

Klamath Reservoir Reach Restoration Prioritization Plan

Klamath Summit Meeting 3-21-2023

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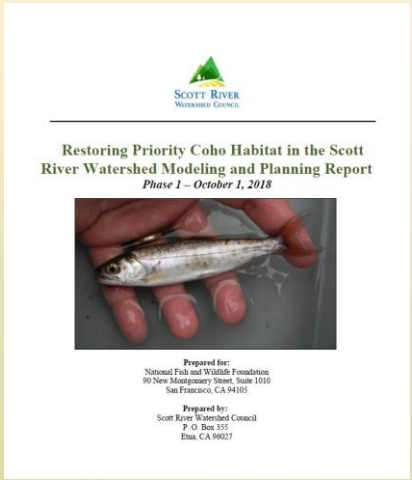
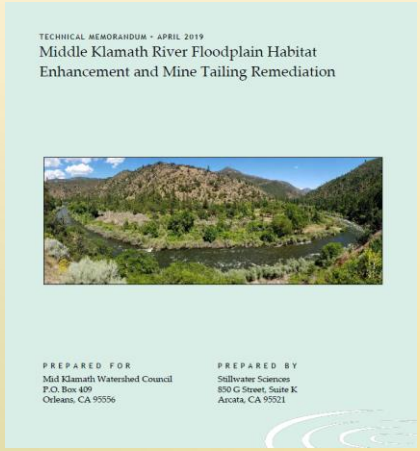
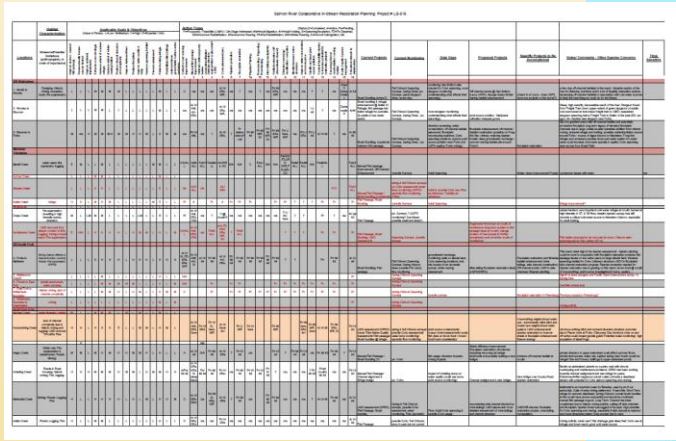
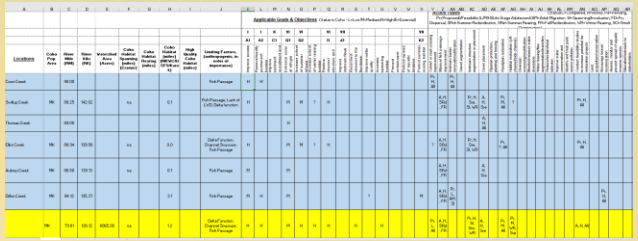
Klamath River Reservoir Reach Habitat Assessment and Restoration Plan

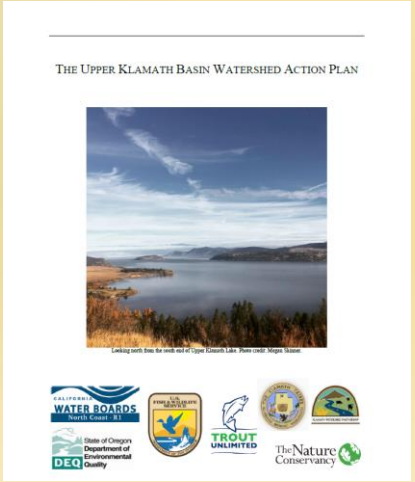
- Several geography-specific Restoration Plans exist both above and below the Klamath Dams.
- Field tours and IFRMP process highlighted a need to assess habitat and develop a prioritized restoration plan in the reservoir reach.

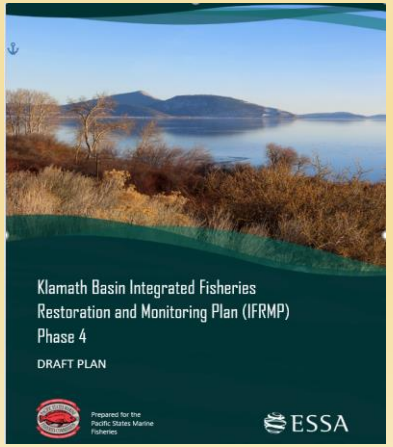


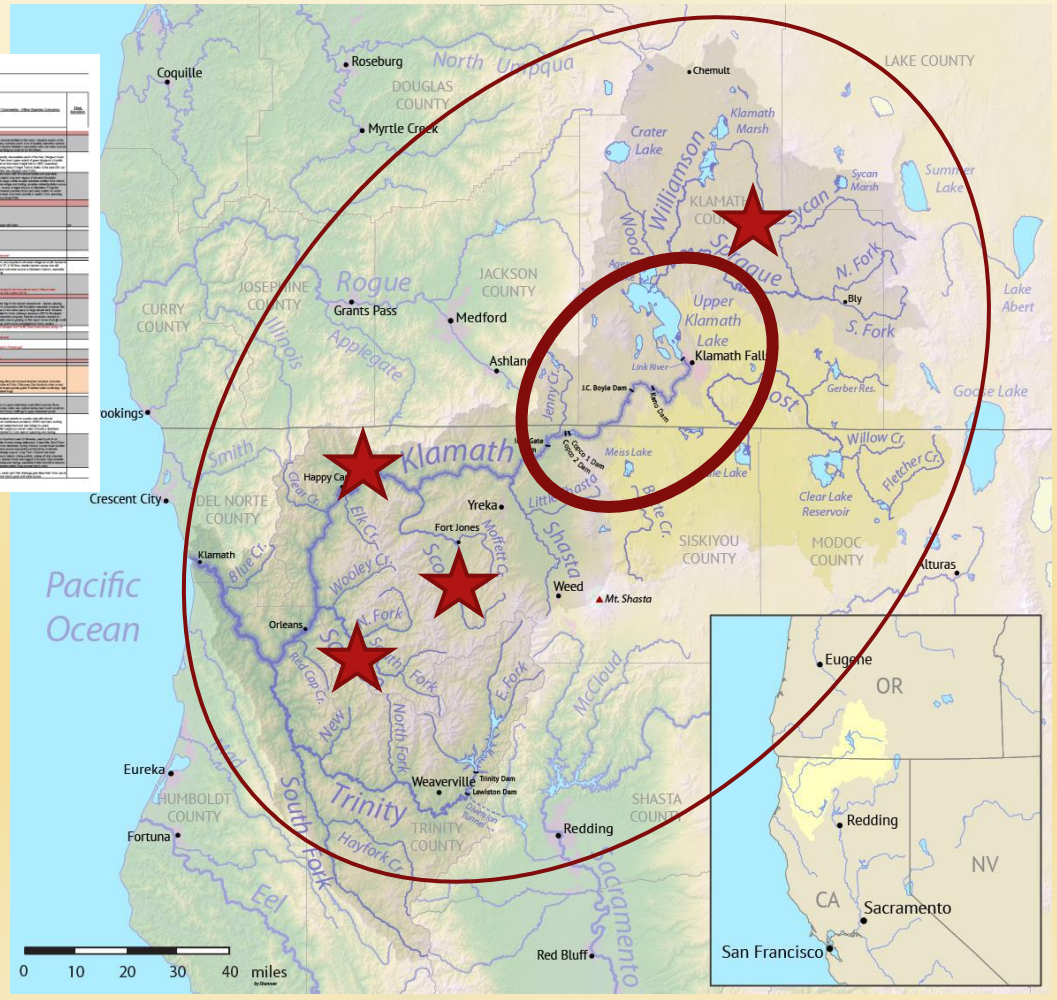






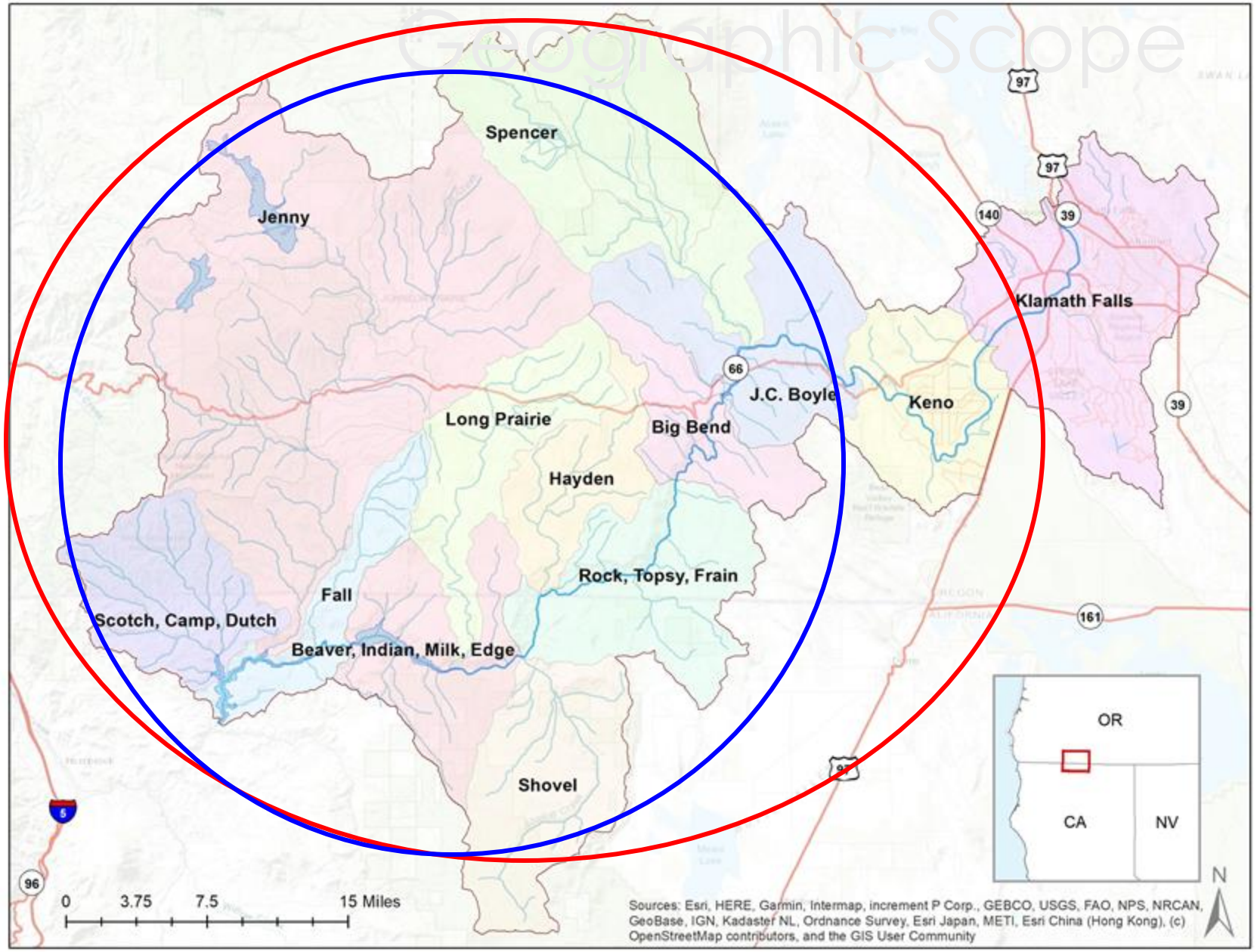






Klamath River Reservoir Reach Habitat Assessment and Restoration Plan Summary

- NOAA Restoration Center funded the effort after recognizing the importance of a road map in the reservoir reach post dam removal for NOAA Trust resources.
- Built a partnership with NOAA, PSMFC, and TU to work on shared goals
- Collaborated with experts in the field (science panel) to vet methods and a Technical Advisory Committee to develop prioritization criteria, score projects and develop prioritized lists for habitat restoration, screening and flow restoration projects.



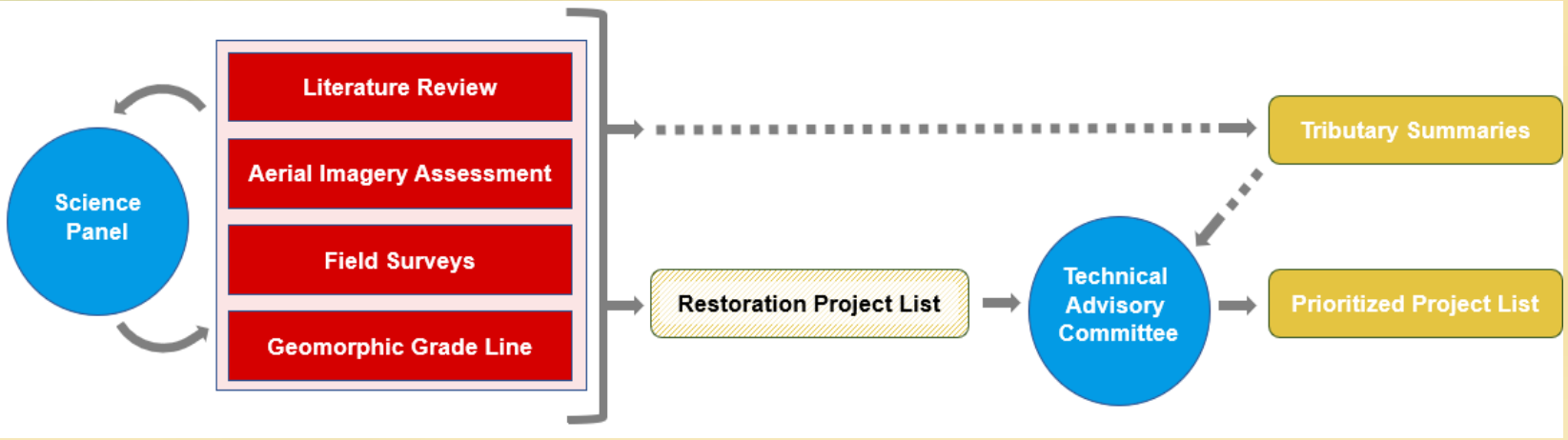
Iron Gate Dam to Link River Dam

Habitat Survey Efforts

Flow and Screening Assessment Efforts

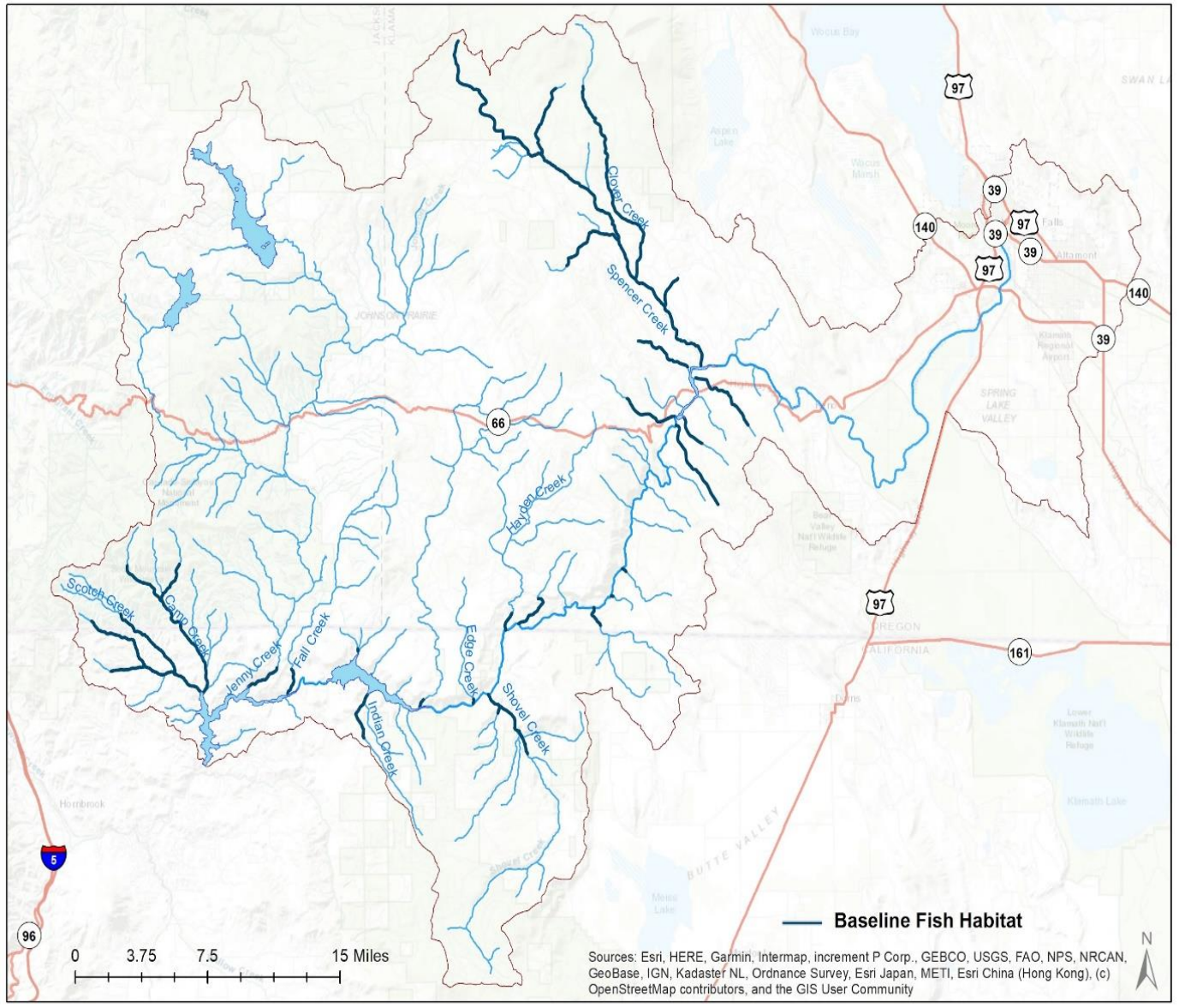
Project Elements

- **Temperature Assessment** (refugia)- Looking for cold water areas to protect and enhance
- **Habitat Assessment** - Collect Baseline data and inform stresses and threats
- **Diversion Assessment** - Focus on locations, volumes, screening and barriers
- **Restoration Project ID** - Develop list of potential projects via field surveys and LiDAR/aerial imagery efforts.
- Technical Advisory Committee and prioritization process
- Final Report



Developed Baseline Fish Habitat Layer for surveys within Anadromy

- This layer utilizes available information from known fish barriers, fish observations, and hydrography attributes to predict potential anadromous reaches.
- The layer was developed using the NHDPlus Version 2.1 (EPA/USGS) hydrography (Holycross 2021).

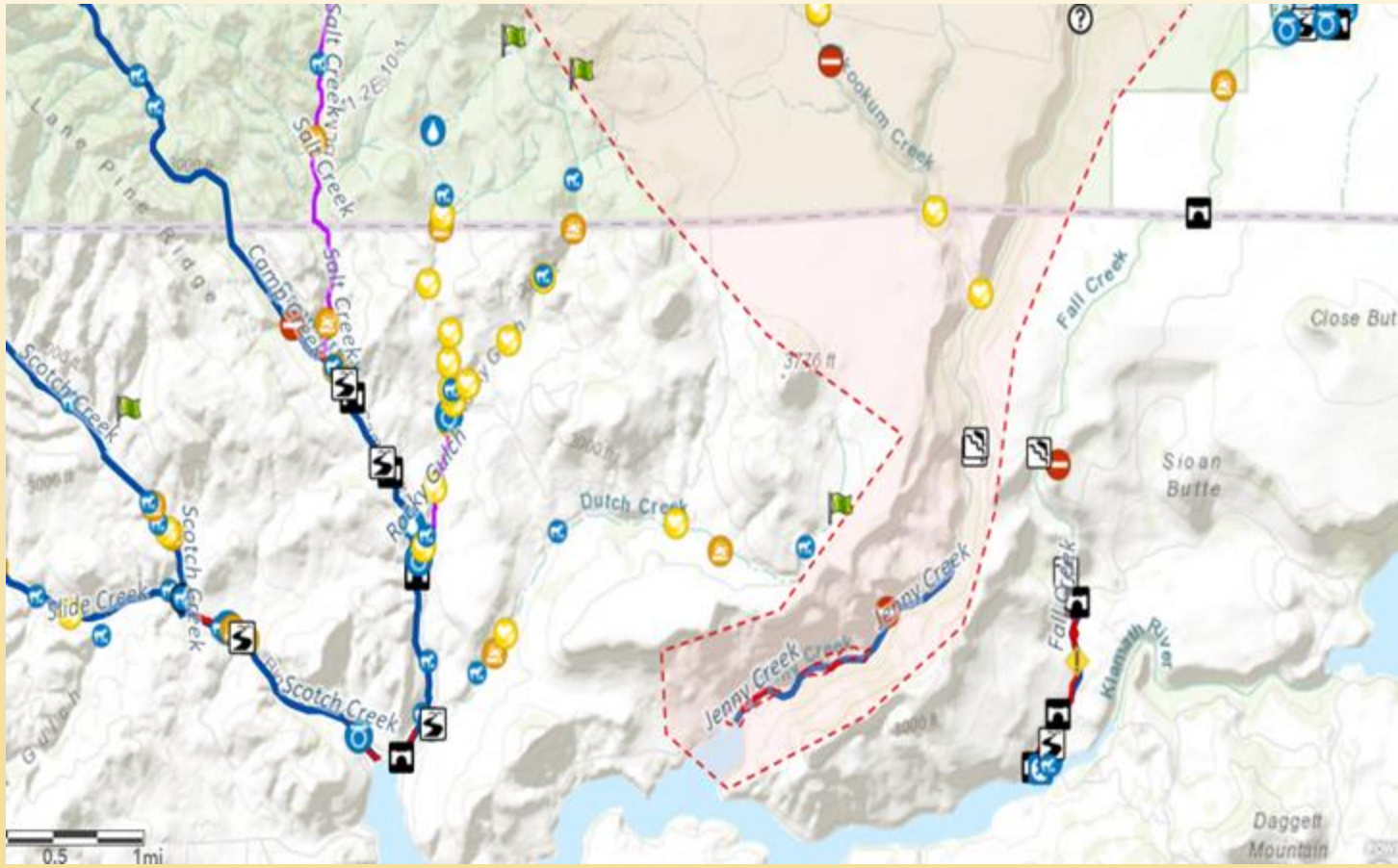


Aerial Imagery Surveys – Above Anadromy

AGOL and Google Earth Imagery
(NHDPlus)

Developed online map to identify key features in the watershed that might have positive or negative effects on the habitat conditions

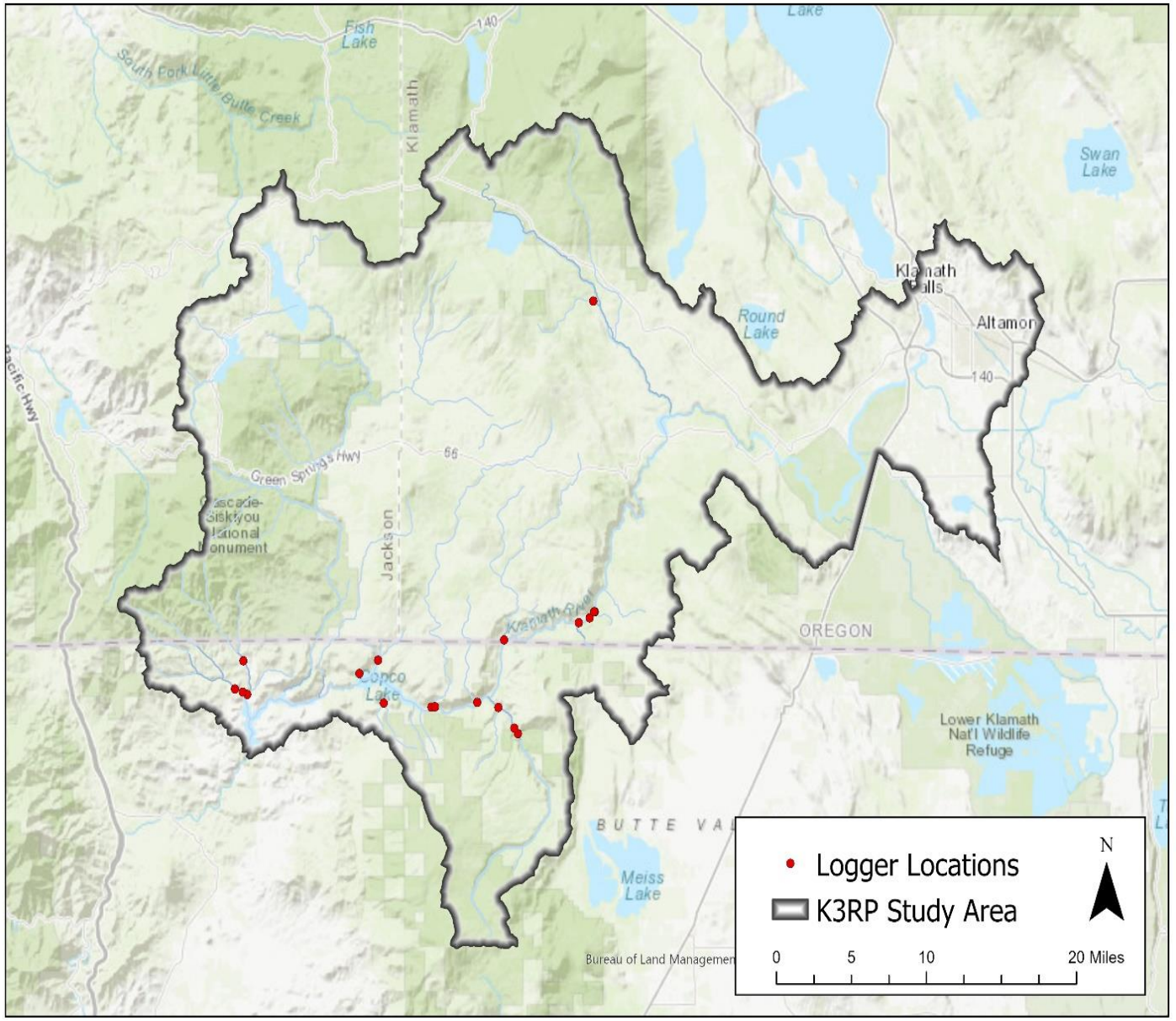
Above and within future anadromous reaches
-**Cattle**
-Crossings
-**Riparian Vegetation**
-Diversions
-Springs
-**Recent Fire**
-Beaver
-Straightened Channel



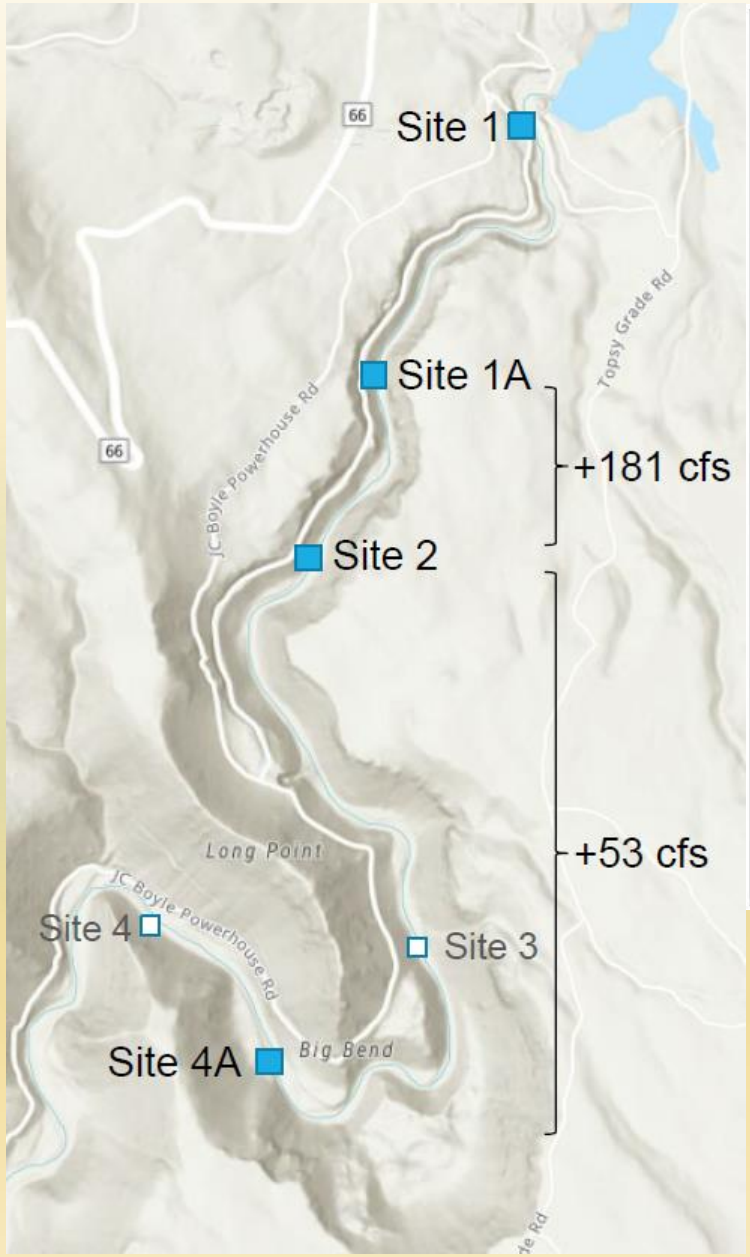
Refugia Project Locations

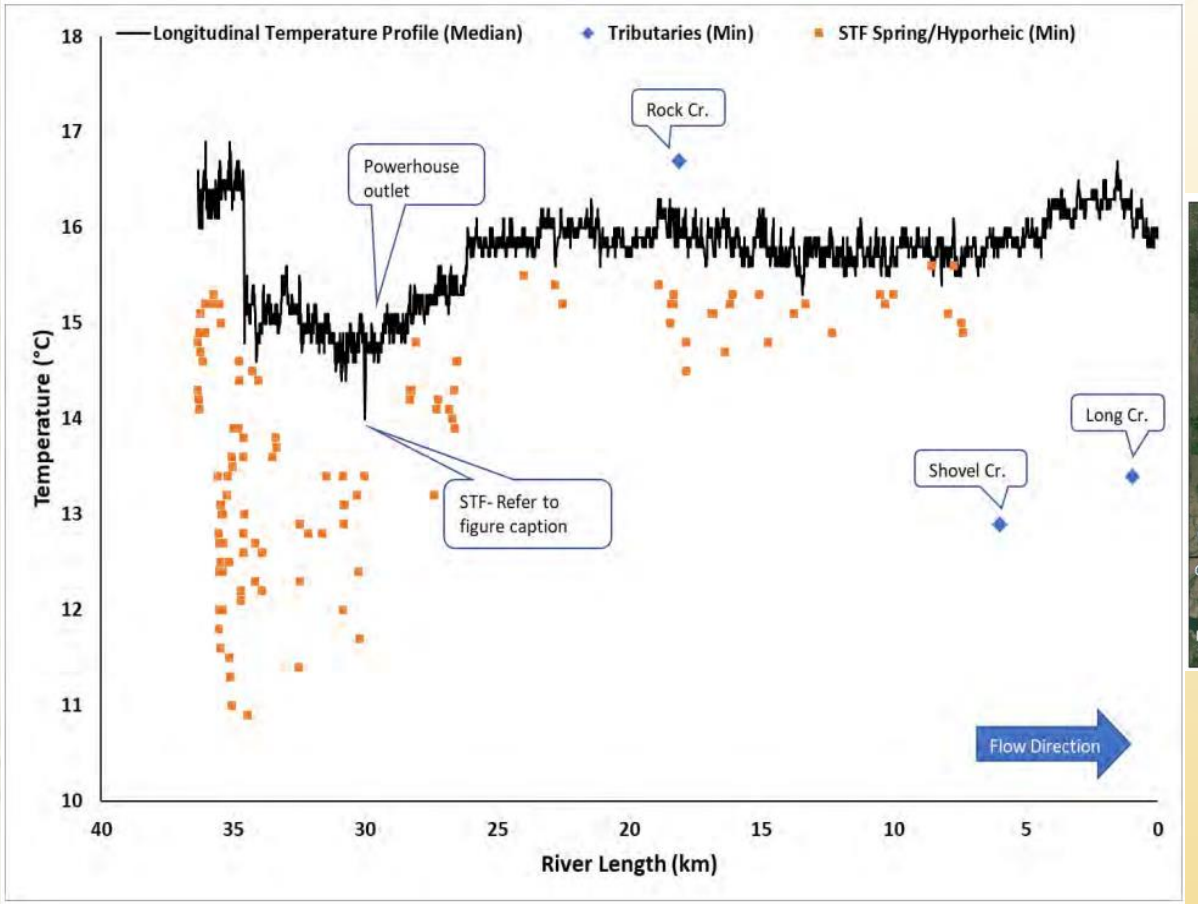
Installed Hobo Temperature loggers at 20 locations

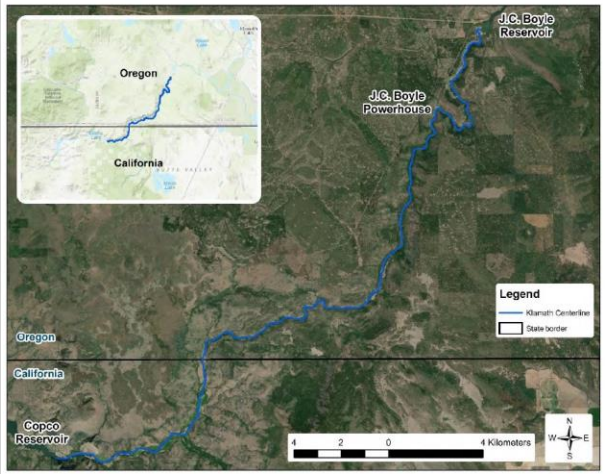
- Scotch Creek (2)
- Camp Creek (2)
- Fall Creek Beaver Pond (1)
- Copco Springs (1)
- Deer Creek (1)
- Long Prairie Creek (2)
- Edge Creek (1)
- Shovel Creek and Tribs (4)
  - Grouse Spring Creek
  - Bear Canyon Creek
  - Panther Canyon Creek
  - Mainstem Shovel Creek
- Hayden Creek (1)
- Rock Creek (1)
- Crayfish Creek (1)
- Frain Creek Spring (1)
- Frain Creek (1)
- Miners Creek (1)
- **PacifiCorp FLIR flight JC Boyle Reach**



PacifiCorp FLIR flight JC Boyle Reach







E&S Environmental, NV5 Geospatial Inc (2022) found 119 Significant Thermal Features.

Deas (2022) found 234 cfs of spring water throughout this reach.

Additional Cold Water Refugia

Shovel Creek

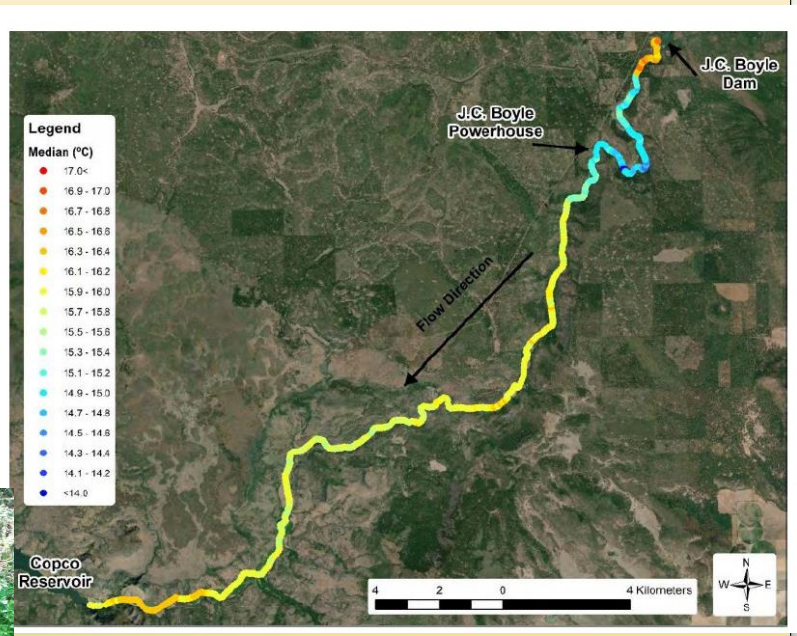
Long Prairie Creek

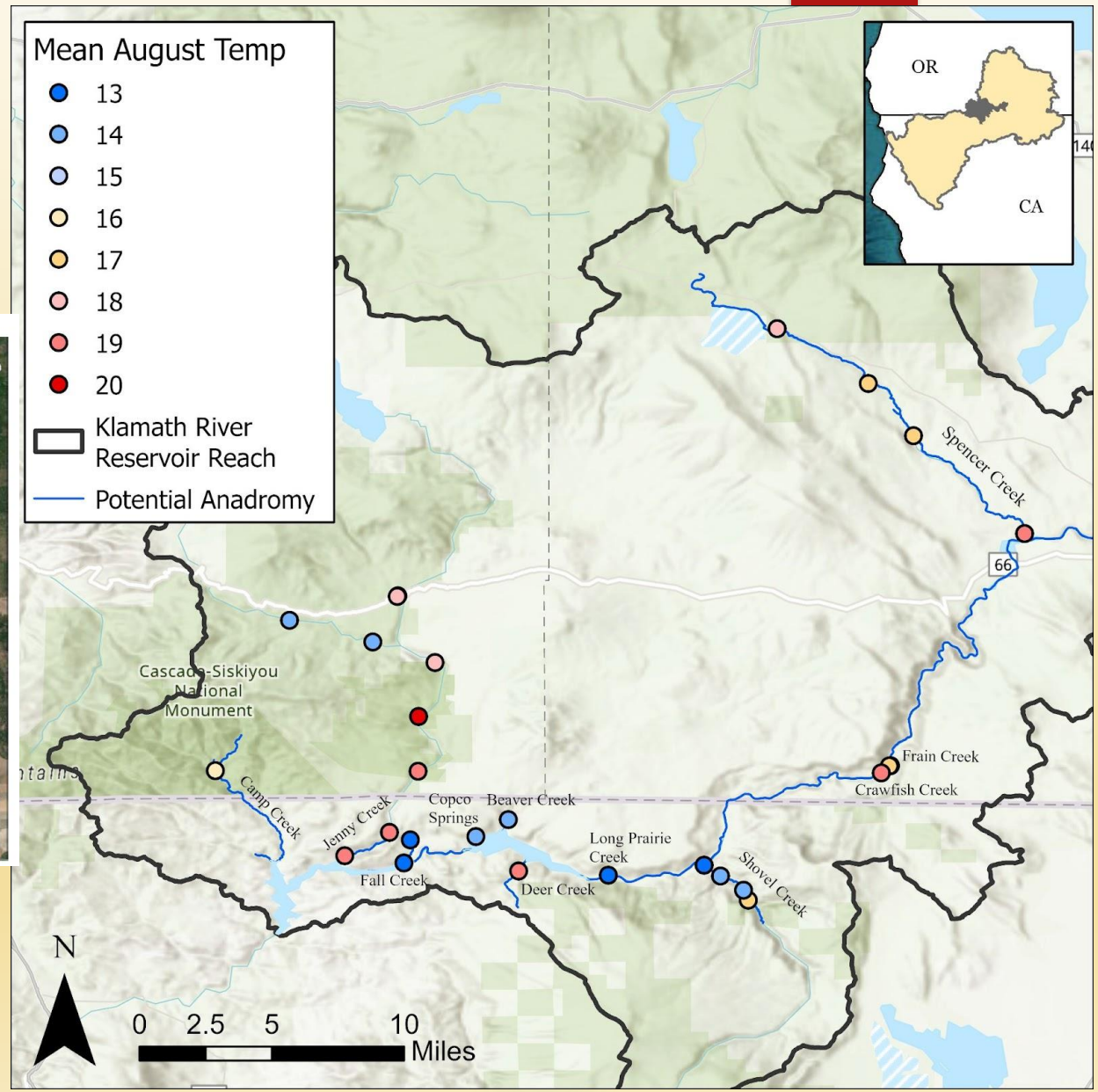
Fall Creek

Beaver Creek

Copco springs

JC Boyle Springs (234 cfs of 13 C water)

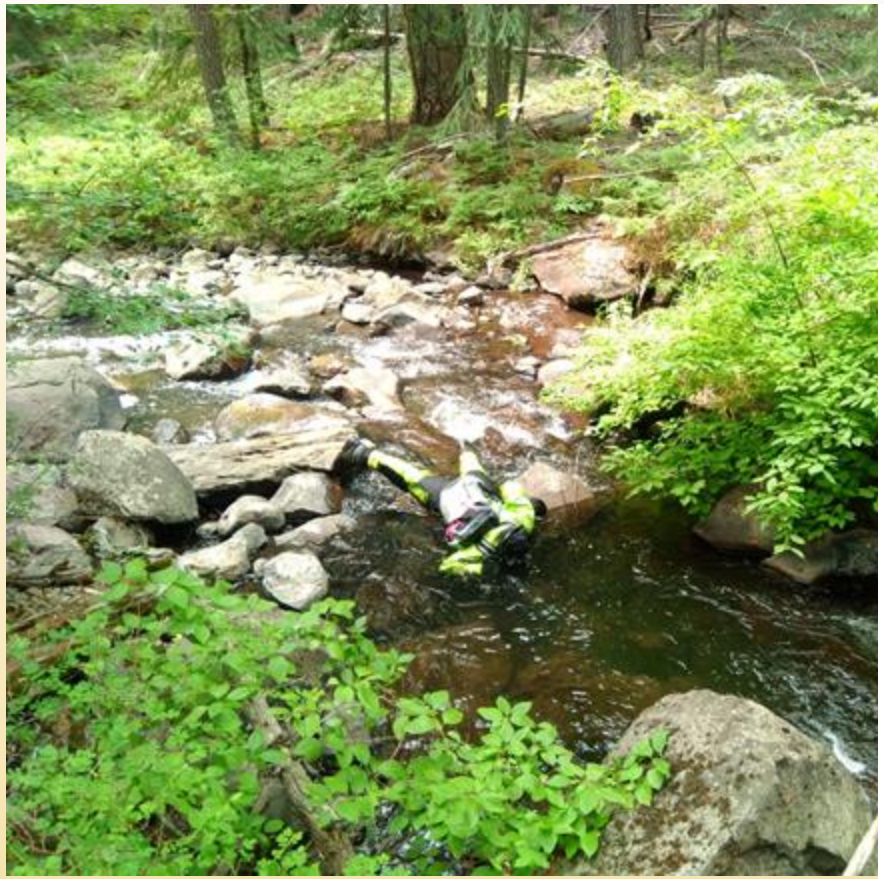




Habitat Surveys

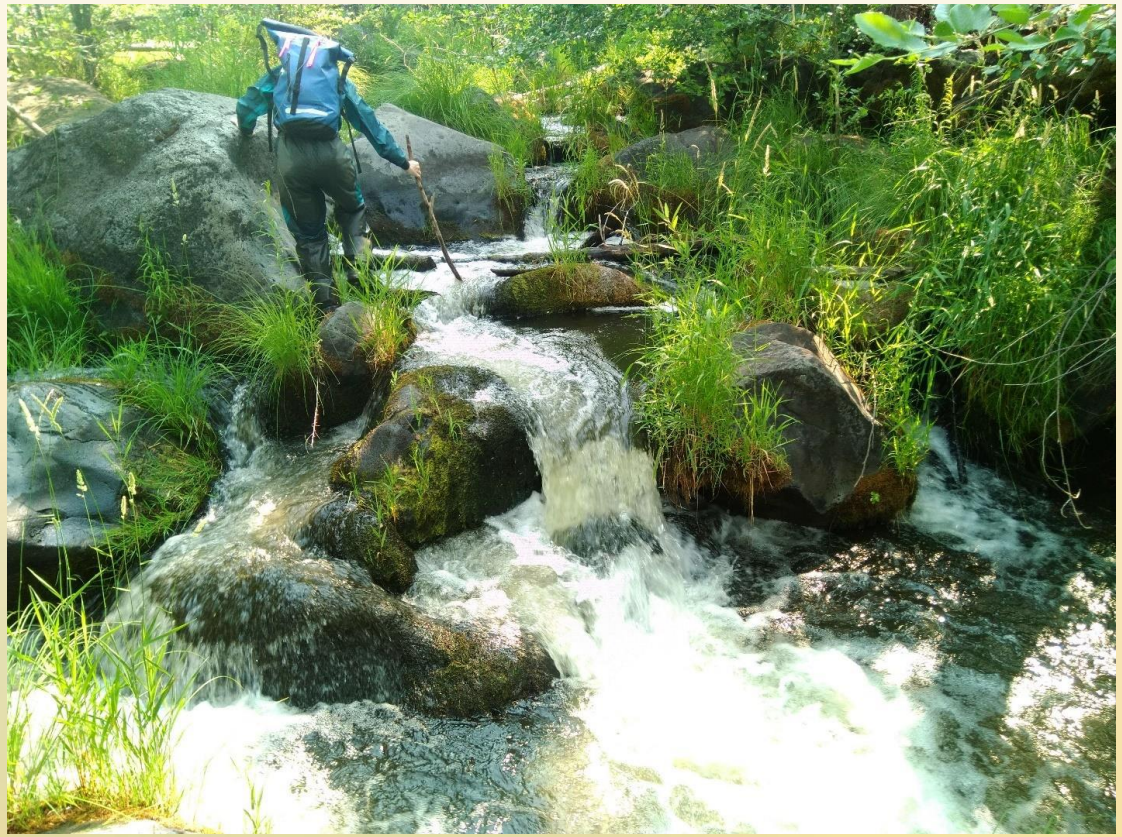
We assessed:
-Stream Flow
-Spawning Gravel
-Riparian Vegetation
-Relative Stream Gradient
-LWD Count
-Temperature
-Salmonid Presence
-Restoration Opportunities

Most of these surveys were completed at the reach level



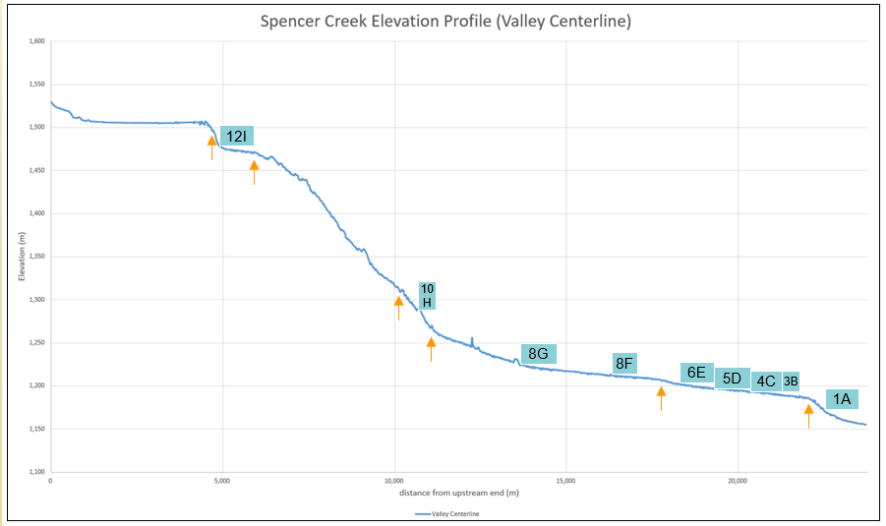
Tributaries	*Expected Length of Anadromy (miles, approximate)*
Klamath River Mainstem (Iron Gate to Lake Euwana)	62.3
Scotch Creek	2.2
Camp Creek	7.5
Jenny Creek	2.4
Fall Creek	1
Beaver Creek	2.1
Raymond Gulch	0
Deer Creek	2
Indian Creek	0
Spannaus Gulch	0
Milk Creek	0
Snackenbury Creek	0
Long Prairie Creek	0
Edge Creek	0.2
Shovel Creek	3.4
Grouse Spring Creek	0.8
Hayden Creek	0.2
Chert Creek	0
Rock Creek	0
Crawfish Creek	0.2
Frain Creek	0.2
Topsy Creek	0
Buck Creek	0
Spencer Creek	17
Clover Creek	0
Miners Creek	0.3
Total	**101.8**

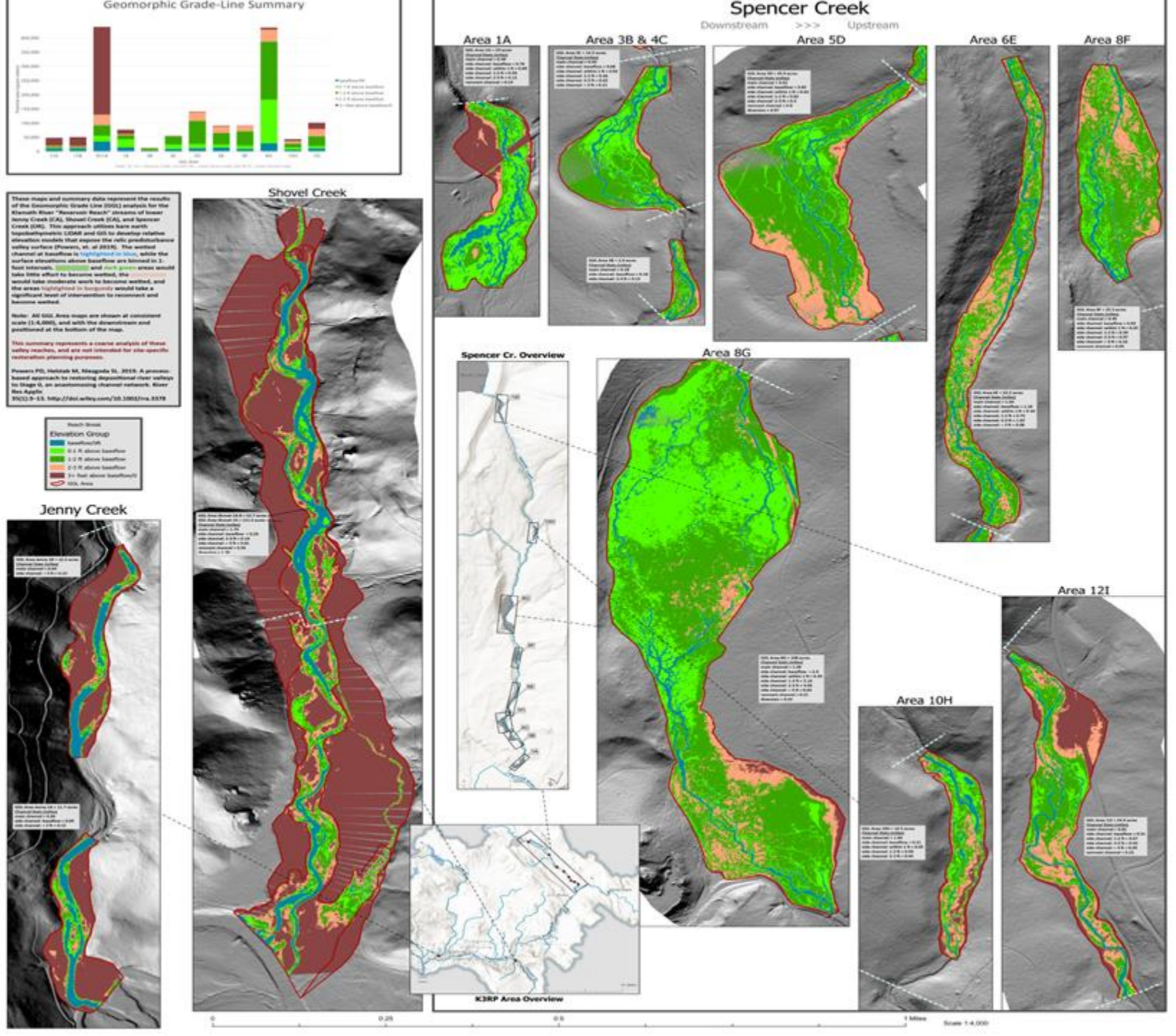
Habitat Summary



	Length	LWD		Gravel		Canopy Cover	Trout
Tributary Reaches	(ft)	(count)	(count/mi)	(ft^2)	(ft^2/mi)	(%)	(present)
Camp Creek (Lower)	1083	6	29	390	1901	70	Y
Camp Creek (Upper)	3022	43	75	73	128	56	N
Crawfish Creek	981	16	86	2	11	64	N
Fall Creek	6008	98	86	108	95	61	Y
Frain Creek	564	0	0	0	0	53	N
Grouse Spring Creek	1000	8	42	0	0	76	Y
Hayden Creek	4092	76	98	0	0	41	N
Jenny Creek (Lower)	4579	46	53	87	100	49	Y
Jenny Creek (Upper)	5346	21	21	56	55	41	Y
Long Prairie Creek (E. Channel)	807	21	137	0	0	53	Y
Long Prairie Creek (W. Channel)	736	11	79	0	0	82	Y
Lower Dutch Creek	1040	0	0	0	0	27	N
Lower Edge Creek	714	0	0	0	0	43	N
Lower Scotch Creek	3760	21	29	225	316	38	Y
Miners Creek	1420	0	0	0	0	70	N
Rock Creek	4957	76	81	10	11	42	N
Shovel Creek (Lower Valley)	3824	18	25	10	14	59	Y
Shovel Creek (Upper Valley)	4627	31	35	13	15	61	Y
Shovel Creek (Canyon Reach)	6800	91	71	144	112	55	Y
Spencer Creek (R1)	2547	11	23	438	908	25	Y
Spencer Creek (R2)	1948	13	35	0	0	40	Y
Spencer Creek (R3)	1481	2	7	430	1533	22	Y
Spencer Creek (R6)	5280	18	18	12700	12700	37	Y
Spencer Creek (R7)	3191	33	55	2315	3831	28	Y
Spencer Creek (R8)	11258	113	53	8055	3778	44	Y
Spencer Creek (R9)	9171	135	78	6680	3846	26	Y
Spencer Creek (R10)	2846	124	230	1305	2421	44	Y
Spencer Creek (R11)	17427	681	206	3346	1014	33	Y
Spencer Creek (R12)	4048	171	223	4925	6424	24	Y
Spencer Creek (R13)	1555	61	207	0	0	34	Y
Spencer Creek (R15)	5757	105	96	55	50	10	Y
Spencer Creek (R16)	2463	37	79	0	0	57	Y
Spencer Creek (R17)	2015	10	26	0	0	10	Y

Geomorphic Grade Line Analysis in Shovel, Jenny and Spencer Creeks to identify floodplain reconnection projects.





Tributary Summaries

3.3.3 Deer Creek

Location

Deer Creek is a tributary that flows into the southern side of Copco Lake (Figure 45). Once Copco Dam is removed, Deer Creek will flow into the Klamath River at river mile 200.4.

Ownership

The watershed is privately owned with some federal (BLM and USFS) parcels.

Size

The watershed is approximately 7 square miles. Estimated 2 miles of anadromy based on Baseline Fish Habitat, but unable to confirm due to private property.

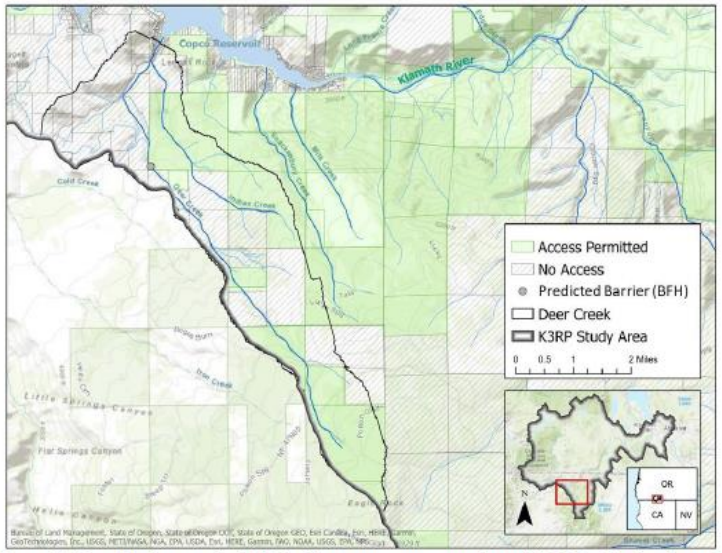


Figure 45. Deer Creek watershed. No habitat surveys were conducted in 2021. The location of the predicted barrier is the expected limit of anadromy in the creek based on the Baseline Fish Habitat model.

Natural Barriers

- Unknown. K3RP and previous groups were unable to gain access.

Man-Made Barriers

- Unknown. K3RP and previous groups were unable to gain access.

Temperature

- Temperatures were within a suitable range for coho salmon and *O. mykiss* during the summer-drought conditions of 2021 (Figure 46) (K3RP Temperature Assessment 2021).

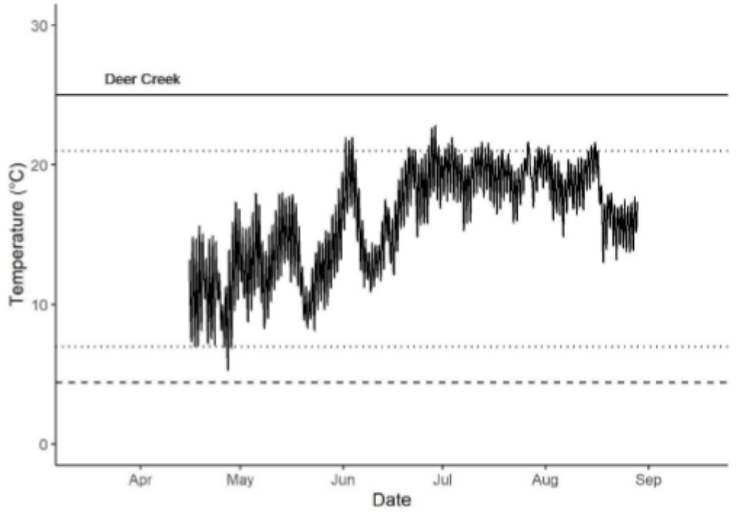


Figure 46. Deer Creek temperature data from 2021 for a logger placed just below Ager Beswick Road Crossing. Logger was installed on 04/15/2021 and the pool remained wetted throughout the summer. The black line indicates the temperature. Recommended summertime rearing temperature for juvenile coho salmon is 7 – 21 °C (dotted lines), cessation of growth occurs at a minima of 4.4 °C (dashed line), and the Upper Lethal Temperature (ULT) occurs at 25.0°C (solid black line).

Stream Flows

- Stream remained wetted during the 2021 drought. On April, 15, flows were ~1.0 CFS and on Augsut 28, flows were ~0.5 CFS. The consistent stream flows even during the drought period might suggest the creek has spring inputs (K3RP Temperature Assessment 2021).

Diversions

- Aerial imagery suggests there are several diversions in the upper watershed for cattle and flood irrigation activities. There is likely a large percentage of summer base flow being diverted on private parcels (K3RP Aerial Imagery Assessment 2021).

Salmonid Presence

- Salmonid presence is unknown, we but suspect *O. mykiss* and possibly coho salmon might use this tributary, especially if the habitat was restored (K3RP Habitat Assessment 2021).
- Bullfrogs were spotted near the Age Beswick culvert during the 2021 K3RP effort and they might have a negative impact on salmonid rearing success (K3RP Habitat Assessment 2021).

Habitat Description

- Unable to survey due to restricted access, but based on assessing the stream from the road, it seems like a relatively small tributary with some sections of low gradient habitat (Figure 47). There might be some areas suitable for coho and *O. mykiss* spawning. The few habitat units near the road crossing have significant issues with fine sediments covering the substrate, likely caused by the upstream cattle ranching (K3RP Habitat Assessment 2021).

Tributary Summaries continued

Figure 47. Looking downstream from the road at the Ager Beswick culvert on Deer Creek on 06/25/2021.

Identified Habitat Limitations

- Diversions likely limit flow (K3RP Aerial Imagery Assessment 2021)
- Significant issues with fine sediments covering the substrate (Figure 48) (K3RP Habitat Assessment 2021).

Figure 48. Looking upstream from the stream channel at the Ager Beswick culvert on Deer Creek on 06/25/2021.

Restoration Recommendations

- Restoration efforts should focus on assessing the impacts of agricultural practices and determine if a water quality improvement project would benefit Deer Creek.

Restoration Projects Identified

- Project #113 (high priority): Assess impacts of agricultural practices and determine if a water quality improvement project would benefit Deer Creek

Project List

- Identified 82 potential projects by goal, reasoning, and specific description
- Developed prioritization Criteria
- Vetted Criteria and project list with TAC

Project_numb	Watershed	Described_locat	Featu	Project_description_NEW	Restoration_Goal_NEW	Project_reasoning_NEW	Restoration_type_NEW
50	Long Prairie Creek	River Right Channel	Point	Replace the undersized culvert structure just upstream of Copco Reservoir	Assess culvert for fish passage. Replace if not passing fish at all life stages.	Erosion patterns below the culvert indicate that it is not properly sized for the channel.	Road Impacts
51	Long Prairie Creek	River Left Channel	Point	Remove the ATV/small vehicle crossing near the mouth or build a bridge	Prevent channel degradation from vehicles crossing the ford	Stream crossing does not have a bridge	Road Impacts
52	Long Prairie Creek	River Right Channel - Lower 300-400 feet	Line	Reconnect the floodplain and add complexity just upstream of the culvert on the RR channel by adding LWD	Floodplain connection, channel complexity for spring, summer and fall rearing.	The lower 300-400 feet of the river right channel is low gradient with some floodplain. Might be a good spot for off-channel ponds and LWD	LWD
55	Miners Creek	Lower 1500 feet of Miner Creek	Line	Install BDAs, raise elevation of the channel, add LWD to increase floodplain connectivity.	Reconnect channel to the floodplain for slow water refugia	Miner's Creek is about 2-4 feet wide and incised (3-4 ft) for much of the lower ½ mile reach. The vegetation was dominated by sedges, willows, and aspens, suggesting that the water table was not far below the surface. This might be a good spot for BDAs. There was also signs of recent beaver activity in the area	Channel alteration
56	Miners Creek	Just above the confluence with Spencer Creek	Point	Decommission logging road or provide an appropriate crossing structure.	Prevent channel degradation	The ford on Miners Creek appears to be degrading channel at the confluence	Road Impacts
57	Scotch Creek	From Iron Gate Reservoir upstream about 1200 feet	Line	Install structures (lwd/BDAs) in the lower 1200 feet	Retain water and provide habitat complexity	Scotch and Camp could benefit from water retention restoration	Water Retention (BDA)
59	Scotch Creek	From about 1 mile to 1.25 miles upstream of IGR	Line	Install BDAs in the meadow upstream of the barrier	Water retention	Scotch and Camp could benefit from water retention restoration. The meadow section has a year round spring. BDAs could also be highly beneficial for other aquatic and terrestrial species in the watershed	Water Retention (BDA)

Habitat Project Prioritization Results

Table 9. Average Technical Advisory Committee restoration project scores for each tributary.

Tributary	Project Count	Mean Weighted Project Score
Beaver Creek	1	3.6
Buck Creek	1	2.0
Camp Creek	3	2.4
Chert Creek	1	1.7
Clover Creek	2	2.1
Copco Springs	1	2.8
Crawfish Creek	4	2.4
Deer Creek	1	3.5
Edge Creek	2	1.8
Fall Creek	9	3.3
Frain Creek	1	2.5
Grouse Spring Creek	1	2.4
Hayden Creek	5	2.8
Jenny Creek	8	3.3
Klamath Mainstem	7	3.4
Long Prairie Creek	5	2.6
Mainstem Klamath, Long Prairie Creek, & Shovel Creek	1	4.7
Miners Creek	2	2.4
Scotch Creek	3	2.8
Shovel Creek	3	3.7
Spencer Creek	20	3.4
Total	**82**	**3.0**

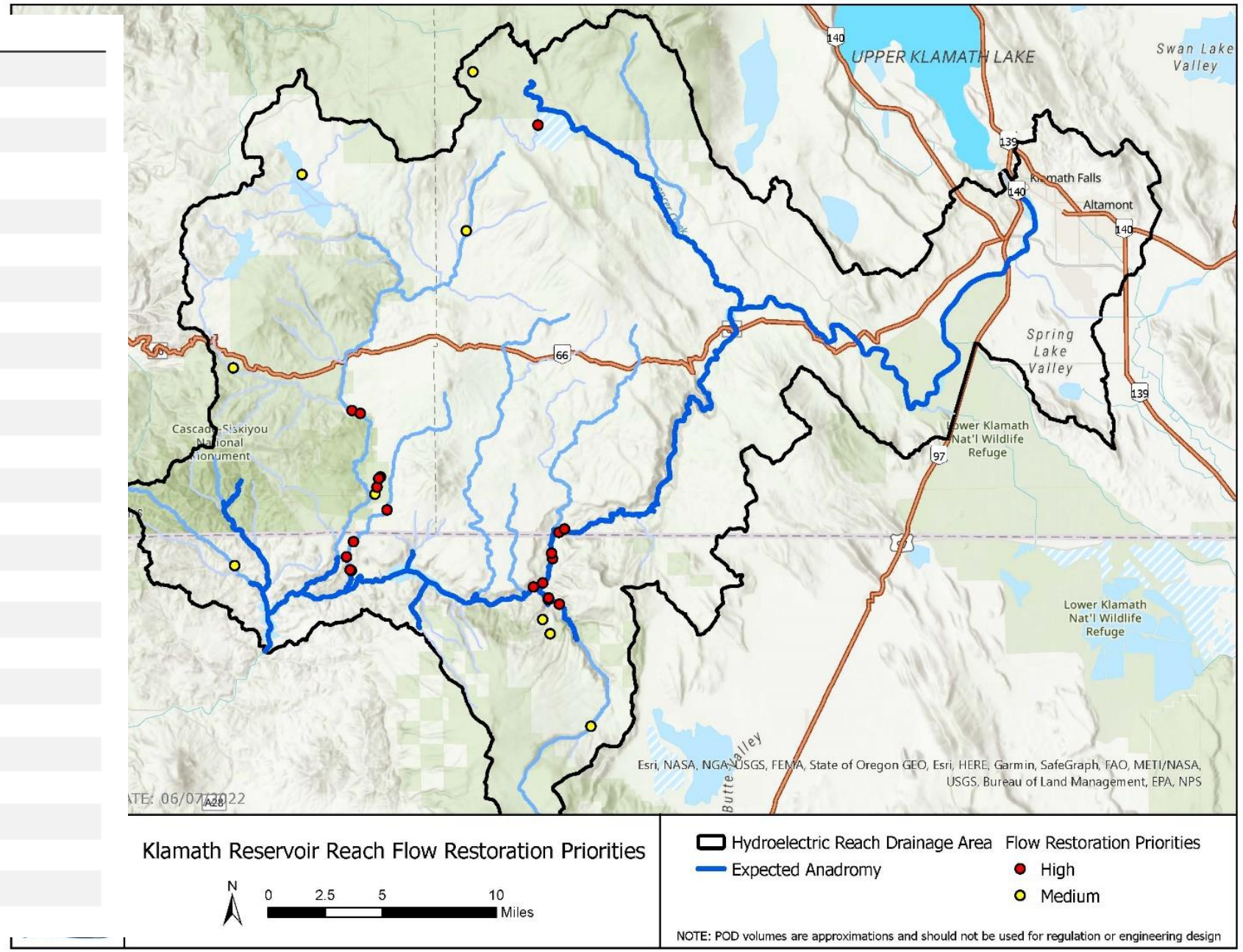
Rank	Project	Location	Project Description	Score	Tier
1	#108	Mainstem Klamath, Long Prairie Creek, & Shovel Creek	Purchase PacifiCorp Parcel A lands for conservation and future restoration	4.69	High
2	#109	Spencer Creek	Obtain a conservation easement in the Spencer Creek floodplain areas for conservation and future restoration	4.54	High
3	#95	Spencer Creek	Make Buck Lake a lake again <OR> regrade channels in the lake to improve habitat conditions, add LWD, BDAs, vegetation, and cattle fencing to the depositional valley 14J	4.34	High
4	#99	Shovel Creek	Regrade stream channel to allow for full floodplain reconnection in this reach, and add cattle fencing	4.17	High
5	#47	Jenny Creek	Develop Upper Jenny Creek riparian and fencing plan to address water quality and temperature	4.16	High
6	#48	Klamath Mainstem	Improve upstream and downstream passage at Keno and Link River Dams for all life-stages of anadromous fish	4.11	High
7	#110	Fall Creek	Assess impacts of agricultural practices and determine if a water quality improvement project would benefit Fall Creek	4.00	High
8	#70	Spencer Creek	Remove cattle operation or work with landowner to keep cattle out of the riparian area and revegetate the riparian zone. Modify or remove diversion infrastructure used for cattle to ensure fish passage. If cattle removal is not possible, add cattle fencing.	3.93	High
9	#89	Spencer Creek	Reconnect floodplain, add LWD, add cattle fencing, and increase riparian vegetation to the depositional valley 4C	3.88	High
10	#91	Spencer Creek	Remove berm, reconnect channel to floodplain, add LWD, add cattle fencing, and increase riparian vegetation to the depositional valley 5D	3.85	High

Flow Restoration Results

Tributary	High Priority	Medium Priority	Low Priority
Beaver Creek			19
Camp Creek			2
Deer Creek			2
Edge Creek			2
Fall Creek	6		18
Hayden Creek			2
Jenny Creek	4	9	47
Klamath River (downstream of Keno Dam)	6		4
Long Prairie Creek			1
Scotch Creek		1	3
Shovel Creek	3	3	1
Spencer Creek	4	2	5
	23	**15**	**106**

Flow Restoration Results – 38 medium and high Projects

Project Number	Primary Tributary	Priority Tier
FA-1a	Fall Creek	High
FA-2	Fall Creek	High
FA-3	Fall Creek	High
FA-4	Fall Creek	High
FA-5	Fall Creek	High
FA-6	Fall Creek	High
GS-1	Shovel Creek	High
JE-2	Jenny Creek	High
JE-4	Jenny Creek	High
JE-6	Jenny Creek	High
JE-7	Jenny Creek	High
KL-1	Klamath River	High
KL-2	Klamath River	High
KL-3	Klamath River	High
KL-4	Klamath River	High
KL-5	Klamath River	High
KL-6	Klamath River	High
SH-1	Shovel Creek	High
SH-2	Shovel Creek	High
SP-6	Spencer Creek	High
SP-7	Spencer Creek	High
SP-8	Spencer Creek	High
SP-9	Spencer Creek	High
JE-1	Jenny Creek	Medium
JE-10	Jenny Creek	Medium
JE-3a	Jenny Creek	Medium



Screening Project Methods

- Used OR and CA water right records from OWRD and CA Water Board and on the ground observations
- **Downstream of Keno (26)** – analyzed all diversions within 400 ft of potential anadromy using all three criteria shown below.
- **Upstream of Keno - 65 diversions** were evaluated during the field/boat survey using criteria 1 and 2 below. We did not have enough data to include category 3 for this reach. 10 were determined not to exist, leaving 55 to prioritize

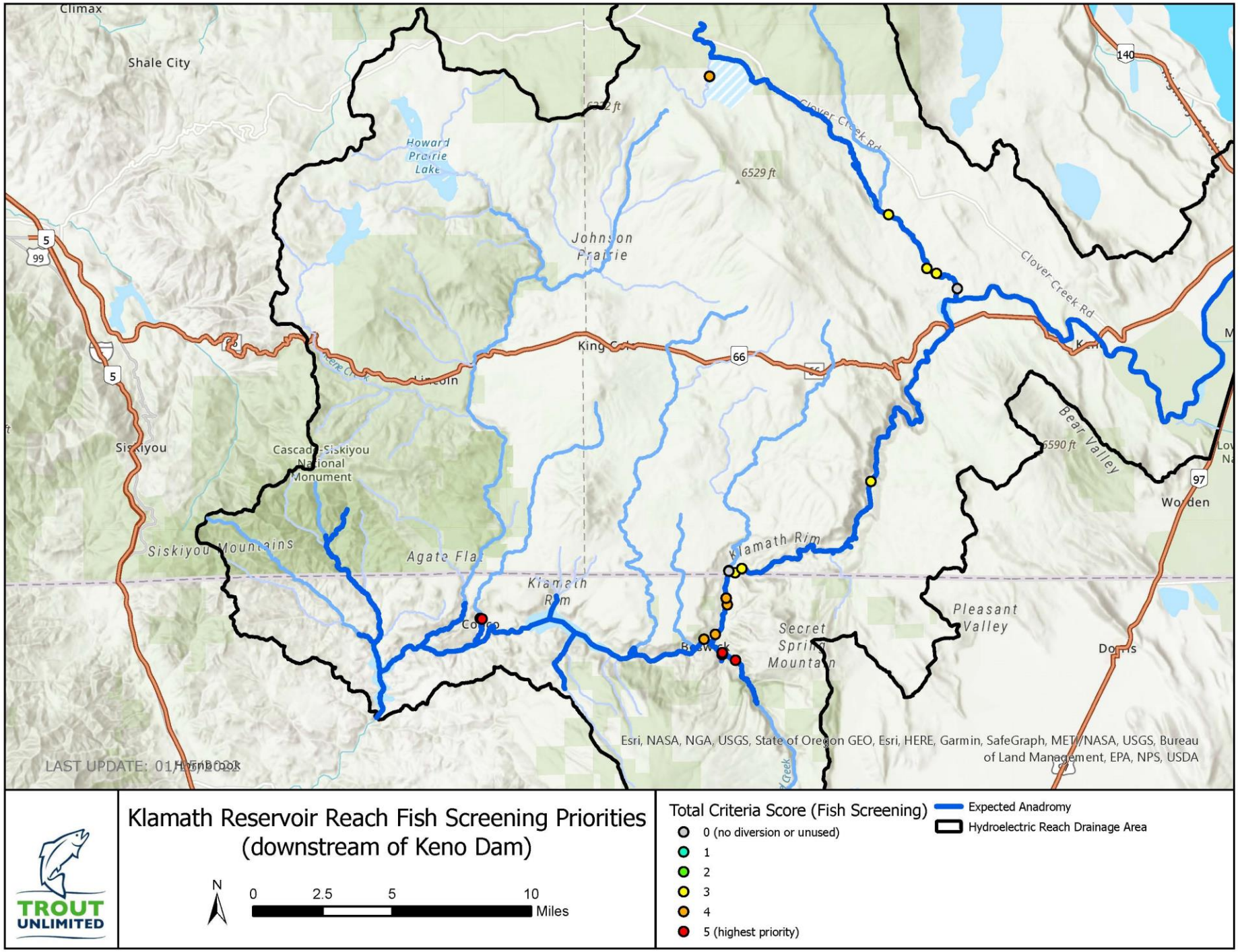
1. Diversion Size: Larger diversions are assigned a higher priority. Score depends on location of diversion (Klamath River Mainstem or Tributary). Estimates of mean September flow rates are derived from the NHD database.	2. Benefit to anadromous salmonids? Consider the number of anadromous salmonids and other native species of concern that will benefit from the project. For this analysis, seasonal races are considered one species.	3. Impact to Fish: Using best professional judgement, evaluate the potential impact to fish from the existing diversion. Factors to consider include entrainment potential, seasonality of diversion, existing infrastructure, and any other factors deemed relevant.
Weight: 0.2	0.2	0.6

Screening results (downstream of Keno)

20 unscreened diversions

3 screened diversions

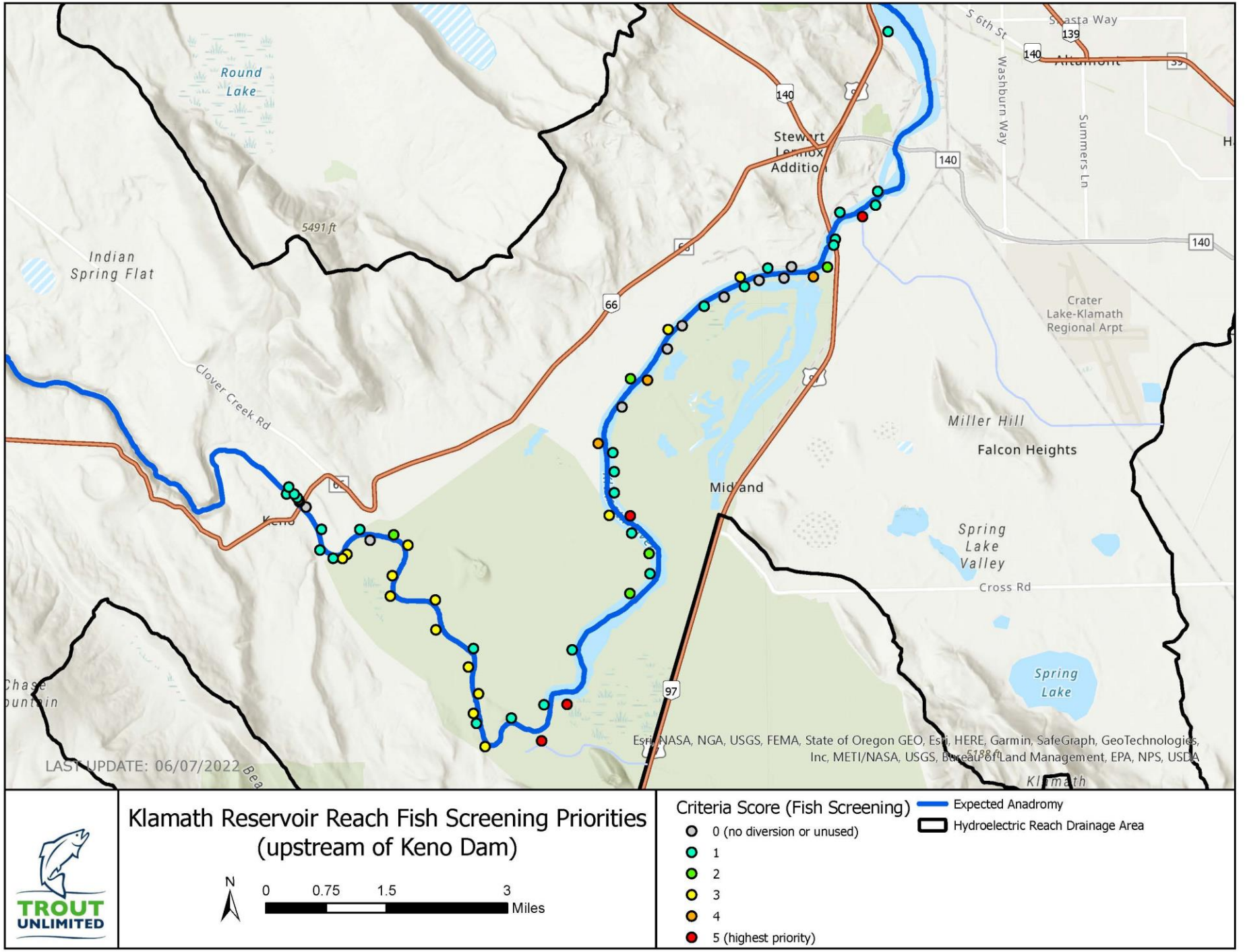
Fall Creek	**4**
Grouse Springs Creek	**1 (Screened)**
Klamath River Downstream of Keno	**8**
Shovel Creek	**2 (both screened)**
Spencer Creek (and tributaries)	**8**



Screening results (upstream of Keno)

50 unscreened diversions

5 screened diversions



Keno Impoundment Reach Top 15 List

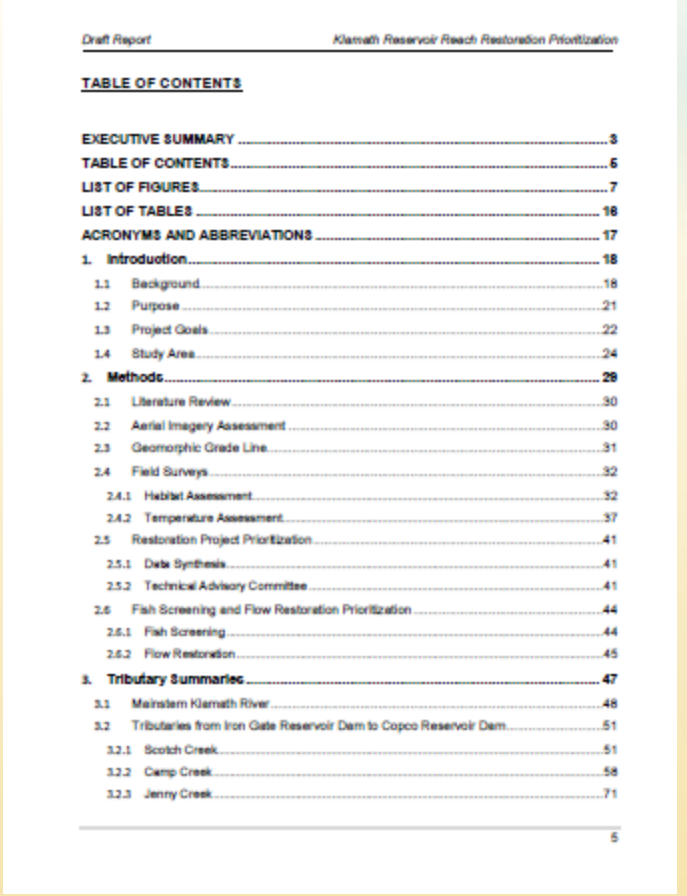
Project Number	Volume (cfs)	Priority Tier	Screened	Project Description
KENO-05	1903	High	no	Lost River Diversion Ditch, open canal at river, radial gates on canal 0.65 miles from river, can flow both directions, used year round
KENO-41	1102.6	High	no	Ady Canal, open canal at river, canal size limits flow to 350cfs
KENO-39	710.1	High	no	North Canal, open canal at river, fence to keep boats out, used year round
KENO-43	545.02	High	no	Klamath Straits Drain, open canal at river, only drains and does not divert from Klamath River
KENO-18	56.64	High	no	open canal at river
KENO-29	32.43	High	no	24" headgate
KENO-13	31.15	High	yes	2 options, pump or headgate. Pump has conveyor belt screen, headgate is unscreened. When pump doesn't work (at certain river levels), headgate is used (according to ODFW). Miller Island #1
KENO-12	20.4	High	no	pump, industrial intake with debris screen
KENO-45	15.18	High	no	24" headgate
KENO-14	14.81	High	unknown	Unclear if/how diversion functions. Heavily vegetated open canal at river
KENO-42	14.72	High	no	2, 24" headgates and one pump house, all unscreened. Unclear which is diversion and which is drain
KENO-49	14.07	High	no	open canal at river
KENO-51	13.33	High	no	24" headgate
KENO-53	13.33	High	no	24" headgate and pump
KENO-36	12.74	High	yes	vertical panel screen on canal at river

Some Caveats regarding our Methods

- Diversion rates in the fish screening data layers are based **on paper water rights**, are approximate and likely do not reflect actual diversion rates.
- Diversion rates are sometimes **maximum rates for a group of diversions**, which means that there would not be the listed rate coming out of each diversion simultaneously.
- Other factors that could potentially influence fish entrainment such as **microhabitat** conditions at the POD, **season and timing** of diversion, or diversion **infrastructure configuration** were outside the scope of this project and were not analyzed.
- The time and cost associated with assessing every diversion in this reach and its potential entrainment **risk is not feasible at this time** and should not preclude moving forward with screening diversions while continuing to prioritize other diversions in the basin.

Current Status and Next Steps

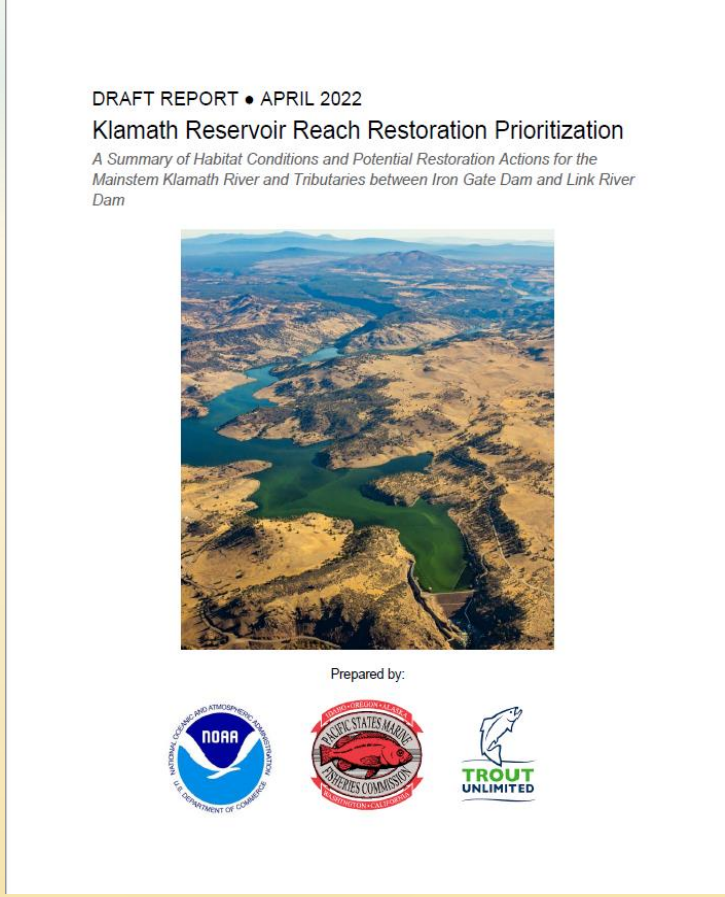
- We released the plan in December 2022. https://k3rp-psmfc.hub.arcgis.com/
- Start working on 82 habitat projects, 70 potential screening projects and 38 potential flow restoration projects.
- Continue collecting temperature data through at least 2023
- Outreach to irrigation discricts,water users, landowners, practitioners, stakeholders.



Draft Report — Klamath Reservoir Reach Restoration Prioritization

TABLE OF CONTENTS

5



DRAFT REPORT • APRIL 2022

Klamath Reservoir Reach Restoration Prioritization

A Summary of Habitat Conditions and Potential Restoration Actions for the Mainstem Klamath River and Tributaries between Iron Gate Dam and Link River Dam

Prepared by:

NOAA

PACIFIC STATES MARINE FISHERIES COMMISSION

TROUT UNLIMITED

Current Outreach Efforts to implement Restoration/Screening

- 27 groups interested in implementing this plan are meeting every 2-3 months to coordinate efforts and let the community know where they intend to work.
- The group met twice so far – Next meeting on May 2 from 1-3pm

NOAA	**Trout Unlimited**
BOR	**Caltrout**
BLM	**RES**
USFWS	**Klamath River Renewal Corporation**
CDFW	**Ducks Unlimited**
ODFW	**Mid Klamath Watershed Council**
Klamath Soil and Water Conservation District	**Klamath Watershed Partnership**
Family Water Alliance	**Ridges to Riffles**
Keno Irrigation District	**Shasta Indian Nation**
Klamath Water Users Association	**Karuk Tribe**
Klamath Drainage District	**Klamath Tribes**
Klamath Irrigation District	**Yurok Tribe**
Green Diamond	**Modoc Nation**
PacifiCorp	

Questions???

Appendix A - Tributary Summaries (pdf)
This document provides specific descriptions of the ownership, identified barriers, temperatur...
Explore

Appendix B: Project Prioritization Summary...
This document contains all of the restoration projects that we were able to identify during the 202...
Explore

Appendix C: Fish Screening Project...
This document has descriptions and photos of each diversion evaluated for fish screening...
Explore

Appendix D: Flow Screening Habitat Proje...
This spreadsheet shows the prioritized restoration projects categorized by habitat...
Explore

Appendix E-H: Methods, Scoring Criteria,...
This document describes the methods and data sources used for the habitat assessment and...
Explore

K3RP Restoration Projects
The layers in the geodatabase show restoration projects identified by the K3RP team....
Explore

K3RP KMZ Maps (zip)
These files show the location of habitat restoration, screening and flow projects identified...
Explore

K3RP Restoration Project Tool
GIS application to view results of the K3RP Habitat Project Prioritization List.
Explore

K3RP_FinalScreening_DSofKENO (layer package)
This layer shows fish screening priorities in the Klamath watershed between Keno Da...
Explore

K3RP_FinalScreening_USofKENO (layer package)
This layer shows fish screening priorities in the Klamath watershed between Lake...
Explore

K3RP_FinalFlowRestoration (layer package)
This layer shows flow restoration priorities in the Klamath watershed between Keno Da...
Explore

Supporting Materials: Temperature (zip)
These files include summarized stream temperature data collected within the Reservoir...
Explore

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https://k3rp-psmfc.hub.arcgis.com/