparkman, M. D. 2002b. Annual Report: Juvenile Steelhead Downstream Migration Study In the Mad River Humboldt County, California, Spring 2001. Project 2a3. Steelhead Research and Monitoring Program. California Department of Fish and Game. Northern Region. January 2002. 52 pp.

Sparkman, M. D. 2002c. 2000-2001 Annual Report: Habitat Utilization and Migration Patterns of Wild and Hatchery Radio Tagged Adult Winter-run Steelhead in the Mad River, California. Project 1e2. California Department of Fish and Game. Northern Region. January 2002. 14 pp.

Sparkman, M. D. 2003. Annual Report: Habitat Utilization and Migration Patterns of Wild and Hatchery Radio Tagged Adult Winter-run Steelhead in the Mad River, California. November 2001–March 31, 2002. Project 1e2. California Department of Fish and Game. Northern Region. 31pp.

Sparkman, M. D. 2004. Negative influences of predacious egg-eating worms, *Haplotaxis ichthyophagus*, and fine sediments on coho salmon, *Onchorhynchus kisutch*, in natural and artificial redds. Master's thesis, Humboldt State University, Arcata, CA. 64 pps.

Stillwater Sciences. 2010. Mad River Watershed Assessment. Final report. Prepared by, Arcata, California in association with Redwood Community Action Agency, and Natural Resources Management Corp. Eureka, California.

U.S. Department of Commerce. 1995. American Indian and Alaska Native Policy. U.S. Department of Commerce, Washington, D.C. 5 pages.

U.S. Environmental Protection Agency. 2007. Mad River total maximum daily loads sediment and turbidity. Final report. U.S. Environmental Protection Agency, Region IX.

U.S. Environmental Protection Agency. 1999. "Consideration of Cumulative Impacts in EPA Review of NEPA Documents", EPA 315-R-99-002. May 1999. Washington, D.C.,

Western Environmental Law Center. 2012. Notice of Intent to Sue for Violations of Endangered Species Act. Sent to US Fish and Wildlife Service and California Department of Fish and Wildlife. November 30, 2012

Will, B. 1973a. Annual Report: Mad River Salmon and Steelhead Hatchery, 1970-1971. California Department of Fish and Game. Northern Region. Anadromous Fisheries Branch Administrative Report No. 73-12. 14 pp.

Williams, T.H., B. Spence, W. Duffy, D. Hillemeier, G. Kautsky, T. Lisle, M. McCain, T. Nickelson, E. Mora, and T. Pearson. 2008. Framework for assessing viability of threatened coho salmon in the Southern Oregon/Northern California Coasts Evolutionarily Significant Unit. NOAA Technical Memorandum NMFS-SWFSC-432. National Marine Fisheries Service, Southwest Fisheries Science Center, Santa Cruz, California. 97 p.

Zuspan, M.G. 2001. Annual Report: Mad River Hatchery Adult Salmon and Steelhead Recovery, 1999/2000 Season. January 2001. Steelhead Research and Monitoring Program. California Department of Fish and Game. Northern Region. 8 pp.

Zuspan, M.G. 2002a. Mad River Hatchery Adult Salmon and Steelhead Recovery, 2000-2001 Season. Project 1a 2. January 2002. Steelhead Research and Monitoring Program. California Department of Fish and Game. Northern Region. 7 pp.

Zuspan, M.G. 2002b. Mad River Hatchery Adult Salmon and Steelhead Recovery, 2001-2002 Season. Project 1a 2. October, 2002. Steelhead Research and Monitoring Program. California Department of Fish and Game. Northern Region. 7 pp.

Zuspan, M.G., and D. Sparkman. 2002. Annual Report: Mad River Winter-run Adult Steelhead Run Size Estimate, 2000-2001 Season. Project 1a3. March 2002. Steelhead Research and Monitoring Program. California Department of Fish and Game. Northern Region. 31 pp.