Klamath Basin Integrated Fisheries Restoration and Monitoring Plan (IFRMP)

Executive Summary

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PACIFIC STATES MARINE FISHERIES COMMISSION
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Executive Summary

Overview and Major Outcomes

The Klamath Basin of south-central Oregon and northern California is one of the largest rivers on the Pacific Coast and was also historically one if its most significant producers of salmon and other native fish. Unfortunately, a wide range of historical and ongoing human activities across the Basin, including construction of four lower Klamath River hydroelectric dams across the river's mainstem as well as numerous smaller dams along its tributaries, have contributed to reduced flows, habitat loss, and increases in nitrogen and sediment inputs in waters that are already naturally phosphorus-rich. Adding to these pressures are more frequent and extended droughts and forest fires associated with accelerating global climate change. For fish, some of these impacts represent key stressors which have significantly impaired underlying watershed functional processes, reduced water quality, and contributed to dramatic declines in the populations of many native fish.

Impacts to fish have been deeply felt by many who live, work, and fish across the basin and have led to decades of conflict and debate over how to restore fisheries of great cultural, health and economic importance while also sustaining other natural goods and services. Many local, Tribal, state, and federal organizations have responded by spearheading a diverse range of restoration efforts, most recently including an effort to remove four lower Klamath River hydroelectric dams.

The **vision** of the Klamath Basin IFRMP is to provide a unifying framework for planning the coordinated restoration and recovery of native fish species from the headwaters to the Pacific Ocean, while improving flows, water quality, habitat and ecosystem processes. The IFRMP serves as the blueprint that describes the highest priority flow, water quality, and habitat restoration and monitoring actions that, in combination with related restoration initiatives, can help reverse the declines of multiple native Klamath Basin fish populations. The Plan helps to answer the basic question: ***given all we know, which functional watershed restoration actions will provide the broadest possible benefits to multiple native Klamath Basin fish species – throughout the Basin and within each sub-basin***. By helping to identify priority restoration actions, the IFRMP will also help inform the wise allocation of funds for restoration and monitoring work in the Klamath Basin.

This final **IFRMP Plan Document** brings together:

- Key basin-wide restoration goals, objectives, and indicators of success
- A list of 146 priority restoration project concepts across 12 subbasins, which are meant to be implemented over many years.

Header Photo: Wood River Wetland | Greg Shine for BLM 2016

- Strategies for closing gaps in basin-wide monitoring for important indicators of fish and watershed status
- Cost estimates for proposed restoration and monitoring activities.
- Recommendations for ongoing plan implementation and adaptively updating restoration priorities through time.

Importantly, the IFRMP acknowledges, weaves together, builds on, and in some cases defers to the many other important prior and ongoing restoration planning processes focused on a narrower set of objectives for specific species, stressors, or regions. In doing so, the IFRMP addresses a long-standing recommendation of the National Research Council to better integrate and close gaps across multiple restoration planning initiatives by providing a standardized and holistic approach to functional ecosystem and habitat restoration planning across the Klamath Basin as a whole.

The implementation of the 36 highest priority activities within this plan (defined as the top-3 ranking project concepts per sub-basin) **over one implementation cycle** comes in at an expected mid-range cost of roughly **$185 Million USD** ($173 Million USD for restoration over 5 years and $12 Million USD for long-term monitoring over 10 years). The cost of implementing all recommended activities in this Plan rises to an expected to cost roughly **$541 Million USD** ($470 Million USD for restoration over 5 years and $71 Million USD for long-term monitoring over 10 years). Refer to Section 4.2.2 and 5.1.2 for more information on restoration and monitoring costs, respectively.

However, it is not feasible or appropriate to pursue all of these project concepts across the basin at the same time, nor would it necessarily be possible to implement one specific project concept in every one of the many sub-basins where it has been recommended to occur. This is partly due to capacity and funding constraints, but also because some projects are expected to be more beneficial if other projects are completed first – for example, addressing water quality issues at a project site before investing in instream habitat restoration – and also because priorities may change over time as events, conditions, and restoration activities in the basin continue to evolve.

To recognize this constraint, the IFRMP has recommended a model whereby participants review and update lists of priority restoration project concepts on a regular basis by working together in an iterative participatory process. This process leverages the IFRMP and linked **Restoration Prioritization Tool** to select a shorter list of restoration project priorities that may be ready for implementation over the next one to two years. This list of near-term restoration priorities represents the **Draft FRMP Restoration Action Agenda (RAA)** for a specific time period.

The latest RAA, available on the IFRMP (https://ifrmp.net/), is meant to provide one source of information to help guide funding considerations. Through this process, restoration practitioners can use the IFRMP to further develop restoration concepts presented in the Plan and submit **detailed proposals for specific projects** that address elements of one or more IFRMP and RAA priorities. This model ensures that restoration occurring in the basin strikes balance between restoration projects that are most beneficial to multiple species and restoration projects that proposal proponents are ready and willing to implement.

The USFWS intends to update both the RAA and the IFRMP periodically to reflect changing conditions, needs, and knowledge in the basin through an adaptive management process that will include additional engagement with participants.

A Participatory Restoration Planning Process

The IFRMP is the culmination of a seven-year collaborative planning process spanning five phases:

- **Phase 1 (2016-2017) focused on information gathering and synthesis**
- **Phase 2 (2017-2018) aimed to clarify IFRMP objectives, frameworks and conceptual models**
- **Phase 3 (2019-2020) aimed to create and test a prioritization method based on multiple criteria**
- **Phase 4 of (2020-2021) aimed to provide more information to support implementation of the Plan**
- **Phase 5 of (2021-2022) aimed to finalize the 2023 - 2024 Plan document, create a 2023-2024 Restoration Action Agenda and develop recommendations for implementation**

Over these five phases, the planning team engaged with a vast team of collaborators committed to improving fishery restoration practices in the Klamath Basin. The data, advice, and tools developed for the IFRMP would not have been possible without the invaluable contributions of the **more than one hundred participants** with expertise on the Klamath Basin (documented in Appendix A the IFRMP Plan Document) who collectively committed many hundreds of hours of time to the development and review of these products. Contributions included provision of data, professional judgement, opinions, critiques, and other input to inform development of a well-integrated basin-wide Plan. Pathways for input included one-on-one interviews, group webinars and workshops, survey responses, and numerous rounds of iterative review and feedback on draft products. **We are sincerely grateful to those participants who contributed their time, expertise, and dedication across many years of this planning process**

Restoration Goals and Objectives

Restoration goals are statements of broad outcomes to be achieved, while restoration objectives are specific and measurable tasks that must be done to make the related goal achievable. The goals and objectives of the IFRMP shown here were drawn and adapted from existing plans to ensure alignment with other ongoing restoration planning work in the Basin and validated by planning participants through a collaborative, facilitated process involving workshops, technical meetings and surveys.

Restoration Prioritization Framework and Tool

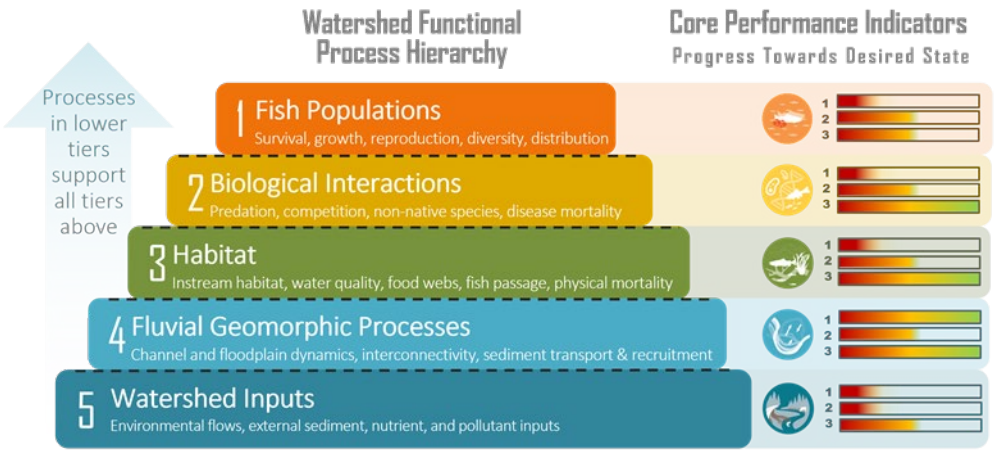
Scientists in river restoration ecology increasingly call for more interconnected approaches to restoration at the basin scale. Current approaches *seek to address multiple root causes of ecosystems degradation* by focusing on restoring ecological processes and functions for the entire landscape rather than the resulting consequences for individual locations and species. This method of restoration work is known as *process-based restoration*. Effective prioritization frameworks provide an organized, repeatable, and transparent reasoning for making restoration decisions, given limited funding, capacity, potential biases, and time. In this sense, prioritization refers to the process of scoring and ranking potential restoration actions to determine the most beneficial sequencing. The goal of IFRMP

prioritization is to inform funding and implementation decisions, and to begin logically grouping top-tier priority restoration projects.

Klamath IFRMP Goals and Objectives Hierarchy

Whole-Basin Nested Goals	Nested Objectives
Fish Populations (FP)  1. Achieve naturally self-sustaining native fish populations	1.1 Increase juvenile production
	1.2 Increase juvenile survival and recruitment to spawning populations
	1.3 Increase overall population abundance and productivity, particularly in areas of high existing abundance or potential future abundance or in special or unique populations
	1.4 Maintain or increase life history and genetic diversities
	1.5 Maintain or increase spatial distributions as necessary
Fisheries Actions (FA) 2. Regulate harvest to support self-sustaining populations. 	ϑ 2.1 Improve management and regulations/enforcement of harvest, bycatch and poaching of naturally produced fish such that populations do not decline and can recover. **While essential for recovery of fish populations, this objective and objective 3.1 are outside the scope of the IFRMP and falls under the responsibility of federal and state agencies with jurisdiction over harvest management.*
Biological Interactions (BI)  3. Reduce biotic interactions that could have negative effects on native fish populations	ϑ 3.1 Do not generate adverse competitive or genetic consequences for native fish when carrying out hatchery, production, or conservation actions
	3.2 Minimize disease-related mortality by reducing vectors and factors known to lead to fish disease outbreaks
	3.3 Reduce impacts of non-native plant and animal species on native fish
Habitat (H)  4. Improve freshwater habitat access and suitability for fish and the quality and quantity of habitat used by all freshwater life stages	4.1 Restore fish passage and re-establish channel and other habitat connectivity, particularly in high-value habitats (e.g., thermal refugia)
	4.2 Improve water quantity and quality for fish growth and survival
	4.3 Enhance, maintain community and food web diversity supporting native fish
	4.4 Reduce fish mortality due to entrainment, scour, stranding
	4.5 Enhance and maintain estuary, mainstem, tributary, lake, wetland, and refuge habitats for all freshwater life stages and life histories of fish
Fluvial Geomorphic Processes (FG)  5. Create and maintain spatially connected and diverse channel and floodplain morphologies	5.1 Improve and maintain productive sediment delivery, storage, sorting, and transport dynamics
	5.2 Increase channel and floodplain dynamics and interconnectivity
	5.3 Promote and expand establishment of diverse riparian and wetland vegetation that contributes to complex channel and floodplain morphologies
Watershed Inputs (WI)  6. Improve water quality, quantity, and ecological flow regimes	6.1 Improve instream ecological flow regimes year-round for the Klamath River mainstem and its tributaries in all sub-basins
	6.2 Reduce anthropogenic sediment inputs while maintaining natural and beneficial sediment inputs
	6.3 Reduce external nutrient and pollutant inputs that contribute to detrimental bio-stimulatory conditions

ϑ **Note: Under the direction of the IFRMP Federal Coordination Group, fishery management actions, and related fish population monitoring is relevant to the Plan but considered 'already in place' and thus out of scope of IFRMP. However, we are integrating with new monitoring undertaken by ODFW, CDFW, and other agencies.**



Klamath IFRMP Process-Based Restoration Principles

After careful consideration of alternatives, and *multiple* rounds of peer-review by Sub-basin Working Group (SBWG) participants, we adopted a **multi-criteria scoring approach** for prioritization. Our multi-criteria scoring process is automated through an interactive web-based **Klamath IFRMP Restoration Prioritization Tool** designed expressly for this purpose, detailed further in Section 3.6. The IFRMP's multi-criterion prioritization framework is based on **six key questions** to ask when considering any restoration project concept:

1. Are focal fish present in the place a project is being proposed?
2. How impaired is the watershed in the place a project is being proposed (how much is restoration needed)?
3. How many stressors is this project going to address?
4. How far and wide will project benefits be felt?
5. Is it feasible to implement this project in this place?
6. How much do we care about the answers to each question?

Restoration Recommendations

The Klamath IFRMP document contains **146 proposed restoration project *concepts*** defined as a broad vision for a specific types of restoration actions in one or more specific priority sub-watersheds of a sub-basin where that action is most needed. These actions were gathered from recommendations within many prior restoration plans in the basin, carrying forward many decades of prior efforts and expertise, and built upon with additional projects put forward by IFRMP planning participants across several phases of the IFRMP planning process. The full set of 146 sub-basin restoration projects are listed on the following page and additional project details and their cost ranges are broken out by sub-basin in Section 4.

The **top three priorities emerging from each sub-basin are shown in Table 4-1** in the main report, and (excluding monitoring) this single approximately 5 year implementation cycle has a collective

estimated mid-point cost of $173 Million USD. This estimate does not include uncosted projects for which no cost information was available at the time of writing, though some of these project costs will likely be significant (see Section 3.7). The remaining 110 project concepts which would need to be completed over the subsequent two decades adds $310 Million USD at the estimated mid-point.

High-Level Summary of IFRMP Priorities by Sub-Region of the Klamath Basin

Sub-Region	Thematic Restoration Priorities Across Projects
	Current restoration priorities in the **Upper Klamath Lake Sub-Region** are largely focused on the restoration of riparian areas, and healthy watershed processes, particularly channel migration, connectivity, flows, and watershed inputs affecting water quality. Improvements to these processes are expected to have broad cascading benefits for fish habitats and populations. Many of these restoration activities were selected as priorities because participants felt they needed to be implemented first to improve the outcomes of other restoration actions identified in the IFRMP.
	Current restoration priorities in the **Mid-Upper Klamath River Sub-Region** are focused on restoring riparian areas, and healthy watershed processes, particularly channel migration, connectivity, cold water refugia, and flows, before addressing other restoration needs. Improvements to these processes are expected to have broad cascading benefits for fish habitats and populations. As these underlying issues are addressed, there is also a desire to improve riparian and instream habitats in select reaches where they are limiting for fish.
	Current restoration priorities in the **Lower Klamath Sub-Region** are focused on restoring channel connectivity, complexity, and flows, in part through ongoing measures to address overall flows, conveyance and distribution of flows, and temperature management associated with the operation of the Trinity and Lewiston dams in the region. Improvements to these processes are expected to have broad cascading benefits for fish habitats and populations. As these underlying issues are addressed, there is also a desire to improve riparian and instream habitats in select reaches where they are limiting for fish.

List of all IFRMP Priorities by Sub-Basin of the Klamath Basin *(listed in order from higher to lower priority)*

UPPER KLAMATH LAKE SUB-REGION

UPPER KLAMATH LAKE SUB-BASIN

UKL 1	Work with agriculture interests and others to improve riparian grazing management and undertake riparian actions to improve habitat conditions in key Upper Klamath Lake tributaries.
UKL 8b_11_11b	Implement low-tech process-based restoration measures in key tributaries to create fish habitat and increase water residence times and groundwater recharge
UKL 14	Work with agriculture interests and others to separate out and treat tailwater discharge in key areas of the sub-basin
UKL 11a	Supplement spawning gravels in key sub-basin tributaries to benefit trout and returning anadromous salmonids.

UKL 3	Restore fringe wetlands in priority areas identified in the UKBWAP to improve water quality and habitat for endangered suckers.
UKL 13	Remove priority fish passage barriers at small dams and culverts across key sub-basin tributaries.
UKL 16	Manage livestock in upland areas to improve vegetation structure, control erosion and reduce sediment flow into streams.
UKL 7	Work with agriculture interests and others to improve summertime flows by encouraging irrigation water use efficiencies and voluntary transfer of water rights for instream flows to benefit fish and riverine processes
UKL 6	Reconnect key springs in the sub-basin and restore surrounding habitat to provide fish refuges during periods of poor water quality.
UKL 10a	Supplement shoreline spawning gravels for lake-spawning suckers in Upper Klamath Lake.
UKL 9	Screen priority diversions around Upper Klamath Lake and other key areas using physical or non-physical exclusion barriers.
UKL 8a	Reconstruct channelized portions of key sub-basin tributaries to improve fish habitat, increase water residence time, and maximize groundwater recharge
UKL 2	Work with agriculture interests and others to improve irrigation practices to reduce sediment and phosphorus loading to key streams in the Upper Klamath Lake sub-basin.
UKL 4	Establish DSTWs across the sub-basin to reduce nutrient loading to Upper Klamath and Agency lakes or downstream tributaries.
UKL 10b	Ensure access for suckers to Upper Klamath Lake shoreline spawning areas by managing lake levels.

WILLIAMSON SUB-BASIN

Williamson 4_7	Work with agriculture interests and others to improve grazing practices and fence and/or plant vegetation to improve riparian and instream conditions within the Williamson River and key tributaries
Williamson 5	Reconnect channels to restore fish access to existing cold-water springs in Williamson River mainstem reaches, key tributaries.
Williamson 3_8b	Implement low-tech process-based restoration measures in key tributaries to create fish habitat and increase water residence times and groundwater recharge
Williamson 10	Improve hydrological and habitat connectivity both within the Williamson River delta and between the Williamson River mainstem and key tributaries.
Williamson 6	Improve connection of Williamson River to the Klamath Marsh NWR and convert existing drains & levees into depressional wetlands.
Williamson 9	Thin lodgepole pine forest encroaching into the upper Williamson River to prevent loss of upland meadows.
Williamson 8a	Add spawning gravels to reaches of the Williamson River to improve habitat conditions for Redband Trout.
Williamson 11	Undertake multiple linked road-related restoration and re-construction projects to enable improved fish passage while diminishing sediment transport into sub-basin streams.
Williamson 2	Undertake upland forest management and prescribed burns to create forest gaps for improved snowpack accumulation and slow release water storage.

SPRAGUE SUB-BASIN

Sprague 3	Work with agriculture interests and others to improve riparian grazing management and undertake riparian actions to improve habitat conditions in the Sprague river mainstem and key tributaries.
Sprague 7b_9	Implement low-tech process-based restoration measures in key tributaries to create fish habitat and increase water residence times and groundwater recharge
Sprague 4	Promote channel migration and improve habitat conditions in the Sprague River mainstem and key tributaries by removing levees and roads.
Sprague 8	Construct DSTWs to reduce nutrient loading and improve water quality in key Sprague sub-basin tributaries.
Sprague 6	Address fish passage issues (particularly for Redband Trout) at road/stream crossings in key areas of the sub-basin.
Sprague 5	Restore cold-water springs that have been ponded or otherwise disconnected in the Sprague River mainstem, key tributaries.
Sprague 11	Improve riparian grazing practices in USFS allotments and some private rangelands within the Sprague sub-basin.
Sprague 10	Undertake upland forest management and prescribed burns to create forest gaps for improved snowpack accumulation and slow release water storage.
Sprague 7a	Add spawning gravels where needed to improve in-stream habitat conditions in key Sprague sub-basin streams.

LOST SUB-BASIN

Lost 9d	Work with agriculture interests and others to install riparian fencing along the mainstem Lost River to reduce grazing impacts.
Lost 11a	Work with agriculture interests and others to improve fish ladder at Keno Dam for better upstream passage for migratory fish species.
Lost 1	Work with agriculture interests and others to improve water use efficiencies throughout the Klamath Project to improve water quality and stream temperatures.
Lost 11b	Improve the fish ladder at Link River Dam to provide better upstream passage for migratory fish species
Lost 3	Explore acquisition of water rights to increase instream flows in key Lost River tributaries.

Lost 5	Install fish screens in the Keno impoundment reach to prevent adult and juvenile fish mortality
Lost 9	Improve habitat conditions at the mouth of Willow Creek/Clear Lake to provide spawning habitat for endangered suckers.
Lost 8	Install passage infrastructure at Harpold and other diversion dams currently restricting access to potential upstream spawning habitats above Tule Lake.
Lost 10a	Improve condition and extent of spawning habitat for suckers in Tule Lake/Lost River.
Lost 7	Install passage infrastructure at Gerber and Miller Diversion dams to allow access to potential upstream spawning habitats in Miller Creek.
Lost 2	Reconfigure Willow Creek/Clear Lake forebay to improve access to Willow Creek spawning areas at low flows.
Lost 10b	Reconfigure and reconnect channels in Sheepy Creek to improve habitat conditions for endangered suckers.

MID-UPPER KLAMATH SUB-REGION

UPPER KLAMATH RIVER SUB-BASIN

UKR 5c	Undertake riparian planting to reduce erosion into the Upper Klamath River mainstem and key tributaries.
UKR 19	Identify and implement projects to protect existing or potential cold-water refugia for fish
UKR 5b	Work with agriculture interests and other to install fencing along riparian corridors to reduce erosion into the UKR mainstem and key tributaries.
UKR 10	Reconnect floodplains and off-channel habitats by removal of levees and other barriers within the UKR sub-basin.
UKR 5a	Improve riparian grazing management to reduce erosion into the UKR mainstem and key tributaries.
UKR 15	Restore reservoir footprint to former conditions in the UKR (once major dams are removed)
UKR 16	Replace existing culverts with bridges at priority road crossings in UKR tributaries to improve access to upstream habitats.
UKR 17	Restore upland wetlands and meadows to improve cold water storage and flood attenuation in the UKR sub-basin.
UKR 7	Reduce fuels and re-introduce low intensity fires to re-establish natural fire regimes across the UKR sub-basin.
UKR 14	Install fish screens at diversions of priority concern within the UKR sub-basin.
UKR 3	Improve irrigation practices to increase instream flows in UKR tributaries to benefit fish and riverine processes
UKR 18	Install BDAs in key UKR tributaries to provide improved seasonal fish rearing habitats.
UKR 20	Address restoration needs of PacifiCorp Parcel A lands
UKR 6	Implement upland road decommissioning in key areas of the UKR sub-basin with high fine sediment input.
UKR 13	Remove/repair road/stream crossings to restore fish passage to upstream habitats within UKR tributaries.
UKR 4	Implement projects to reduce warm tailwater inputs to tributaries in the UKR.

MID KLAMATH RIVER SUB-BASIN

MKR 8	Undertake riparian planting to reduce water temperatures and improve fish habitats.
MKR 6_10	Remove sediment barriers, construct low flow channels to provide access to existing cold water refugia in the MKR sub-basin
MKR 11	Reconnect off-channel habitats by removing or reconfiguring stream levees and dikes.
MKR 14	Install BDAs to provide seasonal fish rearing habitats in MKR tributaries.
MKR 4a	Decommission forestry roads to reduce fine sediment inputs to MKR streams.
MKR 9	Implement projects to provide for fish passage at identified priority fish passage barriers across the MKR sub-basin.
MKR 12	Install in-channel structures such as LWD, boulders, etc. to improve condition of fish habitats.
MKR 3	Manage water withdrawals across the MKR sub-basin to increase instream flows during critical low flow periods.
MKR 5	Undertake upland vegetation management as needed to restore a fire adapted landscape across the MKR sub-basin.
MKR 16	Restore upland wetlands and meadows to improve cold water storage and flood attenuation in the MKR sub-basin.

SHASTA SUB-BASIN

Shasta 6	Undertake riparian rehabilitation actions to maintain shading, reduce water temperatures and improve instream habitat within priority mainstem Shasta River sites.
Shasta 3	Increase cold water refuge habitats for fish in the upper Shasta sub-basin through improved irrigation and groundwater management and secured water rights.
Shasta 9	Undertake habitat restoration projects in streams across the sub-basin to restore floodplain connectivity, create new rearing habitats.

Shasta 1	Work with agriculture interests and others to manage water withdrawals across the Shasta sub-basin to maintain instream flows and to overcome low water barriers to upstream habitats.
Shasta 5	Implement projects to reduce warm tailwater inputs in prioritized implementation areas as guided by the Shasta sub-basin's Tailwater Reduction Plan.
Shasta 10	Add spawning gravels to priority sediment impoverished river reaches as guided by Shasta's Spawning Gravel Evaluation and Enhancement Plan.
Shasta 7	Implement projects to provide for fish passage at identified priority fish passage barriers across the Shasta sub-basin.
Shasta 2	Relocate, redesign, or eliminate the Parks Creek diversion to improve instream flows for fish.
Shasta 8a	Restore fish passage above Dwinnell Dam through removal of the dam.
Shasta 4	Adjust discharges from Dwinnell Dam to improve water temperatures, dissolved oxygen concentrations downstream of dam.
Shasta 8b	Restore fish passage above Dwinnell Dam through construction of dam bypass infrastructure.

SCOTT RIVER SUB-BASIN

Scott 14	Restore upland wetlands and meadows to improve cold water storage and flood attenuation in the Scott River sub-basin.
Scott 15	Callahan Dredge Tailings Remediation
Scott 11	Install appropriate in-channel structures such as LWD, boulders, etc. to improve condition of fish habitats in priority tributaries.
Scott 7	Improve/decommission priority roads identified in Five Counties Road Erosion Inventory to reduce fine sediment inputs to streams.
Scott 3	Implement winter flooding of agriculture land in the Scott River sub-basin as a method of groundwater recharge.
Scott 10	Restore floodplain connectivity and create refuge habitats across Scott River sub-basin streams as identified in the SRWC plan.
Scott 13	Reduce fuel loads and undertake prescribed burns across the southwest Scott River sub-basin to reduce wildfire risks.
Scott 2	Enforce compliance with existing water and environmental laws and regulations for ensuring instream flows within the sub-basin.
Scott 4	Improve irrigation system water use efficiencies and associated monitoring in the sub-basin to benefit fish, riverine processes.
Scott 1	Acquire water rights from willing sellers within priority areas of the Scott River sub-basin to help maintain instream flows for fish.
Scott 5	Remove physical and hydrologic barriers blocking fish passage to key thermal refuge areas within the Scott River sub-basin.
Scott 9	Encourage beaver colonization and/or install BDAs to provide seasonal fish rearing habitats in the mainstem and key tributaries.
Scott 6b	Undertake riparian planting to increase shading, help reduce water temperatures and improve fish habitats within priority streams.
Scott 12	Establish Conservation Easements adjacent to key areas of the Scott River mainstem to allow for levee, dike, and berm removal.
Scott 6a	Improve grazing management of riparian areas to maintain shading, reduce water temperatures, improve fish habitats in priority streams.
Scott 8	Remove or reconfigure priority river/stream levees and dikes identified in the SRWC plan to restore channel form, floodplain connectivity.
Scott 6c	Install fencing along riparian corridors to reduce grazing damage to riparian habitats within priority streams.

SALMON RIVER SUB-BASIN

Salmon 7	Restore upland wetlands and meadows to improve cold water storage and runoff attenuation in the Salmon River sub-basin.
Salmon 5	Protect and enhance existing cold-water refugia through improved maintenance and management of existing riparian areas.
Salmon 3	Build and improve connection to off-channel rearing habitats in Salmon sub-basin tributaries.
Salmon 2	Undertake mine tailing remediation in priority reaches of the Salmon River and North and South Forks mainstems and reconnect floodplains
Salmon 4	Install LWD, boulders, other in-channel structures to improve fish habitats within the Salmon River and sub-basin tributaries.
Salmon 8	Remove physical barriers blocking fish passage to key thermal refuge areas within the Salmon River sub-basin.
Salmon 6a_6	Undertake riparian planting and management to reduce water temperatures within priority reaches of NF, SF Salmon River
Salmon 1	Undertake upland vegetation management as needed to restore a fire adapted landscape across the sub-basin.

LOWER KLAMATH RIVER & ESTUARY SUB-REGION

LOWER KLAMATH RIVER SUB-BASIN

LKR 11	Install BDAs in key tributaries in the LKR to promote increased base flows and provide improved rearing habitats.
LKR 7	Plant riparian vegetation along key LKR tributaries to reduce water temperatures.
LKR 6	Increase habitat connectivity and enhance floodplain habitats in key LKR streams
LKR 10	Install LWD to increase floodplain connectivity and provide cover for spawning and rearing fish in key LKR tributaries.

LKR 3_4	Upland road decommissioning and drainage system improvements to reduce sediment inputs and promote hydrologic restoration throughout the LKR Sub-basin
LKR 13	Remove feral cattle from key LKR tributaries where wild herds exist.
LKR 12	Remove non-native estuary plants from key LKR estuary and off-estuary tributary habitats.
LKR 14	Conduct juvenile fish rescues and relocation in key LKR tributaries prone to seasonal drying.
LKR 15	Seek opportunities to conduct thinning of forest stands and cultural and prescribed burns to restore historic prairie habitats within key LKR tributary watersheds.

TRINITY SUB-BASIN

Trinity 1	Implement managed flows from Trinity and Lewiston dams, gravel augmentation, and reconnect floodplains by removing levees and constructing off-channel habitats.
Trinity 5	Reconnect floodplains in the mainstem Trinity River below the North Fork confluence and key tributaries by removing levees and constructing off-channel habitats.
Trinity 4	Maintain flows in Weaver Creek by alternatively using Trinity River to provide summer water to the Weaverville Community Services District.
Trinity 6	Install in-channel structures such as LWD, boulders, etc. to improve fish habitats in priority tributaries.
Trinity 8	Implement projects to provide for fish passage at identified priority fish passage barriers across the Trinity River sub-basin.
Trinity 17_18	Install temperature control device for Trinity Reservoir and evaluate and develop a new conveyance system from Trinity Reservoir to the Carr tunnels to improve temperature management
Trinity 16	Undertake upland vegetation management as needed to thin forest and reduce fuels across the Trinity River sub-basin.
Trinity 15	Translocate beaver and install BDAs to impound water and create seasonal fish rearing habitats in Trinity River tributaries, particularly in the Weaver basin.
Trinity 2_11	Implement projects in Trinity River tributary streams to improve flows to decrease water temperatures and increase dissolved oxygen.
Trinity 14	Increase Trinity recreational harvest of introduced Brown Trout, adjust hatchery release practices to minimize trout predation on juvenile salmon.
Trinity 12	Stocking of spring Chinook and summer steelhead into Trinity streams where currently extirpated and carcasses where populations still exist.
Trinity 7	Install fish passage infrastructure at Lewiston and Trinity Dams to allow access to upstream habitats.
Trinity 13	Stock Trinity and Lewiston lakes to establish landlocked salmon and/or trout runs, using only fish of Trinity Basin genetic stock.

SOUTH FORK TRINITY SUB-BASIN

SF Trinity 5	Decommission roads and improve road drainage systems to reduce fine sediment delivery to South Fork Trinity streams.
SF Trinity 3	Increase groundwater storage in the South Fork Trinity Sub-basin through upland wetland restoration actions.
SF Trinity 2	Increase storage capacity and delivery capability of Ewing Reservoir to allow increased seasonal water flows in Hayfork Creek.
SF Trinity 6	Reduce cattle grazing and install fencing in riparian areas to reduce fine sediment inputs into sub- basin streams.
SF Trinity 9a	Install LWD, boulders and other in-channel structures to increase habitat complexity in key South Fork Trinity tributaries.
SF Trinity 1a	Identify diversion flow impacts and cease unauthorized water diversions across the Trinity River sub-basin
SF Trinity 7	Improve planning and oversight of diversions to protect thermal refugia in tributaries of the South Fork Trinity sub-basin.
SF Trinity 1b	Work with agricultural irrigators to reduce diversions by developing an incentives and enforcement program to increase flows.
SF Trinity 12	Repair the levee in Hyampom Valley by the municipal airport to reduce downstream erosion.
SF Trinity 9b	Reconnect channels to increase habitat complexity in key South Fork Trinity tributaries.
SF Trinity 4	Stabilize slopes, revegetate vulnerable areas to reduce fine sediment delivery to South Fork Trinity streams through mass wasting events.
SF Trinity 10	Implement projects to provide for fish passage at identified priority fish passage barriers across the South Fork Trinity sub-basin.
SF Trinity 11	Identify priority screening needs at diversions within the South Fork Trinity sub-basin.

Monitoring Recommendations

IFRMP monitoring is intended to provide broad-scale, ongoing tracking of CPI status and trends to confirm that whole-basin recovery of species, habitats, and watershed processes is occurring and is being maintained over time. While **IFRMP monitoring will focus on evaluating basin-wide status and trends**, additional support and funding are also needed to ensure that other ongoing monitoring programs across the Basin will be able to continue to evaluate local project implementation and effectiveness. In many cases, it will be possible to leverage and integrate

existing local monitoring efforts within the basin to inform understanding of status and trends, particularly for fish populations which are already well monitored by state and federal agencies and their partners. **In other cases, new monitoring will be needed under the IFRMP to fill existing monitoring gaps**.

Through a series of webinars convened by the IFRMP in June-August 2021 subject-area experts **identified important monitoring gaps** and made **recommendations as to where/how the IFRMP could best supplement existing monitoring** information to improve basin-scale assessments of CPI status and trends. These recommendations were vetted through additional literature review where possible. Participants noted the importance of **co-locating monitoring sites** for multiple CPIs to minimize sampling effort, the need for **improved standardization of data collection** and storage, the importance of coarse **system-wide assessments**, and the need for better **event-driven monitoring** associated with large storms. Once a full portfolio of monitoring necessities was identified, individual recommendations were ranked into five tiers (Tier 1 – Tier 5) of priority based on the discussions during working groups and expert judgement. Tier 1 monitoring activities are considered the most important for near-term implementation and provide the most comprehensive understanding of basin-wide status and trends. These monitoring priority ranks were also further refined by participants during the 2022 IFRMP RAA planning workshop. The set of Tier 1 priority monitoring actions is shown below; further information on the other monitoring actions and priority ranks can be found in Appendix H of the IFRMP Plan Document. **Implementing Tier 1 monitoring over 10 years has been costed at approximately $12.2 Million USD.**

Key Klamath IFRMP Monitoring Priorities

Watershed Process Tier	CPI	Description
Watershed Inputs	5.2.1 Seasonal Instream Flow	Expand existing network of real-time streamflow gaging stations
	5.2.2 Nutrient Loads	Establish network of automated water samplers
	5.2.3 Fine Sediment Loads and Turbidity	Expand/maintain network of continuous real-time sondes (top priority sites)
Fluvial Geomorphic Processes	5.3.2 Geomorphic Flushing / Scouring Flows	Characterize flushing flows with gage data and transport measurement calibrations
	5.3.4 Channel Complexity	Assess basin-wide planform complexity from aerial imagery
	5.3.5 Sediment Transport	Map substrate sizes with remote sensing (bathymetric LiDAR, air photos)
Habitat	5.4.1 Water Temperature	Expand/maintain network of continuous real-time sondes (top priority sites)
	5.4.2 Water Chemistry (DO, pH, conductivity)	Expand/maintain network of continuous real-time sondes (top priority sites)
	5.4.3 Turbidity	Expand/maintain network of continuous real-time sondes (top priority sites)
	5.4.4 Thermal Refugia	Identify and map thermal refugia across the basin with airborne thermal infrared remote sensing
	5.4.5 Nutrients	Establish network of automated water samplers
	5.4.6 Nuisance phytoplankton and associated algal toxins	Expand/maintain existing monitoring network for evaluating levels of nuisance phytoplankton/algal toxins with indirect measures
	5.4.7 Stream Habitat Condition (Physical)	Assess basin-wide planform complexity from aerial imagery
	5.4.8 Riparian Condition	Assess riparian vegetation with aerial NDVI
Biological Interactions	5.5.1 Disease	Expand existing monitoring network for *Ceratonova shasta* and *Parvicapsula minibornis*
	5.5.1 Disease	Expand existing monitoring network for *Ichthyopthierius multifiliis* (Ich) and *Flavobacterium columnarae* (Columnaris)
	5.5.2 Invasive aquatic species	Establish eDNA sampling network for monitoring invasives
Fish Populations	5.6.1 Focal Species Population Indicators	Establish eDNA sampling network for monitoring distribution of focal fish species
	5.6.1 Focal Species Population Indicators	Fill existing or upcoming gaps on life-cycle monitoring

Recommendations for Implementation

Because the IFRMP identifies over 140 proposed restoration projects that will likely take more than two decades to complete, there is an ongoing need for learning and adjustment through time. Doing this successfully will require several near-term actions as well as longer-term actions to create the enabling conditions for success. These enabling conditions include well-defined tools, workflow pathways and resources to support implementation; ongoing collaboration and learning through monitoring and science synthesis; applying ongoing adaptive management learning updates to the Plan to reflect current context; and clear and dedicated governance partnerships to coordinate and maintain momentum over time.

Section 6 of the report describes recommendations for ongoing implementation of the IFRMP that have been drawn from participants across the planning process and are provided here for further consideration. While some of these recommendations are specifically directed at the FWS, and are clearly identified as such, most are recommendations for consideration by all entities involved in restoration within the basin. Collaborative efforts to carrying out these recommended actions will help to support the ongoing implementation of the IFRMP to deliver the greatest returns on the considerable investments in the IFRMP planning process and ensure the best restoration outcomes for fish, fish habitats, and the ecosystems and communities that rely on them.

The recommendations identified below are mutually supportive of each other and organized in three major categories:

I - Sustain Tools & Linkages to Funding Solicitations

I.1 – As appropriate, all organizations funding restoration in the basin should consider issuing solicitation guidance that encourages proposals to link to IFRMP and RAA priorities

I.2 - FWS should consider supporting long-term maintenance of IFRMP Restoration Prioritization Tool and consider extending the Tool to include a project and data tracking atlas

I.3 – FWS should consider sponsoring the IFRMP website to consolidate key resources and communications

II- Support Ongoing Collaborative Learning Frameworks

II.1 - Articulate how Adaptive Management will help guide the approach to evidence-based decision-making throughout implementation of the IFRMP

II.2 - Support regular Science Symposia to disseminate learning, measure progress, and decide on updates to future IFRMP Restoration Action Agenda priorities

II.3 - Create a monitoring coordination group and work towards standardizing Basin-wide data collection and assessments

II.4 - Provide ongoing impartial technical facilitation to help address emerging issues

III – Establish Ongoing Coordination for IFRMP Implementation

III.1 – Stakeholders in the basin should discuss the establishment of formal and informal coordination roles, agreements, and activities to for IFRMP implementation to sustain ongoing adaptive management and fish population and habitat recovery

In conclusion, it is very rare to achieve the degree of sustained collaboration afforded by the IFRMP planning process and to emerge with a Basin-wide package of practical restoration and monitoring priorities. While no Plan is perfect, the IFRMP stands alone in its commitment to integrate and apply available restoration knowledge at the Basin-wide scale. Between 2016 and 2022 the USFWS provided stable funding (including riding out a global pandemic) while many dedicated participants gave hundreds of hours of their time to create and vet the IFRMP. The IFRMP is a blueprint for fish habitat restoration and monitoring needs in the Klamath Basin and integrates and applies available restoration knowledge at the Basin-wide scale. A set of recommendations identified in Section 6 the Plan provides a package of actionable workflows and tools to sustain ongoing value and relevance.

Now is the time for the Basin to come together to make significant progress in restoring the Klamath Basin. This work has delivered the vision of the Klamath Basin IFRMP to provide a unifying framework for planning coordinated recovery of native fish species from the headwaters to the Pacific Ocean while improving flows, water quality, habitat, and ecosystem processes. All are to be commended for their efforts and the legacy of collaboration that was created. The act of maintaining the IFRMP and its products will inspire others to continue to trust more, do more, and learn more together.

Main report: ESSA and Klamath Basin Working Groups. 2023. Klamath Basin Integrated Fisheries Restoration and Monitoring Plan (IFRMP): Plan Document. Prepared by ESSA Technologies Ltd. For the Pacific States Marine Fisheries Commission (PSMFC) and the U.S. Fish and Wildlife Service (USFWS). 381 pp. + APPENDICES. **Report available at ifrmp.net**

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