State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Director's Office
P.O. Box 944209
Sacramento, CA 94244-2090
www.wildlife.ca.gov

GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

May 3, 2021

Eileen Sobeck
Executive Director
State Water Resources Control Board
1001 I Street, 25th Floor
Sacramento, CA 94814
eileen.sobeck@waterboards.ca.gov

Subject: Scott River Best Available Scientific Information for Instream Flow Criteria and Potential Next Steps

Dear Ms. Sobeck:

The California Department of Fish and Wildlife (CDFW) has been collaborating with the National Marine Fisheries Service (NMFS), the State Water Resources Control Board (SWRCB), and other stakeholders including Siskiyou County to address the current dry conditions and ongoing water use impacts in the Scott River, Siskiyou County. CDFW is also participating in ongoing and critically important government-to-government consultations with affected Tribes to facilitate co-management principles. The Scott River provides aquatic habitat for all life stages (migration, spawning, and rearing) of the State and federally listed threatened Southern Oregon Northern California Coast (SONCC) Evolutionarily Significant Unit (ESU) of Coho Salmon (*Oncorhynchus kisutch*), as well as the culturally significant and commercially important Klamath Basin fall Chinook Salmon (*Oncorhynchus tshawytscha)* (Chinook Salmon).

The purpose of this letter is to further a discussion about solutions and emphasize three primary topics. First, CDFW highlights threats facing Coho and Chinook Salmon in the Scott River due to low flow conditions. Second, CDFW provides an overview of the best available scientific information, which may be used as a starting point for assessing flow needs for Coho and Chinook Salmon in the Scott River. Third, CDFW outlines potential next steps and priority actions for the protection of Coho and Chinook Salmon in the Scott River.

Threats to Coho Salmon and Chinook Salmon Due to Low Flow Conditions

CDFW is deeply concerned with the recent pattern of critically dry water years in the Scott River. Surface water withdrawals that are not scaled to water year type contribute to disconnected flows in the mainstem and tributaries that have impeded or prevented migration of Coho and Chinook Salmon. As recently as the fall and winter of 2020, adult Coho and Chinook Salmon were unable to pass above the confluence of Oro Fino Creek on the mainstem, resulting in significant migration delays and almost complete cohort failure. Cohort failure represents loss of a significant component of the population, increases the potential for extirpation, and greatly impedes natural recovery.

The United States Drought Monitor has predicted ongoing drought in Siskiyou County. Flows at the USGS stream flow gage at Fort Jones (11519500) are currently less than the 25th percentile rankings of daily average flows since 1941. The Interim Instream Flow Criteria for the Protection of Fishery Resources in the Scott River Watershed, Siskiyou County (2017 Flow Report, Enclosure 1) identifies the Scott River as one of the most important Coho Salmon spawning and rearing tributaries in the Klamath River watershed. Changes have occurred in the basin in recent decades that are creating lower base flows than in previous decades when similar amounts of annual discharge were available. CDFW has crafted a report (Enclosure 2) that evaluates the influence of Scott River in-stream flow on the distribution and migration timing of fall Chinook Salmon and Coho Salmon.

CDFW monitoring of Coho Salmon populations tracks three separate brood years, and in the Scott River the difference in brood year strength is striking (Enclosure 2). After four generations of monitoring, brood year 2 has increased from 153 fish in 2008 to 1,671 fish in 2020. The increase in this brood year is an example of how quickly the Coho Salmon population can respond when in-river and/or out-of-basin survival conditions are favorable (the out-of-basin survival estimate for the adults that returned in 2020 was 10.64% compared to the period of record average of 4.77%) (Knechtle and Giudice 2021). Similarly, after four generations brood year 3 has increased from 80 fish in 2009 to 727 fish in 2018. Drought conditions persisted in the Scott Basin in the winter of 2013-2014 reducing in-river productivity, and as a result brood year 1 reduced in run size from 2,644 in 2013 to 250 fish in 2016. Brood year 1 returned last to the Scott River in 2019 when an estimated 365 fish returned. While the capacity of the Scott River to produce Coho Salmon is highlighted in the trajectory of brood years 2 and 3, the reduction in brood year 1 indicates how rapidly the population can change when conditions are poor.

Monitoring of the Chinook Salmon runs in the Scott River between 1978-2020 (Enclosure 2) depicts a range from 14,477 fish (1995) to 467 fish (2004) and has averaged 4,977 fish per year. The Chinook Salmon escapement to the Scott River from 2015 to 2020 has averaged 1,738 fish, representing a reduction from the historical average of 65%. The recent 6-year average escapement for the Klamath Basin is also down from the historical average, although the Klamath Basin reduction for this same period is 43% (CDFW 2021). The Scott River Chinook Salmon population is decreasing at a faster rate than the Klamath Basin as a whole.

Overview of Best Available Scientific Information on Salmonid Flow Needs in the Scott River

CDFW's 2004 Recovery Strategy for Coho Salmon and the 2014 NMFS Final Recovery Plan for the SONCC Coho Salmon identify developing target instream flows, and increasing instream flows, as priority actions. Both recovery strategies include increasing Scott River instream flows as a priority task necessary to improve rearing habitat, fish passage, and stream connectivity. Low summer flows and fall stream flows are a major factor limiting survival of juvenile Coho Salmon (CDFG 2004, NOAA 2014). These same limiting factors apply to Chinook Salmon in the Scott River. Chinook Salmon, while not currently listed under the state or federal endangered species acts, are an important fishery for the Klamath Basin Tribes and commercial and recreational fishing. Petitions to list spring-run Chinook as Threatened have been recently submitted to NMFS and CDFW. Given the declining condition of Coho and Chinook Salmon in the Scott River there is an urgent need to review the best available scientific information and identify appropriate next steps.

The 2017 Flow Report combines the results of three desktop flow assessment methods to develop recommended minimum instream flow criteria which are anticipated to be protective of specific salmonid life stages and general stream function monthly. Interim flow criteria to support fish passage were evaluated using the Q_{fp} formula developed by R2 Resources (2008) for the North Coast Instream Flow Policy (SWRCB 2014). Interim minimum flow criteria to support adult spawning and juvenile rearing were estimated using the Hatfield and Bruce (2000) regression equations. The regressions are based upon the results of 127 site specific studies that used the Physical Habitat Simulation (PHABSIM) method to estimate optimal flow criteria for salmonid adult spawning and juvenile rearing. The salmonid life stages present in the Scott River watershed were identified by month to determine whether flow criteria should be recommended for fish passage (Q_{fp}) or spawning and juvenile rearing (Hatfield and Bruce). To ensure that recommended flow criteria were consistent with Scott River hydrology, CDFW applied the Tessmann's adaption (Tessmann 1980) of the Tennant Method (Tennant 1975). Tessmann's adaption considers the relationship of the monthly mean flow to the mean annual flow. If the flow criteria recommended by Q_{fp} or Hatfield and Bruce exceeded the Tessmann's adaption flow, the recommended flow was truncated to the Tessmann's adaption flow to be consistent with Scott River hydrology. Three water year type conditions (wet, normal, and dry) were identified using data from the USGS stream flow gage at Fort Jones (11519500) and are presented in the report.

Potential Next Steps for Scott River Instream Flow Work

The 2017 Flow Report represents the best available scientific information and sufficient basis to move forward with a flow setting process. A more comprehensive site-specific instream flow study would help to better assess flow needs for Coho and Chinook Salmon in the Scott River watershed. Given the diverse nature of interests within the Scott River watershed, stakeholder coordination and outreach are vital. CDFW is currently working with landowners, Tribes, stakeholders, other agencies, and non-governmental organizations to collect information, identify issues and concerns, and define future study needs. To date, two initial phases of planning for a potential comprehensive flow study have been completed with the assistance of Normandeau Associates. These planning phases have helped to clarify habitat-species relationships, identify potential passage impediments, and identify additional studies that may be helpful to assessing flow needs for Coho and Chinook Salmon recovery. The Instream Flow Study Plan and other documents produced for these two phases can be found at https://wildlife.ca.gov/Conservation/Watersheds/Instream-Flow/Studies/Scott-Shasta-Study.

Additional funding and property access will be sought for phase three (project implementation) for further study. Such funding and access will need to be secured before further comprehensive study efforts can proceed. The top three CDFW priorities for future studies include: 1) west-side tributaries including Sugar, French, and Shackleford/Mill creeks, 2) the mainstem from Shackleford Creek to the South Fork/East Fork confluence, and 3) the canyon from the confluence of the Klamath River to the USGS gage.

Suggested Immediate Actions

Considering ongoing fisheries declines, and current forecast dry conditions, in addition to the longer-term efforts described herein, CDFW recommends immediate actions to help protect Scott River fisheries and habitat. CDFW formally requests the SWRCB consider the instream flow criteria in the 2017 Flow Report and other pertinent data as the best available scientific information regarding fisheries needs in the Scott River. CDFW recommends the instream flow criteria in the 2017 Flow Report be used to initiate a flow setting process, with the understanding that additional information will emerge as part of the process. Similarly, CDFW has provided comments to Siskiyou County, dated March 26, 2020, to consider the recommended instream flow criteria in the 2017 Flow Report when developing the Scott River Valley Basin Groundwater Sustainability Plan due January 1, 2022 to the Department of Water Resources pursuant to the Sustainable Groundwater Management Act (Enclosure 3).

For reasons previously discussed, CDFW urges appropriate consideration of fish and wildlife resources in the regulation of surface and groundwater use as required under the Public Trust Doctrine and other applicable law. CDFW acknowledges that while the 2017 Flow Report focuses on fishery and ecosystem needs, the SWRCB will be required to consider and balance a range of wateruses including irrigation, fisheries protection, municipal, and Tribal cultural uses, in any decision-making regarding minimum instream flows, which may be a consideration in future discussions.

In addition, CDFW recommends collaborating with the SWRCB, NFMS, the Tribes, Siskiyou County, and other stakeholders to evaluate and take actions to protect terrestrial and aquatic species and, wherever possible, work with water users and other parties on voluntary measures to protect species. For example:

1. Recommend additional financial support for water resilience infrastructure projects;
2. Re-evaluate minimum bypass flows and timing of CDFW-regulated and maintained diversions to adjust for water year types;
3. Identify and support enforcement actions to ensure existing laws are followed under the Water Code and Fish and Game Code;
4. Identify and encourage immediate and ongoing voluntary water efficiency actions to increase instream flows;
5. Accelerate funding for water supply enhancement, water conservation, or species conservation projects; and

6. Develop and achieve, this season, minimum flows necessary to maintain connectivity to support fish migration, spawning, and rearing in the Scott River and its west-side tributaries.

CDFW remains committed to supporting investments in voluntary actions including potential water storage projects. Recent examples include the installation of alternative stock water facilities, technical and policy support of point of diversion and irrigation ditch efficiencies, funding restoration of mainstem habitat, and facilitating surface water transactions. Typically, these types of projects require access to private property, some level of environmental analysis, and funding.

To protect fish and wildlife resources, it is imperative that the SWRCB consider the best available scientific information including recommended instream flow criteria from the 2017 Flow Report as a starting point in establishing instream flows. Next steps for these longer-term efforts can include additional support from other agencies, Tribes, and stakeholders to help develop instream flows that balance fish and wildlife needs with other beneficial uses. Through increased coordination with both surface and groundwater management efforts, it is CDFW's desire to work with the SWRCB to achieve resilient and sustainable flows within the Scott River watershed.

If you have any questions regarding this letter, please contact Northern Region Manager Tina Bartlett at tina.bartlett@widlife.ca.gov.

Sincerely,

Charlton H. Bonham
Director

Enclosures:

1 - Interim Instream Flow Criteria for the Protection of Fishery Resources in the Scott River Watershed, Siskiyou County.

2 - Influence of Scott River in-stream flow on the distribution and migration timing of fall Chinook Salmon and Coho Salmon.

3 – CDFW Comments to be Considered for the Scott River Valley Basin Draft Groundwater Sustainability Plan.

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ec: **State Water Resources Control Board**

Joaquin Esquivel, Chair
Joaquin.Esquivel@waterboards.ca.gov

Erik Ekdahl, Deputy Director
Division of Water Rights
Erik.Ekdahl@waterboards.ca.gov

Eric Oppenheimer, Chief Deputy
Eric.Oppenheimer@waterboards.ca.gov

California Department of Fish and Wildlife

Valerie Termini, Chief Deputy Director
Valerie.termini@wildlife.ca.gov

Thomas Gibson, Assistant Chief Counsel
thomas.gibson@wildlife.ca.gov

Tina Bartlett, Northern Region Manager
tina.bartlett@wildlife.ca.gov

Joshua Grover, Branch Chief of Water Branch
joshua.Grover@wildlife.ca.gov

National Marine Fisheries Service

Jim Simondet
Jim.Simondet@noaa.gov

Alecia Van Atta
alecia.vanatta@noaa.gov

INTERIM INSTREAM FLOW CRITERIA FOR THE PROTECTION OF FISHERY RESOURCES IN THE SCOTT RIVER WATERSHED, SISKIYOU COUNTY

Prepared By

California Department of Fish and Wildlife

February 6, 2017

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Cover photo: Low flow barrier to upstream migrating Chinook Salmon in the Scott River Canyon November 20, 2015.

1. Introduction

This document describes the methods and results of an analysis using historical flow data and regional regression relationships to develop interim instream flow criteria suitable for anadromous fish in the Scott River watershed in Siskiyou County. The Scott River watershed provides aquatic habitat for four species of anadromous fish; Chinook Salmon (*Oncorhynchus tshawytscha*), Coho Salmon (*O. kisutch*), steelhead trout (*O. mykiss*), and Pacific Lamprey (*Lampetra tridentata*). Specifically, the Scott River is one of the most important Coho Salmon spawning and rearing tributaries in the Klamath River watershed.

Instream flow requirements can be generated from flow standard setting techniques or from the results of site specific studies. The interim instream flow criteria presented for the Scott River were developed using flow standard setting techniques. Stream flow standards derived from standard setting techniques are designed to identify the environmental resource in need of flow protection, identify biologically significant criterion that can be used to measure potential flow related impacts, and specify the amount of flow required to protect the resource. Most individual standards evaluate only one or more, but not all the criterion needed to fully evaluate the flow needs of an aquatic species. This limitation can lead to prescribing a single minimum threshold or “flat-line” affect (Poff et al. 1997). The seasonal and inter-annual variability in the hydrograph must be maintained to protect stream ecology and provide an ecosystem based standard (Annear 2004).

To account for the seasonal and the inter-annual hydrologic variability of the Scott River, the Department applied a detailed hydrologic analysis along with application of three standard setting methods to evaluate the life history flow needs of salmonids in the Scott River near Fort Jones. Adult fish passage was estimated using the equation developed by R2 Resources (R2 2008) for the State Water Resources Control Board’s (SWRCB) North Coast Instream Flow Policy (SWRCB 2014), spawning and juvenile rearing were evaluated using the Hatfield and Bruce regional equations (Hatfield and Bruce 2000), and the results were adjusted monthly based on estimates of unimpaired hydrology using Tessmann’s adaptation (Tessmann 1980) of the Tennant or Montana Method (Tennant 1975).

2. Background

Coho Salmon were listed as “threatened” in the Southern Oregon Northern California Coast (SONCC) Evolutionarily Significant Unit (ESU) under the federal Endangered Species Act (ESA) in 1997 (Federal Register 1997). In 2014, NOAA- Fisheries released the *Final Recovery Plan for the Southern Oregon/Northern California Coast Evolutionarily Significant Unit of Coho Salmon.* The highest priority Coho Salmon recovery actions identified for the Scott River watershed includes, “increase instream flows.” Specifically, the Coho Salmon recovery tasks identified in Table 1 below address the need to identify instream flow needs and implement a flow needs plan for the Scott River watershed. Low summer and fall streamflow is a major factor limiting survival of juvenile Coho Salmon (CDFG 2004).

Table 1. SONCC Coho Recovery Plan Tasks related to instream flow in the Scott River.

NOAA-Fisheries SONCC Coho Recovery Plan Task ID	Description
SONCC-ScoR.3.1.68.1	Conduct study to determine instream flow needs of coho salmon at all life stages
SONCC-ScoR.3.1.68.2	If coho salmon instream flow needs are not being met, develop plan to provide adequate flows. Plan may include water conservation incentives for landowners and re-assessment of water allocation.
SONCC-ScoR.3.1.68.3	Implement coho salmon instream flow needs plan.

Coho Salmon were also listed as “threatened” by the California Fish and Game Commission (Commission) for the area from Punta Gorda north to the California/Oregon border under the California Endangered Species Act (CESA) in 2005. In 2004, the Department of Fish and Wildlife (Department) published the *Recovery Strategy for California Coho Salmon* which identifies restoration activities necessary to protect and recover Coho Salmon populations to a sustainable level (CDFG 2004). Developing target instream flows for the Scott River was identified as a priority recovery task (Recovery Task WM-9) that needs to be implemented to improve Coho Salmon rearing habitat, fish passage, and stream connectivity.

Public Resources Code (PRC) 10000-10005 mandates the Department to identify instream flow needs for the long-term protection, maintenance and proper stewardship of fish and wildlife resources. The Scott River in Siskiyou County appears on the Department priority stream list for Instream Flow Assessments (CDFG 2008). The Department has participated in a comprehensive effort to develop study plans that would provide the scientific information needed for PRC recommendations for the protection of aquatic resources in the Scott River watershed

3. Scott River Watershed

The Scott River is located in Siskiyou County and is part of the Klamath Mountains Province (Figure 1). The Scott River is one of four major tributary streams to the Klamath River. The watershed drains an area of approximately of 812 square miles. The mainstem Scott River is approximately 58 river miles in length and begins at the confluence of the East Fork Scott River and South Fork Scott River. The lower 21 miles of the Scott River flows through a relatively steep mountainous canyon reach which is primarily owned and managed by the Klamath National Forest. Elevations in this reach range from approximately 1,538 ft. (469 m) at the mouth to 2,635 ft. (803 m) at river mile (RM) 21 near the United States Geological Survey (USGS) stream gage station USGS 11519500 SCOTT R NR FORT JONES CA (USGS 115195500). By contrast, the upper reach that flows through Scott Valley has low stream gradients. The upper reach begins at RM 58 near the town of Callahan and flows north to RM 21 near USGS 115195500. Elevations in this reach range from 2,635 ft. (803 m) at RM 21 to 3,140 ft. (958 m) at RM 58 near Callahan to the north. The headwater tributaries originate in the high mountain ranges of the Trinity Alps Wilderness Area, Russian Wilderness Area, and Marble Mountain Wilderness Areas located to the south and west of Scott Valley. The major tributary streams that contribute to the Scott River around Scott Valley include the East Fork

Scott River, South Fork Scott River, Sugar Creek, French Creek, Etna Creek, Kidder Creek, Shackleford Creek, Patterson Creek, and Moffett Creek.

The watershed has a Mediterranean type climate characterized by warm dry summers and cold wet winters. Rainfall is the primary source of precipitation along the lower elevations present on the valley floor and adjacent lower elevation hill slopes. Snowfall is predominant at higher elevations (>5,000 ft.) along the mountain ranges to the south and west side of Scott Valley. The mountains to the south and west of the valley capture most of the precipitation receiving about 60 to 80 inches of precipitation annually. The mountains along the east side of the valley lie within the rain shadow of higher elevation mountain ranges to the south and west, and only receive about 12 to 15 inches of precipitation annually.

There are two rainfall stations located within Scott Valley, Callahan and Fort Jones, which provide a long history of precipitation data dating back to 1943 and 1944, respectively. Annual rainfall amounts recorded at the Callahan station range from a low of 9.75 inches in 1977 to a high of 36.5 inches in 1958 and averages 20.8 inches. Annual rainfall amounts recorded at the Fort Jones station range from a low of 7.62 inches in 1955 to a high of 35.3 inches in 1958 and averages 21.5 inches.

Aquatic habitat for anadromous fish species within the Scott River basin has been altered by numerous human activities, affecting both instream conditions and adjacent riparian and upland slopes. Alterations to habitat and changes to the landscape include historic beaver trapping, road construction, agricultural practices, river channelization, dams and diversions, timber harvest, mining/dredging, gravel extraction, high severity fires, groundwater pumping, and rural residential development (NOAA-Fisheries 2014). These impacts, along with natural factors such as floods, erosive soil, and a warm and dry climate, have simplified, degraded, and fragmented anadromous fish migrating, spawning, and rearing habitat throughout the Scott River basin (NOAA-Fisheries 2014).

Water rights on the Scott River and its tributaries have been fully adjudicated in the Superior Court of Siskiyou County through three separate decrees, the Shackleford Creek Decree (No. 13775) in 1950, the French Creek Decree (No. 14478) in 1958, and the Scott River Decree (No. 30662) in 1980. The Scott River Decree (SWRCB 1980) describes the water allocations for the vast majority of the watershed. There is presently no watermaster service for this decree or the Shackleford Creek Decree.

A minimum baseflow of 30 cubic feet per second (cfs) during the summer months was allotted to the Klamath National Forest (USFS) for the “instream use for fish and wildlife” within the 1980 Scott River Decree. Additionally, USFS has a right to flow measured at USGS 115195500 for instream uses, but this right is junior to other first priority rights in the decree area. The minimum base flow of this junior right is an additional 32 cfs. USGS gage records at Fort Jones show summer discharge frequently falling below 30 cfs, and often falling below 10 cfs in critically dry water years. Flows failed to meet the USFS water right of 30 cfs in at least nine years since 1977 (QVIR 2011).

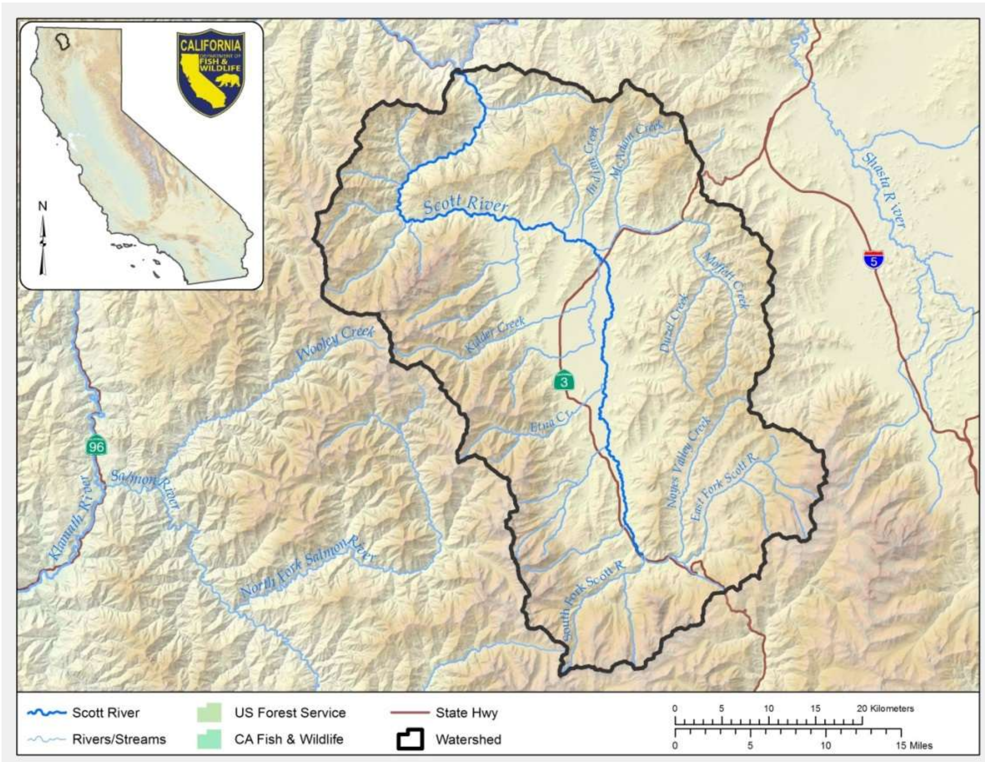

Figure 1. Scott River Watershed in Siskiyou County, California.

Van Kirk and Naman (2008) found that late summer baseflows in the Scott River were 40.3% lower in the recent past (1977 to 2005) than in the historic period (1942 to 1976). Sixty one percent of this drop in discharge is caused by factors other than regional-scale climate change (Van Kirk and Naman 2008). Currently, valley-wide agricultural water diversions, groundwater extraction, and drought have all combined to cause surface flow disconnection along the mainstem Scott River. Figures 2 and 3 illustrate the increase in the frequency of low flow conditions in the Scott River over time. These conditions restrict or eliminate available rearing habitat, elevate water temperature, decrease fitness and survival of over- summering juvenile salmonids, and sometimes result in juvenile fish strandings and mortality.

Agriculture and related activities are the major land use within the Scott Valley. Starting in 1953 there has been an increase in irrigation withdrawals in the Scott Valley of 115% (Van Kirk and Naman 2008). This increase in irrigation withdrawals was accompanied by an 89% increase in irrigated land area (Van Kirk and Naman 2008). Another important shift in the recent past was the change from flood to sprinkler irrigation, which increased efficiency and reduced groundwater recharge (Van Kirk and Naman 2008). Currently, a large proportion (80% or more) of water used for irrigation comes from ground water (Van Kirk and Naman 2008). During the summer, large portions of the mainstem Scott River become completely dry, leaving only a series of stagnant isolated pools inhospitable to salmonids (Figure 4).

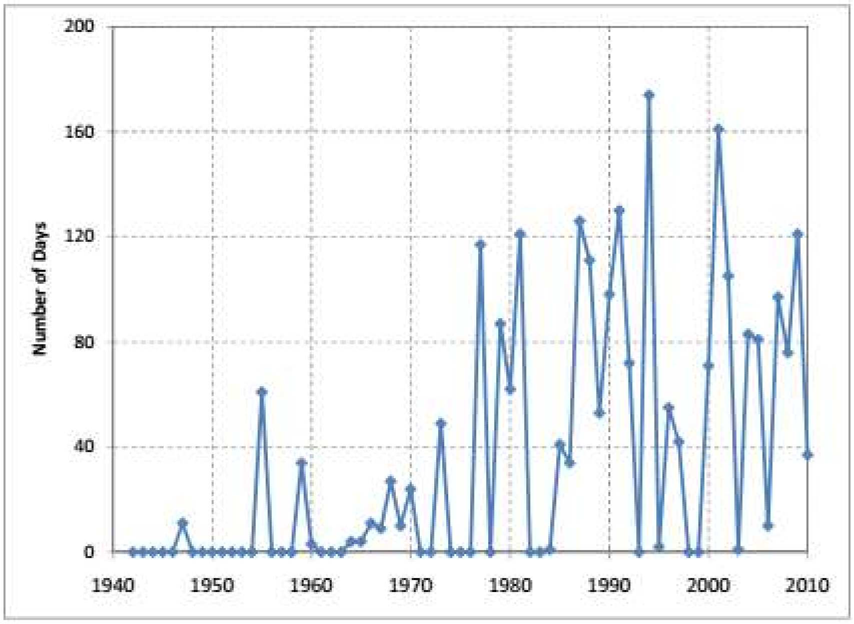

Figure 2. Number of days with flow at Fort Jones below 40 cfs (excerpted from: S.S. Papadopulos & Associates, Inc. 2012)

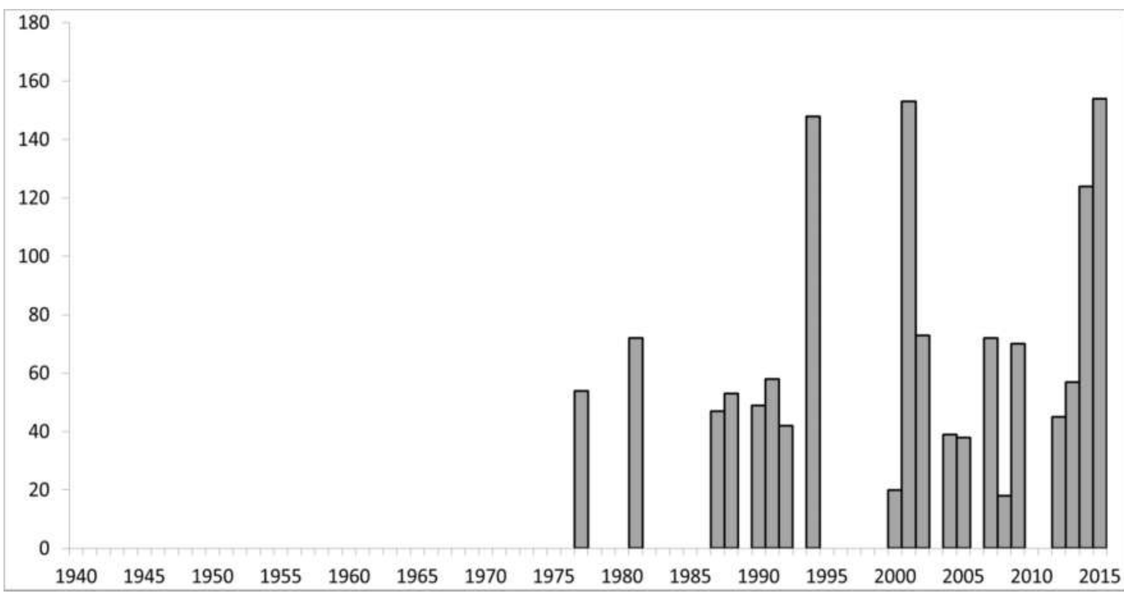

Figure 3. Continuous days of average daily flows less than 15 cfs on the Scott River at the Fort Jones gage (prepared by Steven Stenhouse 2016).

Figure 4. The Scott River at Horn Lane Bridge (photo taken on August 13, 2014 by Chris Adams).

4. Anadromous Fishery Resources

The Scott River provides habitat for four species of anadromous fish species; Chinook Salmon, Coho Salmon, steelhead trout, and Pacific Lamprey. The Department's Klamath River Project (KRP) has been monitoring the escapement of adult anadromous salmonids into the Klamath Basin, including the Scott River, since 1978. Although most of this monitoring effort is focused towards fall-run Chinook Salmon, information regarding Coho Salmon and steelhead trout is also collected as these fish are encountered (Knechtle and Chesney 2016). Unfortunately, high flows and lack of adequate funding has sometimes prevented the collection of complete run size data for either Coho Salmon or steelhead trout and little information exists for Pacific Lamprey.

In 1999, the Department began implementation of the Anadromous Fish Research and Monitoring Program the primary objective of which is to monitor status and trends of juvenile salmonid populations. The original focus for this program was directed towards steelhead trout however, the focus of the program was officially expanded to include the other anadromous salmonid species in 2003. Monitoring of juvenile salmonid emigration from the Scott River was first conducted in the spring of 2000 and has been conducted annually ever since. These two programs combined provide information regarding the relationship between adult returns and juvenile production which improve our understanding of population dynamics and environmental factors that may impact survival of these fish.

A. Chinook Salmon

<u>Status</u>

Chinook Salmon in the Scott River watershed are part of the federally-designated Upper Klamath and Trinity Rivers Chinook ESU, which includes all populations upstream of the confluence of these two rivers. Upper Klamath – Trinity River Chinook Salmon were proposed for federal listing in 1998, but listing was determined to be not warranted.

Life Cycle

The life history patterns of Chinook Salmon vary among runs. The Scott River currently supports only fall-run Chinook Salmon (NRC 2004). Adult Chinook Salmon typically enter the Scott River watershed between mid-September and late-December (Knechtle and Chesney 2016). Chinook Salmon tend to spawn in lower gradient reaches than Coho Salmon, primarily in rivers and larger streams. The timing and distribution of Chinook Salmon spawning within the Scott River watershed has been documented annually during cooperative spawning ground surveys since 1992 (Meneks 2015). Chinook Salmon primarily utilize the mainstem Scott River from its confluence with the Klamath River to approximately Fay Lane. However, Chinook Salmon have been documented in some years spawning in habitat above this point and in the lower portions of some major Scott River tributaries when access is available (M. Knechtle pers. comm.). Spawning distribution within the mainstem can be limited during periods of low flow. Sometimes adult Chinook Salmon are unable to swim upstream of the Scott Canyon reach due to a lack of streamflow. The majority of juvenile Chinook Salmon spend only a few months rearing in freshwater before outmigrating in the spring and early summer. A small proportion of the total juvenile Chinook Salmon production rears in the Scott River for a full year prior to emigrating as age 1 juveniles in late winter/early spring. Peak smolt outmigration from the Scott River typically occurs from April through June (Jetter and Chesney 2016).

Habitat Requirements

Although the life history patterns of Chinook Salmon differ from that of Coho Salmon, the overall habitat requirements of the two species are fairly similar. Like Coho Salmon, Chinook Salmon require adequate flows, cool temperatures, water depths and velocities, appropriate spawning and rearing substrates, and availability of instream cover and food.

Adult Chinook Salmon are particularly dependent on adequate streamflows in the fall, prior to the cessation of irrigation and the onset of significant precipitation, to enable successful migration to their spawning sites. In low flow years like 2015, most of the adult Chinook Salmon were unable to get upstream of the canyon reach during the spawning period. The majority of the observed redds were constructed in the canyon and were subject to a high flow event in March of 2016. The term “redds” refers to the nests that the female salmon digs in the gravel to deposit her eggs.

Water temperatures under 14 °C are optimal for adult Chinook Salmon migration and chronic exposure of migrating adults to temperatures between 17 °C and 20 °C can be lethal (National Research Council [NRC] 2004). Most juvenile Chinook Salmon leave freshwater habitat in the spring and are therefore not as susceptible to the high water temperatures and low streamflows that are common in the Scott River watershed during summer and early fall (Jetter and Chesney 2016). The optimal rearing water temperature range for juvenile Chinook Salmon is approximately 7.2 °C to14.5 °C (Carter 2005).

Population Trends

Prior to the 1950s, there are no estimates of Chinook Salmon populations available for the Scott River watershed. In the mid-1960s, fall-run Chinook Salmon run sizes in the Scott River were estimated at approximately 10,000 fish (CDFG 1965). Fall-run Chinook Salmon escapement estimates for the Scott River watershed have been made annually since 1978 (Figure 3). Since 1978, the Chinook Salmon run in the Scott River has ranged from 14,477 fish (1995) to 497 fish (2004) and has averaged 5,413 fish (Knechtle and Chesney 2016).

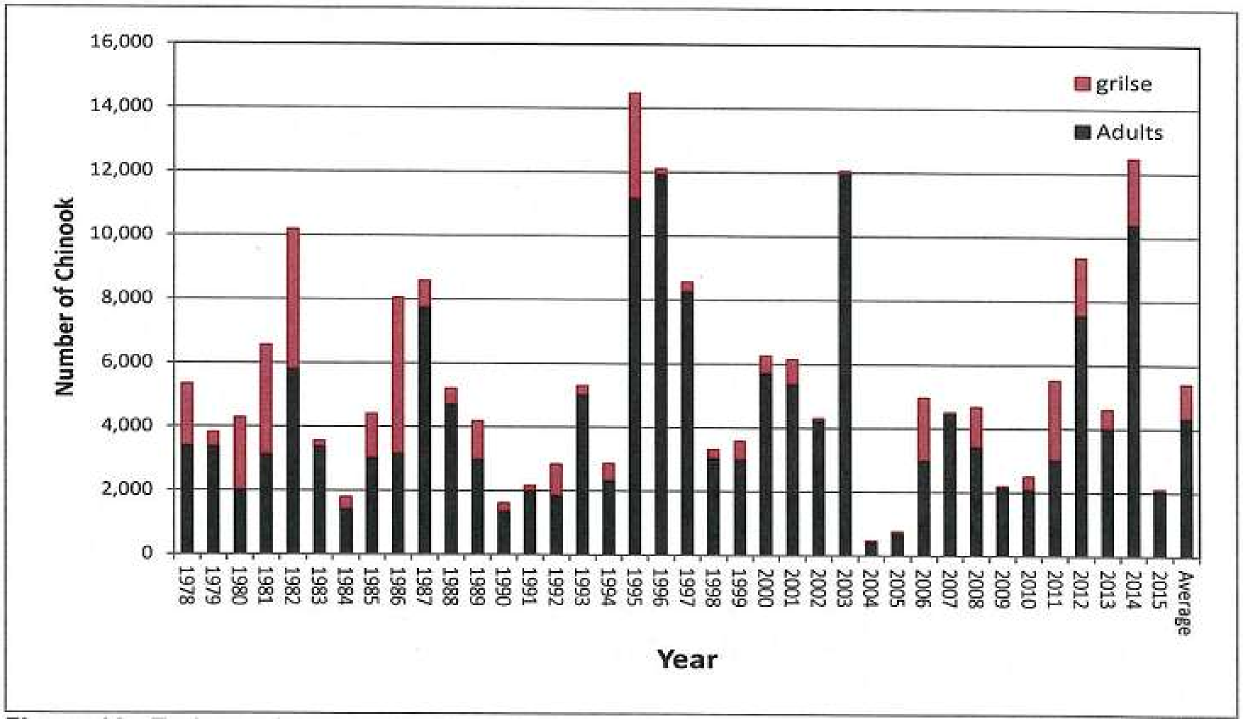

Figure 3. Estimated escapement of Fall-Run Chinook Salmon returning to the Scott River from 1978-2015.

B. Coho Salmon

Status

Coho Salmon in the Klamath River watershed are part of the federally-designated SONCC ESU, which includes all Coho Salmon stocks between Cape Blanco in southern Oregon and Punta Gorda in northern California.

Based on its review of the status of Coho Salmon north of San Francisco, the Department concluded that California Coho Salmon have experienced a significant decline (CDFG 2002). The Department also concluded that Coho Salmon populations have been individually and cumulatively depleted or extirpated and that the natural linkages between individual populations have been fragmented or severed. For the California portion of the Coho Salmon SONCC ESU, an analysis of presence-by-brood-year data indicated that Coho Salmon occupied about 61% of the streams that were previously identified by others (e.g., Brown and Moyle 1991) as historical Coho Salmon streams (i.e., any stream for which published records of Coho Salmon presence could be found). Based on this information, the Department concluded that Coho Salmon populations in the California portion of the SONCC ESU are threatened and will likely become endangered in the foreseeable future in the absence of special protection and management efforts required by CESA. In response to these findings, the Commission adopted amendments to § 670.5 in title 14 of the California Code of Regulations on August 5, 2004, adding California Coho Salmon populations between Punta Gorda and the northern border of California to the list of threatened species under CESA, effective as of March 30, 2005. The Commission adopted the *Recovery Strategy for California Coho Salmon* (CDFG 2004) the previous year.

The NOAA-Fisheries conducted a similar status review of the SONCC Coho Salmon populations in 1995 (Weitkamp et al. 1995). They arrived at similar conclusions as the

Department regarding the likelihood that Coho Salmon in this ESU may become endangered in the foreseeable future if observed declines continue. NOAA-Fisheries listed the ESU as threatened under ESA on May 6, 1997, and designated critical habitat[1] for the ESU on May 5, 1999. The critical habitat designation encompasses accessible reaches of all streams and rivers within the range of SONCC Coho Salmon, including the Scott River. NOAA-Fisheries published the *Final Recovery Plan for the Southern Oregon/Northern California Coast Evolutionary Significant Unit of Coho Salmon* in 2014.

Life Cycle

Adult Coho Salmon enter freshwater from the ocean in the fall in order to spawn. In the Klamath River watershed, Coho Salmon begin entering in early to mid-September and the migration reaches a peak in late September to early October. Arrival in the upper tributaries such as the Scott River generally peaks in November and December. The majority of the Coho Salmon spawning activity in this area occurs mainly during these two months.

The Department has been operating a video fish counting station on the Scott River at RM 19.8 since 2007. In addition, joint interagency and volunteer spawner surveys have been conducted on the Scott River and tributaries since 2001. During the 2007 season, Coho Salmon redds were observed in Scott River canyon, east and south forks, Scott River tailings and the following tributaries: Etna, French, Miners, Kelsey, Kidder, Mill, Patterson, Shackleford and Sugar Creeks (Walsh 2008). Data shows a correlation between increased flows and Coho Salmon moving through the counting station (Knechtle pers comm).

Females usually choose spawning sites near the head of a riffle, just below a pool, where the water changes from a smooth to a turbulent flow. Spawning sites are often located in areas with overhanging vegetation. Medium to small-sized gravel is essential for successful Coho Salmon spawning. After fertilization, the eggs are buried by the female digging another redd just upstream, which carries streambed materials a short distance downstream to the previous redd. The flow characteristics of the redd location usually ensure good aeration of eggs and embryos, and the flushing of waste products.

In California, Coho Salmon eggs generally incubate in the gravels from November through April. However, stream temperatures affect the timing of fry emergence and in the Scott River and its tributaries, incubation may extend into May. After hatching, the hatchlings, called “alevins,” remain within the gravel bed for two to 10 weeks before they emerge as fry into the actively flowing channel between February and June. The fry seek out shallow, low velocity water, usually moving to the stream margins, where they form schools. As the fish feed heavily and grow, the schools generally break up and individual fish set up territories. At this stage, the juvenile fish are called “parr”. As the parr continue to grow and expand their territories, they move progressively into deeper cooler water until July and August, when they inhabit the deepest pools. Rearing areas used by juvenile Coho Salmon include low-gradient coastal streams, lakes, sloughs, side channels, estuaries, low-gradient tributaries to large rivers, beaver ponds, and large slackwaters. The most productive juvenile habitats are found in smaller streams with low-gradient alluvial channels, containing abundant pools formed by large woody debris (LWD) such as fallen trees.

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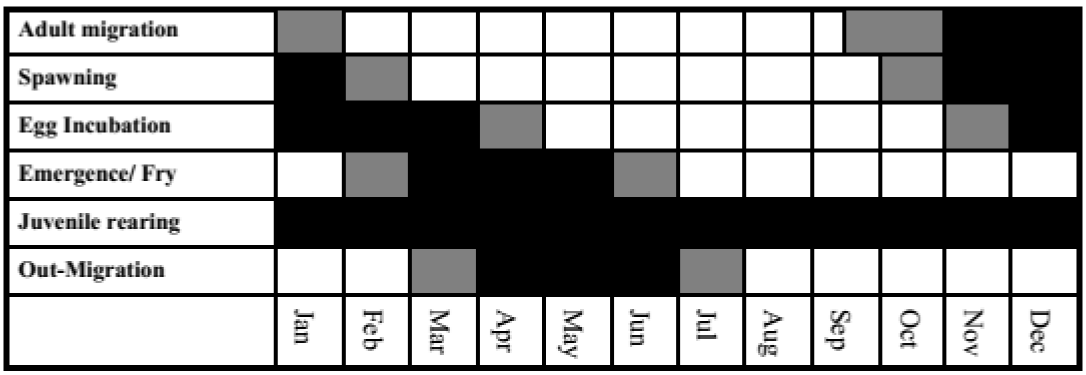
[1] The Endangered Species Act requires the federal government to designate “critical habitat” for any species it lists under the Act. “Critical habitat” is defined as: (1) specific areas within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to conservation, and those features may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation.

Juvenile Coho Salmon typically rear in freshwater for an entire year before ocean entry (Table 2). This necessitates appropriate habitat conditions for juvenile Coho Salmon in streams through the summer and winter months. Flows throughout Scott River watershed are reduced dramatically during the summer months due to surface water diversions, ground water pumping, drought conditions and climate change. These conditions typically result in salmonids being trapped in isolated pools. Fish relocation efforts have been conducted by the Department for decades, moving salmonids from their natal streams prior to dewatering. Inland winter streamflows are characterized by periods of cold low flows interspersed with freshets and possibly floods. Juvenile Coho Salmon require areas of velocity refuge during periods of high flows. Potential habitats offering velocity refuge during winter include off-channel habitats and beaver ponds.

Table 2. Generalized life stage periodicity of Coho Salmon in California watersheds. Gray shading represents months when the life stage is present, black shading indicates months of peak occurrence. (excerpted from CDFG 2002)



After spending one year in fresh water, the majority of the juvenile Coho Salmon hatched during the previous spring begin migrating downstream to the ocean in late March/early April through June. Juvenile salmonids migrating toward the ocean are called “smolts.” Upon entry into the ocean, the immature salmon remain in inshore waters, congregating in schools as they move north along the continental shelf. After 18 months of growing and sexually maturing in the ocean, Coho Salmon return to their natal streams as three-year-olds to begin the life cycle again.

This three-year cycle is fairly rigid among Coho Salmon as they rarely spend less than two years in the ocean.[2] Since all wild female Coho Salmon are typically three years old when spawning, there are three distinct and separate maternal brood year lineages for each stream. For example, almost all Coho Salmon produced in 2015 were progeny of females produced three years earlier in 2012, which in turn were progeny of females produced three years earlier in 2009, and so on (Table 3).

[2] Some Coho Salmon return to spawn after spending only 6 months in the ocean. These fish are referred to as grilse or jacks.

Table 3. Coho Salmon brood year lineages

Brood Year Lineage I	2006	2009	2012	2015
Brood Year Lineage II	2005	2008	2011	2014
Brood Year Lineage III	2004	2007	2010	2013

Loss of one of the three Coho Salmon brood years in a stream is referred to as brood-year extinction or cohort failure. Brood year extinction may occur for reasons including, inability of adults to return to their place of origin, productivity failure, or high mortality (CDFG 2004). This life cycle is a major reason for Coho Salmon's greater vulnerability to catastrophic events compared to other salmonids. Should a major event, such as El Niño floods or anthropogenic disturbance severely deplete Coho Salmon stocks during one year, the effects will be noticed three years later when few or no surviving female Coho Salmon return to continue the brood year lineage.

Habitat Requirements

Suitable aquatic habitat conditions are essential for migrating, spawning, and rearing Coho Salmon. Important components of productive freshwater habitat for Coho Salmon include a healthy riparian corridor, presence of LWD in the channel, appropriate substrate type and size, a relatively unimpaired hydrologic regime, low summer water temperatures, and relatively high dissolved oxygen concentrations. The importance of these habitat parameters is further described below, based on a summary provided in the Department's Recovery Strategy (2004).

Riparian vegetation provides many essential benefits to stream conditions and habitat. It serves as a buffer from sediment and pollution, influences the geomorphology and streamflow, and provides streambank stability. The riparian buffer is vital to moderating water temperatures that influence spawning and rearing by providing the canopy, which protects the water from direct solar heating, and the buffer, which provides a cooler microclimate and lower ambient temperatures near the stream. The riparian canopy also serves as cover from predators, and supplies both insect prey and organic nutrients to streams, and is a source for LWD.

LWD within the stream channel is an essential component of Coho Salmon habitat with several ecological functions. It stabilizes substrate, provides cover from predators and shelter from high water velocities, aids in pool and spawning bed establishment and maintenance, and provides habitat for aquatic invertebrate prey.

The channel substrate type and size, and the quantity and distribution of sediment, have essential direct and indirect functions at several life stages of Coho Salmon. Adults require gravel of appropriate size and shape for spawning (building redds and laying/fertilizing the eggs). Eggs develop and hatch within the substrate, and alevins remain there for some time for protection and shelter. An excess of fine sediment such as sandy and/or silty materials is a significant threat to eggs and fry because it can reduce the interstitial flow necessary to regulate water temperature and dissolved oxygen, remove excreted waste, and provide food for fry. Fine sediments may also envelop and suffocate eggs and fry, and reduce available fry habitat. The substrate also functions as habitat for rearing juveniles by providing shelter from faster flowing water and protection from predators. Furthermore, some invertebrate prey inhabit the benthic environment of the stream substrate.

The characteristics of the water and geomorphology of the stream channel are fundamentally essential to all Coho Salmon life stages. Important characteristics include water velocity, flow volume, water depths, and the seasonal changes and dynamics of each of these (e.g., summer flow, peak flow, and winter freshets). Appropriate water temperature regimes, in particular, are critical throughout the freshwater phases of the Coho Salmon life cycle. Water temperature affects the rate and success of egg development, fry maturation, juvenile growth, distribution, and survival, smoltification, initiation of adult migration, and survival and success of spawning adults. Water temperature is influenced by many factors including streamflow, riparian vegetation, channel morphology, hydrology, soil-geomorphology interaction, solar radiation, climate, and impacts of human activities. The heat energy contained within the water and the ecological paths through which heat enters and leaves the water are dynamic and complex.

The optimal water temperature range for juvenile Coho Salmon is 10 °C to15.5 °C (Stenhouse et al. 2012). When water temperatures exceed 20.3 °C they become detrimental (Stenhouse et al. 2012). Juveniles exposed to temperatures in excess of 25 °C experience high mortality rates (Sandercock 1991). However, duration of exposure is an important factor regarding the effects of water temperature on salmonids. Additionally, environmental conditions in specific watersheds may affect the normal range and extreme end-points for any of these temperature conditions for Coho Salmon. The water temperature requirements for Coho Salmon are dependent on their metabolism, health, and food supply. These factors also need to be considered together when trying to understand the habitat needs of Coho Salmon in a particular watershed or river system.

An adequate level of dissolved oxygen is necessary for each life stage of Coho Salmon and is affected by water temperature, instream primary productivity, and streamflow. Fine sediment concentrations in gravel beds can also affect dissolved oxygen levels, impacting eggs and fry. Dissolved oxygen levels in streams and rivers are typically lowest during the summer and early fall, when water temperatures are higher and streamflows lower than during the rest of the year. Dissolved oxygen concentrations of eight mg/L or higher are typically considered ideal for rearing salmonids including Coho Salmon. Rearing juveniles may be able to survive when concentrations are relatively low (e.g., less than five mg/L), but growth, metabolism, and swimming performance are adversely affected (Bjornn and Reiser 1991).

C. Steelhead/Rainbow Trout

Status

Steelhead within the Scott River basin are part of the federally-designated Klamath Mountains Province Distinct Population Segment (DPS). Listing of this DPS under ESA was determined not to be warranted by NOAA- Fisheries on April 4, 2001. Summer-run steelhead within this DPS are a Department recognized species of special concern.

Life Cycle

Steelhead exhibit one of the most complex life histories of any salmonid species. The resident rainbow trout form spends its entire life in freshwater environments, while the anadromous steelhead form migrates between its natal streams and the ocean. Furthermore, two reproductive forms of steelhead are recognized, the summer-run (stream-maturing) and winter-run (ocean-maturing), which describes the level of sexual development following return to the freshwater environment. Some researchers further divide the winter steelhead into early (fall-run) and late (winter-run) (e.g., Hardy and Addley 2001), but the two forms have similar life histories (NRC 2004) and are treated together here as winter-run steelhead. In addition, the Klamath River Basin is distinctive in that it is one of the few basins producing ‘‘half-pounder’’ steelhead. This life history type refers to immature steelhead that return to fresh water after only two to four months in the ocean, generally over-winter in fresh water, then outmigrate again the following spring (Federal Register 2001).

Unlike salmon, steelhead are iteroparous, meaning they can spawn more than once before they die. In California, females commonly spawn twice before they die. Adult winter-run steelhead typically enter the Klamath River from late August to February before spawning, which extends from January through April, peaking in February and March (NRC 2004). Summer-run steelhead enter freshwater as immature fish from May to July, migrate upstream to the cool waters of larger tributaries, and hold in deep pools roughly until December, when they spawn (NRC 2004). Juvenile steelhead rear in freshwater for one to three years (mostly two) before migrating downstream toward the ocean in spring, primarily during the months of March through May. They then typically reside in marine waters one to three years prior to returning to their natal stream to spawn as three- or four-year olds.

Habitat Requirements

The overall habitat requirements of the various salmonid species are fairly similar. Like Coho Salmon, steelhead require adequate flows, temperatures, water depths and velocities, appropriate spawning and rearing substrates, and availability of instream cover and food. The importance of these habitat parameters are described above for Coho Salmon.

Notable differences in habitat preferences include the fact that while juvenile Coho Salmon prefer pools with low average velocities and are not as common in riffles with high current velocities, juvenile steelhead tend to occupy riffles, as well as deep pools with relatively high velocities along the center of the channel (Bisson et al. 1988). Similar to spring-run Chinook Salmon, adult holding areas are of particular importance to summer-run steelhead who must reside in the freshwater streams and rivers throughout the summer. The thermal tolerance of steelhead is generally higher than that of most other salmonids. Preferred temperatures in the field are usually 15 °C to 18 °C (59-64 °F), but juveniles regularly persist in water where daytime temperatures reach 26 °C to 27 °C (79-81 °F) (Moyle 2002). Long-term exposure to temperatures continuously above 24 °C, however, is usually lethal (NRC 2004; Moyle 2002).

5. Scott River Flows

The primary source of instream flow information for the Scott River is provided by the operation of USGS gage 11519500 located downstream of the town of Fort Jones at the northern end of Scott Valley (RM 21). Additional USGS flow data is available for a few of the tributary streams located around Scott Valley. However, the period of record for most of these gages are generally limited to only a few years (Table 4). USGS 11519500 is the only gage within the watershed that provides a continuous historical record of flows dating back to October 1, 1941. The data from USGS 11519500 was used to estimate instream flow criteria using standard setting techniques. The applicability of the criteria is limited to monitoring and compliance of flow levels at USGS 11519500.

Table 4. Stream gaging stations in the study area.

River and Tributary	Data Source (Period of Record)	Complete Water Years Recorded
Mainstem		
Scott River	USGS #11519500 (1942-present)	73+
West Side Tributaries		
South Fork Scott River	USGS #11518200 (1959-1960)	2
Sugar Creek	USGS #11518300 (1958-1960)	3
Cedar Gulch (Nr Callahan)	USGS #11518310 (1967-1973)	7
French Creek	DWR Data Library (2005-2007)	3
Kidder Creek	Siskyou RCD Flow Data (2009-2005, 2007)	4
Shackleford Creek (Nr Mugginsville)	USGS #11519000 (1957-1960)	4
East Side Tributaries		
East Fork Scott River	USGS #11518050 (1960-1974)	15
Moffett Creek (Nr Fort Jones)	USGS #11518600 (1959-1967)	9
East Fork Scott River (Nr Callahan)	USGS #11518000 (1911)	1
East Fork Scott River (Ab Kangaroo)	USGS #11517950 (1971-1972)	2
East Fork Scott River (Bl Houston)	USGS #11517900 (1971-1972)	2

Typical of streams located along the interior of California, flows in the Scott River are characterized by a snowmelt driven hydrologic pattern with fairly consistent high flows occurring in the spring (Figure 4). Occasional flood flows occur during the winter months as a result of heavy rainfall or rain on snow events. The average annual discharge is 455,994 acre-feet (AF) and the mean annual daily discharge is 631 cfs. The driest water year (WY) on record occurred during the 1977 WY when the total annual discharge was only 54,106 AF. The wettest year on record occurred during the 1974 WY when the total annual discharge was 1,081,013 AF. It is important to note that even though USGS 11519500 has a fairly long period of record, the entire record represents an impaired state to varying degrees due to the long history of agricultural diversions that exist within the basin. Given the lack of diversion data through time it is extremely difficult to develop a reasonable description of unimpaired flow conditions for the historic flow data available at the USGS gage, let alone for each of the tributary streams.

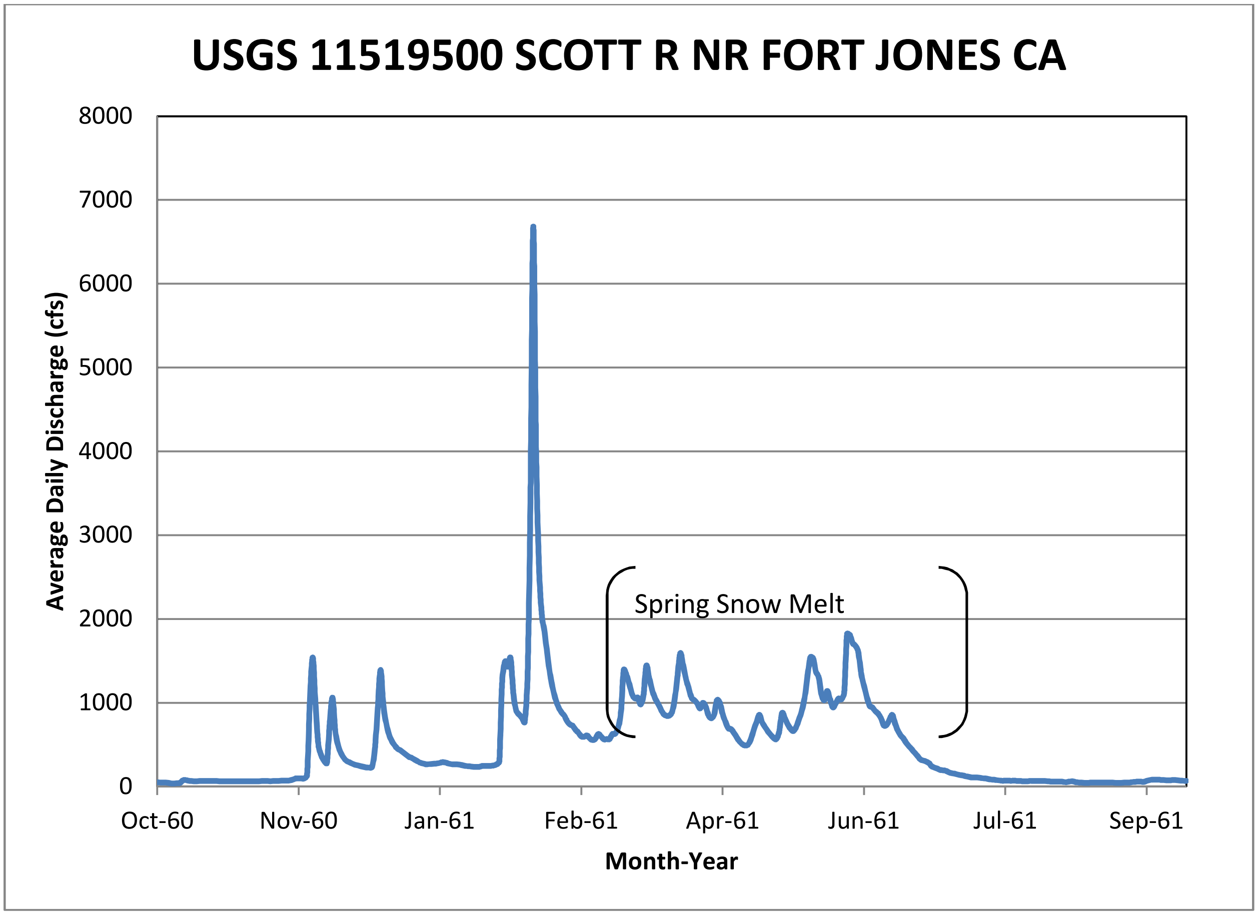


Figure 4. Typical annual hydrograph for the Scott River depicting the influence of large winter storms, spring snow melt, and summer base flows. The data displayed are for the 1961 WY as recorded at USGS 11519500.

Unimpaired flow levels occurring at the north end of the valley were estimated by considering only the first 30 water years of average daily discharges recorded at USGS 11519500, from October 1st, 1942 through September 30th, 1971. Based on historical use information, agricultural demand increased markedly in the 1950's. The period of record used to estimate unimpaired flows represents a period when water supply was changing and is not a completely accurate estimate of unimpaired flows. Due to trends in climate change, estimating current unimpaired flow levels using data from the mid-twentieth century is also flawed. The hydrologic record used represents the best available estimate of unimpaired flows. The total annual flow during this shortened period was 482,162 AF and the mean annual discharge was 666 cfs. The driest WY during this shortened period was the 1955 WY when the total annual flow was only 158,549 AF. The wettest year during this shortened period occurred during the 1958 WY when the total annual flow was 944,053 AF. The instream flow characteristics of the Scott River were described using annual flow duration curve analysis. Two curves were developed: 1) for the entire period of record and 2) for the estimated unimpaired period expressed in terms of probability of exceedance (Figure 5). The discharge level for each percent exceedance increment is provided in Table 5.

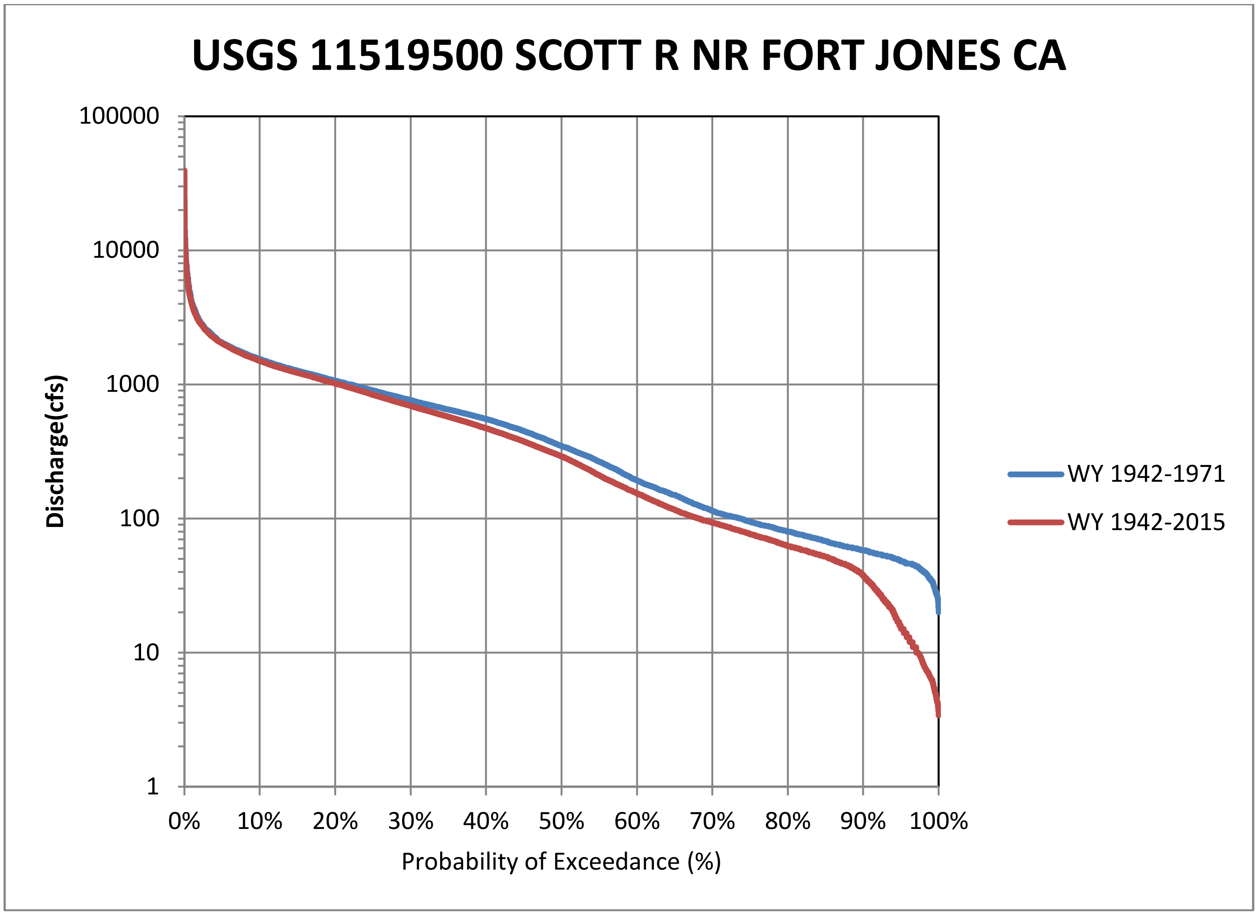


Figure 5. Annual flow duration curves developed for the Scott River (Scott Valley HSA) from USGS 11519500 for WYs 1942 through 2015 (red) and WYs 1942 through 1971 (blue). Water years 1942 through 1971 are assumed to represent an unimpaired condition.

Table 5. Exceedance probability variance between the estimated unimpaired portion of the record (1942-1971) and the full period of record (1942-2015) based on USGS 11519500.

	Discharge (cfs)		
Exceedance Probability	WY 1942 - 1971	Numeric Difference/ Percent Difference	WY 1942 - 2015
90%	58	20 / 66%	38
80%	80	17 / 79%	63
70%	114	21 / 82%	93
60%	192	38 / 80%	154
50%	347	56 / 84%	291
40%	553	82 / 85%	471
30%	763	71 / 91%	692
20%	1070	50 / 95%	1020
10%	1540	40 / 97%	1500

Table 5 illustrates that flows with a higher probability of exceedance from the full period of record were generally found to be lower in magnitude than those from the unimpaired portion, while less likely flow levels were of similar magnitude. The study objectives focus on summer low flow conditions for fishery resources. The use of unimpaired hydrology is necessary to understand the likelihood of flow levels that have historically supported instream resources.

A. *Estimated Unimpaired Water Year Types*

Water year type classifications were determined from mean annual discharge (MAD) of the unimpaired flow record and segregated by exceedance percentage (Table 6). Classifications were limited to three types due to the shortened period of record, wet (exceedance probability less than 30%), normal (exceedance probability between 30% and 70%), and dry (exceedance probability greater than 70%). The break out years into class types is shown in Figure 6.

Table 6. Exceedance probability and water year type based on water years 1942 through 1971.

Water Year	MAD (cfs)	Exceedance Probability	Water Year Type
1958	1304	3.23%	Wet
1956	1253	6.45%	Wet
1971	1085	9.68%	Wet
1965	1078	12.90%	Wet
1952	1019	16.13%	Wet
1953	955	19.35%	Wet
1951	925	22.58%	Wet
1963	910	25.81%	Wet
1970	863	29.03%	Wet
1943	831	32.26%	Normal
1954	800	35.48%	Normal
1969	785	38.71%	Normal
1942	708	41.94%	Normal
1967	651	45.16%	Normal
1946	632	48.39%	Normal
1957	581	51.61%	Normal
1961	529	54.84%	Normal
1948	488	58.06%	Normal
1966	477	61.29%	Normal
1950	474	64.52%	Normal
1968	446	67.74%	Normal
1964	435	70.97%	Dry
1945	405	74.19%	Dry
1949	399	77.42%	Dry
1962	399	80.65%	Dry
1959	396	83.87%	Dry
1960	389	87.10%	Dry
1947	302	90.32%	Dry
1944	233	93.55%	Dry
1955	219	96.77%	Dry

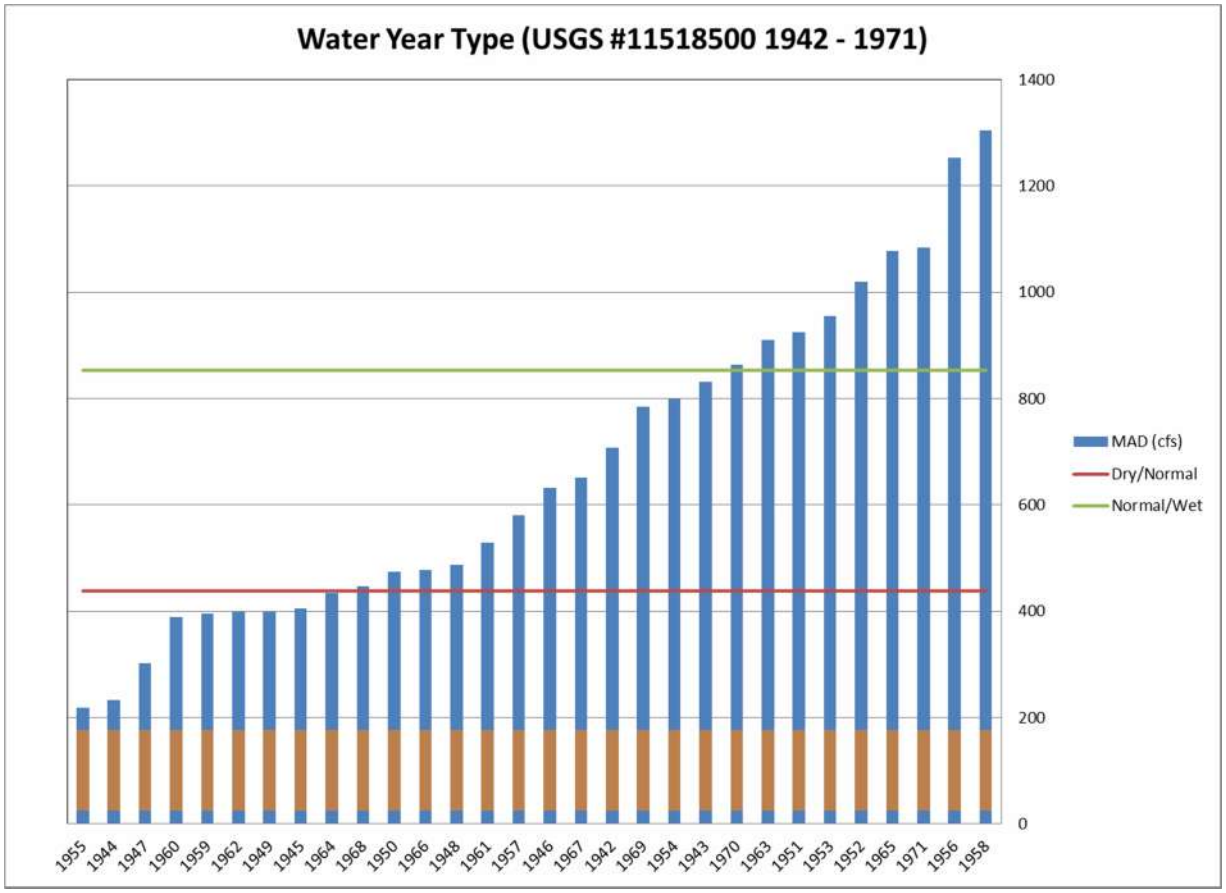


Figure 6. Water year typing for Scott River unimpaired flow near Fort Jones.

B. Stream Assessment Methods

Instream flow assessments fall under three broad categories 1) standard setting hydrology based "desktop" methods that typically do not involved field data collection, 2) single flow monitoring level field surveys, and 3) field data based instream flow studies that develop predictive models that simulate habitat conditions over a range of flows and indicate incremental benefits to resources with changing conditions (Annear et al. 2004). The three categories represent increasing levels of effort, but are also geared towards answering different questions needed to evaluate stream health. For example, incremental studies are designed to answer site and species specific questions by estimating habitat/flow relationships, but not necessarily to provide a flow prescription to protect overall riverine health.

The Department recognizes that interim flow prescriptions are needed for the Scott River while developing and implementing a series of more detailed instream flow study plans. For interim flow determinations, the Department supports the use of the following "desktop" methods, which were developed to support the passage and physical habitat requirements of Pacific salmonids. The main limitation of "desktop" methods is they often prescribe a single minimum flow threshold and do not provide the variable flow regime important for stream health. To avoid the pitfall of prescribing a single minimum threshold, three different standard setting methods were applied to the Scott River using the long term hydrologic time series recorded at USGS 11519500. Each method was selected to identify flow needs for priority stream functions as follows:

- Q_{fp} fish passage equation (R2 2008);
- Hatfield & Bruce (2000) for spawning and rearing; and
- Tessmann's adaption of the Tennant Method for basin wide hydrology (1980).

The results were combined below depending upon fish species life stage periodicity to develop an annual flow prescription in half month increments.

Interim flows that support fish passage can be developed by applying the Q_{fp} formula contained in Appendix E of R2 Resources (2008), which was prepared to support the North Coast Instream Flow Policy (SWRCB 2014). The Q_{fp} regression formula uses watershed area, mean annual discharge, and minimum passage depth to estimate an appropriate passage flow. This formula was developed using data from Idaho (R2 2004), Deitch (2006) and 22 cross sections collected in 13 streams in Mendocino, Sonoma, Napa, and Marin counties. The authors note "The relation appears to be descriptive of streams over a region broader than the Policy area, and is generally consistent across passage depth requirements."

The Q_{fp} formula is: $Q_{fp} = 19.3 * Q_m * D_{min}^{2.1} * DA^{-0.72}$

Where Q_{fp} = the minimum fish passage flow (cfs), Q_m = mean annual flow (cfs), D_{min} = minimum passage depth criterion (feet), and DA = drainage area (mi^2). As reported above, the mean annual discharge was 666 cfs for the less-developed period of water year 1942 through water year 1971. The D_{min} for Chinook Salmon and Coho Salmon and for steelhead trout was selected from the values of CDFG (2012) as noted in Table 7 below:

Table 7. Minimum depths required for passage.

Species	Minimum Passage Depth (ft)
Chinook Salmon (adult)	0.9
Steelhead (adult) Coho Salmon	0.7

Interim minimum flows that support the spawning and juvenile rearing life stages were estimated using the Hatfield and Bruce (2000) regression equations. These equations were developed using the "peak of the curve" results (i.e. optimum flow) from 127 Physical Habitat Simulation (PHABSIM) studies conducted across western North America, with most of the data representing California, Washington, Idaho, and Oregon. The regressions equations use MAD, latitude, and/or longitude to identify appropriate flows for each life stage. Thirteen species were included in the database, but only four had sufficient sample size to be analyzed separately and those included Chinook Salmon, Rainbow Trout, steelhead trout, and Brown Trout. The data from Coho Salmon streams with PHABSIM results were included in the all species category regression equations. The equations applied in this analysis are provided in Table 8.

Table 8. Hatfield & Bruce equations for Chinook Salmon and Coho Salmon and steelhead trout in the Scott River.

Species	Life stage	Equation
Chinook Salmon	Spawning	$\log_e$ (optimum flow) = -51.71 + 0.682 * $\log_e$(MAD) + 11.042 * $\log_e$(longitude)
	Juvenile	$\log_e$ (optimum flow) = -0.998 + 0.939 * $\log_e$(MAD)
All Species (Coho Salmon)	Spawning	$\log_e$ (optimum flow) = -12.392 + 0.660 * $\log_e$(MAD) + 1.336 * $\log_e$(latitude) + 1.774 * $\log_e$(longitude)
	Juvenile	$\log_e$ (optimum flow) = -6.119 + 0.679 * $\log_e$(MAD) + 1.771 * $\log_e$(latitude)
Steelhead trout	Spawning	$\log_e$ (optimum flow) = -33.064 + 0.618 * $\log_e$(MAD) + 7.26 * $\log_e$(longitude)
	Juvenile	$\log_e$ (optimum flow) = -8.482 + 0.593 * $\log_e$(MAD) + 2.555 * $\log_e$(latitude)

The latitude and longitude of USGS streamflow gage 11519500 were selected for consistency with the hydrology data (latitude = 41.64083°N, longitude = 123.0139°W).

Table 9 presents the results of the application of the Q_{fp} and Hatfield & Bruce regression equations.

Table 9. Hatfield & Bruce results for Chinook Salmon and Coho Salmon and steelhead trout in the Scott River.

Species	Life stage	Basis	Result
Chinook Salmon	Adult Migration	Q_{fp}	103 cfs
	Adult Spawning	Hatfield & Bruce	351 cfs
	Juvenile Rearing	Hatfield & Bruce	165 cfs
Coho Salmon	Adult Migration	Q_{fp}	61 cfs
	Adult Spawning	Hatfield & Bruce	217 cfs
	Juvenile Rearing	Hatfield & Bruce	129 cfs
Steelhead trout	Adult Migration	Q_{fp}	61 cfs
	Adult Spawning	Hatfield & Bruce	362 cfs
	Juvenile Rearing	Hatfield & Bruce	134 cfs

The results were applied to the seasonal period when the lifestage of each species is expected to occur; Department staff prepared a life stage periodicity chart, Figure 7, based on the most recent experience with the fishery resources in the Scott River.

	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec	
Adult Chinook Migration																	X	X	X	X	X	X	X	X
Chinook Spawning	X																			X	X	X	X	X
Chinook Rearing	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Adult Coho Migration	X																		X	X	X	X	X	X
Coho Spawning	X	X	X																		X	X	X	X
Coho Rearing	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Adult Steelhead Migration	X	X	X	X	X	X[1]	X[1]	X[1]	X[1]	X[1]									X[1]	X[1]	X	X	X	X
Steelhead Spawning	X	X	X	X	X	X	X[1]	X[1]	X[1]										X[1]	X[1]	X[1]	X[1]	X[1]	X
Steelhead Rearing	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Figure 7. Chinook Salmon, Coho Salmon, and Steelhead trout life stage periodicity chart (X known to occur in Scott River; X[1] may occur due to life history variations, but not used in calculations).

Integrating the flows developed using Q_{fp} and Hatfield & Bruce with the life stage periodicity, and subsequently selecting the highest semimonthly flow, produces the following flow regime for the Scott River. Although the flows in Table 10 below are protective of Coho Salmon life stage requirements, none of the values generated from the All Species category were incorporated into the table because the other categories given in Table 8 resulted in the highest semimonthly flow.

Table 10. Interim annual streamflow criteria for salmonids in the Scott River using Q_{fp} and Hatfield & Bruce methods.

Time Period	Recommended Interim Streamflow
Jan 1 - Mar 31	362 cfs
Apr 1 - Apr 30	134 cfs
May 1 - Jul 15	165 cfs
Jul 16 - Oct 15	134 cfs
Oct 16 - Dec 15	351 cfs
Dec 16 - Dec 31	362 cfs

It is important to note that this flow regime does not directly consider the hydrology of the Scott River watershed – except through application of the mean annual discharge in the Q_{fp} and Hatfield & Bruce regression equations. To ensure that any recommended flow regime is consistent with basin hydrology, the Department applied Tessmann's adaptation of the Tennant Method. As provided in Table 11, the Tessmann adaptation considers a situational analysis of the mean annual flow and the mean monthly flow when determining the proposed minimum monthly flow prescription. For a given month, if the mean monthly flow is less than 40% of the mean annual flow, the prescribed flow is set at the mean monthly flow. If the mean monthly flow is greater than 40% of the mean annual flow and 40% of the mean monthly flow is less than 40% of the mean annual flow, the prescribed flow is set at 40% of the mean annual flow. If 40% of the mean monthly flow is greater than 40% of the mean annual flow, then the prescribed flow is set at 40% of the mean monthly flow. The results of the application of the Tessmann Adaptation are presented in Table 12.

Table 11. Tessmann situational flow analysis and proposed flow prescription response.

Situation	Minimum Monthly Flow
MMF < 40% MAF	MMF
MMF > 40% MAF and 40% MMF < 40% MAF	40% MAF
40% MMF > 40% MAF	40% MMF

Table 12. Tessmann Adaption of flow data from USGS 11519500.

Month	Mean Monthly Flow	Tessmann Flow[3]	Month	Mean Monthly Flow	Tessmann Flow
October	139 cfs	***139 cfs***	**April**	1,081 cfs	***432 cfs***
November	328 cfs	***266 cfs***	**May**	1,235 cfs	***494 cfs***
December	880 cfs	***337 cfs***	**June**	771 cfs	***308 cfs***
January	1,118 cfs	***447 cfs***	**July**	202 cfs	***202 cfs***
February	1,249 cfs	***500 cfs***	**August**	77 cfs	***77 cfs***
March	885 cfs	***354 cfs***	**September**	62 cfs	***62 cfs***

[3] This application of Tessmann's adaptation of the Tennant Method assumes a mean annual flow of 666 cfs.

6. Recommended Interim Flow Criteria

The recommended interim minimum instream flow criteria for the Scott River was developed by applying the lesser of the minimum flow developed using the Q_{fp} and Hatfield & Bruce regression equations and the monthly flow determined using Tessmann's adaptation of the Tennant Method. The interim flow criteria in Table 12 are intended to be thresholds measured at USGS 11519500. If the flow level falls below the interim criteria, the natural flow level would be maintained instream allowing for natural recession of the hydrograph. This approach provides interim protection for the migration, spawning and rearing life stages of salmon and steelhead while considering basin specific hydrology. The recommended interim flow regime is provided below in both graphic (Figure 8) and tabular form (Table 13).

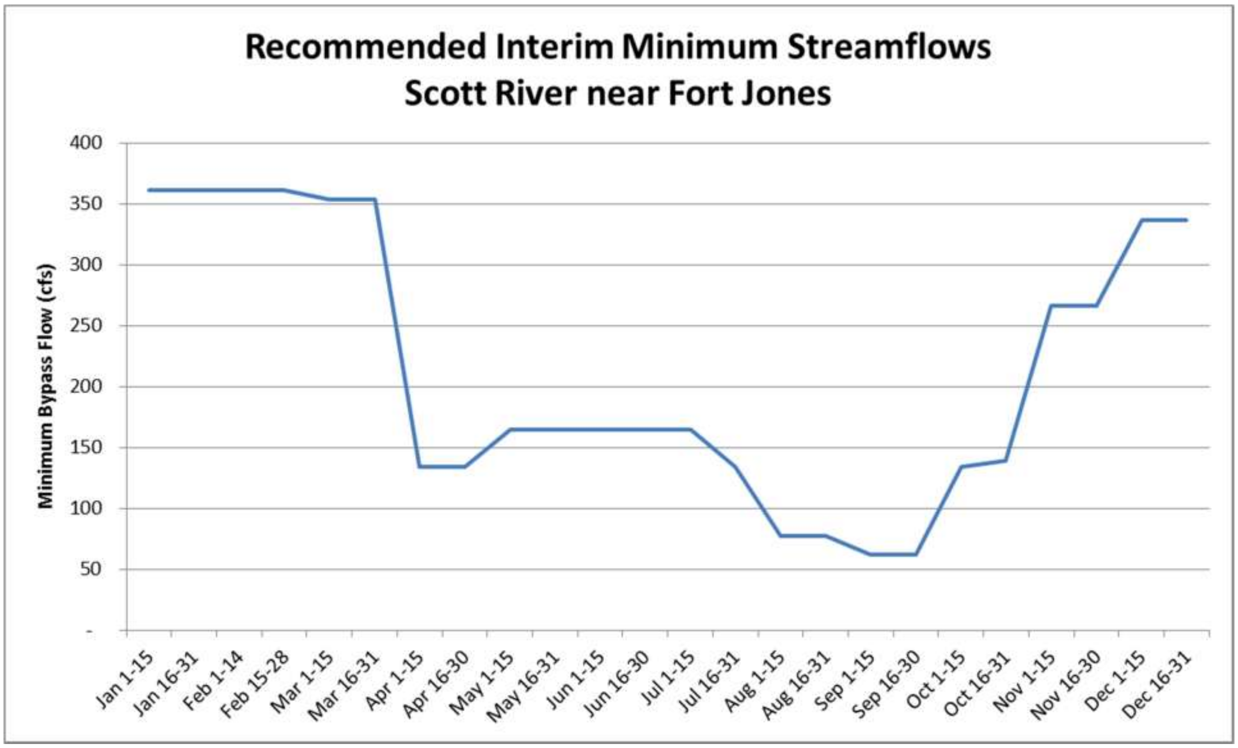


Figure 8. Annual hydrograph of recommended interim flow criteria for the Scott River at the Fort Jones gauge.

Table 13. Scott River Recommended Interim Flow Criteria measured at USGS 11519500.

Time Period	Recommended Flow	Time Period	Recommended Flow	Time Period	Recommended Flow
Jan 1 – 15	362 cfs or NF	May 1 – 15	165 cfs or NF	Sep 1 – 15	62 cfs or NF
Jan 16 – 31	362 cfs or NF	May 16 – 31	165 cfs or NF	Sep 16 – 30	62 cfs or NF
Feb 1 – 14	362 cfs or NF	Jun 1 – 15	165 cfs or NF	Oct 1 – 15	134 cfs or NF
Feb 15 – 28	362 cfs or NF	Jun 16 – 30	165 cfs or NF	Oct 16 – 31	139 cfs or NF
Mar 1 – 15	354 cfs or NF	Jul 1 – 15	165 cfs or NF	Nov 1 – 15	266 cfs or NF
Mar 16 – 31	354 cfs or NF	Jul 16 – 31	134 cfs or NF	Nov 16 – 30	266 cfs or NF
Apr 1 – 15	134 cfs or NF	Aug 1 – 15	77 cfs or NF	Dec 1 – 15	337 cfs or NF
Apr 16 – 30	134 cfs or NF	Aug 16 – 31	77 cfs or NF	Dec 16 – 31	337 cfs or NF

*NF = Natural Flow

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State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Region 1 – Northern
601 Locust Street
Redding, CA 96001
(530) 225-2300
www.wildlife.ca.gov

Memorandum

May 3, 2021

To: Tina Bartlett
Northern Region Manager
California Department of Fish and Wildlife
601 Locust Street
Redding, CA 96001

From: Joe Croteau
Klamath Watershed Program Manager
California Department of Fish and Wildlife
1625 South Main Street
Yreka, CA 96097

Subject: Influence of Scott River in-stream flow on the distribution and migration timing of fall Chinook Salmon and Coho Salmon.

Introduction

This document describes the hydrologic conditions and observed adult fall Chinook Salmon (*Oncorhynchus tshawytscha*, Chinook Salmon) and Coho Salmon (*O. kisutch*) migration response from 2007 to 2020 in the Scott River watershed in Siskiyou County. Concerns over delayed migration and restricted distribution of adult spawning Chinook Salmon and Coho Salmon in recent years has prompted this evaluation. The Scott River is one of the most important salmon producing tributaries in the Klamath River watershed. Since 1978 the Scott River Chinook Salmon population has contributed on average 9% of the Klamath Basin natural area spawners (CDFW 2021). Additionally, the Scott River Coho Salmon population is defined as a "core independent" population of the Southern Oregon Northern California Coast Evolutionarily Significant Unit under the federal Endangered Species Act. Coho Salmon are listed as "threatened" under both the federal Endangered Species Act (NOAA 1997) and the California Endangered Species Act (CDFG 2002).

Watershed Description

The following watershed description has been excerpted directly from CDFW (2017).

> *"The Scott River is located in Siskiyou County and is part of the Klamath Mountains Province (Figure 1). The Scott River is one of four major tributary streams to the Klamath River. The watershed drains an area of approximately of 812 square miles. The mainstem Scott River is approximately 58 river miles in length and begins at the confluence of the East Fork Scott River and South Fork Scott River. The lower 21 miles of the Scott River flows through a relatively steep mountainous canyon reach which is primarily owned and managed by the Klamath National Forest. Elevations in this reach range from approximately 1,538 ft. (469 m) at the mouth to 2,635 ft. (803 m) at river mile (RM) 21 near the United States Geological Survey (USGS) stream gage station USGS 11519500 SCOTT R NR FORT JONES CA (USGS 11519500). By contrast, the upper reach that flows through Scott Valley has low stream gradients. The upper reach begins at RM 58 near the town of Callahan and flows north to RM 21 near USGS 11519500. Elevations in this reach range from 2,635 ft. (803 m) at RM 21 to 3,140 ft. (958 m) at RM 58 near Callahan to the north. The headwater tributaries originate in the high mountain ranges of the Trinity Alps Wilderness Area, Russian Wilderness Area, and Marble Mountain Wilderness Areas located to the south and west of Scott Valley. The major tributary streams that contribute to the Scott River around Scott Valley include the East Fork Scott River, South Fork Scott River, Sugar Creek, French Creek, Etna Creek, Kidder Creek, Shackleford Creek, Patterson Creek, and Moffett Creek.*
>
> *The watershed has a Mediterranean type climate characterized by warm dry summers and cold wet winters. Rainfall is the primary source of precipitation along the lower elevations present on the valley floor and adjacent lower elevation hill slopes. Snowfall is predominant at higher elevations (>5,000 ft.) along the mountain ranges to the south and west side of Scott Valley. The mountains to the south and west of the valley capture most of the precipitation receiving about 60 to 80 inches of precipitation annually. The mountains along the east side of the valley lie*

within the rain shadow of higher elevation mountain ranges to the south and west, and only receive about 12 to 15 inches of precipitation annually.

Aquatic habitat for anadromous fish species within the Scott River basin has been altered by numerous human activities, affecting both instream conditions and adjacent riparian and upland slopes. Alterations to habitat and changes to the landscape include historic beaver trapping, road construction, agricultural practices, river channelization, dams and diversions, timber harvest, mining/dredging, gravel extraction, high severity fires, groundwater pumping, and rural residential development (NOAA-Fisheries 2014). These impacts, along with natural factors such as floods, erosive soil, and a warm and dry climate, have simplified, degraded, and fragmented anadromous fish migrating, spawning, and rearing habitat throughout the Scott River basin (NOAA-Fisheries 2014)."

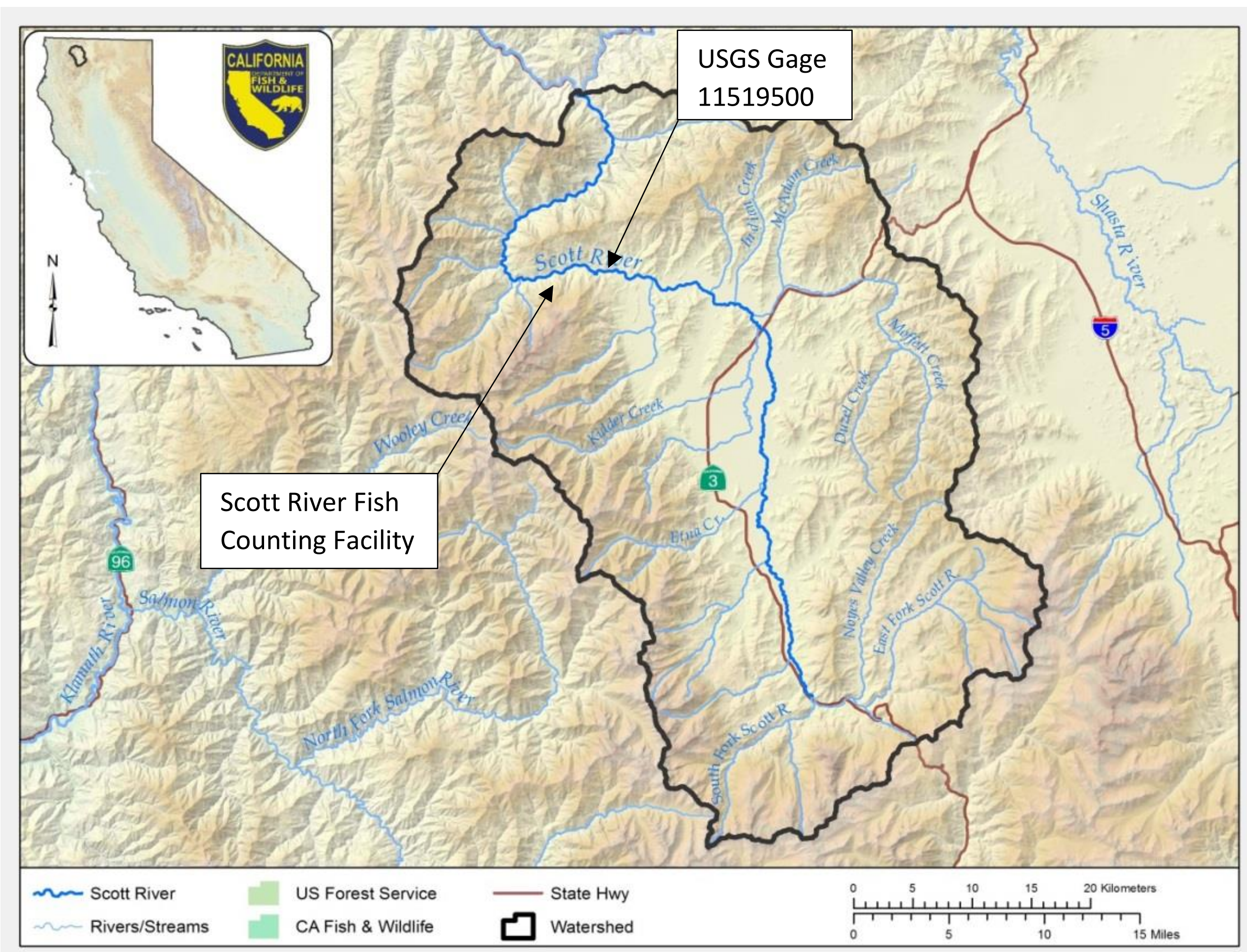

Figure 1. Scott River Watershed in Siskiyou County, California.

Flow Data

The USGS has continuously operated the Scott River near Fort Jones flow gage (Figure 1; USGS 11519500, (41º 38' 26.07"N; 123º 0' 54.31"W) on the mainstem of the Scott River downstream of Fort Jones near the transition between the valley and canyon reaches since October 1941. All flow data referenced in this report was collected at the USGS Fort Jones gage. Annual discharge (acre-feet) of each water year (October 1 through September 30) for the period of record (1942-2020) has been ranked based on its probability of exceedance within the flow record and segregated into roughly 20% bins to characterize "extremely wet", "wet", "normal", "dry" and "critically dry" water year types. Annual discharge for the Scott River varies greatly based on this water year type grouping. In "extremely wet" years average basin discharge was 805,998 acre-feet, and in "critically dry" years average annual discharge was 156,964 acre-feet (Figure 2).

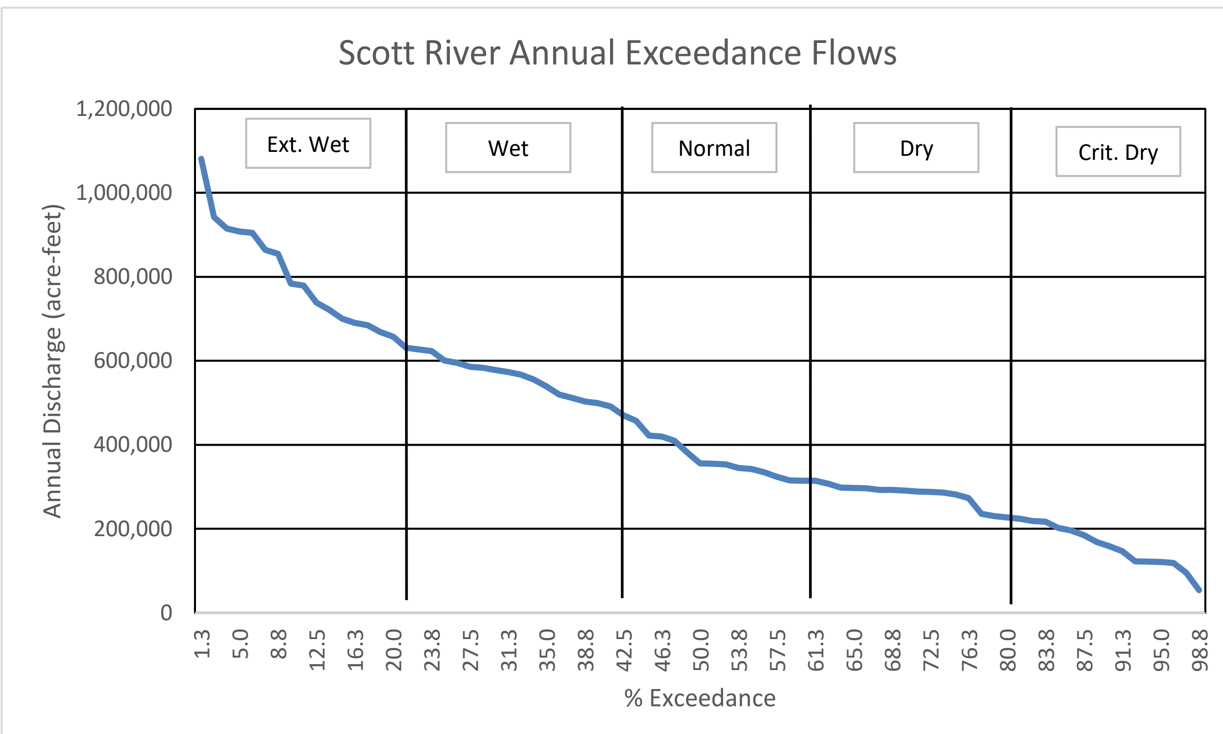

Figure 2. Annual discharge (acre-feet) measured at USGS Fort Jones gage (11519500) ranked by exceedance probability and grouped into roughly 20% bins to characterize annual water year types from 1942-2020.

Seasonal discharge is typical of Mediterranean climates with a rain dominated hydrograph from October through March and a snow melt dominated hydrograph from April through June. After the snowmelt hydrograph period ends streamflow diminishes to summer base flows reaching their minimums in September. From 2007 to 2020 average monthly mean flows ranged from a high of 961.7 cubic feet per second (cfs) in April to a low of 19.1 cfs in September. Average September base flows in the Scott River averaged 19.1 cfs between 2007 and 2020 and have ranged from a low of 6.3 cfs in 2020 to a high of 61.6 cfs in 2011 (Table 1).

Table 1. Mean monthly flows (cfs) measured at USGS Fort Jones gage (11519500) from 2007-2020.

Scott Mean Monthly Flow 2007-2020												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2007	696.29	523.82	1073.65	634.10	539.19	141.78	37.56	8.23	7.08	103.67	112.70	269.90
2008	381.84	496.66	749.03	657.13	1459.06	567.70	100.55	22.64	16.94	36.69	140.12	129.45
2009	234.87	287.07	613.00	497.43	928.97	308.71	35.55	10.74	7.04	17.63	48.02	73.58
2010	498.39	436.82	528.81	863.43	1122.55	1616.87	292.49	40.37	36.17	126.33	348.00	1020.94
2011	1019.87	529.46	1168.00	1452.03	1204.35	1579.80	609.39	95.47	61.65	91.26	102.71	135.24
2012	461.61	334.41	793.39	1632.73	1142.42	411.83	82.54	17.27	12.18	29.89	139.53	1014.00
2013	341.19	378.54	561.61	779.27	500.52	118.08	29.46	11.25	11.58	45.31	50.46	54.21
2014	59.53	488.16	851.00	309.30	131.72	44.45	9.69	6.87	7.01	29.56	147.35	983.74
2015	509.81	2234.89	582.35	253.50	155.32	75.44	10.46	7.06	7.19	6.27	7.75	308.40
2016	1226.65	1341.03	2311.29	1514.07	962.45	359.30	79.07	14.01	10.05	296.59	514.33	1093.00
2017	1518.39	3841.07	2337.74	1659.33	1962.58	1011.70	191.67	49.16	52.34	65.57	317.67	187.71
2018	292.00	327.39	385.39	915.33	460.29	96.54	17.80	6.16	8.13	12.55	37.55	179.86
2019	684.13	853.36	987.65	1980.03	1300.23	661.20	91.27	19.04	24.18	48.96	56.16	144.75
2020	294.10	313.52	200.65	315.70	431.06	184.21	18.02	9.28	6.31	7.13	12.70	52.60
Average	587.05	884.73	938.82	961.67	878.62	512.69	114.68	22.68	19.13	65.53	145.36	403.38

Much attention in the Scott River has focused on maintaining the United States Forest Service water right of 30 cfs for the "instream use for fish and wildlife" (CDFW 2017) as identified in the 1980 Scott River Decree (SWRCB 1980 N. 30662). During "normal," "dry" and "critically dry" water year types the percent of days in September for which the daily average flows are less than 30 cfs were 31%, 56% and 80% respectively. From 1942-2020, during the "wet" and "extremely wet" water years, mean September flows have been above 30 cfs for all years but one (Table 2). To evaluate if September mean flows have changed in recent decades among similar water year types, September mean flows were evaluated prior to and after 1980.

Table 2. Number of years and percent of years that USGS Fort Jones gage (11519500) mean September monthly flows (cfs) are less than 30 cfs for five different water year types from 1942-2020.

Water Year Type	Number of Years	Number of Years Mean September flow <30cfs	Percent of Years Mean September flow <30cfs
Extremely Wet	16	0	0.0%
Wet	16	1	6.3%
Normal	16	5	31.3%
Dry	16	9	56.3%
Critically Dry	15	12	80.0%

Water years have been ranked from wettest to driest by annual discharge (acre-feet) and corresponding mean September flows (cfs) have been grouped into two categories: black bars represent mean September flows from water years prior to 1980, and red bars represent mean September flows from water years after 1979 and are presented in Figure 3. Fourteen water years have been highlighted due to their similarity in annual discharge. These 14 water years had similar annual discharges, but corresponding mean September flows were very different depending on the time period that the water year occurred. The seven water years in this example from 1942-1979 had mean September flows above 30 cfs in six of the seven years and averaged 47 cfs (black highlight). The seven water years in this example from 1980-2020 had mean September flows less than 30 cfs six of the seven years and averaged 16 cfs (red highlight) (Figure 3).

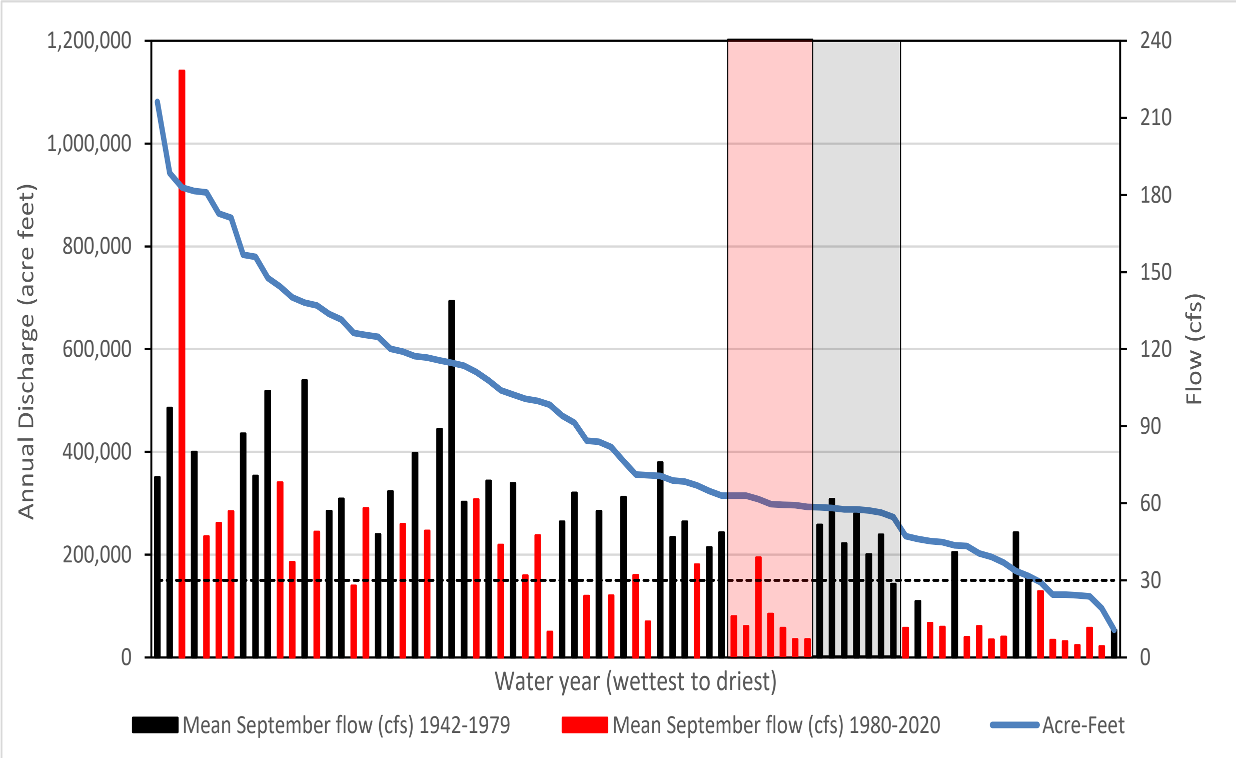

Figure 3. Scott River annual discharge (acre-feet) measured at USGS gage (11519500) for each water year ranked from wettest to driest from 1942-2020 (blue line). Mean September flows (cfs) for corresponding water years are plotted as red (1980-2020) and black (1942-1979) bars. For reference, a dashed black line has been placed at 30 cfs. Red and black highlighted sections show 14 years with very similar amounts of annual discharge (seven years from each time period) and very different mean September flows.

Prior to 1980 there were four "critically dry" water years and the average September flow during these years was 33.1 cfs. After 1980 there have been 11 "critically dry" water years and the average September flow during these years was 9.7 cfs. Similarly, during the 16 "dry" water years average September flows were 44.1 cfs prior to 1980 and 14.9 cfs after 1980. During the 16 "normal" water years average September base flows prior to 1980 were 60.0 cfs and the average after 1980 was 22.4 cfs. Prior to 1980 mean September flows were significantly higher during drier water year types than after 1980 (Table 3). Similarly, Van Kirk and Naman (2008) reported a 40.3% reduction in summer baseflows in the recent past (1977-2005) than in the historic period (1942-1976). Changes have occurred in the basin in recent decades that are creating lower base flows than in previous decades when similar amounts of annual discharge were available.

Table 3. Mean September flow (cfs) at USGS Fort Jones gage (11519500) for five water year types separated into two time periods 1942-1979 and 1980-2020.

Water Year Type	1942-1979 Period Mean September flow cfs	1980-2020 Period Mean September flow cfs
Extremely Wet	81.8	76.9
Wet	77.2	46.5
Normal	55.9	22.4
Dry	44.4	14.9
Critically Dry	33.1	9.7

It is important to acknowledge the degree of influence water year type has on the fall hydrograph and its influence on subsequent Chinook Salmon and Coho Salmon migration. It is also important to note that after spring snowmelt runoff has occurred meaningful increases in base flows are subject to the onset of fall and winter storms. Currently, water withdrawal is not scaled based on water year type, which may further exacerbate low base flows during drier water year types. Surface and ground water withdrawals have not been evaluated in this document to determine if implementation of the Decree is linked to the reductions in observed September flows. In recent decades, demand for groundwater in Scott Valley has increased (S.S. Papadopulus 2012) and the effects of this action are currently under evaluation by Siskiyou County under the authority of the Sustainable Groundwater Management Act.

Adult Population Trends

The Scott River Fish Counting Facility (SRFCF) is located at river mile 18.2 at the transition between the canyon and valley reaches (41º 38' 10.93"N; 123º 04' 3.08"W) (Figure 1). The SRFCF is an important component of the California Department of Fish and Wildlife's (CDFW) annual adult estimation effort and has been used to estimate escapement of Chinook Salmon since 2008 and Coho Salmon since 2007. Traditional mark-recapture, carcass, and redd survey methods are utilized to estimate adult abundance downstream of the SRFCF. Estimates from downstream of the counting station are added to estimates from the counting station to generate a Scott River basin estimate. Additionally, CDFW has operated a rotary screw trap near the mouth of the Scott River (41º 43' 32.30"N; 123º 0' 34.37"W) since 2000 and provides annual estimates of out-migrating salmonids. Information gathered at the adult and juvenile monitoring stations allows for estimating adult returns and juvenile production in the Scott

River. The pairing of these two datasets allows for estimation of in-river productivity and out-of-basin survival.

Chinook Salmon

Since 1978, the Chinook Salmon run in the Scott River has ranged from 14,477 fish (1995) to 467 fish (2004) and has averaged 4,977 fish (Figure 4). Chinook Salmon escapement to the Scott River from 2015 to 2020 averaged 1,738 fish, a 65% reduction from the historical average (4,977). Average escapement for the Klamath Basin from 2015-2020 is also down from the historical average, by 43% (CDFW 2021). It is concerning that the Scott River Chinook population is decreasing at a faster rate than the Klamath Basin as a whole.

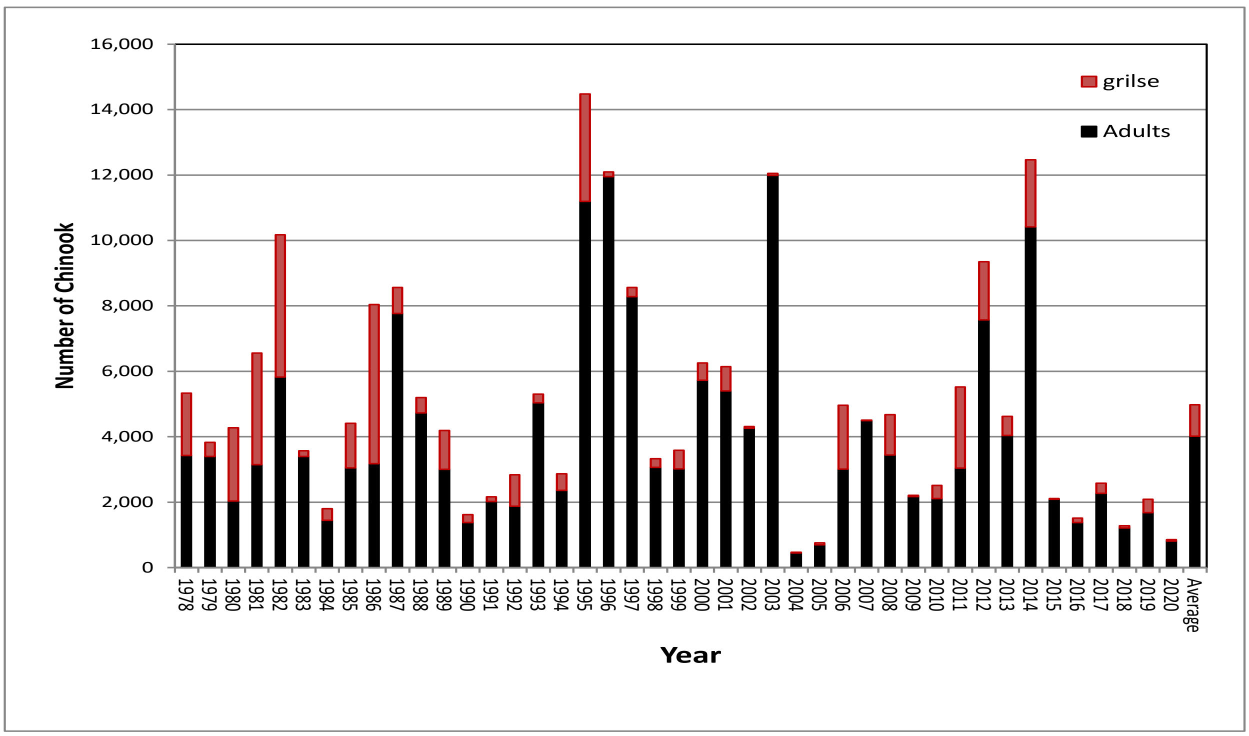

Figure 4. Estimated escapement of Chinook Salmon returning to the Scott River from 1978 to 2020.

Coho Salmon

Since video operations began in 2007 estimated escapement of Coho Salmon in the Scott River has ranged from a low of 63 to a high of 2,752 and averaged 726 (Figure 5). Coho Salmon populations are generally tracked as three separate brood years, with cohorts returning every three years, and in the Scott River the difference in brood year strength is striking. The difference in brood year strength has been observed for multiple decades in the Scott River (CDFG

2006). After four generations of monitoring, brood year 2 has increased from 153 fish in 2008 to 1,671 fish in 2020. The increase in this brood year is an example of how quickly the Coho Salmon population can respond when in-river and/or out-of-basin survival conditions are favorable (the out-of-basin survival estimate for the adults that returned in 2020 was 10.64% compared to the period of record average of 4.77%) (Knechtle and Giudice 2021). Similarly, after four generations brood year 3 has increased from 80 fish in 2009 to 727 fish in 2018. Drought conditions persisted in the Scott Basin in the winter of 2013-2014 reducing in-river productivity, and as a result brood year 1 reduced in run size from 2,644 in 2013 to 250 fish in 2016. Brood year 1 returned last to the Scott River in 2019 when an estimated 365 fish returned. While the capacity of the Scott River to produce Coho Salmon is highlighted in the trajectory of brood years 2 and 3, the reduction in brood year 1 indicates how rapidly the population can change when conditions are poor.

Adult Migration

Chinook Salmon typically return to the Scott River in mid-September and stage for multiple weeks near the mouth of the Scott River prior to migrating upriver to spawn in valley and canyon reaches. CDFW operated a counting station near the mouth of the Scott River from 1985-1991, and in five of the seven years of monitoring the first Chinook Salmon was observed at the counting station on or before September 12. In all seven years Chinook Salmon were observed by September 26. For the purposes of this document, we consider the SRFCF the upstream limit of the canyon and the downstream limit of the valley. In most years Chinook Salmon have access to spawning habitat in all canyon and mainstem areas downstream of the "tailings" just north of the town of Callahan. It has long been assumed that spawning habitat in the valley reaches and tributaries upstream of the canyon provides increased survival potential verses spawning in the canyon. Valley reaches allow access to high quality spawning habitat that is largely connected to its floodplain. Valley reaches also provide access to seasonal high quality rearing habitat that degrades as the dry season progresses. The importance of connectivity between spawning reaches and floodplain habitat cannot be understated. Floodplain connectivity allows water to spread out as flows increase, mitigating increasing water velocities, protecting incubating eggs from scour and providing rearing juvenile salmonids flow refuge, cover and feeding opportunities that is less abundant in canyon reaches. Additionally, when adult salmon have access to upstream reaches for spawning, more rearing habitat is seeded with juvenile fish. Access to more rearing habitat increases potential production, which can in turn increase adult returns.

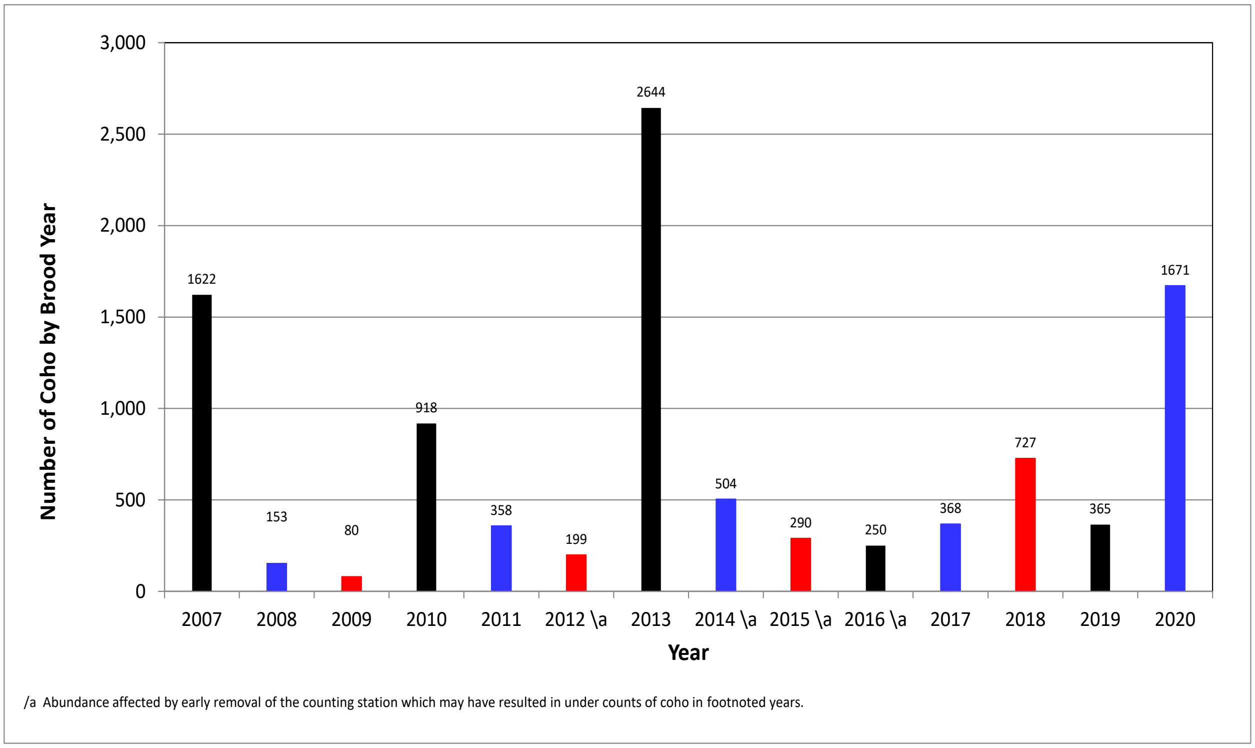

Figure 5. Estimated escapement by brood year of adult and grilse Coho Salmon returning to the Scott River from 2007 to 2020. Individual brood years are represented by different colors.

Adult Passage Timing at SRFCF

The timing of Chinook Salmon passage through the SRFCF has consistently started in early October. With the exception of 2020, the Chinook Salmon run migrated through the SRFCF almost entirely during October, with 50% of the cumulative annual migration occurring in a narrow 17-day period between October 14 and October 30 (Figure 6), and without stage flow increases. The years 2015, 2018 and 2020 were the three driest falls during the period of monitoring at the counting facility. It is unclear why Chinook Salmon migration timing was delayed in 2020 compared to the other 12 years. The run in 2020 was the lowest for the period of analysis, and the few fish that did migrate past the counting station were observed roughly two weeks after peak spawning occurred. The proportion of Chinook Salmon that spawned downstream of the counting station in 2015, 2018 and 2020 were 82%, 68% and 69% respectively which corresponded with the three lowest average October flow years. While the ability of Chinook Salmon to migrate does not appear to be limited by flow, the proportion of fish migrating upstream of SRFCF does appear to depend on flow.

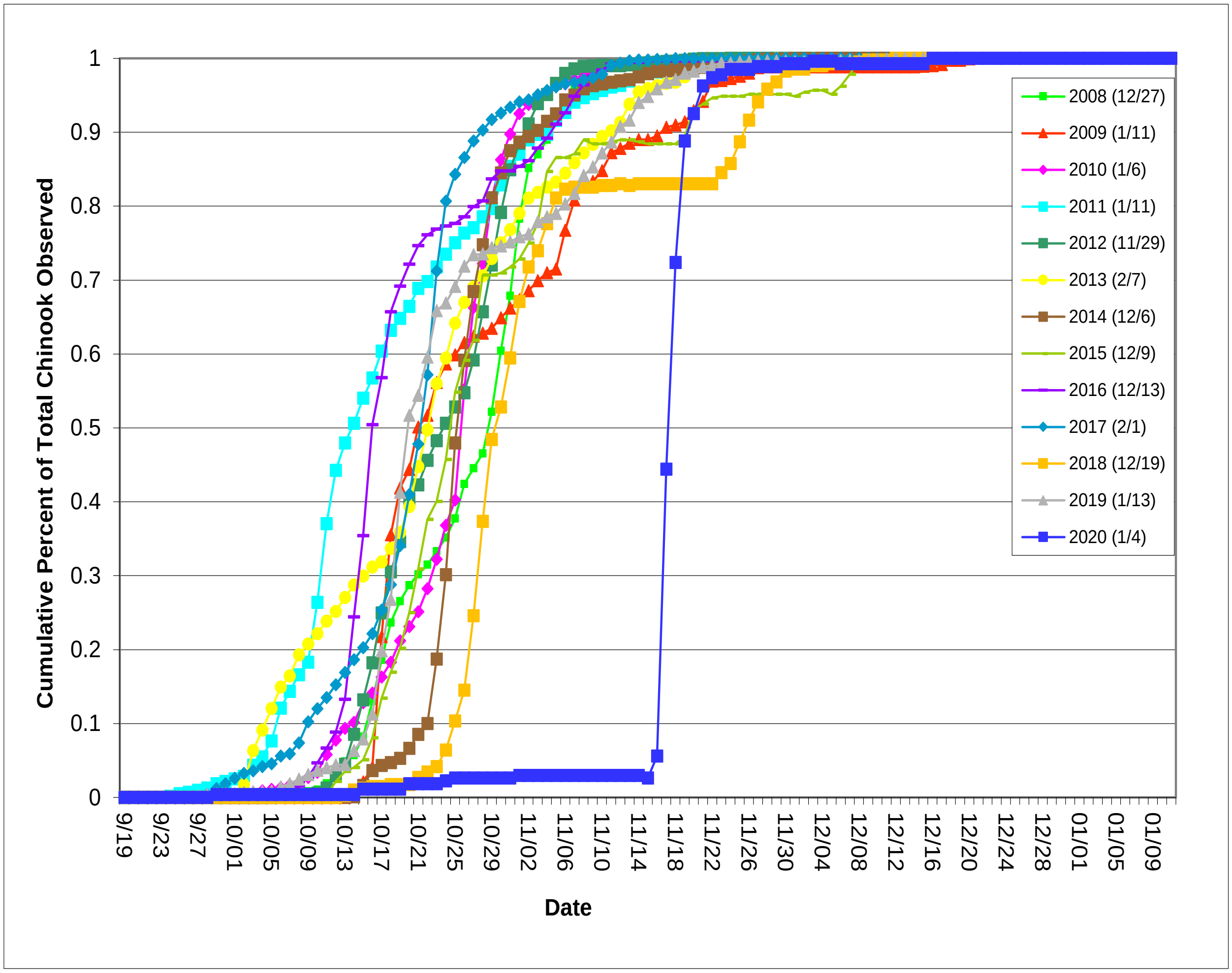

Figure 6. Cumulative percent of total observed Chinook Salmon observations by day at the SRFCF annually from 2008-2020. Dates in parentheses indicate the last date the fish counting facility was operated for each year.

Coho Salmon migration timing through the counting station is much more protracted and is heavily influenced by increases in flow. While Chinook Salmon will attempt to migrate regardless of the base flow condition in the fall, Coho Salmon migration is largely linked to flow events. The tendency for Chinook Salmon to spawn at a higher rate in mainstem habitats and Coho Salmon to spawn in tributaries may help explain this difference (i.e., Coho Salmon have evolved to respond to flows which make tributary habitats accessible). During the 14-year period from 2007 to 2020 the date when 50% of the cumulative annual Coho Salmon migration was achieved has ranged over a 44-day period between November 6 and December 19 (Figure 7). The average peak daily migration observed at the SRFCF from 2007 to 2020 was November 21. It is also common to observe a very high proportion of the entire Coho Salmon run pass through the SRFCF in a very short period of time. For example, in eight of the 14 years of monitoring more than 50% of the annual migration was observed passing through the SRFCF in a four-day period. Coho Salmon response to flow is almost instantaneous indicating that these fish are staging downstream of the counting station in the canyon reaches waiting for a flow increase to migrate upstream. Coho Salmon migration through the SRFCF is not clearly linked to a minimum flow threshold but migration is strongly associated with increases in flow.

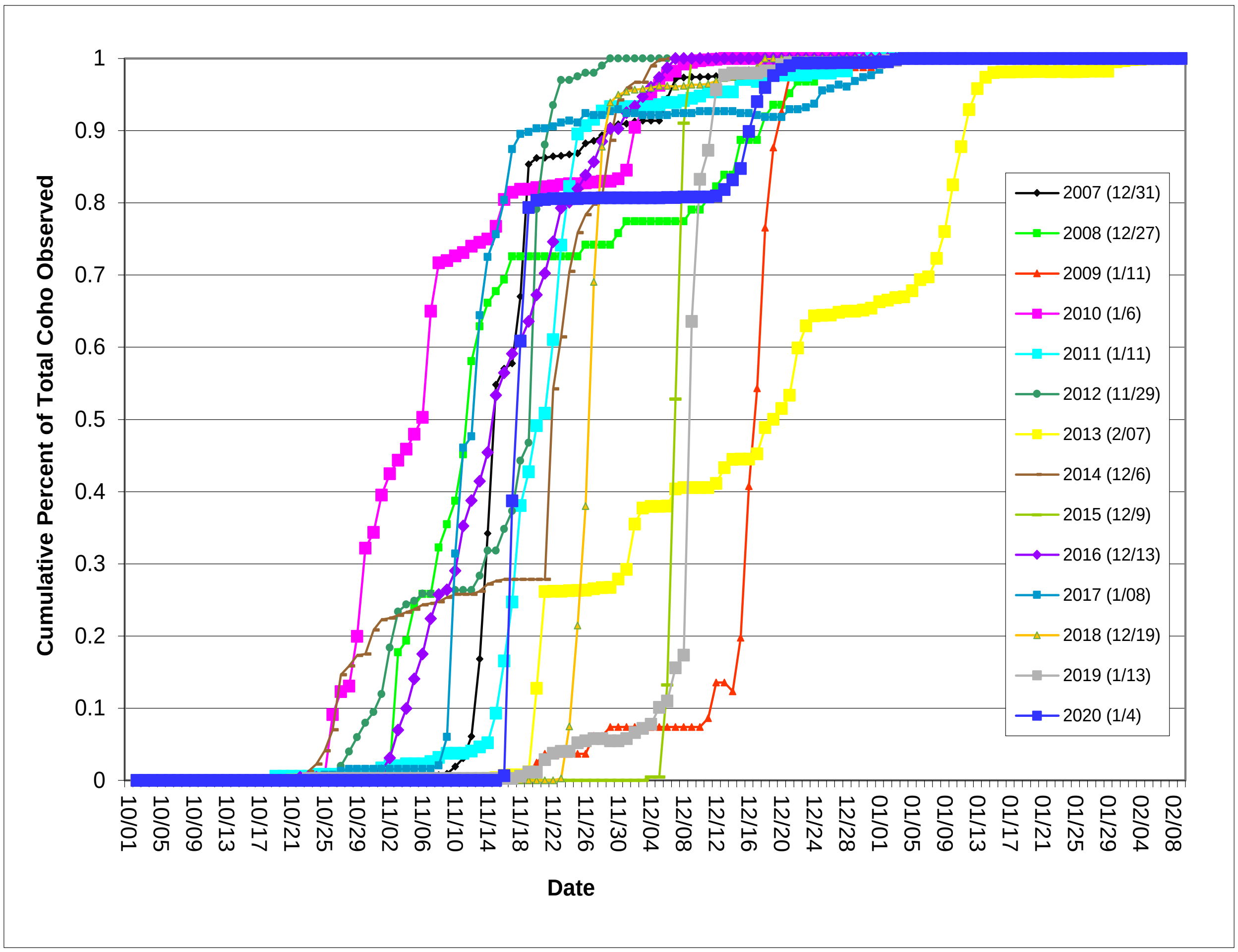

Figure 7. Cumulative percent of total observed Coho Salmon observations by day at the SRFCF annually from 2007-2020. Dates in parentheses indicate the last date the fish counting facility was operated for each year.

Proportion of Run Above and Below SRFCF

Proportions of the Chinook Salmon run distributed upstream versus downstream of the counting station for years 2008-2020 are detailed in Table 4. Over this period an average of 65% of the Chinook Salmon run migrated into the valley. The three years (2015, 2018, 2020) with the lowest percent of fish spawning in the valley coincided with some of the lowest mean October flows since 2008. It is important to track this metric as it helps describe the spatial distribution of annual spawning. There is a lower risk of catastrophic loss due to potential redd scour when eggs are deposited throughout the watershed.

Table 4. Scott River Chinook Salmon abundance estimates by area and percentages of the total above and below the SRFCF during the 2008-2020 seasons.

Year	Downstream of Counting Station	Upstream of Counting Station	% Downstream of Counting Station	% Upstream of Counting Station	Total Basin Estimate
2008	1,439	3,234	31%	69%	4,673
2009	1,014	1,197	46%	54%	2,211
2010	280	2,228	11%	89%	2,508
2011	983	4,538	18%	82%	5,521
2012	1,208	8,144	13%	87%	9,352
2013	1,252	3,372	27%	73%	4,624
2014	2,995	9,476	24%	76%	12,471
2015	1,741	372	82%	18%	2,113
2016	363	1,152	24%	76%	1,515
2017	297	2,279	12%	88%	2,576
2018	875	404	68%	32%	1,279
2019	537	1,553	26%	74%	2,090
2020	586	269	69%	31%	855
Average	1,044	2,940	35%	65%	3,984

To determine what specific time period and flow was most critical to the spawning distribution of Chinook Salmon the proportion of fish that spawned upstream of the counting station was plotted against the average daily flows for different half-month periods from September 1 through November 30. From 2012 to 2020 the average date of peak redd abundance was October 31 (Meneks 2020). The half-month period from October 16-31 was strongly associated with the proportion of the Chinook Salmon run that migrated upstream of the counting station (Figure 8).

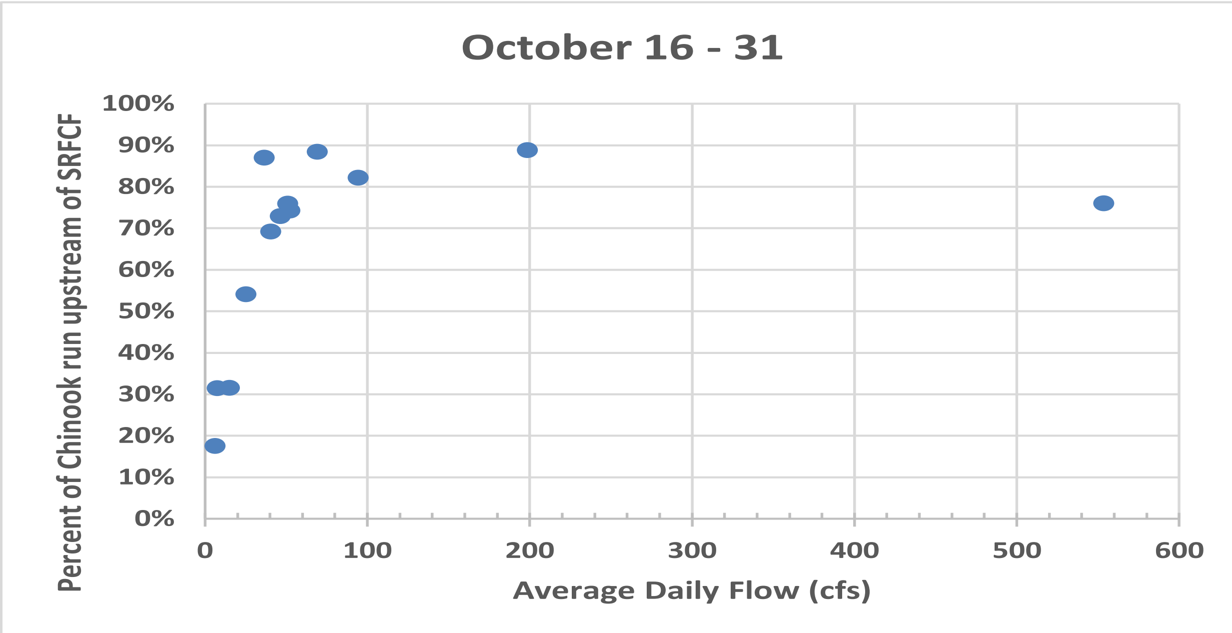

Figure 8. Annual percent of Chinook Salmon observed upstream of SRFCF plotted against the average of daily flows (cfs) at USGS Fort Jones gage (11519500) for October 16 to October 31 from 2008-2020.

In 2014 average flow from October 1-15 was seven cfs and from October 16-31 average flow was 51 cfs. During 2014 the period of October 16-31 was still within the "migration" period for Chinook Salmon and 76% of the run migrated into the valley. In 2012, when 87% of Chinook Salmon migrated upstream of the counting station, Chinook Salmon moved through the counting station the entire month of October. In 2012 the October 1-15, and 16-31 average flows were 23 cfs and 37 cfs respectively. 2016 was very similar to 2012 when average flows between October 1-15 were 22 cfs and were sufficient to distribute Chinook Salmon upstream of the counting station. Flows between October 16-31 of 25 cfs during the 2009 migration were sufficient to distribute 54% of Chinook Salmon upstream of the counting station (Table 5, Figure 9).

Table 5. Percent of Chinook Salmon migration estimated upstream of SRFCF and average daily flows (cfs) at USGS Fort Jones gage (11519500) for half month periods from September 1 - November 30 annually from 2008-2020.

		Averge Daily Flow (cfs)					
Run Year	Chinook Upstream of Counting Station	Sep 1- Sep 15	Sep 16-Sep 30	Oct 1- Oct 15	Oct 16 - Oct 31	Nov 1 - Nov 15	Nov 16 - Nov 30
2008	69%	15	19	33	41	159	122
2009	54%	7	7	10	25	37	59
2010	89%	28	45	49	199	409	287
2011	82%	58	66	88	94	95	111
2012	87%	10	15	23	37	56	223
2013	73%	7	17	44	46	47	54
2014	76%	7	7	7	51	72	222
2015	18%	7	7	6	6	7	8
2016	76%	11	9	22	554	534	495
2017	88%	45	59	62	69	94	541
2018	32%	8	8	10	15	22	53
2019	74%	15	34	45	52	56	56
2020	31%	6	7	7	7	9	16

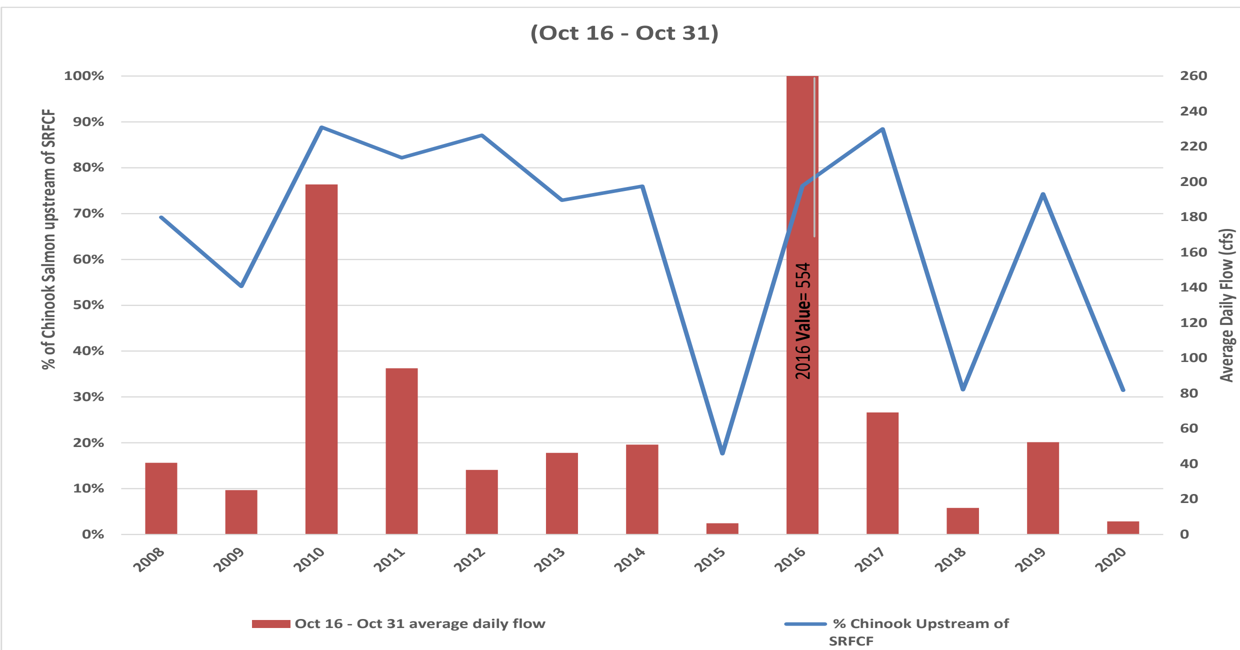

Figure 9. Annual percent of Chinook Salmon observed upstream of SRFCF plotted with average daily flows (cfs) at USGS Fort Jones gage (11519500) for October 16 to October 31 by year from 2008-2020.

In 2015 when 18% of Chinook Salmon migrated upstream of the counting station daily flows were less than 9 cfs for the entire migration period. In 2018, 32% of

Chinook Salmon migrated into the valley and the migration window was largely closed for Chinook Salmon when flows came up during the Nov 15-30 period. During 2020 average daily flows were less than 16 cfs for the entire Chinook Salmon migration period and 31% of the run migrated upstream of the counting station (Table 5, Figure 9). In most years by November 1st the peak of Chinook Salmon spawning has occurred and the opportunity for storms to influence Chinook Salmon spawning distribution decreases (Meneks 2021). October average daily flows measured at the Fort Jones gage at or above 22 cfs have been sufficient to distribute more than 50% of the Chinook Salmon population upstream of SRFCF.

Coho Salmon return to spawn later than Chinook Salmon and passage through the counting station is linked to stage increases in the hydrograph (Appendix A). As a result of Coho Salmon migrating when base flows are increasing and the innate response of Coho Salmon to migrate further upstream than Chinook Salmon, an annual average of 99.2% of the Coho Salmon run has been estimated upstream of the counting station. The SRFCF is a good tool for measuring the proportion of the run that migrates upstream of the canyon, but it does not measure tributary connectivity or mainstem connection upstream of the counting station.

During 2013, 2,752 Coho Salmon were observed migrating upstream of the counting station and had extremely limited access to tributaries, forcing almost the entire 2013 run to spawn in the main stem Scott River. It was estimated that Coho Salmon had access to the lower quarter mile of spawning habitat downstream of a low flow barrier in French Creek (Yokel 2014). Shackelford Creek briefly connected to the mainstem Scott River on November 22, 2013 for roughly two days allowing temporary access for Coho Salmon. Redd surveys during the 2013-2014 season documented 97% of the Coho Salmon spawning occurred in the mainstem Scott River. The remaining 3% of Coho Salmon redds were documented in French Creek (2.5%) and Shackelford Creek (0.5%) (Yokel 2014). During the fall and winter of 2013-2014 daily mean flows at the Fort Jones gage were less than 60 cfs for the entire Coho Salmon migration period and provided minimal access to tributaries (Yokel 2014). Mean daily flows more than 60 cfs were required to restore effective tributary access for Coho Salmon during the 2013-2014 season.

In 2020 1,309 Coho Salmon migrated through the SRFCF on a storm event November 17-19. The November 17-19 mean daily flows (26.4 cfs) were high enough for Coho Salmon to migrate through the counting station but not to connect the mainstem Scott River just upstream of Shackelford Creek.

Shackleford Creek was connected temporarily during the mid-November storm and some Coho Salmon were observed in Shackelford Creek in the third week of November. The mid November 2020 storm was too small to increase base flows for the season and average daily flows at the Fort Jones gage from November 20-December 12 were 11.3 cfs. In 2020, hundreds of Coho Salmon were staging in the main stem Scott River downstream of Shackleford Creek because the main stem river was dry upstream of Shackelford Creek near the confluence of Oro Fino Creek (Meneks 2021). A winter storm in mid-December connected the mainstem Scott River when Fort Jones gage flows from December 16-31 averaged 89.1 cfs. It is unclear how much beyond December 15th the Coho Salmon run could have staged without spawning. In 2020 significant numbers of Coho Salmon were observed spawning in the French Creek and Shackelford Creek watersheds (Voight 2021).

In-River Productivity

Considerable attempts were made to link Chinook Salmon freshwater productivity, defined as 0+ Chinook produced per returning adult, and flows from specific month and half month periods. This analysis did not yield consistent results indicating that flows alone, for these time periods, are not correlated with in-river productivity for Chinook Salmon in the Scott River. This does not demonstrate a lack of influence of flows on in-river Chinook Salmon productivity, but instead suggests that additional environmental factors likely have a larger effect on production or interact with flow to affect production. Scott River Chinook Salmon return to spawn during low flow periods and have a strong tendency to exhibit an "ocean-type" life history (0+ migration to the ocean shortly after hatching) strategy. Except for the migration and spawning phases when stream flow can be low the majority of their remaining rearing and outmigration phases occur during the highest runoff months of the year.

Coho Salmon in-river productivity, as measured by yearlings (1+) produced per returning adult, was compared with annual discharge. Scott River Coho Salmon have a strong tendency to exhibit an extended freshwater rearing life history relying on freshwater rearing habitat for up to 18 months. For the period of record the two years with the highest annual run-off overlapped with the two years of highest in-river Coho Salmon production (Figure 10). While these observations suggest that wetter water years improve in-river production for Coho Salmon additional analysis is needed to better understand this relationship.

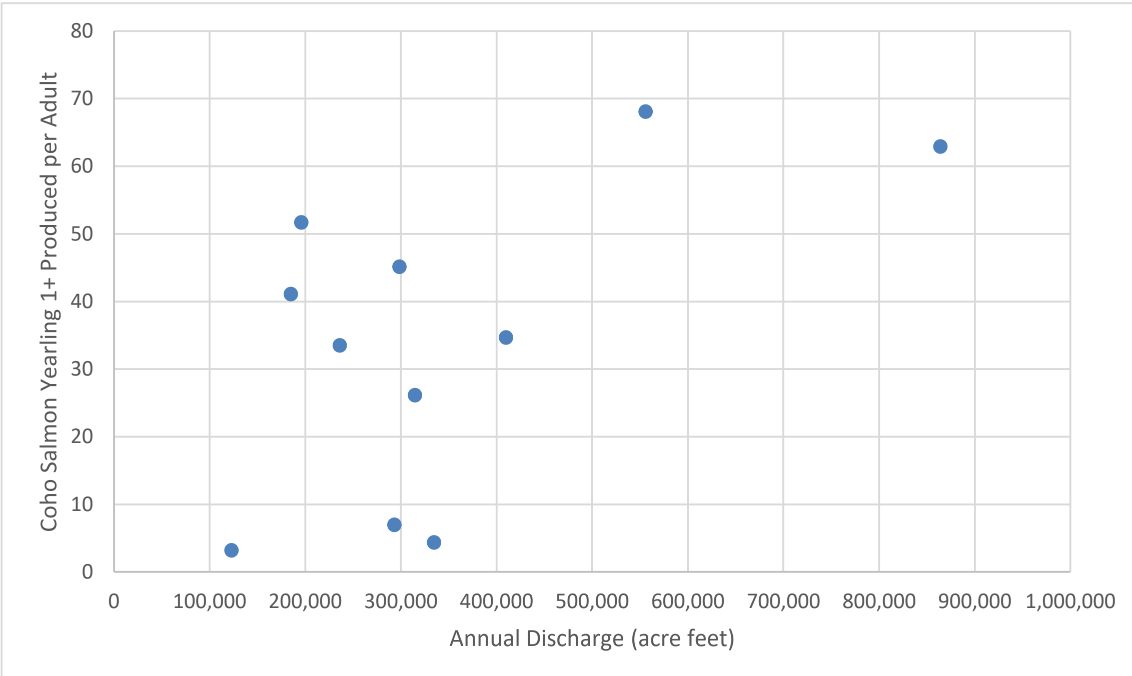

Figure 10. Coho Salmon yearling (1+) produced per returning adult plotted against annual discharge (acre-feet) measured at USGS Fort Jones gage (11519500) for brood years 2007-2014, and 2016-2018.

Summary

This document describes how flow conditions affect annual Chinook Salmon and Coho Salmon migration timing, distribution and rearing conditions. Through this analysis it has been demonstrated that even if the October average daily flows measured at the Fort Jones gage is at or above 22 cfs, roughly only 50% of Chinook Salmon population will migrate upstream of the SRFCF. Additionally, there are significant negative influences on available annual discharge when surface diversions and ground water extractions are not scaled to accommodate differences in water year types ("extremely wet" to "critically dry") The variability of annual discharge directly influences fall migration flows and rearing conditions throughout the year.

During this analysis it was noted that for the period of record the two years with the highest annual discharge corresponded with the two years of highest in-river Coho Salmon juvenile production in terms of recruits per spawner. The capacity of the Scott River to produce Coho Salmon is highlighted in the trajectory of two of the three brood years, but the drastic reduction in brood year 1 indicates how rapidly the population can decline when conditions are poor. Changes in climate and how much and when water is extracted, and crop conversions in recent decades, are resulting in lower base flows than in previous decades when similar amounts of annual discharge were available. Without immediate remedies, mainstem disconnection, tributary disconnection and rearing conditions will continue to be problematic for migrating adult and juvenile salmonids.

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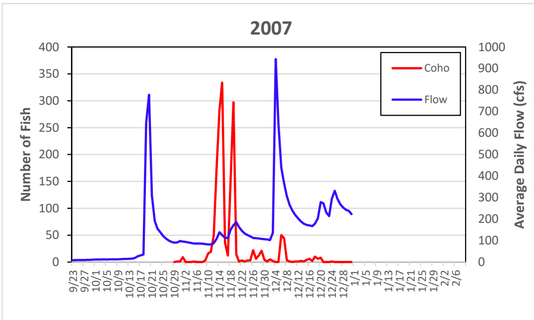
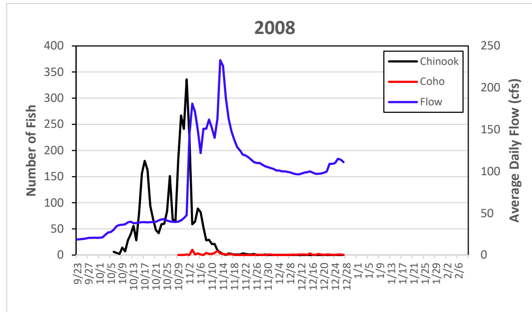
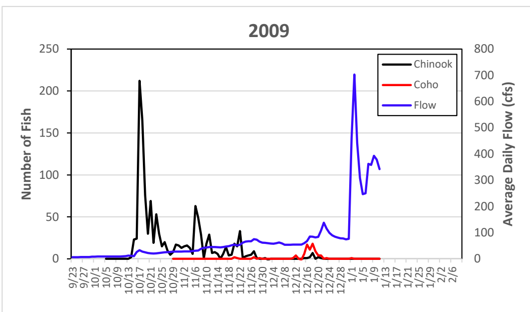
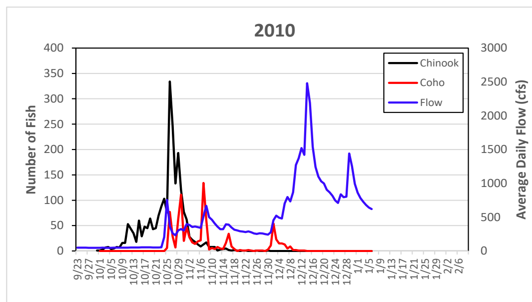
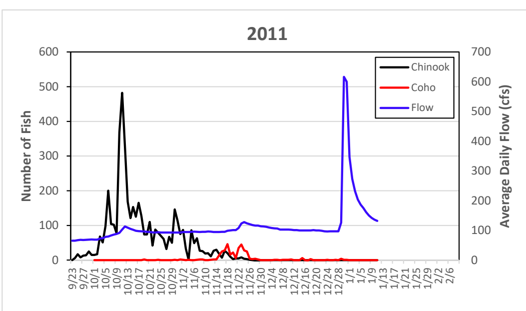
Appendix A. Daily Chinook Salmon and Coho Salmon observations at the SRFCF and daily flow measured at the USGS Fort Jones gage (11519500) from 2007-2020.

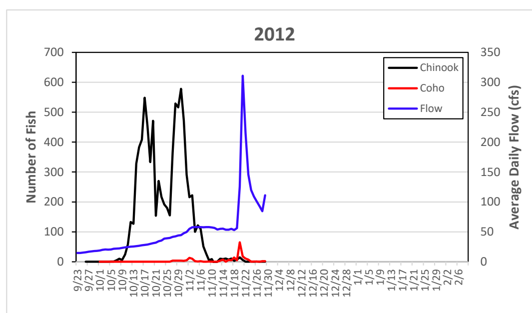


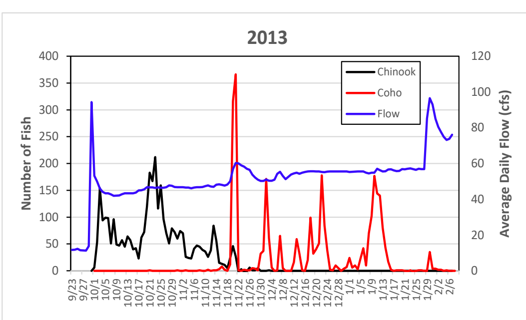


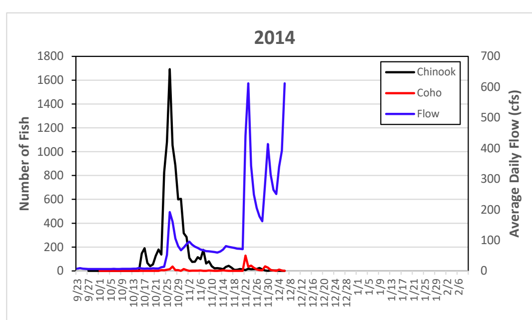












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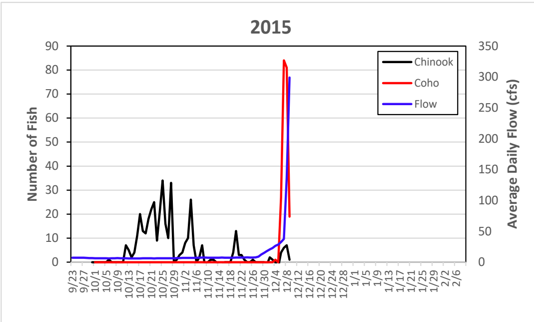
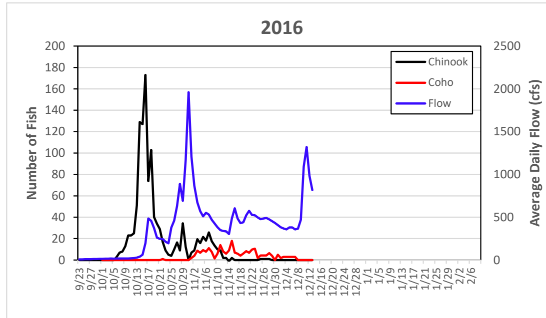
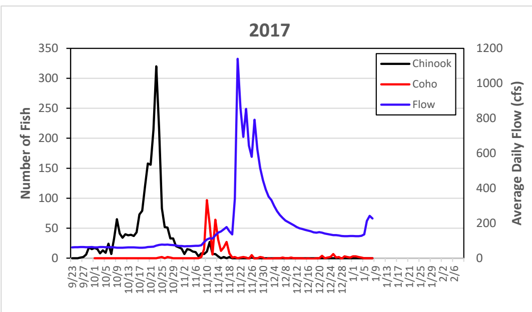
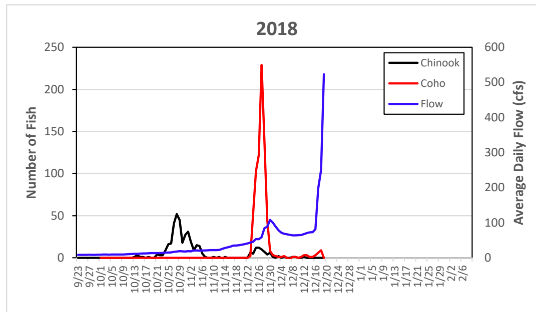
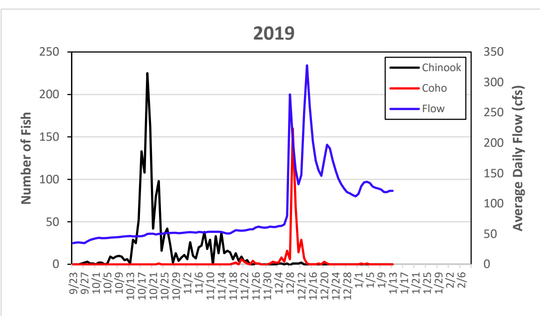
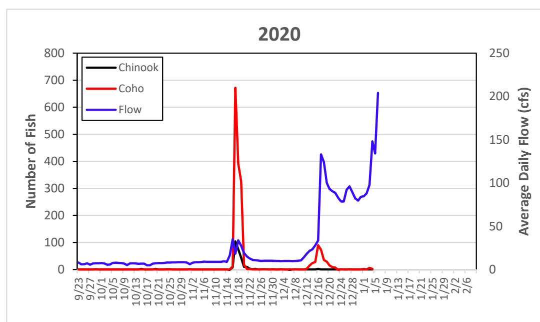












State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Northern Region
601 Locust Street
Redding, CA 96001
www.wildlife.ca.gov

GAVIN NEWSOM, Governor
CHARLTON H. BONHAM, Director

March 26, 2020

Matt Parker
Natural Resources Specialist
Siskiyou County Flood Control and Water Conservation District
1312 Fairlane Road
Yreka, California 96097

Subject: California Department of Fish and Wildlife Comments to be Considered for the Scott River Valley Basin Draft Groundwater Sustainability Plan

Dear Matt Parker:

The California Department of Fish and Wildlife (Department) Region 1 appreciates the opportunity to provide comments to the Siskiyou County Flood Control and Water Conservation District, designated as the Groundwater Sustainability Agency (GSA), in advance of the preparation of the Scott River Valley Basin (Basin) Draft Groundwater Sustainability Plan (GSP). The GSP will be prepared pursuant to the Sustainable Groundwater Management Act (SGMA). As the trustee agency for the State's fish and wildlife resources, the Department has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and the habitat necessary for biologically sustainable populations of such species (Fish & G. Code §§ 711.7 and 1802).

Development and implementation of GSPs under SGMA represents a new era of California groundwater management. The Department has a strong interest in the sustainable management of groundwater, as many sensitive ecosystems and species depend on groundwater and interconnected surface waters. SGMA and its implementing regulations afford ecosystems and species specific statutory and regulatory consideration, including the following as pertinent to GSPs:

- GSPs shall **identify and consider impacts to groundwater dependent ecosystems** (23 Cal. Code Regs. § 354.16 (g) and Water Code § 10727.4(l));
- GSAs shall **consider all beneficial uses and users of groundwater**, including environmental users of groundwater (Water Code § 10723.2 (e));
- GSPs shall **identify and consider potential effects on all beneficial uses and users of groundwater** (23 Cal. Code Regs. §§ 354.10(a), 354.26(b)(3), 354.28(b)(4), 354.34(b)(2), & 354.34(f)(3));
- GSPs shall **establish sustainable management criteria that avoid undesirable results** within 20 years of the applicable statutory deadline, including **depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water**

(23 Cal. Code Regs. § 354.22 et seq. and Water Code §§ 10721 (x)(6) & 10727.2 (b)) and describe monitoring networks that can identify adverse impacts to beneficial uses of interconnected surface waters (23 Cal. Code Regs. § 354.34 (c)(6)(D)); and

- GSPs shall **account for groundwater extraction for all Water Use Sectors** including managed wetlands, managed recharge, and native vegetation (23 Cal. Code Regs. §§ 351(al) & 354.18(b)(3)).

Furthermore, the Public Trust Doctrine imposes a related but distinct obligation to consider how groundwater management affects public trust resources, including navigable surface waters and fisheries. Groundwater hydrologically connected to navigable surface waters and surface waters tributary to navigable surface waters are also subject to the Public Trust Doctrine to the extent that groundwater extractions or diversions affect or may affect public trust uses (*Environmental Law Foundation v. State Water Resources Control Board* (2018), 26 Cal. App. 5th 844). Accordingly, groundwater plans should consider potential impacts to and appropriate protections for navigable interconnected surface waters and their tributaries, and interconnected surface waters that support fisheries, including the level of groundwater contribution to those waters.

In the context of SGMA statutes and regulations, and Public Trust Doctrine considerations, the Department supports groundwater planning that carefully considers and protects groundwater dependent ecosystems and fish and wildlife beneficial uses and users of groundwater and interconnected surface waters.

General Guidance

The Department is providing guidance on specific information we request be included in the GSP. The Department supports ecosystem preservation and enhancement in compliance with SGMA and its implementing regulations based on Department expertise and best available information and science.

For consideration of fish and wildlife resources during groundwater planning, the Department created documents to assist GSAs with development of the GSP:

- Fish and Wildlife Groundwater Planning Considerations (Attachment 1); and
- Fish and Wildlife Groundwater Planning Considerations: Freshwater Wetlands (Attachment 2).

Both documents can also be downloaded at: www.wildlife.ca.gov/conservation/watersheds/groundwater. Links to relevant information from the Department of Water Resources and State Water Resource Control Board can also be found at this website.

Basin Specific Information

The Department is aware of the following information pertinent to development of the Basin GSP. The Scott River watershed (included in the Klamath River watershed) provides aquatic habitat for four species of anadromous fish: Chinook Salmon, Coho Salmon, Steelhead Trout, and Pacific Lamprey. Additionally, the Scott River watershed also supports populations of bank swallow, western pond turtle, foothill yellow-legged frog, greater sandhill crane, and other bird species that rely on habitats supported and supplemented by both surface water and groundwater.

The Southern Oregon Northern California Coast (SONCC) Evolutionarily Significant Unit (ESU) of Coho Salmon (found in the Klamath River watershed) was listed as "threatened" under the federal Endangered Species Act in 1997, and by the California Fish and Game Commission (Commission) under the California Endangered Species Act (CESA) in 2005. In 2004, the Department published the Recovery Strategy for California Coho Salmon which identifies restoration activities necessary to protect and recover Coho Salmon populations to a sustainable level. Developing target instream flows for the Scott River is identified as a priority recovery task necessary to improve rearing habitat, fish passage, and stream connectivity. In 2014, National Oceanic and Atmospheric Administration - Fisheries released the Final Recovery Plan for the SONCC ESU of Coho Salmon (Recovery Plan). The primary objective in the Recovery Plan is to return Coho Salmon to a level of sustainability, while the highest priority recovery action identified for the Scott River watershed is increased instream flows. Specifically, the recovery tasks address the need to identify instream flow needs and implement a flow needs plan for the Scott River watershed. Low summer and fall streamflows are a major factor limiting survival of juvenile Coho Salmon (CDFG 2004). In 2017, the Department developed a document titled Interim Instream Flow Criteria for the Protection of Fishery Resources in the Scott River Watershed, Siskiyou County, available at the following location: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=143476&inline. The document recommends interim flow criteria to provide protection for the migration, spawning and rearing life stages of salmon and steelhead while considering Basin specific hydrology.

The Scott River is one of the most important Coho Salmon spawning and rearing tributaries in the Klamath River watershed. Scott River is identified by the Department as a high priority watershed for Coho Salmon recovery. Threats to Coho Salmon, such as excessively high-water temperatures in the spring, summer, and early fall, reduce available juvenile rearing habitat. Low flows in the fall and winter can delay adult passage to critical spawning areas.

Many sensitive species and habitats in the Basin comprise groundwater dependent ecosystems (GDEs), the natural communities that rely on groundwater to sustain all or a portion of their water needs. Some of the special status species in the Scott River watershed that rely on surface water supported and supplemented by groundwater include bank swallow, western pond turtle, foothill yellow-legged frog, greater sandhill crane, and other bird species.

Bank swallows were listed as threatened under CESA in 1989. Bank swallows primarily live along bodies of water, such as rivers, streams, reservoirs, and ocean coasts. This species is highly colonial and breeds in nesting burrows that are constructed in near-vertical banks. Their diet consists of aquatic and terrestrial insects that they catch over water bodies and associated floodplain grasslands. Bank swallow reproductive success appears to be positively associated with the previous winter's streamflow, suggesting that higher flows in winter (prior to the initiation of nesting) improve nesting habitat and foraging conditions. If groundwater depletion results in reduced streamflow, the foraging success of bank swallows may be diminished due to the reduced availability of aquatic insects.

The western pond turtle was designated as a California species of special concern (SSC) in 1994. The western pond turtle's preferred habitat is permanent ponds, lakes, streams or permanent pools along intermittent streams, associated with standing and slow-moving water. A potentially important limiting factor for the Western pond turtle is the relationship between water level and flow in off-channel water bodies, which can both be affected by groundwater pumping.

The Northwest/North Coast clade of foothill yellow-legged frog is designated as a SSC. The range and predicted habitat for foothill yellow-legged frog falls within the Basin, as identified in the Department's California Natural Diversity Data Base (CNNDB). Additionally, according to the Department's 2019 document titled "*A Status Review of the Foothill Yellow-Legged Frog (Rana boylii) in California*", foothill yellow-legged frog's historic range falls within the Basin. This species is rarely encountered far from permanent water. Tadpoles require water for at least three or four months while completing their aquatic development. Adults eat both aquatic and terrestrial invertebrates, and the tadpoles graze along rocky stream bottoms. Groundwater pumping that impairs streamflow could have negative impacts on foothill yellow-legged frog populations.

Greater Sandhill crane was listed as threatened in California under CESA in 1983. This species is reliant on freshwater wetlands for breeding, roosting and foraging habitat. Freshwater wetlands may be directly supported by groundwater. The Greater Sandhill crane roosts in shallow ponds, flooded agricultural fields, sloughs, canals or lakes. Cranes forage in wetlands, wet meadows, and wildlife-friendly managed agricultural lands, including pasture, grain crops and alfalfa. Excessive groundwater pumping can lead to a decrease in wetland habitat, which is very important habitat to Greater Sandhill cranes for their breeding, roosting and foraging. When water tables in meadows are lowered as a result of stream incision caused by overgrazing, riparian vegetation removal, or other means, cranes' breeding habitat is adversely affected.

Aquatic habitat within the Basin has been altered by numerous human activities and natural factors, affecting instream conditions, degrading anadromous fish migrating, spawning and rearing habitat, and negatively impacting adjacent riparian and upland slopes throughout the Basin. Alterations to habitat and changes to the landscape include historic beaver trapping, road construction, agricultural practices, river channelization, dams and water diversions, timber harvest, mining/dredging, gravel extraction, high severity fires, groundwater pumping, and rural residential development. Agriculture and related activities are the major land use within the Scott River Valley. Current valley-wide agricultural water diversions, groundwater extraction, and drought, along with historic alterations, have combined to cause surface flow disconnection along the mainstem Scott River. These conditions restrict or eliminate available rearing habitat, elevate water temperature, decrease fitness and survival of over-summering juvenile salmonids, and sometimes result in juvenile fish stranding and mortality. According to Van Kirk and Naman (2008), a large proportion (80 percent or more) of water used for irrigation in the Basin comes from groundwater. During the summer, large portions of the mainstem Scott River become completely dry, leaving only a series of isolated pools inhospitable to salmonids.

The unsustainable use of groundwater can impact the shallow aquifers and interconnected surface waters on which groundwater dependent ecosystems depend and may lead to adverse impacts on fish and wildlife and the habitat upon which they depend. Determining the effects that groundwater levels have on surface water flows in the Basin would provide an understanding of how the groundwater levels may be associated with the health and abundance of riparian vegetation. Poorly managed groundwater pumping and surface water flows have the potential to reduce the abundance and quality of riparian vegetation, reducing the amount of shade provided by the vegetation, ultimately leading to increased water temperatures in the Basin. It is imperative to understand the groundwater hydrology of the Scott River system and its relationship to surface hydrology, especially in areas where groundwater could improve Scott River water temperatures, the health of riparian vegetation, and habitat connectivity for anadromous fish. Additionally, it would be beneficial to evaluate cumulative effects of groundwater and surface water use on the Scott River flows and temperature, particularly between late spring and early fall. Because numerous protected species in the Scott River watershed rely on high quality surface water supplemented by groundwater, both surface and groundwater diversions need to be managed together to effectively to maintain sustainability of the protected species. Additionally, shallow groundwater levels near interconnected surface water should be monitored to ensure that groundwater use is not depleting surface water and affecting fish and wildlife resources in the Basin.

Recommended Tools

To enable Department staff to adequately review and comment on the Scott River Valley Basin GSP, the Department requests the GSA identify and evaluate current and future impacts to fish and wildlife resources and sensitive ecosystems that depend on groundwater and interconnected surface water. In order for the GSA to adequately evaluate impacts to fish and wildlife resources and sensitive resources, we request the following information be included or consulted during GSP development, as applicable:

1. An assessment of groundwater dependent flora and fauna within the Basin area should be conducted, with particular emphasis upon identifying special-status species including rare, threatened, and endangered species. This assessment should also address locally unique species, rare natural communities, and wetlands.

    a. The Department's CNDDB should be searched to obtain current information on previously reported sensitive species and habitat in the Basin. As a reminder, the Department cannot and does not portray the CNDDB as an exhaustive and comprehensive inventory of all rare species and natural communities statewide. Field verification for the presence of sensitive species and habitats will always be an important consideration.

    b. A complete assessment of rare, threatened, and endangered invertebrate, fish, wildlife, reptile, and amphibian species should be presented in the draft GSP. Seasonal variations in use within the Basin should also be addressed. SSC status applies to animals generally not listed under the federal Endangered Species Act or the California Endangered Species Act, but which nonetheless are declining at a rate that could result in listing, or historically occurred in low numbers and known threats to their persistence currently exist.

2. State and Federally Listed Animal Species List http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=109405&inline)
3. State and Federally Listed Plant Species Information and List (https://www.wildlife.ca.gov/Conservation/Plants/Info) (http://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=109390&inline)
4. Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Sensitive Natural Communities (https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=18959&inline=1)
5. California SSC List (https://www.wildlife.ca.gov/Conservation/SSC)
6. Groundwater Resources Hub (https://groundwaterresourcehub.org/)
    a. Identifying Environmental Surface Water Beneficial Users (https://groundwaterresourcehub.org/sgma-tools/environmental-surface-water-beneficiaries/)
    b. Critical Species LookBook (https://groundwaterresourcehub.org/sgma-tools/the-critical-species-lookbook/)
    c. Groundwater Dependent Ecosystems (GDEs) Guidance Document (https://groundwaterresourcehub.org/sgma-tools/gsp-guidance-document/)

   d. Best Practices for Identifying GDEs (https://groundwaterresourcehub.org/public/uploads/pdfs/TNC_NCdataset_BestPracticesGuide_2019.pdf)
   e. GDE Pulse (https://groundwaterresourcehub.org/sgma-tools/gde-pulse/)
7. Drafting SGMA Groundwater Plans with Fisheries in Mind (https://ggucuel.org/wp-content/uploads/CUEL-SGMA-FISHERIES-GUIDEBOOK.pdf)
8. Scott Valley Community Groundwater Study Plan (http://groundwater.ucdavis.edu/files/136426.pdf)
9. Groundwater and Stream Interaction in California's Central Valley: Insights for Sustainable Groundwater Management (https://www.scienceforconservation.org/products/groundwater-and-stream-interaction)
10. Scott Valley Groundwater, various journal articles and reports (http://groundwater.ucdavis.edu/Research/ScottValley)
11. State Water Resources Control Board, SGMA factsheets https://www.waterboards.ca.gov/water_issues/programs/gmp/sgma.html

The Department appreciates the opportunity to provide initial comments on the development of the Scott River Valley Basin GSP. For questions, please contact Region 1 SGMA Coordinator Suzanne Turek at Suzanne.Turek@wildlife.ca.gov. Additionally, you can contact the Klamath Watershed Coordinator Janae Scruggs at Janae.Scruggs@wildlife.ca.gov.

Sincerely,

DocuSigned by:
Tina Bartlett
1D82ADE7303A474...

Tina Bartlett
Regional Manager

ec: Matt Parker
Siskiyou County Flood Control and Water Conservation District
mparker@co.siskiyou.ca.us

Pat Vellines, Craig Altare
California Department of Water Resources
Patricia.Vellines@water.ca.gov, Craig.Altare@water.ca.gov

Jim Simondet
National Marine Fisheries Service
jim.simondet@noaa.gov

Natalie Stork
State Water Resources Control Board
Natalie.Stork@waterboards.ca.gov

Joshua Grover, Robert Holmes, Briana Seapy, Tina Bartlett, Curt Babcock,
Joe Croteau, Brad Henderson, Suzanne Turek, Janae Scruggs
California Department of Fish and Wildlife
Joshua.Grover@wildlife.ca.gov, Robert.Holmes@wildlife.ca.gov,
Briana.Seapy@wildlife.ca.gov, Tina.Bartlett@wildlife.ca.gov,
Curt.Babcock@wildlife.ca.gov, Joe.Croteau@wildlife.ca.gov,
Brad.Henderson@wildlife.ca.gov, Suzanne.Turek@wildlife.ca.gov,
Janae.Scruggs@wildlife.ca.gov

Attachment 1.

Fish & Wildlife Groundwater Planning Considerations

California Department of Fish and Wildlife

GROUNDWATER PROGRAM

contents

preface

In 2014, California passed the Sustainable Groundwater Management Act (SGMA) (AB1739, SB 1168, SB 1319), authorizing local groundwater sustainability agencies (GSAs) to develop groundwater sustainability plans (GSPs) for a subset of California's alluvial aquifers. To comply with SGMA, GSAs must achieve sustainable groundwater management, defined by SGMA as the avoidance of locally-defined undesirable results. To achieve sustainability, GSAs must develop and implement effective groundwater management plans that consider the interests of all beneficial uses and users of groundwater, including environmental users of groundwater. [Water Code § 10723.2.]

In many groundwater basins, fish and wildlife that rely on groundwater are among these beneficial uses and users. Many sensitive species and habitats comprise groundwater dependent ecosystems (GDEs), which are natural communities that rely on groundwater to sustain all or a portion of their water needs. The unsustainable use of groundwater can impact the shallow aquifers and interconnected surface waters on which GDEs depend and may lead to adverse impacts on fish and wildlife.

As trustee for California's fish and wildlife resources, CDFW intends to engage as a stakeholder in groundwater planning processes (where resources are available) to represent the groundwater needs of GDEs and fish and wildlife beneficial uses and users of groundwater. The information provided here is intended to help local groundwater planners, groundwater planning proponents and consultants, and CDFW staff work together to consider the needs of fish and wildlife when developing groundwater management plans and implementing SGMA. The document includes three categories of groundwater planning considerations:

- Scientific Considerations;
- Management Considerations; and
- Legal, Regulatory, and Policy Considerations.

Links to additional guidance and considerations developed by CDFW and other organizations that address the impacts of groundwater pumping on GDEs and depletion of interconnected surface water can be found at the end of this document.

Except to the extent that this document directly references existing statutory or regulatory requirements, use of these groundwater planning considerations is not mandated under law and should not be interpreted as a rule, regulation, order, or standard for local groundwater plans. Practical application of these considerations must be based on the best available information and groundwater basin-specific conditions.

Relevance to CDFW Mission

As trustee for the State's fish and wildlife resources, the California Department of Fish and Wildlife (CDFW) has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and the habitat necessary for biologically sustainable populations of such species. [FGC §§ 1802 and 711.7(a).] CDFW has an interest in the sustainable management of groundwater, as many sensitive ecosystems and public trust resources depend on groundwater and interconnected surface waters.

Accordingly, CDFW encourages thoughtful groundwater planning that carefully considers fish and wildlife and the habitats on which they depend. This groundwater planning considerations document focuses on impacts to groundwater dependent ecosystems (GDEs) and interconnected surface waters (ISW), both of which may provide habitat for fish and wildlife and are defined under SGMA as:

GROUNDWATER DEPENDENT ECOSYSTEMS: ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface. [23 CCR § 351(m).]

INTERCONNECTED SURFACE WATER:
surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer, and the overlying surface water is not completely depleted. [23 CCR § 351(o).]

SGMA statute and regulations require specific consideration of both GDEs and ISW in the development of a groundwater sustainability plan (GSP). SGMA-governed groundwater plans must:

- Identify GDEs within the basin [23 CCR § 354.16(g)];
- Consider impacts to GDEs [Water Code § 10727.4(l)]; and
- Address six undesirable results, one of which is depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water. [Water Code § 10721(x)(6).]

To encourage GSAs to examine groundwater management impacts on fish and wildlife and the GDE and ISW habitats on which they depend, the CDFW Groundwater Program has catalogued fish and wildlife groundwater planning considerations that address CDFW's key interests.

Key Groundwater Planning Questions

CDFW suggests GSAs consider the following questions during GSP development:

GROUNDWATER DEPENDENT ECOSYSTEMS (GDES)

1. How will groundwater plans identify GDEs and address GDE protection?
2. How will GSAs determine if GDEs are being adversely impacted by groundwater management?
3. If GDEs are adversely impacted, how will groundwater plans facilitate appropriate and timely monitoring and management response actions?

INTERCONNECTED SURFACE WATERS (ISW)

1. How will groundwater plans document the timing, quantity, and location of ISW depletions attributable to groundwater extraction and determine whether these depletions will impact fish and wildlife?
2. How will GSAs determine if fish and wildlife are being adversely impacted by groundwater management impacts on ISW?
3. If adverse impacts to ISW-dependent fish and wildlife are observed, how will GSAs facilitate appropriate and timely monitoring and management response actions?

Groundwater Planning Considerations[1]

CDFW encourages GSAs to think holistically about ecosystem protection and enhancement when designing groundwater plans. The following compilation of fish and wildlife considerations is provided for GSAs to consider during the development of GSPs.

SCIENTIFIC CONSIDERATIONS

The Department of Water Resources GSP Regulations (DWR's Regulations) generally require reliance on 'best available science[2],' consistent with scientific and engineering professional standards of practice. [23 CCR § 351(h).] CDFW relies on ecosystem-based management informed by credible science in all resource management decisions to the extent feasible. [FGC § 703.3.] Accordingly, CDFW expects groundwater plans and supporting documentation to follow 'best available science' practices. Application of the following scientific concepts can improve the likelihood that a groundwater plan will avoid impacts to fish and wildlife beneficial uses and users of groundwater, GDEs, and ISW.

1. Hydrologic Connectivity[3]
   Whether terrestrial vegetation can access groundwater and whether surface water is hydrologically connected with groundwater are important determinations in the context of groundwater planning. If hydrologic connectivity exists between a terrestrial or aquatic ecosystem and groundwater, then that ecosystem is a potential GDE and must be identified in a GSP. [23 CCR §354.16 (g).] Aquatic ecosystems reliant on ISW are also specifically relevant to the regulatory requirement to avoid significant and unreasonable adverse impacts to beneficial uses of surface water. [Water Code § 10721 (x)(6).] Hydrologic connectivity between surface water and groundwater, as well as groundwater accessibility to terrestrial vegetation, must therefore be evaluated carefully, and conclusions should be well-supported. Hydrologic connectivity considerations include:

   a. *Connected surface waters:* As defined by DWR's Regulations, ISW are surface waters that are hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted. [23 CCR § 351(o).] These waters can receive water from the aquifer, or lose water to the aquifer, depending on hydraulic gradients.
   b. *Disconnected surface waters:* Disconnected streams occur where surface water is not connected by a continuous saturated zone to an underlying aquifer. In disconnected surface water, lowering the groundwater table does not affect the rate of loss from the surface water to groundwater.
   c. *Transition surface waters:* In a transition surface water, the surface waters are hydraulically connected to the underlying aquifer by a capillary fringe[4]. Due to the capillary fringe connection, water table elevation changes can still affect the exchange rate of surface waters[5]. Therefore, in some cases, lowering the groundwater elevation under a streambed without a continuous saturated connection to the underlying aquifer may increase the rate of loss from the surface water body into the underlying aquifer. This potential for increased loss rates during transitional states of connectivity can ultimately increase the area or flow-duration of stream reaches that may be perceived as 'disconnected.'

d. *Terrestrial vegetation:* Many terrestrial plants known as phreatophytes depend on water from shallow aquifers. The depth to which these plants can root and the depth to groundwater collectively determine if the plants can rely on groundwater resources to sustain them. Depth to groundwater fluctuates across seasons and over time, as does plant rooting depth, so connectivity between terrestrial vegetation and shallow groundwater may change over time. Understanding baseline conditions and vegetation groundwater needs across time and species, as well as tolerance for rate of change, can inform groundwater management thresholds.

e. *Geospatial extent of connectivity:* Groundwater interconnectivity with surface water and groundwater accessibility by terrestrial vegetation are impacted by groundwater management regimes that raise or lower the groundwater table. These changes in water table elevation can impact the geospatial extent of connectivity, expanding or decreasing the connected interface. This means gaining and losing stream reaches[6] can grow or shrink in length, and interconnected wetlands and phreatophyte vegetation can grow or shrink in acres of coverage based on changes to groundwater table depth.

f. *Temporal duration of connectivity:* Raising and lowering the groundwater table can also impact the temporal duration of: 1) hydrologic connectivity between the water table and surface waters, and 2) accessibility of groundwater to terrestrial vegetation. Groundwater elevation changes over time can cause transitions from connected/accessible groundwater to disconnected/inaccessible groundwater, and vice versa.

2. Interconnected Surface Water Depletions

ISW depletions attributable to groundwater extraction can occur through two different mechanisms: captured recharge and induced infiltration (described below). Both should be considered when evaluating the possibility of depletions to ISW and establishing ISW sustainability criteria in GSPs. This evaluation is often best accomplished through empirical measurements coupled with numerical modeling.

a. *Captured recharge:* Groundwater withdrawals from aquifers hydrologically connected to surface waters can intercept groundwater travelling downgradient that would otherwise have discharged to surface waters.

b. *Induced infiltration:* Groundwater withdrawal can create a localized cone of depression and induce flow from ISW to groundwater, transforming a previously gaining stream reach to a losing stream reach.

3. Fish and Wildlife Species Water Needs

An evaluation of GDEs and ISW depletions should identify possible impacts to fish and wildlife beneficial uses and users of groundwater and ISW and should consider the following aspects of species water needs across life history phases when defining undesirable results and setting minimum thresholds required by DWR's Regulations.

a. *Temporal Water Needs:* Aquatic and terrestrial species require different quantities and qualities of water at different times and for different durations. There are climate-driven, seasonal variations in water availability to which species are accustomed – for example, migratory water fowl rely on wetlands during fall and spring migrating seasons when surface water was historically available. There are anthropogenic-driven variations in temporal water availability that can compromise species survival – for example, groundwater capture from a stream in summer months caused by irrigation well pumping near a stream can decrease flow, reduce cold groundwater inflows, and increase instream temperatures; thereby degrading cold-water refuge critical to migrating and spawning salmonids. Importantly, groundwater pumping and recharge actions have 'lag' impacts on water availability that are governed by the location and quantity of groundwater extraction as well as aquifer characteristics. Understanding the timing of water availability with respect to species needs across all life history phases will allow groundwater planners to better account for groundwater management impacts to fish and wildlife beneficial uses and users of groundwater and ISW.

b. *Spatial Water Needs:* Similar to temporal water needs, species are sensitive to the location and coverage of ISW and GDE wetland habitat available to them. Wetland geographic coverage dictates associated migratory bird carrying capacities, and specific instream salmonid habitats receiving groundwater inflows can best support spawning and rearing success. Therefore, the location of groundwater extraction and any associated cones of depression can impact GDE and ISW habitats. Wells closer to GDEs and ISW – both laterally and vertically – may have more influence on the location and coverage of available habitat than wells farther away. These spatial relationships between groundwater extraction, and spatial coverage and location of GDE and ISW habitat are dependent on aquifer and well characteristics.

c. *Hydrologic Variability:* Water availability is naturally variable, and many species rely on a degree of hydrologic variability. This variability can be important to cue animal behavior such as spawning, growth, and migration. Groundwater plans should consider how groundwater management influences the hydrologic variability of ISW quality and quantity and what cascading impacts these variations may have on fish and wildlife species and their habitat.

d. *Water Availability:* At a basic level, water available for fish and wildlife species is subject to the same regulatory paradigms and dynamic climate conditions as water available for municipal and agricultural uses. CDFW expects groundwater budget projections to include fish and wildlife water needs and, when possible, anticipate regulatory and climate impacts on water availability.

e. *Water Quality:* Groundwater quality and ISW quality play a significant role in habitat adequacy. Groundwater pumping can impact many components of water quality including water temperature, dissolved oxygen, salinity, turbidity, and contaminants. Pumping can reverse hydraulic gradients and reduce cold and oxygen-rich inflows to ISW, leach soil constituents such as nitrates, and convey underground point source contamination to ISW. Groundwater plans should demonstrate an understanding of how groundwater management actions will affect water quality.

4. Habitat Value

Groundwater management plans that seek to minimize impacts to GDEs and avoid ISW depletion should consider the following:

a. *Connectivity:* Habitat connectivity is a key ecological attribute of thriving ecosystems. A functional network of connected terrestrial and aquatic habitats is essential to the continued existence of California's diverse species and natural communities. Components of natural and semi-natural landscapes must be large enough and connected enough to meet the needs of all species that use them. In identifying and evaluating groundwater management impacts to beneficial uses and users of groundwater, GDEs, and ISW, habitat connectivity impacts should also be considered.

b. *Heterogeneity:* Habitat heterogeneity, such as vegetation age and diversity, is a key ecological attribute of many functional ecosystems and often a predictor of animal species richness. In identifying and evaluating groundwater management impacts to beneficial uses and users of groundwater, GDEs, and ISW; habitat heterogeneity impacts should be considered.

c. *Groundwater Elevation:* Groundwater-dependent habitats, including ISW, are particularly susceptible to changes in the depth of the groundwater. Lowered water tables that drop beneath root zones can cutoff phreatophyte vegetation from water resources, stressing or ultimately converting vegetated terrestrial habitat. Induced infiltration attributable to groundwater pumping can reverse hydraulic gradients and may cause streams to stop flowing, compromising instream dissolved oxygen and temperature characteristics, and eventually causing streams to go dry. The frequency and duration of exposure to lowered groundwater tables and low-flow or no-flow conditions caused by groundwater pumping, as well as habitat and species resilience, will dictate vulnerability to changes in groundwater elevation. For example, some species rely on perennial instream flow, and any interruption to flow can risk species survival. Impacts caused by changes in groundwater elevation should be considered in the evaluation of groundwater management effects on GDEs and ISW.

5. Monitoring Systems

Effective monitoring methods and systems can aid in understanding groundwater management impacts to GDEs and ISW and informing subsequent action. Groundwater planners are encouraged to design robust monitoring systems with meaningful methods for tracking GDE and ISW conditions over time that account for the following monitoring considerations:

a. *Fundamental Components*: An effective monitoring system to evaluate impacts to GDEs and ISW depletions will ideally provide data that is representative of groundwater-dependent habitat throughout the alluvial basin and will be designed to capture geospatial and temporal variability at a scale meaningful to fish and wildlife beneficial uses and users of groundwater and ISW. GSAs should consider frequency of measurements and observation point density to ensure measurements capture seasonal and operational variability. Monitoring methods should follow accepted technical procedures established by the USGS[7,8], (or equivalently robust methods) and reference DWR's best management practices[9].
b. *Early Recognition*: An effective monitoring system to evaluate impacts to GDEs and ISW depletions will be designed to capture early signs of adverse impacts, so that adaptive management can initiate to avoid undesirable results. Early signs of adverse impacts may manifest as stressed phreatophyte vegetation, increased instream temperature, etc.
c. *Meaningful Baselines*: Where historical baseline information on GDEs and ISW is absent, prompt groundwater information collection is critical to understanding the relationship between climatic variations/water year type and groundwater demand/availability. Monitoring systems can help inform baselines that reflect hydrologic variability and that can be used to measure the impact of management actions on groundwater resources.

d. *Interconnectivity Efficacy*: An effective monitoring system to evaluate impacts to GDEs and ISW depletions will be able to identify and help characterize groundwater-surface water interaction by using appropriate methods including but not limited to paired groundwater and streamflow monitoring; seepage measurements; nested piezometers; geochemical and physical property monitoring; and application of monitoring data to water budget calculations, analytical modeling, and numerical modeling.

e. *Monitoring Characteristics*: A groundwater plan may consider tracking a range of GDE and ISW characteristics to determine groundwater management impacts over time. These characteristics include but are not limited to: geospatial and temporal habitat coverage; changes in groundwater interconnectivity status; habitat connectivity, heterogeneity, or density; habitat 'health' (e.g., application of biological indices, remote sensing/aerial imagery); and species/vegetation presence (e.g., biological surveys).

f. *Scalability*: An effective monitoring system will be designed to improve information gaps over time as resources become available; groundwater plans may choose to identify prioritized monitoring locations and systems that can be implemented in phases based on resource availability.

6. Data Quality

Data quality underscores all components of a groundwater plan and subsequent plan updates. Transparent groundwater plans will clearly identify data used to develop plans and include narratives on data collection methods, equipment calibration, quality assurance checks, data processing steps, and on how data were used to inform plan components. Groundwater plans may also choose to identify available data that were not used and explain why it was excluded from analysis.

SCIENTIFIC CONSIDERATIONS	✓	Hydrologic Connectivity
	✓	Interconnected Surface Water Depletion
	✓	Fish and Wildlife Species Water Needs
	✓	Habitat Value
	✓	Monitoring Systems
	✓	Data Quality

MANAGEMENT CONSIDERATIONS

CDFW encourages groundwater planners to detail how management actions will consider fish and wildlife beneficial uses and users of groundwater and what management actions will be initiated on what timeline if adverse impacts to fish and wildlife beneficial uses and users of groundwater, GDEs, or ISW are observed. The following are considerations to inform responsive management.

1. Data Gaps and Conservative Decision-Making Under Uncertain Conditions

Current groundwater management suffers from information gaps, but it is expected that groundwater management agencies (local, state, and federal) will develop or expand groundwater monitoring systems to improve information availability over time. Even with existing data gaps, GSAs must avoid significant and unreasonable adverse impacts to beneficial uses of groundwater and ISW. Information shortages should trigger conservative groundwater management decisions that err on the side of caution when it comes to protecting fish and wildlife and their habitats. For example, in determining the presence of GDEs, if hydrologic connectivity with the water table is uncertain, CDFW recommends including a GDE until hydrologic connectivity can be disproven. The same cautionary principle applies to establishing minimum thresholds for sustainability criteria; conservative thresholds have a higher likelihood of avoiding adverse impacts to fish and wildlife beneficial uses and users of groundwater and ISW. For example, groundwater is a critical cold-water reserve for aquatic inhabitants of ISW, and ISW are expected to increase in water temperature under warming climate conditions. The amount of increase in ISW temperature due to climate change is a data gap and sufficient groundwater elevations to buffer increasing ISW temperatures is important to consider.

2. Adaptive Management

Decision-making with imperfect information requires groundwater managers to be agile and responsive to dynamic circumstances. Groundwater plans should detail how groundwater monitoring and management structures will be designed to adapt to changing resource conditions and information availability. Plans should include discussions on how and on what timeline adverse impacts will be addressed, if observed. Plans should also consider implementation of adaptive management strategies to account for 'lag' impacts wherein groundwater responses to changes in management regimes are delayed due to aquifer characteristics. 'Lag' effects may necessitate conservative aquifer-rebound timeline projections.

3. **Prioritized Resource Allocation**
   With limited resources available, groundwater planners may choose to allocate available monitoring and management resources (e.g., DWR Technical Support Services funding) to prioritized GDEs and ISW. Prioritization may reflect criteria such as habitat value or vulnerability, species dependency, and/or 'indicator' GDEs or ISW.

4. **Multi-Benefit Approach**
   Groundwater planners are encouraged to design project and management actions for multiple-benefit solutions, including habitat improvements. Evaluation of supply augmentation management actions (e.g., managed aquifer recharge) and demand reduction management actions (e.g., limitations on groundwater extraction) may include a quantification of impacts on GDEs and ISW to justify actions that serve multiple beneficial uses and users of groundwater. Planners may also consider marginal cost increases in project and management actions to optimize habitat outcomes, thereby broadening funding opportunities, such as recharge projects that contribute both to aquifers as well as instream flow.

MANAGEMENT CONSIDERATIONS		
	✓	Data Gaps and Conservative Decision-Making Under Uncertain Conditions
	✓	Adaptive Management
	✓	Prioritized Resource Allocation
	✓	Multi-Benefit Approach

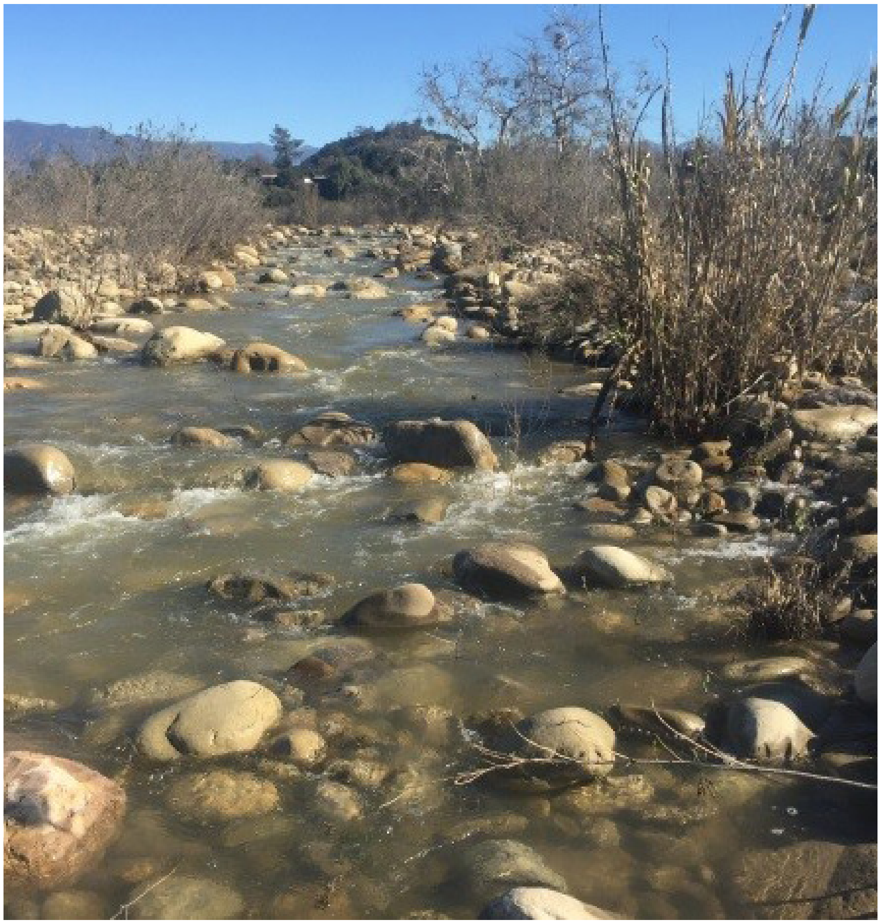
LEGAL, REGULATORY, AND POLICY CONSIDERATIONS

Apart from SGMA requirements, there are numerous laws, regulations, and policies that protect fish and wildlife. The following compilation is provided for GSAs to consider during the development and implementation of groundwater plans. Where applicable and reasonable, GSAs should consider the list below to ensure compliance with existing laws, regulation, and policies. These include but are not limited to:

1. **California Endangered Species Act (CESA), Federal Endangered Species Act (ESA)**
   GDEs and ISW in SGMA-regulated basins contribute to habitat for over 120 federal or State-listed Threatened and Endangered (T&E) species. GDEs and ISW in SGMA-regulated basins also overlap with federally-designated Critical Habitat, areas that contain features essential to the conservation of T&E species. Groundwater management decisions in basins with T&E species and/or Critical Habitat should evaluate groundwater management impacts to species and habitats of concern.[10]

2. **Lake and Streambed Alteration (LSA)**
   The Fish and Game Code requires an entity to notify the Department prior to commencing any activity that may substantially divert or obstruct the natural flow of, or substantially change or use the material from the bed, channel, or bank of any river, stream, or lake, or deposit debris, waste, or other materials where it could pass into any river, stream, or lake. An LSA Agreement is required when the activity may substantially adversely affect existing fish and wildlife resources.

3. **California Environmental Quality Act (CEQA)**
   Groundwater plans developed under SGMA are exempt from CEQA. However, project and management actions needed to achieve basin sustainability are subject to CEQA. CDFW will likely have a CEQA review and permitting nexus with groundwater project and management actions (e.g., Incidental Take Permits, Lake and Streambed Alteration Agreements, etc.). Accordingly, CDFW will expect CEQA lead agencies to thoroughly address proposed groundwater management project impacts (i.e., 'significant effects') to GDEs and ISW.




4. **Public Trust Doctrine**

Public trust resources entitled to protections under the Public Trust Doctrine include navigable surface waters and fisheries. Tributary waters, including groundwater hydrologically connected to navigable surface waters and surface waters tributary to navigable surface waters, are also subject to the Public Trust Doctrine to the extent that extractions affect or may affect public trust uses. Accordingly, groundwater plans should consider public trust protections for navigable ISW and their tributaries, and ISW that support fisheries, including the level of groundwater contribution to those waters.

5. **Clean Water Act and Porter Cologne Act**

Water quality degradation, one of the six sustainability indicators required in SGMA groundwater sustainability plans, is also governed by the Clean Water Act and Porter-Cologne Act and has a significant impact on habitat viability. GDEs and ISW are vulnerable to groundwater quality shortcomings. For example, groundwater pollutants can be taken up by phreatophytic vegetation in GDEs or flow into gaining streams. Groundwater extraction can also compound existing ISW water quality impairment designations under the Clean Water Act. For example, reduced streamflow recharge from depleted aquifers can exacerbate temperature and algae Total Maximum Daily Loads. In addition, the preservation and enhancement of fish, wildlife, and other aquatic resources are designated as beneficial uses under the Porter-Cologne Act. Groundwater extraction could cause or exacerbate temperature or other water quality conditions for those uses. Thorough groundwater plans will consider groundwater quality impacts under the Clean Water Act/Porter Cologne Act.

6. **State, Federal, Tribal Protected Lands and Waters**
   Lands and waters governed by state, federal, and tribal governments are held in the protection of the public trust, including CDFW Wildlife Areas, Ecological Reserves, and conservation easements. These lands merit specific consideration and protection in groundwater plans to ensure no adverse impacts occur to the GDEs and ISW on these lands so they can continue to meet their habitat management objectives. This policy consideration applies to groundwater allocations and groundwater fees – public lands providing valuable habitat should be considered for categorical allocations or pricing that allow the lands to continue to serve their public functions successfully.

7. **Instream Flow Requirements/Recommendations**
   The State Water Resources Control Board (SWRCB) and Regional Water Quality Control Boards (RWQCBs) enforce legally-mandated instream flow requirements, such as the instream flow requirements for cannabis compliance gages[11]. CDFW and other environmental organizations develop instream flow recommendations based on field measurements, desktop analyses, and species/habitat needs. Both instream flow requirements and instream flow recommendations can inform development of sustainability criteria (e.g., minimum thresholds) in groundwater plans to help prevent the occurrence of undesirable results. Because flow requirements and/or recommendations represent thresholds beyond which adverse impacts to water rights holders and/or aquatic species are expected to occur, they should be considered in groundwater plans.

8. SWRCB Water Quality Control Plan

The SWRCB adopted a Water Quality Control Plan in December 2018 for the Bay Delta: San Joaquin River Flows and Southern Delta Water Quality, which set new regulatory requirements for instream flow. The Lower San Joaquin River flow requirements, as adopted[12], would provide a range of 30 to 50 percent of unimpaired flow from February through June in the Merced, Tuolumne, and Stanislaus Rivers. Groundwater plan water budgets and projections should account for these instream flow regulatory requirements accordingly.

9. California Water Action Plan (WAP)

The California Natural Resources Agency state-wide WAP identifies a list of actions to support reliable water supply in California for all beneficial uses and users and calls for the protection and restoration of important ecosystems. Among priority efforts is ensuring sufficient water for wetlands and waterfowl and enhancing water flows in streams statewide. These statewide priorities should be reflected in groundwater planning for GDEs and ISW.

10. California Biodiversity Initiative[13]

This initiative addressing Executive Order B-54-18 seeks to work across agencies and organizations to secure California's biodiversity benefits for the State's short- and long-term environmental and economic health. Two key groundwater-related facets of this initiative are: 1) improving understanding and protection of the State's native plants, and 2) managing lands and waters to achieve biodiversity goals. This initiative supports CDFW's interest in planning for the conservation of non-listed rare plants and species of concern, in addition to T&E species, and should be reflected in groundwater plan GDE considerations.

LEGAL, REGULATORY AND POLICY CONSIDERATIONS	✓	California Endangered Species Act, Endangered Species Act
	✓	Lake and Streambed Alteration
	✓	California Environmental Quality Act
	✓	Public Trust Doctrine
	✓	Clean Water Act/Porter Cologne Act
	✓	State, Federal, Tribal Protected Lands and Waters
	✓	SWRCB Water Quality Control Plan
	✓	Instream Flow Requirements/Recommendations
	✓	California Water Action Plan
	✓	California Biodiversity Initiative

Resources

CDFW RESOURCES

The following CDFW resources are publicly available to help identify, prioritize, and protect GDE and ISW habitats and the species therein in the context of groundwater planning processes. These reports, programs, plans, and tools are best used in conjunction with groundwater planning resources from other organizations and agencies (see Additional Resources).

1. **California State Wildlife Action Plan (2015 Update; SWAP)**
   SWAP identifies priorities for conserving California's aquatic and terrestrial resources and includes habitat conservation targets by geographic area. Among SWAP goals are: *maintain and enhance the integrity of ecosystems by conserving key natural processes and functions, habitat qualities, and sustainable native species population levels*; and *integrate wildlife conservation with working landscapes and environments*. Groundwater is specifically recognized as a critical component of habitat connectivity and water quality, quantity, and availability goals for enhancing ecosystems.

2. **CDFW Instream Flow Program**
   The CDFW Instream Flow Program conducts instream flow studies and establishes instream flow recommendations pursuant to PRC § 10000. Instream flow studies are carried out based on statewide stream priorities, including Water Action Plan priorities. The studies assess the amount and timing of surface water flow and collect data to recommend flow regimes required to maintain healthy aquatic resources. Groundwater planners are encouraged to cross-reference groundwater plan development (including water budgets and surface water-groundwater models) with CDFW's Instream Flow Program data and recommendations. Specifically, groundwater planners may wish to consider instream flow criteria and recommendations detailed in the program's technical reports to inform surface water depletion undesirable result definitions and monitoring approaches.

3. **California National Diversity Database (CNDDB)**
   CNDDB inventories narrative and geospatial information on the status and locations of rare plants and animals in California. The CNDDB spatial data can be downloaded as a shapefile or accessed via the Biogeographic Information and Observation System (BIOS) Data Viewer, a system designed to enable the management, visualization, and analysis of biogeographic data. This tool may inform GDE and ISW identification and prioritization for monitoring and protection. Note, CNDDB may not cover all GDEs and ISW, and as a positive detection database, it is not a replacement for on-the-ground surveys. Geographic areas with limited information on CNDDB often signify an absence of survey work. It is therefore inappropriate to imply that rare and endangered plants and animals do not occur in an area due to lack of information in the CNDDB.

4. Areas of Conservation Emphasis (ACE)
   ACE contains geospatial data on native species richness, rarity, endemism, and sensitive habitats for six taxonomic groups: birds, fish, amphibians, plants, mammals, and reptiles. ACE also summarizes information on the location of four sensitive habitat types (i.e., wetlands, riparian habitat, rare upland natural communities, and high-value salmonid habitat) which may inform the identification of GDEs and ISW and integration of habitat protection into groundwater plans.

5. Vegetation Classification and Mapping Program (VegCAMP)
   VegCAMP develops and maintains maps classifying vegetation and habitat in the state to support conservation and management decisions at the local, regional, and state levels. This tool may help identify and prioritize GDEs, as well as provide information regarding their vegetation composition. Note, the tool may not map all GDEs.

6. Natural Community Conservation Plans (NCCP)
   NCCP identify and provide for the regional protection of plants, animals, and their habitats, while allowing compatible and appropriate economic activity. Not all groundwater basins intersect an approved (n=16) or developing (n=10+) NCCP. Where groundwater basins do intersect an NCCP, the NCCP may be referenced to identify local habitat priorities and protections that may inform GDE and ISW monitoring and management.

7. Regional Conservation Investment Strategies (RCIS)
   RCIS use a science-based approach to identify conservation and enhancement opportunities that, if implemented, will help California's declining and vulnerable species by protecting, creating, restoring, and reconnecting habitat. These opportunities are paired with investment strategies and mitigation credits to incentivize habitat protection. There is potential for groundwater plans to leverage crediting opportunities with project and management actions that optimize GDEs and ISW for habitat value for fish and wildlife beneficial uses and users of groundwater.

ADDITIONAL RESOURCES

The following resources may also be useful in the development of local GSPs that protect GDEs and ISW for fish and wildlife beneficial uses and users of groundwater and ISW. This list is non-exhaustive, and CDFW does not endorse all aspects of these documents; they are included for information purposes only.

1. *Center for Law, Energy & the Environment, UC Berkeley School of Law. 2018.* *Navigating Groundwater-Surface Water Interactions under SGMA.* A report on legal and institutional questions on groundwater-surface water interactions under SGMA.

2. *Community Water Center. 2019.* *Guide to protecting Drinking Water Quality Under the Sustainable Groundwater Management Act.* A factsheet to address best management practices for drinking water concerns.

3. *Department of Water Resources. 2018.* *Natural Communities Commonly Associated with Groundwater Dataset.* A map viewer and data-base allowing viewing and download of Vegetation and Wetland layers that are contained in the Natural Communities Commonly Associated with Groundwater dataset.

4. *Department of Water Resources. 2018.* *SGMA Data Viewer*. Online mapping tool displaying a variety of datasets related to the SGMA sustainability indicators.

5. *Environmental Defense Fund. 2018.* *Addressing Regional Surface Water Depletions in California*. A proposed approach for SGMA compliance on the avoidance of depletions of ISW that have significant and unreasonable adverse impacts on beneficial uses of surface water.

6. *Golden Gate University Center on Urban Environmental Law. 2018.* *Drafting SGMA Groundwater Plans with Fisheries in Mind*. A guidebook for using SGMA to protect fisheries.

7. *Stanford University. 2018.* *Guide to Compliance with California's SGMA*. A guide on how to avoid the "undesirable result" of "significant and unreasonable adverse impacts on beneficial uses of surface waters."

8. *The Nature Conservancy. 2014.* *Groundwater and Stream Interaction in California's Central Valley: Insights for Sustainable Groundwater Management*. A report providing technical information on the state of streams and groundwater resources in the Central Valley to illustrate the physical inter-relationship between the surface and groundwater.

9. *The Nature Conservancy. 2018.* Considering Nature Under *SGMA: Environmental User Checklist*. A checklist to help ensure that groundwater plans adequately address nature as required under SGMA.

10. *The Nature Conservancy. 2018* *Groundwater Dependent Ecosystems under SGMA*. Guidance for preparing groundwater sustainability plans with careful consideration of GDEs.

11. *The Nature Conservancy. 2018* *GDE Rooting Depth Database*. A maximum-rooting depth database provides information that can help assess whether groundwater dependent plants are accessing groundwater.

12. *The Nature Conservancy. 2019* *GDE Pulse Tool.* Compilation of 35 years of satellite imagery for every polygon in the Natural Communities Commonly Associated with Groundwater Dataset to assess changes in GDEs

13. *Union of Concerned Scientists. 2017.* *Navigating a Flood of Information*. Guidance for evaluating and integrating climate science into California groundwater planning.

Fish & Wildlife Groundwater Planning Considerations Summary

1. CDFW cares about sustainable groundwater management, because groundwater is a critical component of functional ecosystems and habitats, and because it is within CDFW's jurisdiction to conserve, protect, and manage fish, wildlife, native plants and the habitats on which they depend. [FGC § 1802, 711.7(a).] As trustee for California's fish and wildlife resources, CDFW intends to engage in groundwater planning processes (where resources are available) to represent the groundwater needs of GDEs and fish and wildlife beneficial uses and users of groundwater.

2. Groundwater plans should answer key questions about GDEs and ISW including the existence of GDEs and ISW, the determination of adverse impacts attributable to groundwater management, and the identification of appropriate management response actions that minimize or mitigate adverse impacts to GDEs and ISW.

3. GSAs may choose to evaluate and integrate into groundwater plans a range of scientific, management, and legal fish and wildlife planning considerations – complementary to the SGMA statute and regulations – to carefully account for groundwater management impacts to fish and wildlife beneficial uses and users of groundwater.

4. CDFW and other public entities have a variety of publicly available resources that can be used to help identify, prioritize, and protect GDE and ISW habitats and the species therein in the context of groundwater planning processes.

CDFW provides this document only as a consideration in groundwater planning. CDFW is neither dispensing legal advice nor warranting any outcome that could result from the use of these considerations. Following these considerations does not guarantee success of a GSP or compliance with SGMA which will be determined by the Department of Water Resources and the State Water Resources Control Board, or compliance with other applicable laws and regulations. Furthermore, except to the extent that this document directly references existing statutory or regulatory requirements, the information contained herein merely represents considerations, not requirements, that may be considered in light of the individual circumstances of each groundwater plan.

Appendix

FISH & WILDLIFE GROUNDWATER PLANNING CONSIDERATIONS TABLES

The following is a distilled, tabular compilation of fish and wildlife groundwater planning considerations intended to support the development of groundwater sustainability plans (GSPs) that protect fish and wildlife and the groundwater dependent ecosystems (GDEs) on which they depend.

Find the complete Fish and Wildlife Groundwater Planning Considerations Document here: https://www.wildlife.ca.gov/Conservation/Watersheds/Groundwater.

Scientific Considerations	
CDFW expects groundwater plans and supporting documentation to follow 'best available science' practices, including careful application of scientific concepts to help avoid adverse impacts to fish and wildlife beneficial uses and users of groundwater.	
HYDROLOGIC CONNECTIVITY	Whether terrestrial vegetation can access groundwater and whether surface water is hydrologically connected with groundwater are important determinations in the context of groundwater planning. If hydrologic connectivity exists between a terrestrial or aquatic ecosystem and groundwater, then that ecosystem is a potential GDE and must be identified in a GSP. Changes in geospatial extent and temporal groundwater interconnectivity of these ecosystems can impact their habitat value to fish and wildlife.
SURFACE WATER DEPLETIONS	Interconnected surface water (ISW) depletions attributable to groundwater extraction can occur through two different mechanisms: captured recharge and induced infiltration. Both should be considered when evaluating the possibility of depletions to ISW and establishing ISW sustainability criteria in GSPs.
FISH AND WILDLIFE SPECIES WATER NEEDS	An evaluation of GDEs and ISW depletions should identify possible impacts to fish and wildlife beneficial uses and users of groundwater and should consider a range of species water needs across life history phases including basic spatial and temporal water availability, as wells as sufficient hydrologic variability and water quality.
HABITAT VALUE	GSPs that seek to minimize impacts to GDEs and avoid ISW depletion should contemplate impacts to habitat characteristics including habitat connectivity, heterogeneity, and sensitivity to groundwater elevation changes.
MONITORING SYSTEMS	Effective monitoring methods and systems can aid in understanding groundwater management impacts to GDEs and ISW and inform subsequent action. An effective monitoring system will provide data representative of groundwater-dependent habitats throughout the alluvial basin and will be designed to capture geospatial and temporal variability at a scale meaningful to fish and wildlife beneficial uses and users of groundwater and ISW. Robust monitoring systems will be scalable; and capable of identifying early signs of adverse impacts, informing baselines, and characterizing interconnected surface waters.
DATA QUALITY	Data quality underscores all components of a groundwater plan and subsequent plan updates. Transparent groundwater plans will clearly identify data used to develop plans and include narratives on data collection methods, equipment calibration, quality assurance checks, data processing steps, and on how data was used to inform plan components.

Management Considerations

CDFW encourages groundwater planners to detail how management actions will consider fish and wildlife beneficial uses and users of groundwater and what management actions will be initiated on what timeline if adverse impacts to fish and wildlife beneficial uses and users of groundwater, GDEs, or ISW are observed.	
CONSERVATIVE DECISIONS UNDER UNCERTAIN CONDITIONS	Information gaps common to groundwater management should inspire conservative groundwater management decisions that err on the side of caution when it comes to protecting fish and wildlife and their habitats.
ADAPTIVE MANAGEMENT	Decision-making with imperfect information requires groundwater managers to be agile and responsive to dynamic circumstances. GSPs should detail how groundwater monitoring and management will be able to adapt to changing resource conditions and information availability.
PRIORITIZED RESOURCE ALLOCATION	With limited resources available, groundwater planners may choose to allocate available monitoring and management resources to prioritized GDEs and ISWs. Prioritization may reflect criteria such as habitat value or vulnerability, species dependency, and/or 'indicator' GDEs or ISWs.
MULTI-BENEFIT APPROACH	Groundwater planners are encouraged to design project and management actions for multiple-benefit solutions, including habitat improvements. Evaluation of supply augmentation and demand reduction management actions may quantify or describe impacts on GDEs and ISW to justify actions that serve multiple beneficial users of groundwater.

Legal, Regulatory, and Policy Considerations

Apart from SGMA requirements, there are numerous laws, regulations, and policies that protect species and habitat and can inform development and implementation of GSPs.	
CALIFORNIA ENDANGERED SPECIES ACT, ENDANGERED SPECIES ACT	GDEs and ISWs in SGMA-regulated basins contribute to habitat for over 120 federal or State-listed Threatened and Endangered (T&E) species. Basins with T&E species should evaluate groundwater management impacts to species and habitats of concern.
LAKE AND STREAMBED ALTERATION (LSA)	The Fish and Game Code requires an entity to notify the Department prior to commencing an activity that may substantially divert/obstruct the natural flow of any river/stream/lake.
CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA)	SGMA project and management actions necessary to achieve basin sustainability may be subject to CEQA.
PUBLIC TRUST DOCTRINE	Public trust resources entitled to protections under the Public Trust Doctrine include navigable surface waters and fisheries. Tributary waters, including groundwater hydrologically connected to navigable surface waters and surface waters tributary to navigable surface waters, are also subject to the Public Trust Doctrine to the extent that extractions affect or may affect public trust uses.
CLEAN WATER ACT AND PORTER COLOGNE ACT	Water quality degradation, one of the six sustainability indicators required in GSPs, is also governed by the Clean Water Act and Porter Cologne Act and has a significant impact on habitat viability.
STATE, FEDERAL, TRIBAL PROTECTED LANDS AND WATERS	Lands and waters governed by state, federal, and tribal governments are held in the protection of the public trust, including CDFW Wildlife Areas, Ecological Reserves, and conservation easements. These lands merit specific consideration in GSPs.
INSTREAM FLOW REQUIREMENTS/ RECOMMENDATIONS	The State Water Resources Control Board (SWRCB) and Regional Water Quality Control Boards enforce legally-mandated instream flow requirements. CDFW and other environmental organizations develop instream flow recommendations based on field measurements, desktop analyses, and species/habitat needs. These requirements and recommendations can inform GSP sustainability criteria.
SWRCB WATER QUALITY CONTROL PLAN	The SWRCB adopted a Water Quality Control Plan in December 2018 for the Bay Delta: San Joaquin River Flows and Southern Delta Water Quality, which set new regulatory requirements for instream flow that inform future water availability.
CALIFORNIA WATER ACTION PLAN (WAP)	The California Natural Resources Agency state-wide WAP identifies a list of actions to support reliable water supply in California for all beneficial users and calls for the protection and restoration of important ecosystems.
CALIFORNIA BIODIVERSITY INITIATIVE	This initiative addressing Executive Order B-54-18 seeks to work across agencies and organizations to secure California's biodiversity benefits for the State's short- and long-term environmental and economic health.

Endnotes

1 CDFW acknowledges that groundwater knowledge and understanding is imperfect and reserves the right to update these groundwater planning considerations as additional information becomes available and knowledge of groundwater systems in relationship to habitat and species needs improves over time.

2 'Best available science' refers to the use of sufficient and credible information and data specific to the decision being made and the time frame available for making that decision. [23 CCR § 351(h).]

3 SGMA states, "the groundwater sustainability agency shall consider the interests of all beneficial uses and users of groundwater, as well as those responsible for implementing groundwater sustainability plans including surface water users, if there is a hydrologic connection between surface and groundwater bodies." [Water Code § 10723.2(f).] SGMA also defines 'significant depletions of interconnected surface waters' as "reductions in flow or levels of surface water that is hydrologically connected to the basin such that the reduced surface water flow or levels have a significant and unreasonable adverse impact on beneficial uses of the surface water." [Water Code § 10735.2(d).] These uses of the term hydrologic connectivity in SGMA may differ from other state and federal wetland identification protocols such as the SWRCB Wetland Delineation methods.

4 The capillary fringe is the area directly above the water table that may hold water in the pores through capillary pressure, a property of surface tension that draws water upward.

5 Cook, P.G., P. Brunner, C.T. Simmons, and S. Lamontagne. 2010. What is a Disconnected Stream?

6 A gaining stream is one in which the stream channel bottom is lower than the adjacent groundwater elevation, meaning water moves from the aquifer into the channel. A losing stream is one in which the stream channel bottom is above the groundwater elevation, and water moves from the channel into the surrounding aquifer.

7 Cunningham, W. L., and C. W. Schalk. 2011. Groundwater Technical Procedures of the U.S. Geological Survey.

8 Rantz, S.E. 1982. Measurement and Computation of Streamflow: Vol. 1. Measurement of Stage and Discharge.

9 Department of Water Resources. Best Management Practices for Sustainable Management of Groundwater.

10 CDFW also seeks protection and preservation of non-T&E species, with specific consideration for Species of Special Concern that directly depend on groundwater for survival.

11 SWRCB. 2018. Cannabis Compliance Gages (Cannabis Policy, Attachment A, Section 4).

12 SWRCB. 2018. Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary.

13 2018. California Biodiversity Initiative. California Natural Resources Agency, California Department of Food and Agricultures, Governor's Office of Planning and Research.

Attachment 2.

Fish & Wildlife Groundwater Planning Considerations

Freshwater Wetlands

JUNE | 2019

PREFACE

In 2014, California passed the Sustainable Groundwater Management Act (SGMA) (AB1739, SB 1168, SB 1319), authorizing local groundwater sustainability agencies to develop groundwater sustainably plans for a subset of California's alluvial aquifers. This document provides considerations to assist local groundwater sustainability agencies in avoiding or minimizing adverse impacts to freshwater wetland beneficial uses and users of groundwater in local groundwater management planning and implementation. The information provided is intended to help local groundwater planners, groundwater planning proponents and consultants, and California Department of Fish and Wildlife (CDFW) staff work together to protect wetlands as a public trust resource.

WETLANDS

When acting in an advisory role, CDFW typically considers the U.S. Fish and Wildlife Service's definition of wetlands as "…lands transitional between terrestrial and aquatic systems..." that have one or more of the following attributes:

(1) at least periodically, the land supports plants that grow wholly or partially in water;
(2) the substrate is predominantly impermeable or semi-impermeable soil that allows for shallow water retention rather than rapid percolation of surface water to groundwater; and
(3) the substrate is non-soil and is saturated with water or covered by shallow water at some point during the growing season of each year.

It is estimated that California has lost more than 90% of its historical wetlands.[1]

[1] Central Valley Joint Venture Implementation Plan

ECOSYSTEM SERVICES

Wetlands may provide some or all of the following critical ecosystem services:

- purify water by trapping sediments and breaking down pollutants and bacteria;
- recharge groundwater aquifers and contribute to streamflow;
- reduce peak water flows during storm events (flood control);
- store carbon through wetland vegetation and decomposition of organic matter;
- support biodiversity through habitat provision for hundreds of species, including state and federally listed species; and
- buffer climate extremes such as drought and flood.

SOCIO-ECONOMIC VALUE

Wetlands may generate some or all of the following socio-economic values:

- sustain migrating waterfowl and fisheries;
- provide recreation opportunities including waterfowl hunting, bird watching, hiking, and fishing;
- remediate polluted waters by removing excess nitrogen and sediment;
- protect eroding streambanks from high velocity flows;
- support food-supply (e.g. rice fields); and
- maintain cultural and aesthetic values of the landscape, including tribal wetland resources.

WETLAND MANAGEMENT CATEGORIES

Wetlands are often categorized based on the timing of flooded habitat and the species they support. Examples of managed Central Valley freshwater wetland types and their beneficiary species are as follows:

- Seasonal wetlands | Typically flooded for 6 months from October through March | Provide habitat for migratory waterfowl and shorebirds | Most abundant wetland in California;
- Semi-permanent wetlands | Typically flooded for 10 months from October through July | Provide critical habitat for breeding waterfowl and shorebirds, and state and federally listed species (e.g. state-listed Tricolored blackbird); and
- Permanent wetlands | Flooded year-round | Provide critical habitat for molting waterfowl and state- and federally listed-species (e.g., giant garter snake).

WATER RESOURCES

Wetlands – naturally-occurring and managed – receive water from precipitation, surface water, and/or groundwater. Most wetlands have seasonal water needs, meaning they require 'flooding' (natural or managed) during specific times of the year. For example, in the Central Valley, many wetlands undergo a fall 'flood-up' wherein wetlands are inundated during the fall, ensuring saturated surface conditions for waterfowl migrating south during the winter.

Naturally occurring wetlands rely on precipitation; surface water over-bank flow during floods; and/or high groundwater tables that intersect the ground surface and cause pooling, constituting a groundwater dependent ecosystem. Managed flooding, relying on surface water diversions and groundwater extraction, is used to mimic historic natural flooding or groundwater seepage which has diminished or ceased entirely under contemporary reservoir management regimes and groundwater resource development.

POLICIES & PROTECTIONS

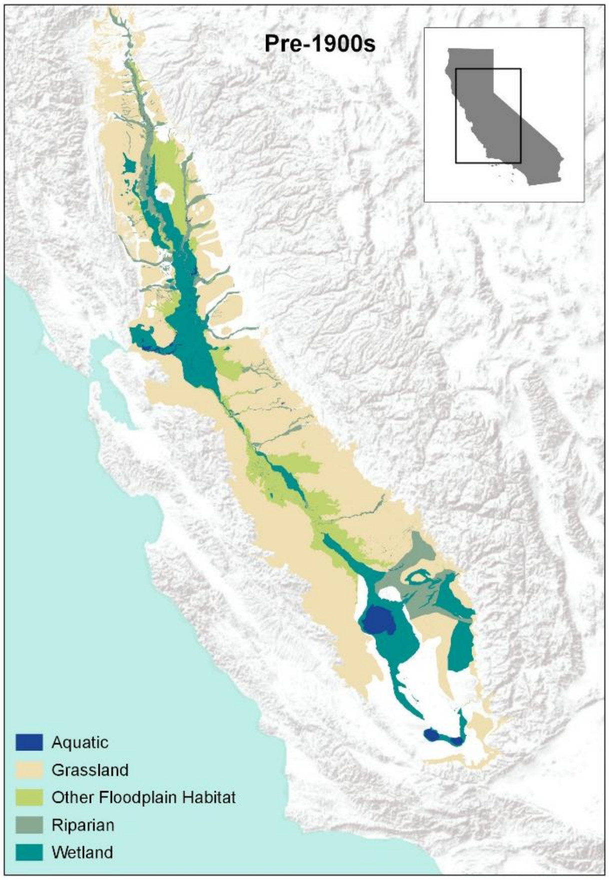
Many policies exist to protect wetlands against further loss and degradation. For example, The Wetlands Conservation Policy (Executive Order W-59-3), also known as the state's "No Net Loss" policy, was an executive order issued in 1993 providing for the coordination of state-wide activities for the preservation and protection of wetland habitats. The State Water Resources Control Board (SWRCB) also adopted a resolution to ensure that wetlands and riparian areas that historically were protected under the federal Clean Water Act remain protected under the state Porter-Cologne Water Quality Control Act (Resolution No. 2019-0015). Wetlands may also be entitled to protection under the public trust doctrine to the extent that public trust resources, including fish and wildlife, depend on them.

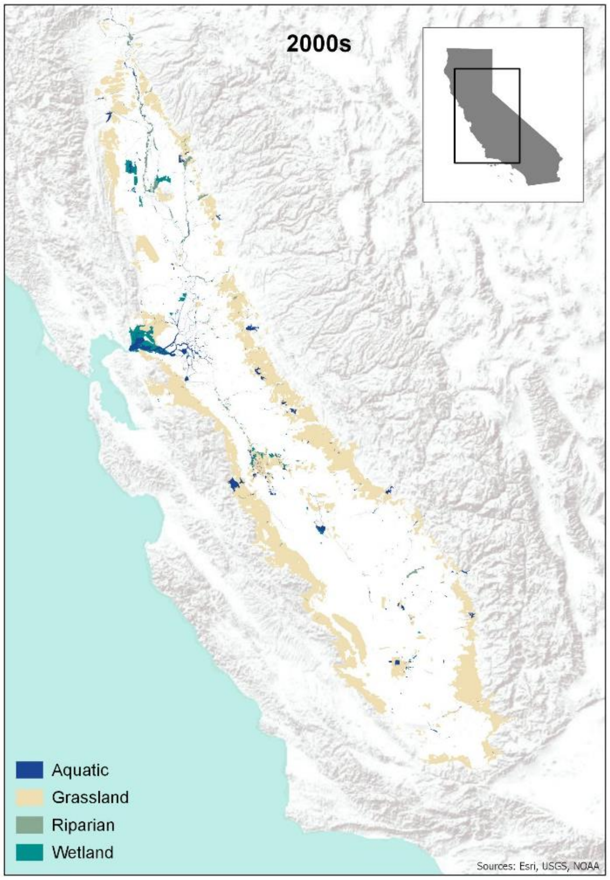
In support of wetland goals and in recognition of their value, various state and federal laws, partnerships, and programs are designed to protect wetlands from further decline. These include but are not limited to: Clean Water Act, Central Valley Project Improvement Act, Central Valley Joint Venture, Inland Wetland Conservation Program of the Wildlife Conservation Board, National Wildlife Refuge System – Wetlands of International Importance, State Wildlife Areas, Ramsar Convention on Wetlands, Endangered Species Act – Critical Habitat Designations, United States Fish and Wildlife Service (USFWS) and Natural Resources Conservation Service (NRCS) federal easement programs, State easement programs (e.g., Permanent Wetland Easement Program), and State incentive programs (e.g., California Waterfowl Habitat Program).

CHALLENGES

Despite existing protections, wetland habitats face a range of threats such as development, increasing operations costs, and surface water delivery constraints. A significant number of California wetlands are actively managed, relying upon human intervention to ensure the presence and maintenance of desired wetland habitat conditions. This on-going upkeep requires landowners to have adequate funding for water deliveries and maintenance activities, which can be difficult to secure.

Increased water costs and potential groundwater extraction curtailment, in part resulting from implementation of the Sustainable Groundwater Management Act (SGMA), may pose threats to the continued existence of functional wetlands. Increased costs and decreased water availability may limit landowners' ability to manage wetland habitats to meet necessary ecosystem functions. While lands themselves may be protected from development by fee title purchase or easements, the habitat values on those lands are not necessarily protected from degradation, particularly if they are dependent on managed intervention. An inability to preserve protected lands *and* manage wetlands for habitat outcomes is likely to reduce the abundance and quality of available habitat, leading to species decline.





HABITAT LOSS IN CALIFORNIA'S CENTRAL VALLEY FROM PRE-1900'S TO THE 2000'S. *MAP CREDIT: DUCKS UNLIMITED*

HISTORIC AND CURRENT (CIRCA 1995) AQUATIC/GRASSLAND/RIPARIAN + HISTORIC WETLAND DATA SOURCE: GEOGRAPHIC INFORMATION CENTER. 2003. THE CENTRAL VALLEY HISTORIC MAPPING PROJECT. CHICO (CA): CALIFORNIA STATE UNIVERSITY. AVAILABLE FROM: HTTPS://WWW.WATERBOARDS.CA.GOV/WATERRIGHTS/WATER_ISSUES/PROGRAMS/BAY_DELTA/DOCS/CMNT081712/SLDMWA/CSUCHICODPTOFGEOGRAPHYANDPLANNINGCENTRALVALLEY.PDF

CURRENT (CIRCA 2009) MANAGED WETLAND DATA SOURCE: PETRIK, K., D. FEHRINGER AND A. WEVERKO. 2013. MAPPING SEASONAL MANAGED AND SEMI-PERMANENT WETLANDS IN THE CENTRAL VALLEY OF CALIFORNIA. FINAL REPORT TO THE CENTRAL VALLEY JOINT VENTURE. DUCKS UNLIMITED, INC., RANCHO CORDOVA, CA.

SUGGESTIONS FOR CONSIDERING WETLANDS IN GROUNDWATER PLANNING AND MANAGEMENT

Wetlands are at risk of further decline. Competing water demands are likely to drive up water costs and reduce available water that might otherwise naturally return to a wetland or be applied to a managed wetland. Minimizing the financial and water supply burdens on wetland landowners supports the long-term presence and maintenance of these critical habitats. Groundwater and watershed planning processes should consider the following opportunities to ensure continued ecological and socio-economic benefits generated by wetlands:

- Identify where wetlands are hydraulically connected with the groundwater table to determine the presence of groundwater dependent ecosystems (GDEs); the identification of GDEs is required in SGMA groundwater planning [see, e.g., Water Code § 10727.4(l)].
- Account for natural and managed wetland groundwater use and recharge in water budgets as required by SGMA [Title 23 California Code of Regulations § 351(al), § 356.2(b)(4)]; account for agricultural tailwater inflows to wetlands and wetland outflows to down-stream systems in basin water budgets.
- Monitor wetland coverage over time to track trends and identify relationships to groundwater resources and management practices.
- Credit wetlands for recharge contributions and water quality improvement contributions.
- Consider categorical groundwater pricing or allotments (e.g., reduced groundwater costs for wetlands, or seasonal allotments to meet habitat needs); managed wetlands typically lack the capacity to absorb new costs in the same way as for-profit landowning entities (e.g., some wetlands are enrolled in incentive programs that have contractual obligations such as 'no-profit' clauses).
- Identify opportunities for mutual benefit project and management actions that help recover groundwater levels and that benefit wetland existence (e.g., managed aquifer recharge projects; water supply remediation; addition of semi-permanent wetlands by capturing excess waters from December through April and retaining this water until July or August); targeting multi-benefit actions can assist in identifying funding to implement groundwater management projects.
- Share information about existing wetland incentive programs to private wetlands facing increasing groundwater costs (e.g., California Waterfowl Habitat Program); note that available incentive program funding will support less than one quarter of Central Valley private wetlands through 2028, leaving 75% vulnerable to significant losses).

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