2016 Fall Chinook Salmon Spawning Ground Survey

Salmon-Scott Rivers Ranger District
Klamath National Forest

Prepared by
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March 31, 2017

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ABSTRACT

Cooperative spawning ground surveys between the U.S. Forest Service, California Department of Fish and Wildlife, Yurok Tribe, Karuk Tribe, Quartz Valley Indian Reservation, Salmon River Restoration Council, and local schools and volunteers have occurred on the Klamath National Forest since 1992. In addition to providing information to land managers in regard to where these fish spawn, these surveys are used to estimate the total in-river spawner escapement of Fall Chinook salmon (*Oncorhynchus tshawytscha*) by the Klamath River Technical Team and the Pacific Fisheries Management Council for determination of harvest allocations for the subsequent year.

The Salmon River and Scott River are surveyed on an annual basis using both carcass mark-recapture and redd count techniques. Mark-recapture of carcasses (and in some cases, redd counts) are used for population estimations. Redd counts are utilized on the rivers' tributaries, which may not be regularly visited during the spawning season. The 2016 cooperative survey began October 10th and ended December 9th. While surveys began with very low discharge, a series of storm events starting mid-October pushed stream flow to high levels which persisted through the spawning season. These flows affected the survey schedule for both drainages. Most surveys on Salmon River were cancelled. For the Scott River, many surveys were either cancelled or reach access curtailed due to high water. Overall survey effort was severely impacted. Due to timing and size, the storms may have negatively have affected fish spawning. Surveys in both drainages also included tributary visits.

Approximately 1,058 fish returned to the Salmon River and 1,515 fish returned to the Scott River. Run estimates, made by California Department of Fish and Wildlife, are compiled through a combination of redd count and mark-recapture carcass surveys. The Scott River also employs weir videography. Using data collected since initiation of organized surveys in 1978, year 2016 returns are below average for both Salmon River [ranked 35th (of 39 years)] and Scott River [ranked 37th (of 39 years)].

INTRODUCTION

Since 1978, the California Department of Fish and Wildlife (CDFW) has determined Fall Chinook salmon spawner escapement in the Klamath River watershed using a combination of weirs, mark-recapture surveys, redd surveys, and hatchery return information. This data is used in the determination of stock size projections for the management of Klamath River Fall Chinook salmon stocks by the Klamath River Technical Team and the Pacific Fisheries Management Council.

The CDFW, Klamath National Forest (KNF), and Six Rivers National Forest (SRNF) (the Forests are hereafter collectively referred to as USFS) have conducted Chinook spawner surveys for many years. Since missions differ among agencies, the objectives for these surveys were always slightly different. The USFS traditionally counted redds and live fish in order to estimate number and distribution of spawning Chinook salmon. Beginning in 1992, CDFW and USFS joined together to accomplish spawner escapement surveys, partially due to shrinking budgets in both State and Federal programs, but also the desire to increase cooperative operations between agencies. These surveys now include collaboration with the Karuk Tribal Government, Yurok Tribal Government, Quartz Valley Tribal Government, Salmon River Restoration Council, Siskiyou Resource Conservation District, Mid-Klamath Watershed Council, Northern California Resource Center, and local volunteers and public schools. The cooperative effort has improved the accuracy of CDFW estimates by enabling surveys that are more extensive and frequent in nature.

In fall 2016, a combination of redd and mark-recapture counts were completed in the Salmon River and Scott River drainages, including mainstems and tributaries, in order to determine Fall Chinook spawner escapement and distribution (**Table 1**). This report summarizes redd count surveys conducted from October 10th through December 9th on the KNF portion of the Salmon and Scott Rivers (i.e., within the Salmon-Scott Rivers Ranger District [SSRD]). The exception of this is Wooley Creek and the Salmon River below Nordheimer Creek, which were surveyed by SRNF personnel. Data from these locations is covered in documents produced by SRNF.

A separate report is prepared by CDFW biologists for the escapement estimates to be used by the fisheries management councils. A portion of the Fall Chinook MegaTable as compiled by the CDFW has been included in **Appendix A** (CDFW 2017).

Table 1. The 2016 survey schedule for KNF crews for the Salmon River and Scott River. Cooperators may have surveyed on days denoted as federal holidays when KNF crews were not present. On the Salmon River only, CDFW may have surveyed one or two reaches by boat when the water was otherwise unsafe to enter.

Survey Week	Scott River (Monday)	Salmon River (Tuesday)	No surveys on Wednesday	Scott River (Thursday)	Salmon River (Friday)
1	Oct-10 (ns - holiday)	Oct-11		Oct-13	Oct-14 (ns - high water)
2	Oct-17 (ns - high water)	Oct-18 (ns - high water)		Oct-20	Oct-21
3	Oct-24	Oct-25 (ns - high water)		Oct-27 (ns - high water)	Oct-28 (ns - high water)
4	Oct-31 (ns - high water)	Nov-01 (ns - high water)		Nov-03 (ns - high water)	Nov-04
5	Nov-07	Nov-08		Nov-10	Nov-11 (ns - holiday)
6	Nov-14	Nov-15 (ns - high water)		Nov-17 (ns - high water)	Nov-18 (ns - high water)
7	Nov-21 (ns - high water)	Nov-22 (ns - high water)		Nov-24 (ns - holiday)	Nov-25 (ns - holiday)
8	Nov-28	Nov-29 (ns - high water)		Dec-01	Dec-02 (ns - high water)
9	Dec-05 (ns - high water)	Dec-06 (ns - high water)		Dec-08 (Last day Scott)	Dec-09 (ns - high water; last day Salmon)

*ns - no survey

METHODS

In 2016, redd surveys were conducted on the Salmon River and Scott River, as well as various tributaries. **Table 2** summarizes each reach for 2016, including reach number and length, number of times surveyed, and total number of redds counted over the course of the survey season. Each mainstem reach of the respective rivers were to be surveyed once to twice weekly, but high water impacted the schedule, especially Salmon River.

- Salmon River is surveyed from mile marker 10 on the North Fork (NF) to the confluence with the South Fork (SF); Matthews Creek campground on the SF to the confluence with the NF; and the mainstem Salmon River from the confluences to Nordheimer Creek. The NF also includes occasional surveys from mile marker 12 to mile marker 10.
    - Tributaries surveyed in 2016 include Blackbear Creek, Knownothing Creek and its forks, Little North Fork Salmon River, Methodist Creek, and Nordheimer Creek.
    - The mainstem below Nordheimer Creek and Wooley Creek are surveyed on a different schedule by SRNF personnel, and is detailed in a separate report.

- Scott River is surveyed from Callahan in the upper Scott Valley to the confluence of the Klamath River. Reaches below Meamber Bridge were led by a CDFW/KNF agency cooperative; and reaches above Meamber Bridge were conducted by the Siskiyou Resource Conservation District. Lack of access across or through private property excluded some segments or portions within reaches from survey, particularly in the valley.
    - Tributaries surveyed in 2016 include canyon tributaries of Canyon Creek, Kelsey Creek, and Tompkins Creek; and valley tributaries of French Creek, Shackleford Creek, and Sugar Creek.

The USFS and CDFW held two training sessions for agency employees, Tribal employees, and volunteers. On October 4th, the redd survey/carcass mark-recapture training was held at Indian Scotty Group campground on the Scott River. Similar training was held at Oak Bottom River Access on the mainstem Salmon River on October 5th. Topics discussed at the trainings incorporated redd and fish identification; carcass marking, including the explanation of mark-recapture estimates; scale and otolith sampling; data collection; salmonid life cycles; and survey safety procedures.

Table 2. Fall Chinook spawning survey reach descriptions for Salmon River and Scott Rivers in 2016. Salmon River reaches surveyed by Six Rivers National Forest not included.

Stream Name	Reach Name	Reach Number	Miles	Number of Times Surveyed[1]	Total Number of Redds Surveyed…
Salmon River					
Mainstem	Otter Bar to Nordheimer Ck	4A	1.6	6	22
	Forks of Salmon to Otter Bar	4B	2.4	7	17
North Fork	Mile 2 to Forks of Salmon[2]	9A	2.0	2	9
	Mile 4 to Mile 2	9B	2.0	2	13
	Mile 6 to Mile 4	10A	2.0	1	12
	Mile 8 to Mile 6	10B	2.0	0	0
	Mile 10 to Mile 8	11A	2.0	0	0
	Mile 12 to Mile 10	11B	2.0	1	0
South Fork	Henry Bell to Forks of Salmon	5A	3.0	3	21[3]
	O'Farrill Gulch to Henry Bell	5B	2.0	3	26
	Indian Ck to O'Farrill Gulch[2]	6A	3.0	3	24
	Matthews Ck to Indian Ck	6B	2.2	1	23
Tributaries	Blackbear Creek		1.5	1	0
	Knownothing Creek		2.5	1	1
	Knownothing Ck (EF)		1.5	1	0
	Knownothing Ck (WF)		1.7	1	1
	Little NF Salmon River	A (lower)	2.3	1	0

Stream Name	Reach Name	Reach Number	Miles	Number of Times Surveyed[1]	Total Number of Redds Surveyed…
	Methodist Creek		2.4	2	1
	Nordheimer Creek	A (lower)	1.8	2	1
Scott River					
	Midpoint to Confluence	1	2.5	7	51
	"Cabin Hole" to Midpoint	2	2.5	7	47
	George Allen to "Cabin Hole"[4]	3	3.0	8	36 (4)
	Tompkins Creek to George Allen	4	2.5	6	20
	Bridge Flat to Tompkins Creek	5	4.0	5	5
	CDFW Weir to Bridge Flat	6	3.8	4	6
	USGS Gauge to CDFW Weir	7	3.5	5	0
	Shackleford Creek to USGS Gauge	8	2.9	6	24
	Oro Fino Creek to Meamber Bridge	9	3.0	5	1[5]
	Hwy 3 to Oro Fino Creek	10	3.0	0	Not surveyed
	Eller Lane to Hwy 3	11	7.0	4	0[5]
	Sweezy to Eller Lane	12	2.5	8	0[5]
	Horn Lane to Sweezy	13	3.0	8	11[5]
	Young's Dam to Horn Lane	14	2.0	10	16[5]
	Fay Lane to Young's Dam	15	3.5	2	61[5]
	Callahan to Fay Lane	16	6.7	0	2[5]
Tributaries (Canyon)	Canyon Creek		1.3	3	0
	Kelsey Creek		0.6	3	0
	Tompkins Creek		2.5	2	0
Tributaries (Valley)	French Creek		2.5	3	2[5]
	Shackleford Creek		2.6	5	8[5]
	Sugar Creek		1.4	2	0[5]

[1]Flagging marking redds may have been removed prior to end of carcass surveys. "Times Surveyed" includes ALL surveys, even those performed end-of-season when redds may have been no longer counted.
[2]Several locations may not flagged due to crew safety concerns (Reach 6A) or request to avoid a redd concentration area by adjacent landowner (Reach 9A). Any numbers in parenthesis represent the maximum number of unflagged redds observed during a single survey and not accounted for via GPS.
[3]Reach 5A (Henry Bell to Forks of Salmon) is not flagged. Number reported is the maximum number of observed redds (10/11/16).
[4]Portions of private property in Reach 3 of Scott River not flagged, although property was still traversed. Numbers in parenthesis is the maximum number of unflagged redds.
[5]Scott River reaches 9 through 16 and valley tributaries are not flagged. Number reported is the total number of observed redds. See the text and associated Table 3 for additional information, including date of maximum observance. Additionally, the portion of the reaches actually surveyed is dependent upon landowner access.

On the Salmon and Scott Rivers, crews conducted two concurrent protocols on survey reaches, using redd counts and carcass counts (CDFW 2016). A typical crew consisted of two people. Each crew walked two to four miles of river each survey day unless health or safety concerns limited ability to survey. The number of times a reach was surveyed was directly related to the number of people available on the survey dates. When a lack of available surveyors was a concern, the reaches to be surveyed were determined by the level of activity observed on the prior survey date and personnel knowledge of the system. Access to private land was also a limiting factor on the Scott River. An attempt was made to have people survey different reaches throughout the season so as to reduce estimator bias.

On both rivers, all redds were counted, flagged, and location marked on a topographic map, with total number of redds tallied at the end of each reach. Reaches where redds were not marked due to safety or landowner preference regarding flagging on their property are listed below. Additionally, redds (where flagged) were characterized as to size (width/length) and habitat type in which it was observed. Throughout the season redds were GPSed. Original field maps of redd locations are available at the Salmon-Scott Rivers Ranger District Office in Fort Jones, CA.

- Salmon River, not flagged – Reach 5A; canyon segment of 6A
- Scott River, not flagged – portion of Reach 3 in front of a landowner's house

RESULTS

Salmon River

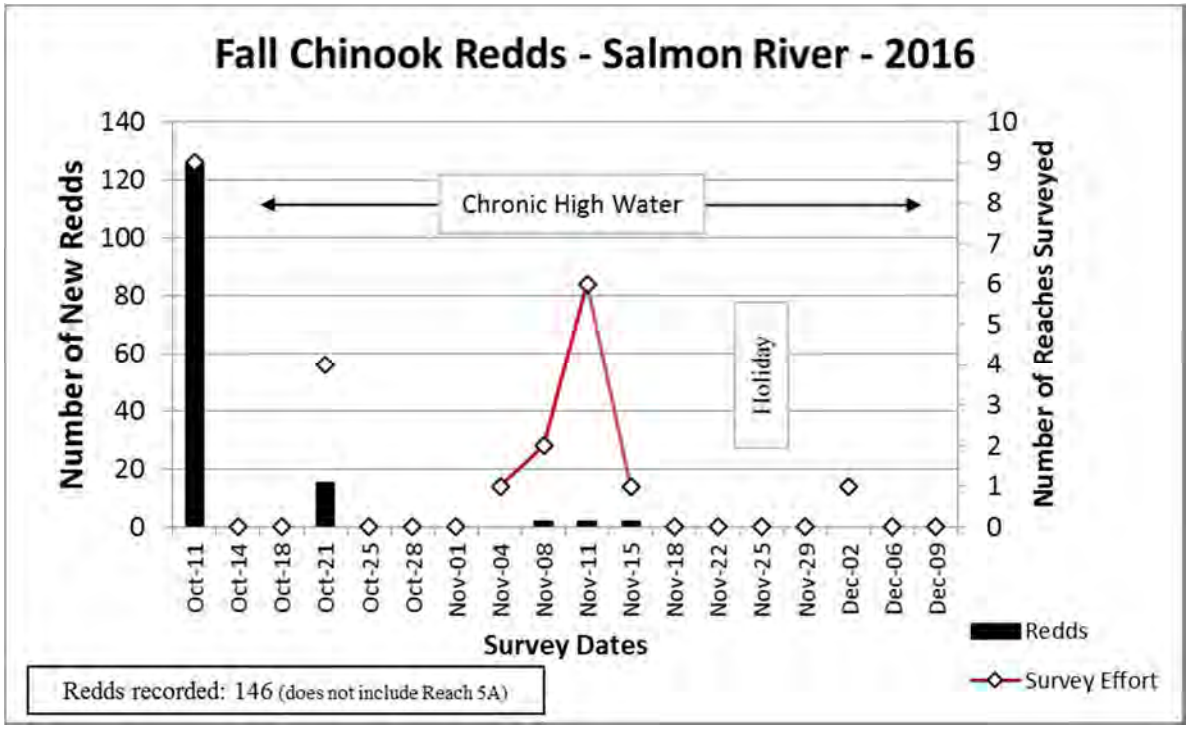
Overall effort on the Salmon River was very poor. High, turbid, and unsafe water conditions characterized much of the survey season following a series of large storm events which began in mid-October (**Appendix B**). Due to the high energy character of the Salmon River, combined with challenging terrain, many survey days were cancelled. Reach 4 was surveyed more consistently than other reaches because CDFW had boats that allowed access in flows too high for walking. However, even when rafting, conditions were often too difficult to allow for an comprehensive survey effort. Furthermore, high water was observed to "flatten" redds such that sites marked early in the season were unable to be discerned later because of substrate movement. It is likely that many redds were missed through the course of the survey season. Tributary surveys occurred in early November when creeks could be accessed, but the mainstem/forks were mostly too high for safe entry.

The Salmon River probably reached peak spawning in early- or mid-October (**Figure 1**). In most years since 2010 when detailed reporting of survey efforts upon the SSRD began, the temporal pattern for the Salmon River is for spawning to be heavy at the survey start, with a subsequent decline in number of new redds thereafter, except when a freshet may trigger an uptick. In 2016, peak date and temporal pattern cannot be determined due to high water and turbid conditions causing cancellation of surveys; and even when surveyors were able to walk reaches, ability to observe redds was negatively impacted. Overall survey effort was affected by number of surveyors available, weather, and flows. See **Appendix C** for a table of redd numbers organized by reach and date.

Prediction for fish returning to the Klamath River system, including Salmon River, was for low numbers. How fish may have distributed themselves in a low-run year is unknown due to the confounding factor of high water disrupting the survey effort. The little data able to be gathered suggests that fish were primarily spawning in concentrated use areas and other often-used

locations as identified in past years. Only 143 redds were identified in 2016, not including Reach 5A (and 164 redds with Reach 5A). This is compared to an average of ~830 redds and ~925 redds, respectively as per previous, for surveys conducted between 2011 and 2015. Unlike other years, no reach recorded over 100 redds. Reach 5B (SF Salmon River) had the most spawning recorded with 25 redds. See **Appendix D** for redd spatial distribution and location information.

Figure 1. Fall Chinook redds observed and survey effort on the Salmon River in 2016. Surveys occurred on NF Salmon River from Mile 12 to Forks of Salmon; on SF Salmon River from Matthews Creek to Forks of Salmon; and on the mainstem Salmon River from Forks of Salmon to Nordheimer Creek.



Specific areas of the Salmon River display a greater preference for use by spawning Fall Chinook. The mapping of redds by GPS (with hardcopy map back-ups) since 2011 is revealing patterns. There are areas which show annual use at low densities, as well as scattered redds which likely represent opportunistic use of habitat which may be locally limited in extent or transient. There are also sites that have shown heavy use only once (and light or no use otherwise), and which may indicate exploitation only when certain conditions are met, such as water flow or fish return numbers.

Focus for the concentrated use area dataset is upon locales which exhibit multiple years of use at moderate or greater density of redds. Specifically, “concentrated use areas” are defined as redd groups which possess a minimum density of 6 redds within an approximate 100 meter linear distance in at least two years since 2011. Exceptions for inclusion in the dataset includes spawning seasons of exceptional drought [i.e., 2015] or when persistently high early season flows confounded survey effort [i.e., 2016]. Due to possible changes in fish patterns during years of exceptional drought, data from those seasons will be collected as they occur and eventually collated into their own dataset.

New for 2016 is the addition of a regular use area dataset which identifies well-defined clusters of redds which occur in the same location every or most years. The concentrated use area dataset is a subset of the larger regular use area dataset, which additionally includes sites which do not meet the strict linear density requirement of the former. Locales often represent pool tail-outs or lower gradient riffle/glide areas.

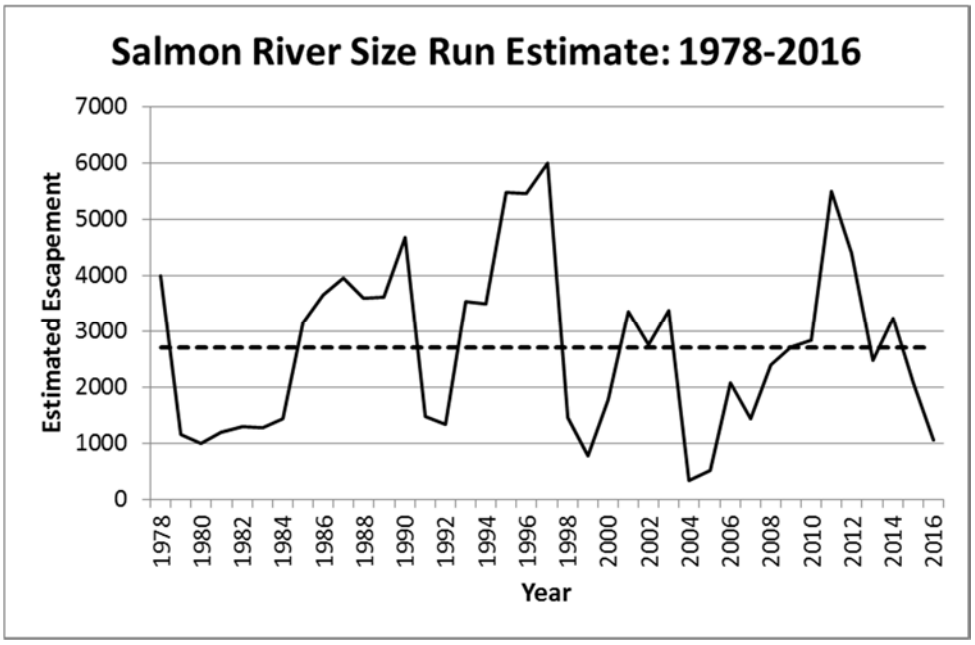
Continued acquisition of data will better refine identified concentrated use areas, as well as further define other sites with consistent, but lighter, use. In particular, additional data is needed to determine the trigger conditions for spawning grounds with occasional, yet heavy, utilization.

- Mainstem Salmon River (Nordheimer Creek to Forks of Salmon – ~4.0 miles)
    - 17 regular use areas
    - 11 concentrated use areas (subset of regular use areas)
        - Notable sites include upstream of Otter Bar; Horn Field; and the river access at Forks of Salmon (below the school).
- North Fork Salmon River (Forks of Salmon to Kelly Gulch – ~12.0 miles)
    - 37 regular use areas
    - 18 concentrated use areas (subset of regular use areas)
        - Notable sites include Forks of Salmon from Post Office to mouth; Pollocks Gulch vicinity; and Red Bank engine access.
- South Fork Salmon River (Forks of Salmon to Matthew Creek – ~10.2 miles)
    - 44 regular use areas
    - 25 concentrated use areas (subset of regular use areas)
        - Notable sites include upstream from Knownothing Creek; Hotelling Gulch vicinity; approximate river mile 4.3; County Road 1C02 river crossing downstream of O'Farrill Gulch; downstream/upstream of Methodist Creek; and Matthews Creek vicinity.

The GoogleEarth redd overlay will be updated to include the addition of a regular use area dataset. The concentrated use area portion of the dataset will not be updated due to lack of a suitable annual dataset since 2014 to alter/adjust currently mapped localities.

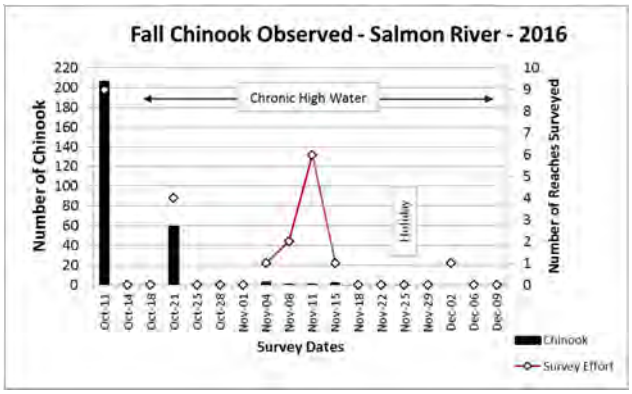
Using survey data, the Salmon River is estimated to have had 1,058 fall-run Chinook salmon return in the fall of 2016 (**Figure 2**; **Appendix A**). Based on long-term tracking data compiled by CDFW, 2016 was below average, ranking 35th (of 39 years) for run size.

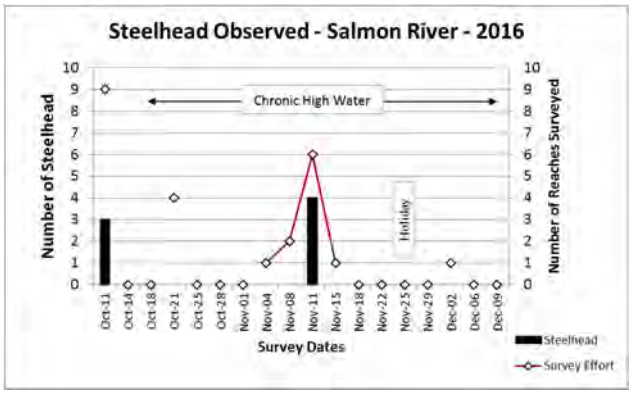
Figure 2. Salmon River fall-run size estimates for 1978 to 2016. Dashed line is average over long-term survey period.



Live Chinook and steelhead were tallied during surveys (**Figure 3**). As with redds, fish observation is affected by number of surveyors, weather, discharge conditions, and surveyor experience. Peak live Chinook was observed on the first survey of October 11th; and steelhead numbers were low throughout the survey season. Similar to the redd count, river conditions of extended high discharge and turbidity negatively affected ability of surveyors to walk/boat reaches, or detect fish when it was safe to enter the water. It is likely more Chinook and steelhead were present than were reported. See **Appendix C** for a table of fish numbers organized by species, reach, and date.

Figure 3. Observation of Fall Chinook and steelhead during the 2016 Salmon River surveys.





No Coho were incidentally observed during the Fall Chinook surveys.

Salmon River tributary surveys occurred during early-November. Similar to mainstem and forks surveys, high water and turbid conditions limited timing of tributary visits. In early-November, the Salmon River was largely unsafe to enter, but conditions on tributaries were suitable for survey. Chinook salmon redds and live Chinook were observed on Knownothing Creek,

Methodist Creek, and Nordheimer Creek; and WF Knownothing Creek recorded redds only. No steelhead were seen on any tributary.

Scott River

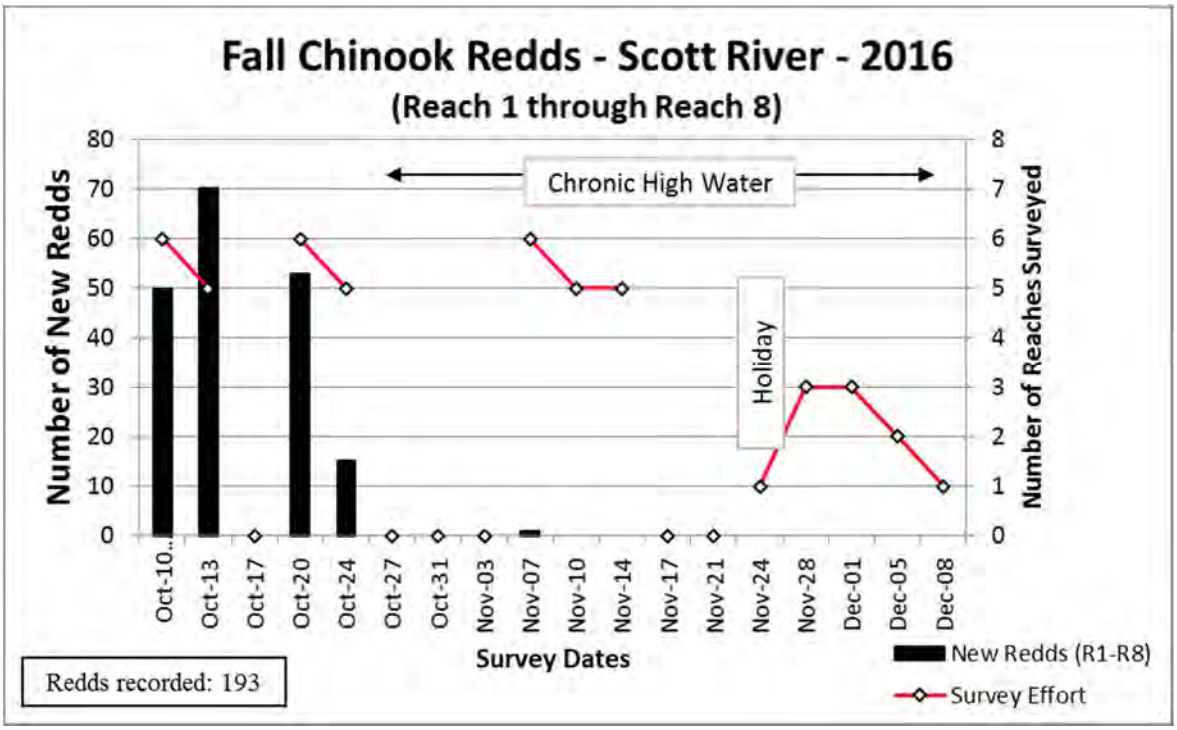
Overall effort on the Scott River was very poor. High, turbid, and unsafe water conditions characterized much of the survey season following a series of large storm events which began in mid-October (**Appendix B**). While the river was overall more accessible than the Salmon River, surveyors were often forced to walk their reach together along one bank, which limited the ability to search. Furthermore, high water was observed to "flatten" redds such that sites marked early in the season were unable to be discerned weeks (or days) later because of substrate movement. It is likely that many redds were missed through the course of the survey season.

Based on the available data, the Scott River reached the peak of spawning in mid-October for Reach 1 through Reach 8 (**Figure 4**). Similar to the Salmon River, the exact date is difficult to determine due to high water and turbid conditions inhibiting the ability of surveyors to observe redds. Multiple survey cancellations because of unsafe river discharge also impacted data collection. Overall survey effort was affected by number of surveyors available, weather, and flows. See **Appendix C** for a table of redd numbers organized by reach and date.

Access to portions of Reach 2 and Reach 3 which traverse private property in the lower Scott River has been an issue most years since 2010. Starting in 2015, direction was to walk and flag all properties. The only exception is Reach 3 within the riverfront viewscape of the Trabucco residence, where no flags are hung for several hundred feet. In this location, all redds are counted each time. The maximum number of unflagged redds observed during a single survey in Reach 3 was 4. Redds in the unflagged portions of this reach are not included in final map outputs.

Prediction for fish returning to the Klamath River system, including Scott River, was for low numbers. How fish may have distributed themselves in a low-run year is unknown due to the confounding factor of high water disrupting the survey effort. The little data able to be gathered suggests that fish were primarily spawning in concentrated use areas and other often-used locations as identified in past years. The number of redds recorded in Reach 1-8 in 2016 was 193, as compared to the range of 476 to 1128 redds (annual average ~830) counted between 2011 and 2015. As a consequence of the low redd count, redd density throughout the survey area was also low, even within areas of normally elevated use. **Appendix D** for redd spatial distribution and location information.

Figure 4. Fall Chinook redds observed and survey effort on the Scott River in 2016. Due to differences in redd tracking between canyon and valley reaches, data displayed is for Reach 1 through Reach 8 only.



The Siskiyou Resource Conservation District (RCD) performed redd and carcass surveys upon private property from Reach 9 through Reach 16, as well as several Scott Valley tributaries. Landowner preference is to leave redds unflagged. Normally, because "new" and "old" redds cannot be reliably differentiated, all redds are counted during each survey date. However, for 2016, the amount of spawning was so low that GPS was able to be used to track individual redds and log the appearance of new construction (L. Magranet, per. comm). A total of 91 redds were recorded; and peak spawning for most reaches was reached in the latter half of October (**Table 3**). Similar to the canyon reaches, the Scott Valley reaches and tributaries experienced high flow in October. Because of the storm event, redds both completed and in-progress were flattened; and water visibility afterwards was limited. For additional information concerning the Scott Valley effort, contact RCD for a copy of their spawning survey report.

Table 3. Total number of redds and date of maximum observed for Reach 9 through Reach 16 for Scott River in 2016.

	Reach 9	Reach 10	Reach 11	Reach 12	Reach 13	Reach 14	Reach 15	Reach 16	Total
Total Redds	1	N/A	0	0	11	16	61	2	91
	Oct-26				Oct-24	Oct-24	Oct-24	Dec-05	

Specific areas of the Scott River display a greater preference for use by spawning Fall Chinook. The mapping of redds by GPS (with hardcopy map back-ups) since 2011 is revealing patterns. There are areas which show annual use at both high and low densities, as well as scattered redds which likely represent opportunistic use of habitat which may be locally limited in extent and/or only available under certain discharge conditions.

Focus for the concentrated use area dataset is upon locales which exhibit multiple years of use at moderate or greater density of redds. Defined the same as for the Salmon River, "concentrated use areas" are sites which possess a minimum density of 6 redds within an approximate 100 meter linear distance in at least two years since 2011. Exceptions for inclusion in the dataset includes spawning seasons of exceptional drought [i.e., 2015] or when persistently high early season flows confounded survey effort [i.e., 2016]. Due to possible changes in fish patterns during years of exceptional drought, data from those seasons will be collected as they occur and eventually collated into their own dataset.

New for 2016 is the addition of a regular use area dataset which identifies well-defined clusters of redds which occur in the same location every or most years. The concentrated use area dataset is a subset of the larger regular use area dataset, which additionally includes sites which do not meet the strict linear density requirement of the former. Locales often represent pool tail-outs or lower gradient riffle/glide areas.

Continued acquisition of data will better refine identified concentrated use areas, as well as further define other sites with consistent, but lighter, use.

- Scott River (Reach 1 through Reach 8 – ~24.5 miles)
    - 76 regular use areas
    - 39 concentrated use areas (subset of regular use areas)
        - Notable sites include Johnson Bar River Access; County Road 7F01 (Scott River Road) bridge above Johnson Bar; approximate river mile 2.9 (above Middle Lick Gulch); swimming hole just upstream of Scott Bar; Gold Flat River Access; Middle Creek vicinity; Indian Scotty Campground; and most locales in Reach 8.

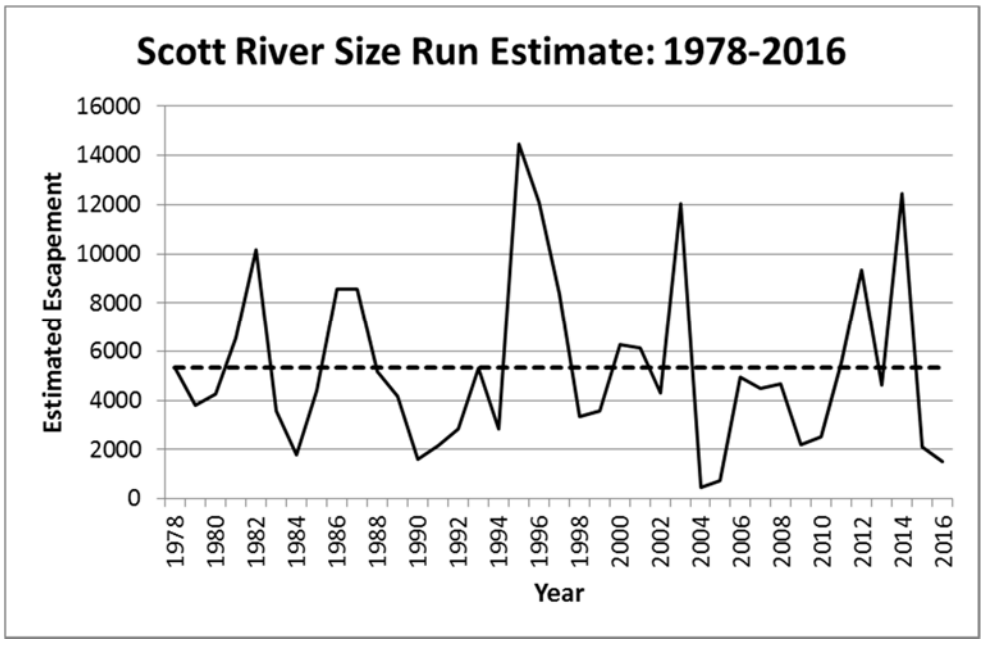
In 2015, several locations were provisionally identified for inclusion to the concentrated use dataset, but another year of observation under less extreme discharge conditions is required for confirmation.

- Scott Bar upstream/downstream of the bridge. Elevated use has been visually observed in the past, but 2015 was the first year with a season-long GPS dataset. (Surveys through town either did not occur or were sporadic 2011 to 2014).
- Two locations in the vicinity of private (Trabucco) property. In 2015, the private property, except within line-of-sight of the house, underwent comprehensive survey for the first time, including flagging of redds. Previous surveys in this segment of Reach 3 (2011 to 2014) either did not occur, were sporadic, and/or flagging was not set.
- Possible extension of concentrated use area at Schuler Gulch. Extension may represent an area which has greater spawning under conditions of lower discharge. Low discharge may be season-long (as in 2015), else earlier season prior to stormwater inputs.

The GoogleEarth redd overlay will be updated to include the addition of a regular use area dataset. The concentrated use area portion of the dataset will not be updated due to lack of a suitable annual dataset since 2014 to alter/adjust currently mapped localities.

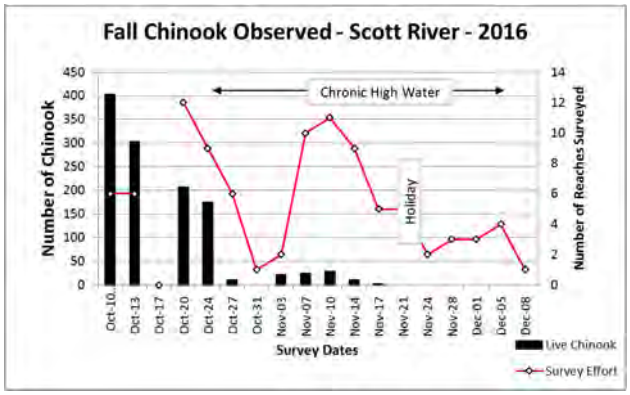
Using survey data and video weir observation, the Scott River is estimated to have had 1,515 Fall Chinook salmon return in 2016 (**Figure 5**; **Appendix A**). Based on long-term tracking data compiled by CDWF, 2015 was below average, ranking 37th (of 39 years) for run size.

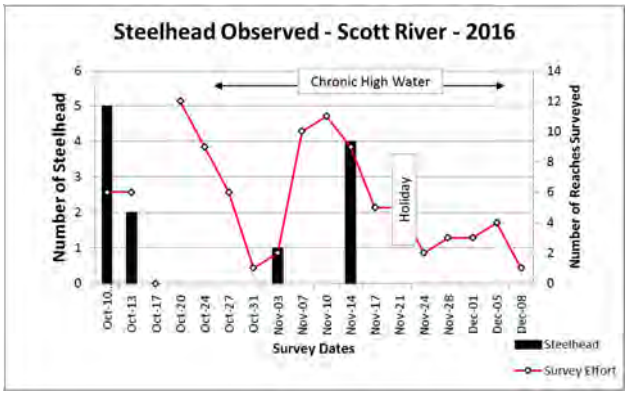
Figure 5. Scott River fall-run size estimates for 1978 to 2016. Dashed line is average over long-term survey period.



Live Chinook and steelhead were tallied during surveys (**Figure 6**). As with redds, fish observation is affected by number of surveyors, weather, discharge conditions, and surveyor experience. Peak live Chinook was observed in mid-October; and steelhead numbers were generally low. Similar to the redd count, river conditions of extended high discharge and turbidity negatively affected ability of surveyors to detect fish. Additionally, the few crewmembers whom attempted to snorkel reported a poor ability to see to the bottom of pools where fish (and carcasses) typically congregate. It is likely more Chinook and steelhead were present than were observed. See **Appendix C** for a table of fish numbers organized by species, reach, and date.

Figure 6. Observation of Fall Chinook and steelhead during the 2016 Scott River surveys (all reaches).





Coho were incidentally observed during the Fall Chinook surveys:

- November 14th
  - 2 Coho observed in Reach 1 (Confluence to Mid-Point)
- December 8th
  - 1 Coho observed in Reach 8A (Graveyard Gulch to USGS Gage)
- November/December
  - Multiple Coho observed in Scott River Reach 15 and Reach 16, French Creek, and Shackleford Creek by RCD crews

Scott River tributary surveys occurred during October, November, and December (**Appendix C**).

- Canyon Reaches: Neither live fish, carcasses, nor redds were seen within Canyon Creek, Kelsey Creek, or Thompkins Creek.
- Valley Reaches: Live fish, carcasses, and redds were seen in French Creek and Shackleford Creek. Neither fish (live/dead) nor redds were reported at Sugar Creek.

DISCUSSION

The survey season for 2016 was characterized by wet weather. Starting in mid-October, the remains of Typhoon Songda, after crossing the Pacific Ocean from Japan, brought an unusual amount of early fall rain across the region. Further storms followed; and while they were not associated with the typhoon, they set a pattern of regular rain events of higher intensity than has been observed for many years. Consequently, elevated flows and turbidity within the Scott and Salmon Rivers negatively impacted surveys and caused multiple cancellations. As usual, the Salmon River drainage was more impacted by precipitation than the Scott River due to a generally west-facing aspect of the former that intercepts storms moving inland from the ocean.

In addition to weather, low salmon numbers also defined the 2016 survey season. Early-season prediction for Fall Chinook returns to the Klamath River basin was for a low run year, potentially the lowest in nearly two decades (KRRT 2016). The general impression from the first survey day for both Salmon River and Scott River was of lower-than-normal fish numbers and redds. However, Fall Chinook can exhibit a variability in regards to spawn timing. For example, Scott River in 2011 and 2014 had initial redd numbers similar (or lower) than 2016; and spawning peaks did not arrive until late-October to early-November. A major contrast is that both those years had considerably more fish observed in the river, a condition lacking in 2016. An accurate estimate of fish/redd numbers in Scott/Salmon Rivers cannot be provided in detail for 2016 because of the impact to survey effort by the storm events. However, the impression of low fish numbers was consistent with data reported around the region, including the Trinity River system (spawning surveys, Trinity River Hatchery, Willow Creek Weir), Scott River and Shasta River video weirs, and other similar sources. The final estimate of run size by CDFW confirmed run size throughout the Klamath Basin to be one of the lowest on record since 1978 (**Appendix A**).

See **Table 4** for a summary of discharge, storm timing, and run size since 2011 for Salmon River and Scott River.

The effect high water had upon Fall Chinook distribution within the Scott River and Salmon River drainages is unclear. Low water has a clear impact to fish distribution by creating low-water barriers which are difficult to navigate; and the impact is compounded in those years, such as 2015, when fall freshets fail to materialize, thus prolonging the drought baseflow condition. Theoretically, the arrival of a significant storm, especially when occurrence is near the start of the spawning season, should allow fish to ascend higher in the drainage than usual, including the entry into normally inaccessible tributaries. Unfortunately, it is unknown if such happened in 2016 due to surveys confounded by unsafe water conditions and turbidity, as described previously in this document, negatively impacting effort. The small run size also inhibited any attempt to determine adult distribution. Not only were there fewer fish for crews to observe, when they could access the river, but animals were very efficient at predating/scavenging the few fish and/or carcasses persent. In contrast to a larger run year, the number of fish overwhelms what animals can eat, leaving plenty of fish for surveyors to recorded. The potential impact of high water upon Fall Chinook distribution may be better clarified during summer 2017 when federal/state agencies, tribes, and non-governmental entities perform juvenile salmonid surveys. While the surveys are neither coordinated nor comprehensive, data collected may show if some Chinook were able to successfully access and spawn in higher drainage areas.

Table 4. Summary of river discharge, storm timing, and Fall Chinook run size for Salmon River and Scott River for 2011 through 2016.

Year	Salmon River			Scott River		
	Discharge[1]	Storms[2]	Run Size[3]	Discharge	Storms	Run Size
2011	Normal	Early Late	Well above average	Normal	None	Average to above
2012	Normal	Mid-Late Late	Well above average	Low	Late	Well above average
2013	Normal to low	Early Late	Average to below	Very low to low	None	Below average
2014	Normal	Mid-Early Mid-Late Late	Above average	Low to normal	Mid-Early Late	Well above average
2015	Low to very low	None	Below average	Very low	None	Well below average
2016	High to very high	Mid-Early Mid-Late Late	Well below average	Very high to high	Mid-Early Mid-Late Late	Well below average

[1]Discharge – defined using the same daily discharge percentile cut-offs as the USGS gage dataset (see Appendix B for gage locations). Only considered for the active survey period.

- Very low - majority of daily discharge is below 10th percentile of daily means
- Low - majority of daily discharge is between 10th and 25th percentile of daily means
- Normal - majority of daily discharge is between 25th and 75th percentile of daily means
- High - majority of daily discharge is between 75th and 90th percentile of daily means
- Very high - majority of daily discharge is above 90th percentile of daily means

If there is no definite top rank, then top two ranks are included, with first descriptor the majority rank

[2]Storms – fall freshet/storm timing defined as:

- None - no appreciable change in discharge (on gages) due to storms
- Early (before Oct 15)
- Middle-Early (Oct 15 to Oct 31)
- Middle-Late (Nov 1 to Nov 15)
- Late (after Nov 16)

[3]Run size – run size defined as:

- Average (to above/below) - within 10% of long-term average
- Above/below average - within 10% to 50% of long-term average
- Well above/below average - more than 50% deviation from long-term average

Elevated flows during the incubation period can negatively affect Fall Chinook if streambed scour is greater than the depth of egg deposition in redds. Floods have been observed to affect salmonids (Holtby and Healey 1986; Erman, *et al*. 1988); and multiple models and experiments have examined the conditions whereupon redds become susceptible to scour (Lislie 1989; Montgomery, *et al*. 1996; Bigelow 2003). For the Salmon River and Scott River drainages, elevated flows are generally associated with spring run-off, as well as the occasional rain-on-snow event. While fall storms during the spawning season are common – freshets elevate discharge above summer baseflow, allowing upstream distribution of fish on mainstems and into tributaries – persistent high water generally does not begin until late-November or early-December. An extreme and enduring early-fall high water event, such as that seen in 2016, is unusual. While no specific studies are available, it is likely that scour events which occur during spawning are more impactive than those that happen once the redd has compacted during the

normal progression of fall and winter flows. Buxton, *et al.* (2015) examined the stability of artificially constructed redds in a laboratory flume. In addition to concluding the redd structure to be less stable compared to unspawned gravels, they suggested the potential for detrimental erosion (i.e., scour) to be greatest immediately after construction. However, once the redd eroded to be flush with the streambed, then the likelihood of scour was equal to that of nearby undisturbed substrate. For the Salmon/Scott River drainages, it is likely most redd erosion occurs during the normal (low scour risk) storm events of fall and early winter, leading to a "flattening" of redds; and at that point, very high flood flows are required initiate the bedload movement that exposes salmonid embryos to scour mortality. Therefore, it is not inappropriate to conclude that early and high flows of 2016, when fish were still spawning and, therefore, redds were newly constructed, had a negative effect on survival of Fall Chinook spawn.

Although specifics in regards to the Salmon/Scott River drainages are unknown, it is anticipated that climate change will eventually have an effect on the region. Safeeq, *et al*. (2015) took historical winter data from the western United States to determine which regions were more sensitive to projected temperature increases and, hence, shifts in the projected proportion of precipitation falling as snow and/or rain. For the Klamath Mountains, they projected that by 2040, the average winter precipitation year will look more like what happens during current warm winters. In other words, the average snow line will be higher, there will be less snow at low elevations and less snow overall as more precipitation falls as rain. In turn, there will be hydrologic changes as a smaller, higher elevation snowpack translates to less cumulative spring run-off and less water in general through the remainder of the year. Leng, *et al.* (2016) agrees that there will be an alteration in stream flows in the Pacific Northwest area, including northern California; and under most scenarios, modeling suggests that earliest emergence of significant changes – beyond normal background variability – regarding decreased summer discharge could occur in the region as early as the 2030s. In contrast, the elevation of winter flows as more precipitation falls as rain instead of snow, may not occur until the 2070s (Leng, *et al.* 2016). Winter temperatures will not only be affected, but temperatures throughout the year; and by the 2060s, what is now considered to be an exceptionally "hot" summer day will become much more common in California, as will be the occurrence of multiple sequential "hot" days (Pierce, *et al*. 2013). The effect of climate change upon timing and amount of precipitation is less clear. The most recent research on climate models for California suggest that average annual precipitation in the northern portion of the state will remain relatively constant (Pierce, *et al*. 2013). A slight increase in winter precipitation may be offset by less summer precipitation, but overall, precipitation patterns will likely remain within the range of historical natural variation, making it very difficult to resolve if climate change is having an effect of precipitation amount or timing (Pierce, *et al*. 2013).

The potential effect of climate change upon winter flood events has recently begun to be examined. For mountainous drainages similar to the Salmon/Scott Rivers, models suggest flood frequency will increase (Mantua, *et al*. 2010; Goode, *et al.* 2013). In turn, the potential for scour to impact salmonids increases due to more rain-on-snow events and shifts in the hydrograph to an earlier spring melt that increases the temporal overlap between high water events and salmonid egg incubation (Goode, *et al*. 2013). The specific likelihood for scour to affect fish has multiple dimensions, including (Goode, *et al.* 2013):

- Spawn timing – Fall spawning species/runs with overwintering eggs are more vulnerable to high water events than species/runs with other spawning strategies.

- Fish size – Larger fish bury eggs deeper than small fish. Therefore, the former have less exposure to streambed scour compared to the latter.
- Spawn location upon the landscape – Fish that spawn lower in a drainage may have an elevated risk of scour exposure. Small, higher elevation streams are generally located where air temperature is less; and, thus, snow melts slower and there is less rain-on-snow exposure.
- Landform – Scour risk is greatest in confined valleys. Unconfined floodplains allow water to spread out upon the landscape, thereby decreasing direction of the flood's power downward upon the streambed.
- Geology – Landforms that produce finer grain sediments are at higher risk for scour compared to landforms that produce coarser sediments.

Details regarding the degree of increase in winter flood events within the Salmon/Scott River drainages is not known because studies looking at the region have not been published. The "what" and "how" fish species, like Fall Chinook, may be affected has other factors to consider. For instance, fish may adjust spawning behavior (e.g., greater egg burial depth) to compensate. Additionally, if channels are allowed to adjust morphology to accommodate changes in flow regime, streams may exhibit habitat resiliency to climate change. The caveat is that unconfined valleys with access to their floodplain can adjust better compared to the often bedrock/boulder confined channels that define much of the Salmon/Scott Fall Chinook survey area. Management activities that increases in-stream woody debris (i.e., add a roughness element) or decreases human-caused channel confinement (i.e., remove berms to open the floodplain) may also decrease the detrimental impact of scour.

The challenge of climate change will eventually affect fall-run Chinook. Current inter-annual variability, including recent past and near future, of factors such as river discharge and run-size are not necessarily attributable to climate change, but are likely instead within the variability of the natural cycle. However, observations of Chinook behavior and habitat use made during current cycles of dry, normal, and high water, as well as differences between above- and below-average run years, do provide a view of future expectations as the climate shifts. For instance, river discharge, in conjunction with the timing of fall storms, strongly influences access. The underlying summer/fall baseflow is expected to be affected by climate change, with less winter snowpack and/or more frequent incidences of drought directly influencing how much water upmigrating Fall Chinook encounter when they enter the river. As low flow and exceptionally low flow conditions become more common, then a scenario similar to that observed in 2015 may also become more frequent; and those circumstances can be amplified in drainages like the Scott River which include large amounts of water withdrawal for irrigation and other purposes. On the other hand, at this time it appears climate change will minimally affect normal fall precipitation events, so their occurrence will remain within the range of past variation (i.e., sometimes they occur [2012, 2014]; and sometime they do not [2015]). These events will become increasingly critical in permitting Fall Chinook to access traditionally utilized locations which may otherwise be difficult to reach. Large, early-fall storms, similar to that observed in 2016, that can present an unseasonably early scour risk to redds are likely to retain their current return interval. How future impacts from climate change will ultimately affect success of Fall Chinook, and other fish species, is a large question, one which requires a long-term dataset like that available from the Scott River and Salmon River to address.

Survey Observations and Recommendations

The desired result for spawning (redd) surveys conducted in the Salmon River and Scott River watersheds is to create a dataset applicable in guiding locally informed management decisions (Forest Service and private individuals) in regards to projects, ongoing/proposed upland and riparian land use activities, and response to climate change. Products, such as the GoogleEarth overlay of redd regular use and concentrated use areas, are one result, and others may occur in the future as needs are defined.

Many issues and problems encountered each year during the Fall Chinook surveys are observed on an annual basis. Most concerns are of the type which are addressed by agency managers early, with individual crews or as a survey whole, and then not adequately followed up upon during the remainder of the spawning season. This laxity allows undesirable crew habits to re-emerge later in the season, else persist if not effectively corrected from the start. Additionally, other common problems may not be seen during cursory in-season QA/QC, only showing up when data is closely examined and compiled in the post-season.

To address common annually reoccurring issues, it is the responsibility of the agency survey manager, or their representative, to ensure crews fully understand all aspects of survey protocol. Although pre-season training introduces (or re-introduces) the protocol to crew, the information imparted may not be fully understood by a new crewmember, or yearly adjustments in protocol might not be wholly absorbed by a multi-season surveyor. Therefore, it is highly recommended that survey managers begin each survey day by reminding crew of the expected protocol. This activity should occur prior to acquisition of datasheet/map packets, before crews have begun to scatter to their assigned reach and it is much more difficult to capture the group attention. This daily announcement may include proper dictation of carcass and/or redd numbers, GPS protocols, reminder to fill in summary sheets, and any other issue of concern. Where reaches have special instructions, like flag/no-flag segments or no-access private property areas, conversation should also be undertaken with individual crews.

Communication between KNF and CDFW survey managers is paramount. In addition to attending the normal pre-season multi-agency meeting, survey managers for Salmon River and Scott River should communicate with each other prior to the survey season. The goal is to exchange recommendations on how to better administer the upcoming spawning surveys, which may include suggestions for minor changes in datasheets, protocol, and so forth. Furthermore, and of particular importance during the survey season, managers which observe the emergence or persistence of an issue during their survey day should convey such to other manager(s) to ensure the problem is specifically and immediately addressed the next survey day, not the following week, or later.

Due to the multiple cancelled surveys in 2016, it was a challenge to determine if effort made over the years has continued to decrease datasheet errors. Therefore, observations and recommendations below are a compilation of earlier years, except when noted otherwise.

The morning rush by surveyors to leave for assigned reaches means not all datasheets/maps may be gathered, even with repeated verbal reminders. Survey fatigue also begins to set in during November. As a consequence, there are times when not all datasheets/maps are turned in, leading to missing data; and data quality starts to slip by the end of the season compared to the

beginning. Over the last several years gains have been made in respect to returning all datasheets, but problems persist.

- Recommendation is to continue to provide data packets (carcass sheets, redd sheets, maps) to each crew individually. This procedure should occur on both the Salmon River and the Scott River. Packets may be handed out personally by the survey administrators, else via a delegated individual. During the free-for-all morning gathering of datasheets/maps, there are inevitably crews who forget something. Additionally, this point of interaction is a good time to provide reminders to individuals and/or crew as to protocol or reach-specific instructions.

Commonly observed crew-associated issues for agency managers to address during training and the daily survey announcements:

- Correctly fill out all datasheets.
    - Complete header information as appropriate – start/end time, weather, streamflow, temperature (when available), crew names, etc. Header information allows survey administrators to gage effort. For instance, it is expected that better data will have been gathered in conditions of clear water and sunny skies, compared to rain/wind with high flows.
    - For redds, always use the header/map sheet. Only use the continuation sheet as the primary datasheet for redds when no header/map sheet is available.
    - Count all live fish. Record total live Chinook seen during a survey on both the carcass and redd datasheets. The redd sheet also asks for Coho and steelhead. <u>If there are no fish, write a "0"</u>. This action confirms to the administrator that a count was undertaken.
    - "Live fish" on the summary sheet is <u>Chinook only</u> (includes jacks and adults). If other species are to be reported, they should be written in the comment section.
    - <u>Redd dimensions should be measured to the nearest 0.1 meter</u>, or as close as possible given equipment limitations. **Do not** use feet. **Do not** use the nearest meter or half meter. **Do not** assume all redds are the same size and thereby report the same dimensions repeatedly.
    - "Unflagged Segments" on the redd sheet should only be filled in when and where not flagged. This may be an entire reach (i.e., Reach 5A, Salmon River) or a partial reach (i.e., Reach 3, Scott River). For reaches which are only partially flagged, the final redd count will be split into two components: measured redds and count-only (not-measured) redds.
    - <u>Always fill out the hardcopy maps</u>! They are used for post-season QA/QC, as well as a back-up should GPS data be lost or not collected.
        - This is <u>especially</u> important in years, such as 2016, with low fish numbers, numerous cancelled surveys, and overall poor effort due to high water. Some locations only had one or two surveys, compared to the normal regime of six to ten (or more). Every bit of data helps for local and State management of the fish stocks, including spawning ground usage and estimation of run size.
- Perform the GPS protocol correctly.
    - <u>Each redd is a single GPS point – do not lump multiple redds into a single point</u>. GPS points are used to delineate location of spawning areas for management and

monitoring purposes. Mapping resolution for GIS or GoogleEarth is lost when redds are grouped.
    - Input the correct redd number label.
    - When a crew is GPSing, they should capture **all flags** which have not already been mapped, not just the new ones recorded that survey day. Do not assume that a redd has already been GPSed - check flagging for knots.
    - Use information on flagging – date and redd number – to build a redd GPS point. Do not sequentially number all redds on the day that the GPS is used, regardless of original date of discovery.
- Other issues
    - At the end of the survey day, turn in all datasheets and maps, even those with negative information; and completely fill out the summary sheet, ensuring information is entered on the correct date.
    - Where reaches are split into "A" and "B", survey administrators need to ensure crews are aware of which subreach is being surveyed. Subreaches primarily occur on the Salmon River, although, depending upon fish numbers, they may also be used part of the season for Reach 8 of the Scott River.
    - If a reach is ended early due to injury, weather, or other reason, mark on the map where the survey stopped.
    - Redd flagging should always include survey date and redd number to avoid double-counting.
    - To avoid multiple measurements of the same redd within "Unflagged Segments", as well as maintain survey speed, there is no need to take redd dimensions within these areas. Mapping and/or GPSing should still occur, as directed by the survey administrator.
    - Ensure crews know any "special instructions" for a reach, such as flag/no-flag segments and entry/exits to avoid private property.
    - Where there are "special instruction" areas that are skipped for part of the season (e.g., Salmon River, Reach 9A, at Pollocks Gulch by request of adjacent landowner), be sure that redds are recorded and GPSed prior to end of the season.
    - It is obvious that some individuals/crews present at the pre-season trainings are not fully paying attention. Training is viewed primarily as a social occasion; and some individuals are not fully engaged. These individuals/crew are often same ones whom have built habits, sometimes undesirable, through years of surveying; and even when reminded during the season to make adjustments, they return to their old practices within a survey or two.
        - Of particular concern, there are also individuals who should be at the survey trainings, but do not show up.

In 2015, the Fall Chinook survey almost met the desired goal, as stated in prior reports, for sufficient equipment be available to allow all reaches to be GPSed for redds every survey. KNF and both CDFW offices were able to commit sufficient GPSes to cover their own crews, as well as often possessing an extra machine for use by non-agency crews. Additionally, most tribal crews, watershed councils, and other entities now possess their own GPS units. While there were occasional issues in regards to batteries or malfunctioning (or misplaced) equipment, spare units allowed for near universal coverage. Unfortunately, due to weather-related survey issues experienced in 2016, including cancellations, continued progress towards the GPS goal could not

be ascertained. However, the KNF survey administrator did continue to progress in the weekly tracking and gathering of GPS files, thereby ensuring better electronic spatial coverage and identification of data gaps. It is strongly recommended that all agencies/entities continue to commit to bringing at least one GPS-per-crew to every survey.

Continuing, there are several recommendations aimed specifically at KNF and CDFW, as based upon multiple years of survey observations:

- The KNF administrator should continue to ensure that redd/map datasheets are always available, thereby eliminating the need for crews to improvise.
- The "Unflagged Segment" of the redd datasheet should be revisited by KNF to determine if there is a modification which will make it more clear to crews as to where and when this section should be filled in.
    - Alter maps to include a special instruction box for reaches which include segments which are not flagged.
- The Forest Service should continue incorporation of several GPS-centric items into the annual pre-season survey training "Redd Station", including -
    - How to title redd GPS points.
    - Presentation of a visual on how multiple years of GPS data have led to delineation of spawning concentration areas.
    - Visual comparison of accuracy of GPSing versus potential inaccuracy of hardcopy maps: even the best map reader can be several hundred feet off, which in turn will affect precision of the map product produced for management and monitoring purposes.
    - Emphasize importance of hardcopy maps as a back-up to GPS data, using the 2014 incident of KNF losing a GPS as an example.
- Pre-season training at all data collection stations should emphasize <u>crew</u> QA/QC prior to turning in datasheets, including correct header information and numbering for redds, carcasses, and scale/tissue envelopes.
- As necessary, flagging should be placed on the river and the road to demark entry/exit points to reaches, private property, flagged/unflagged segments, and so forth.
- Require crews to carry at least one gaff with measure marks (meters and tenth-meters)
- Discuss between USFS and CDFW survey administrators about how to manage *consistently* individuals/crews whom have been identified as exhibiting undesirable habits.
- Coordination with CDFW to investigate the possibility of minor modifications to daily summary sheets.
    - Expand the "Live Fish" field to specify "Live Fish – Chinook", "Live Fish – Steelhead", and "Live Fish – Coho". Alternately, "Live Fish" is altered to ensure surveyors understand it is Chinook only.
    - Include a checkbox with each reach for the survey manager to mark when a reach is not surveyed. The manager should also comment why the reach was omitted (e.g., high water, insufficient crew, safety concerns).

Since 2011, there have been multiple successes in achieving higher quality and more consistent data:

- Protocol consistency between Salmon River and Scott River watersheds (on Salmon-Scott Rivers Ranger District).

- When data packets are handed out by a survey administer or representative to crews, it is more likely that everything will be returned at the end of the day.
- Overall, crews are more likely to turn in the entirety of the datasheet/map packets, even when no redds, fish, and/or carcasses are found. It is better understood that a negative result is still valid information, whereas "missing data" is the same as if the survey was never completed.
- The CDFW summary sheets were altered to provide separate entries for "A" and "B" subreaches, as appropriate. This change eliminated the need for crews to manually draw a divider under the reach number and increased the likelihood that data was reported in the correct location.
- Forest Service redd datasheets were altered to incorporate a map on the back of the header page. Redd datasheets were also updated to include an example of a redd GPS point.
- KNF more often checks on-site stock of redd/map datasheets to ensure sufficient supplies are available for survey use.
- Evolution of GPSing, such as incorporation of knotting flags to show that mapping has already occurred.
- More GPSes are available to map redds. Between KNF, CDFW, watershed councils, tribal crews, and other entities, there is often sufficient equipment to GPS every reach every day for both Salmon River and Scott River drainages.
- More regular downloading of GPSes. The KNF administrator brings a computer once a week to surveys to capture GPS data and tracks the downloaded data files.

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Personal Communication

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Appendix A – California Department Fish and Wildlife "MegaTable"

Due to large size of the Klamath River Fall Chinook "MegaTable" (1978 to 2016), only the most recent years and summary tables are provided in this Forest Service document. See the original California Department of Fish and Wildlife document for the full MegaTable, including footnotes and acronyms.

Klamath River Basin Fall Chinook Salmon Spawner Escapement, In-river Harvest and Run-size Estimates, 1978-2016 a/

SPAWNER ESCAPEMENT

	2014			2015			2016		
Hatchery Spawners:	Grilse	Adults	Totals	Grilse	Adults	Totals	Grilse	Adults	Totals
Iron Gate Hatchery (IGH)	1,039	24,300	25,339	220	7,956	8,176	151	2,436	2,587
Trinity River Hatchery (TRH)	221	6,975	7,196	224	3,129	3,353	401	1,142	1,543
Hatchery Spawner Subtotals:	1,260	31,275	32,535	444	11,085	11,529	552	3,578	4,130
Natural Spawners:									
Main Stem Klamath River n/ (excluding IGH)	1,844	22,443	24,287	259	7,407	7,666	159	2,902	3,061
Salmon River basin	527	2,706	3,233	92	1,978	2,070	26	1,032 hh/	1,058
Scott River basin	2,051	10,419	12,470	21	2,092	2,113	139	1,376	1,515
Shasta River basin	3,945	14,412	18,357	133	6,612	6,745	135	2,754	2,889
Bogus Creek basin	323	12,607	12,930	45	2,308	2,353	38	830	868
Misc. Klamath tributaries o/ (above Yurok Reservation)	1,498	6,877	8,375	49	2,244	2,293	30	1,205	1,235
Yurok Reservation tribs. (Klamath River) p/	332	1,245	1,577	149	632	781	27	264	291
Klamath Natural Spawner Subtotals:	10,520	70,709	81,229	748	23,273	24,021	554	10,363	10,917
Main Stem Trinity River dd/ (excluding TRH)	6,620	23,312	29,932	2,660	4,727	7,387	1,295	3,444	4,739
Misc. Trinity tributaries o/ (above Hoopa Reservation)	47	515	562	26	46	72	21	55	76
Hoopa Reservation tribs. (Trinity River) p/	52	568	620	38	66	104	24	62	86
Trinity Natural Spawner Subtotals:	6,719	24,395	31,114	2,724	4,839	7,563	1,340	3,561	4,901
Natural Spawner Subtotals	17,239	95,104	112,343	3,472	28,112	31,584	1,894	13,924	15,818
Total Spawner Escapement	18,499	126,379	144,878	3,916	39,197	43,113	2,446	17,502	19,948

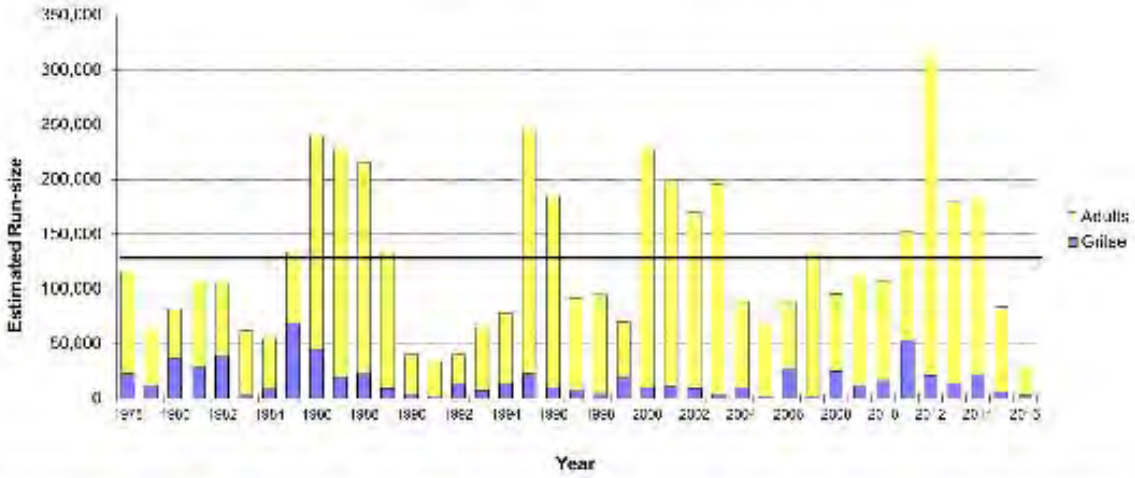
IN-RIVER HARVEST

	2014			2015			2016		
Angler Harvest	Grilse	Adults	Totals	Grilse	Adults	Totals	Grilse	Adults	Totals
Klamath River (below Hwy 101 bridge)	268	1,093	1,361	292	2,914	3,206	31	801	832
Klamath River (Hwy 101 to Weitchpec)	2,847	1,875	4,722	1,224	2,258	3,482	91	24	115
Klamath River (Weitchpec to IGH)	75	1,496	1,571	65	2,607	2,672	24	416	440
Trinity River basin above Weitchpec aa/	174	922	1,096	24	63	87	15	69	84
Angler Harvest Subtotals:	3,364	5,386	8,750	1,605	7,842	9,447	161	1,310	1,471
Tribal Harvest e/									
Klamath River (below Hwy 101 bridge)	153	20,096	20,249	405	22,508	22,913	121	3,185	3,306
Klamath River (Hwy 101 to Trinity mouth)	130	3,432	3,562	44	3,520	3,564	19	1,224	1,243
Trinity River (Hoopa Reservation)	65	2,439	2,504	47	2,020	2,067	20	750	770
Tribal Harvest Subtotals:	348	25,967	26,315	496	28,048	28,544	160	5,159	5,319
Total In-river Harvest	3,712	31,353	35,065	2,101	35,890	37,991	321	6,469	6,790

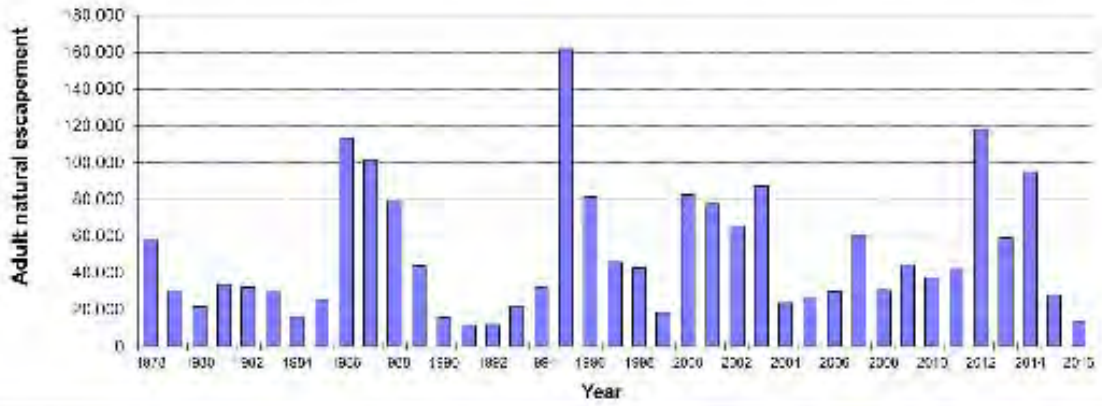
IN-RIVER RUN

	2014			2015			2016		
Totals:	Grilse	Adults	Totals	Grilse	Adults	Totals	Grilse	Adults	Totals
In-river Harvest and Escapement	22,211	157,732	179,943	6,017	75,087	81,104	2,767	23,971	26,738
Angling Mortality (2.04% of harvest) ff	69	110	179	33	160	193	3	27	30
Net Mortality (8.70% of harvest) ff	31	2,282	2,313	43	2,451	2,494	14	458	472
Klamath Basin disease testing jj/	10	272	282	1	103	104	2	111	113
Total In-river Run	22,321	160,396	182,717	6,094	77,801	83,895	2,786	24,567	27,353

Klamath River Basin Fall-Run Chinook Salmon Run-size Estimates, 1978-2016 a/



Klamath River Basin Adult Fall-Run Chinook Salmon Natural Escapement Estimates, 1978-2016 a/



a/ 2016 data are preliminary

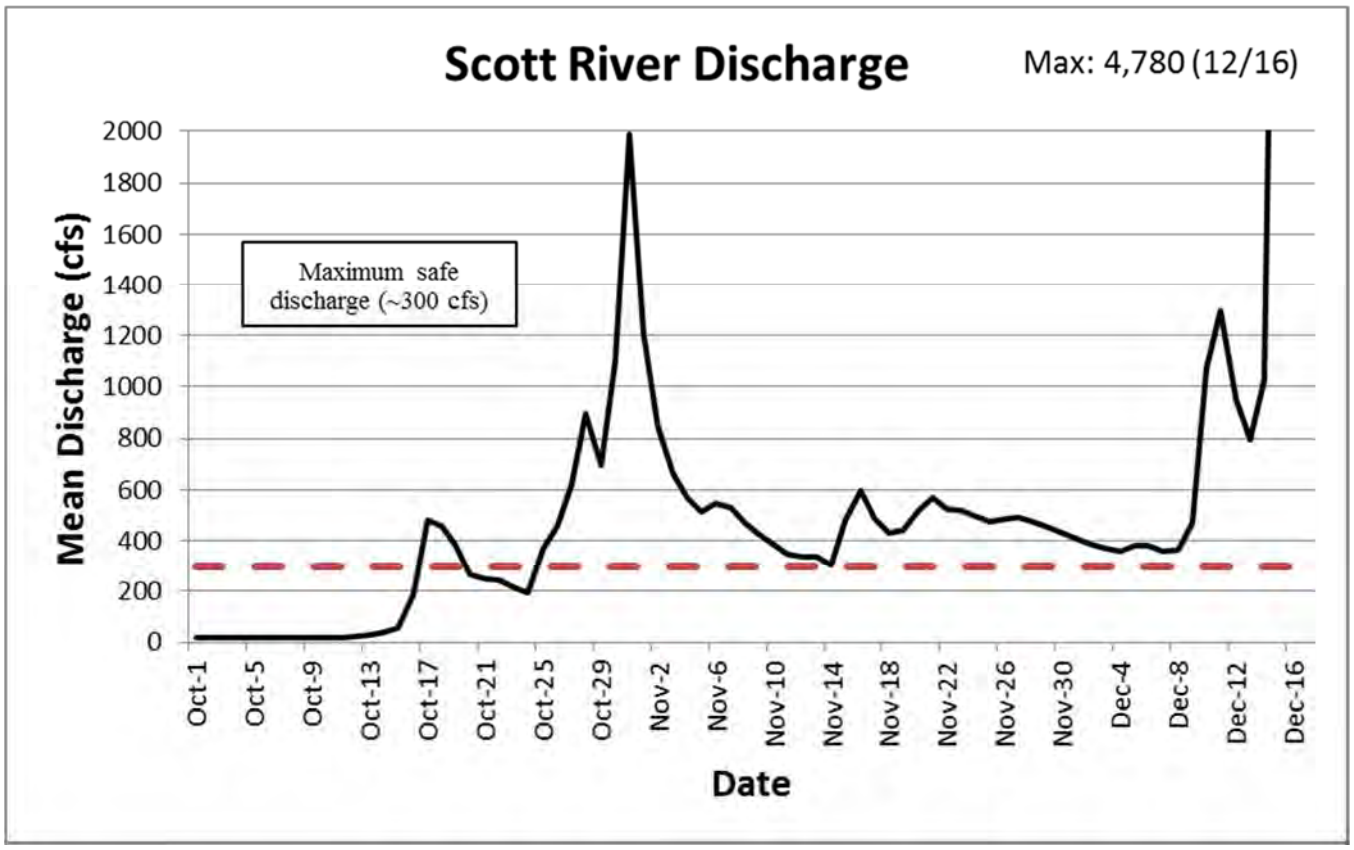
Appendix B – USGS Discharge Charts

Scott River

The Scott River gauge (11519500) is located 10.8 miles downstream from Fort Jones, CA.

- Legal location T.44N., R.10W., Sec. 29 (Mount Diablo Meridian); or
- Lat. 41°38'27" by Long. 123°00'50" (referenced NAD 1927)

The graph shown provides a daily mean of discharge at the gauge and includes October 1st through December 17th, 2016, which encompasses the redd/carcass survey dates and is inclusive effort by CDFW and/or other cooperators which may have continued after KNF had ended the survey season. Instantaneous discharges measured at the gauge can be higher or lower than that pictured. Variability in flow or on-site assessment of conditions of a specific reach during an actual survey day may have provided a window of safe discharge not reflected in the figure.

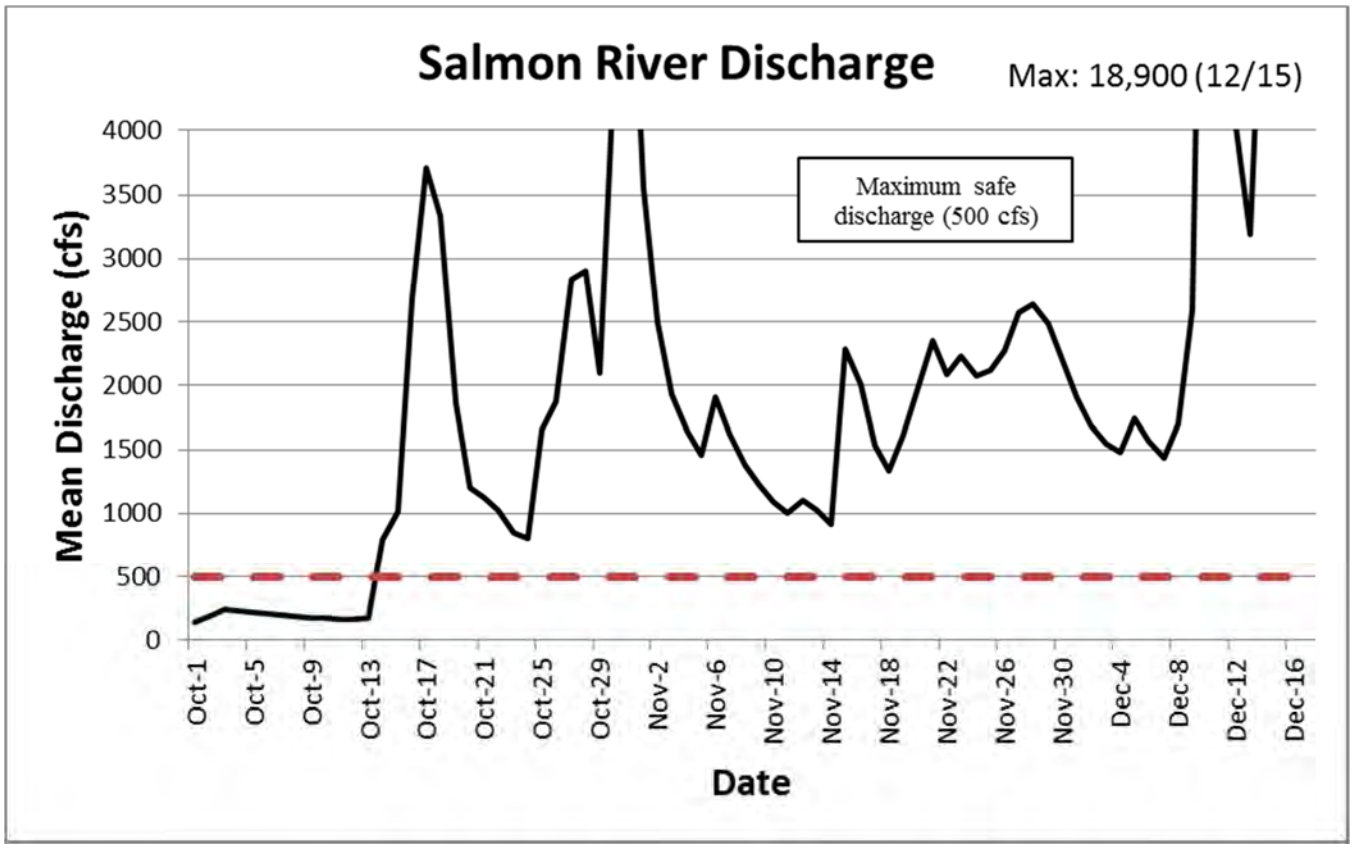


Salmon River

The Salmon River gauge (11522500) is located 1.0 miles upstream from Somes Bar, CA, at the confluence with the Klamath River.

- Legal location T.11N., R.6E., Sec. 3 (Humboldt Meridian); or
- Lat. 41°22'36" by Long. 123°28'33" (referenced NAD 1927)

The graph shown provides a daily mean of discharge at the gauge and includes October 1st through December 17th, 2016, which encompasses the redd/carcass survey dates and is inclusive effort by CDFW and/or other cooperators which may have continued after KNF had ended the survey season. Instantaneous discharges measured at the gauge can be higher or lower than that pictured. Variability in flow or on-site assessment of conditions of a specific reach during an actual survey day may have provided a window of safe discharge not reflected in the figure.



Appendix C – Redd and Fish Survey Tables (2016)

Salmon River Redds

Reach	Date																	
	Oct-11	**Oct-14**	**Oct-18**	**Oct-21**	**Oct-25**	**Oct-28**	**Nov-01**	**Nov-04**	**Nov-08**	**Nov-11**	**Nov-15**	**Nov-18**	**Nov-22**	**Nov-25**	**Nov-29**	**Dec-02**	**Dec-06**	**Dec-09**
Mainstem																		
4A - Otter Bar to Nordheimer Ck	13	----	----	10	----	----	----		2	0	2	----	----	----	----	nd	----	----
4B - Forks to Otter Bar	12							0										
North Fork																		
9A - Mile 2 to Forks	8	High Water	High Water	|-- High Water --|	High Water	High Water	High Water	High Water ---|	High Water --|	1	High Water ---|	High Water	High Water	Holiday	High Water	High Water ---|	High Water	High Water
9B - Mile 4 to Mile 2	13									0								
10A - Mile 6 to Mile 4	12																	
10B - Mile 8 to Mile 6																		
11A - Mile 10 to Mile 8																		
11B - Mile 12 to Mile 10									0									
South Fork																		
5A - Henry Bell to Forks[1]	(21)	|----	|----	(21)	|----	|----	|----	|----	|----	(1)	|----	|----	|----	|----	|----	|----	|----	|----
5B - O'Farrill Gulch to Henry Bell	20			5						1								
6A - Indian Ck to O'Farrill Gulch	24			0						0								
6B - Matthews Ck to Indian Ck	23																	

[1]Reach 5A is not flagged - total number of redds counted each survey

*Underline = days which included pulling flagging. Carcass surveys ("cs") may be conducted after this date, but redds are not recorded.

*nd = no data (surveys performed, but datasheets or data missing; number likely 0)

Salmon River Tributary Surveys

Tributary	Date	Redds	Chinook	Steelhead
Blackbear Creek	Nov-08	0	0	0
Knownothing Creek	Nov-08	1	3	0
Knownothing Ck (EF)	Nov-08	0	0	0
Knownothing Ck (WF)	Nov-08	1	0	0
Little NF Salmon River	Nov-04	0	0	0
Methodist Creek	Nov-04	0	3	0
	Nov-08	1	1	0
Nordheimer Creek	Nov-04	1	3	0
	Nov-08	0	0	0

Salmon River (Live) Chinook Observation

Reach	Date																	
	Oct-11	**Oct-14**	**Oct-18**	**Oct-21**	**Oct-25**	**Oct-28**	**Nov-01**	**Nov-04**	**Nov-08**	**Nov-11**	**Nov-15**	**Nov-18**	**Nov-22**	**Nov-25**	**Nov-29**	**Dec-02**	**Dec-06**	**Dec-09**
Mainstem																		
4A - Otter Bar to Nordheimer Ck	7	|----	|----	26	|----	|----	|----		1	nd	2	|----	|----	|----	|----	nd	|----	|----
4B - Forks to Otter Bar	17							3										
North Fork																		
9A - Mile 2 to Forks	26	High Water	High Water	|-- High Water --|	High Water	High Water	High Water	High Water ---|	High Water --|	0	High Water ---|	High Water	High Water	Holiday	High Water	High Water ---|	High Water	High Water
9B - Mile 4 to Mile 2	15									1								
10A - Mile 6 to Mile 4	5																	
10B - Mile 8 to Mile 6																		
11A - Mile 10 to Mile 8																		
11B - Mile 12 to Mile 10									0									
South Fork																		
5A - Henry Bell to Forks	33	|----	|----	9	|----	|----	|----	|----	|----	0	|----	|----	|----	|----	|----	|----	|----	|----
5B - O'Farrill Gulch to Henry Bell	57			10						0								
6A - Indian Ck to O'Farrill Gulch	32			14						0								
6B - Matthews Ck to Indian Ck	14																	

*nd = no data (surveys performed, but datasheets or data missing; number likely 0)

Salmon River (Live) Steelhead Observation

Reach	Date																	
	Oct-11	**Oct-14**	**Oct-18**	**Oct-21**	**Oct-25**	**Oct-28**	**Nov-01**	**Nov-04**	**Nov-08**	**Nov-11**	**Nov-15**	**Nov-18**	**Nov-22**	**Nov-25**	**Nov-29**	**Dec-02**	**Dec-06**	**Dec-09**
Mainstem																		
4A - Otter Bar to Nordheimer Ck	0	----	----	0	----	----	----		0	2	0	----	----	----	----	nd	----	----
4B - Forks to Otter Bar	0							nd										
North Fork																		
9A - Mile 2 to Forks	0	High Water	High Water	-- High Water --	High Water	High Water	High Water	High Water ---	High Water --	2	High Water ---	High Water	High Water	Holiday	High Water	High Water ---	High Water	High Water
9B - Mile 4 to Mile 2	0									0								
10A - Mile 6 to Mile 4	0																	
10B - Mile 8 to Mile 6																		
11A - Mile 10 to Mile 8																		
11B - Mile 12 to Mile 10									0									
South Fork																		
5A - Henry Bell to Forks	2	------	------	0	------	------	------	------	------	0	------	------	------	------	------	------	------	------
5B - O'Farrill Gulch to Henry Bell	0			nd						0								
6A - Indian Ck to O'Farrill Gulch	1			nd						0								
6B - Matthews Ck to Indian Ck	0																	

*nd = no data (surveys performed, but datasheets or data missing; number likely 0)

Scott River Redds

Reach	Date																	
	Oct-10	**Oct-13**	**Oct-17**	**Oct-20**	**Oct-24**	**Oct-27**	**Oct-31**	**Nov-03**	**Nov-07**	**Nov-10**	**Nov-14**	**Nov-17**	**Nov-21**	**Nov-24**	**Nov-28**	**Dec-01**	**Dec-05**	**Dec-08**
R1 - Midpoint to Confluence	36	4	No Survey - High Water	10	1	No Survey - High Water			0		0	No Survey - High Water	No Survey - High Water	Holiday		0		
R2 - "Cabin Hole" to Midpoint	-[2]	29		15	3				0		0					0		
R3 - George Allen to "Cabin Hole"[1]	6	22		4	3				1	0	0					0		
R4 - Townsend Gulch to George Allen	8	9		0	3					0							0	
R5 - Bridge Flat to Townsend Gulch	0				5				0	0					0			
R6 - CDFG Weir to Bridge Flat	0	6								0							0	
R7 - USGS Gauge to CDFG Weir				0					0		0			0	0			
R8 - Blw Meamber Bridge to USGS Gauge				24					0	0	0				0			0
R9 - Oro Fino Creek to Meamber Bridge[3]		0		0		1	No Survey - High Water			0		0		Holiday				
R11 - Eller Lane to Hwy 3[3]				0		0				0		0						
R12 - Sweezy to Eller Lane[3]				nd	nd	nd			nd	nd	nd	nd	0					
R13 - Horn Lane to Sweezy[3]				nd	8	nd			nd	3	nd	nd	0					
R14 - Youngs Dam to Horn Lane[3]				0	15	nd		0	nd	1	0	0	0					
R15 - Fay Lane to Youngs Dam[3]				0	44	nd		3	1	7	1		0				5	
R16 - Callahan to Fay Lane[3]													0				2	

*nd = no data (surveys performed, but redd count not reported) / Underline = days which included pulling flagging

[1]Reach 3 - Does not include redds counted in front of house on private property (Trubucco)

[2]The first survey of Reach 2 did not map, flag, nor GPS redds. Therefore, decision was made to roll redds recorded (2) into Oct 13th survey, and count them as if they had not been encountered the prior survey.

[3]Survey for RCD (valley) reaches may not occur on the same schedule as lower reaches. RCD data is placed in dates as close as possible to canyon survey days.

*Note: surveys included unflagged sections of Reach 3; and the redd count from this location is not included in the above table. The Reach 2 maximum number of unflagged redds was 12. This redd count is reported separately in the document (Table 2) and not included in the compounded redd number (Figure 4).

Scott River Tributary Surveys

Scott Canyon (Agency-Cooperative)

Tributary	Date	Redds	Chinook	Steelhead
Canyon Creek	Oct-18	0	0	0
	Nov-03	0	0	0
	Dec-02	0	0	0
Kelsey Creek	Nov-03	0	0	0
	Dec-02	0	0	0
	Dec-09	0	0	0
Tompkins Creek	Nov-21	0	0	0
	Dec-02	0	0	0

Scott Valley (Siskiyou Resource Conservation District)

Tributary	Date	Redds	Chinook	Steelhead
French Creek	Nov-01	1	1	0
	Nov-11	0	0	0
	Nov-16	1	0	0
Shackleford Creek	Nov-18	8	3[1]	0
	Dec-01	0	0	0
	Dec-08	0	0	0
	Dec-12	0	1[1]	0
	Dec-19	0	0	0
Sugar Creek	Nov-01	0	0	0
	Nov-11	0	0	0

[1]Live fish not positively identified. May be Chinook or Coho.

Scott River (Live) Chinook Observations

Reach	Date																	
	Oct-10	**Oct-13**	**Oct-17**	**Oct-20**	**Oct-24**	**Oct-27**	**Oct-31**	**Nov-03**	**Nov-07**	**Nov-10**	**Nov-14**	**Nov-17**	**Nov-21**	**Nov-24**	**Nov-28**	**Dec-01**	**Dec-05**	**Dec-08**
R1 - Midpoint to Confluence	89	45	No Survey - High Water	11	14	No Survey - High Water			0		0	No Survey - High Water	No Survey - High Water	Holiday		0		
R2 - "Cabin Hole" to Midpoint	100	94		21	15				0		0					0		
R3 - George Allen to "Cabin Hole"	57	32		13	2				1	1	1					0		
R4 - Townsend Gulch to George Allen	28	37		26	0					2							0	
R5 - Bridge Flat to Townsend Gulch	88				12				0	0					0			
R6 - CDFG Weir to Bridge Flat	41	95								0							0	
R7 - USGS Gauge to CDFG Weir				0					0		0			0	0			
R8 - Blw Meamber Bridge to USGS Gauge				70					4	3	3				0			0
R9 - Oro Fino Creek to Meamber Bridge[1]		0		0		1	No Survey - High Water			1		1^2		Holiday				
R11 - Eller Lane to Hwy 3[1]				2		1				0		0						
R12 - Sweezy to Eller Lane[1]				4	10	2			3	0	1	2^2	0					
R13 - Horn Lane to Sweezy[1]				11	14	0			2	7	1^2	1	0					
R14 - Youngs Dam to Horn Lane[1]				18	30	5		2	3	4	1	1	0					
R15 - Fay Lane to Youngs Dam[1]				31	77	2		20	12	11	4		0				1^2	
R16 - Callahan to Fay Lane[1]													0				1^2	

*nd = no data (surveys performed, but Chinook count not reported)

[1]Survey for RCD (valley) reaches may not occur on the same schedule as lower reaches. RCD data is placed in dates as close as possible to canyon survey days.

[2]Fish not conclusively identified. May be Chinook or Coho.

Scott River (Live) Steelhead Observations

Reach	Date																	
	Oct-10	**Oct-13**	**Oct-17**	**Oct-20**	**Oct-24**	**Oct-27**	**Oct-31**	**Nov-03**	**Nov-07**	**Nov-10**	**Nov-14**	**Nov-17**	**Nov-21**	**Nov-24**	**Nov-28**	**Dec-01**	**Dec-05**	**Dec-08**
R1 - Midpoint to Confluence	0	0	No Survey - High Water	0	nd	No Survey - High Water			0		4	No Survey - High Water	No Survey - High Water	Holiday		0		
R2 - "Cabin Hole" to Midpoint	0	0		0	0				0		0					0		
R3 - George Allen to "Cabin Hole"	0	0		nd	0				0	0	0					0		
R4 - Townsend Gulch to George Allen	0	0		nd	nd					nd							0	
R5 - Bridge Flat to Townsend Gulch	0				0				0	0					0			
R6 - CDFG Weir to Bridge Flat	5	0								nd							nd	
R7 - USGS Gauge to CDFG Weir				nd					nd		0			nd	0			
R8 - Blw Meamber Bridge to USGS Gauge				nd					0	nd	0				0			nd
R9 - Oro Fino Creek to Meamber Bridge[1]		2		0		0	No Survey - High Water			0		0		Holiday				
R11 - Eller Lane to Hwy 3[1]				0		0				0		0						
R12 - Sweezy to Eller Lane[1]				0	0	0			0	0	0	0	0					
R13 - Horn Lane to Sweezy[1]				0	0	0			0	0	0	0	0					
R14 - Youngs Dam to Horn Lane[1]				0	0	0		0	0	0	0	0	0					
R15 - Fay Lane to Youngs Dam[1]				0	0	0		1	0	0	0		0				0	
R16 - Callahan to Fay Lane[1]													0				0	

*nd = no data (surveys performed, but steelhead count not reported; number likely 0)

[1]Survey for RCD (valley) reaches may not occur on the same schedule as lower reaches. RCD data is placed in dates as close as possible to canyon survey days.

Appendix D – Redd Spatial Distribution and Location

Redd density on maps is displayed as number of redds observed (as GPSed or mapped) per approximate 100 meter of survey. Where tributaries were surveyed, only those which recorded redds are included in this appendix.

Salmon River Data

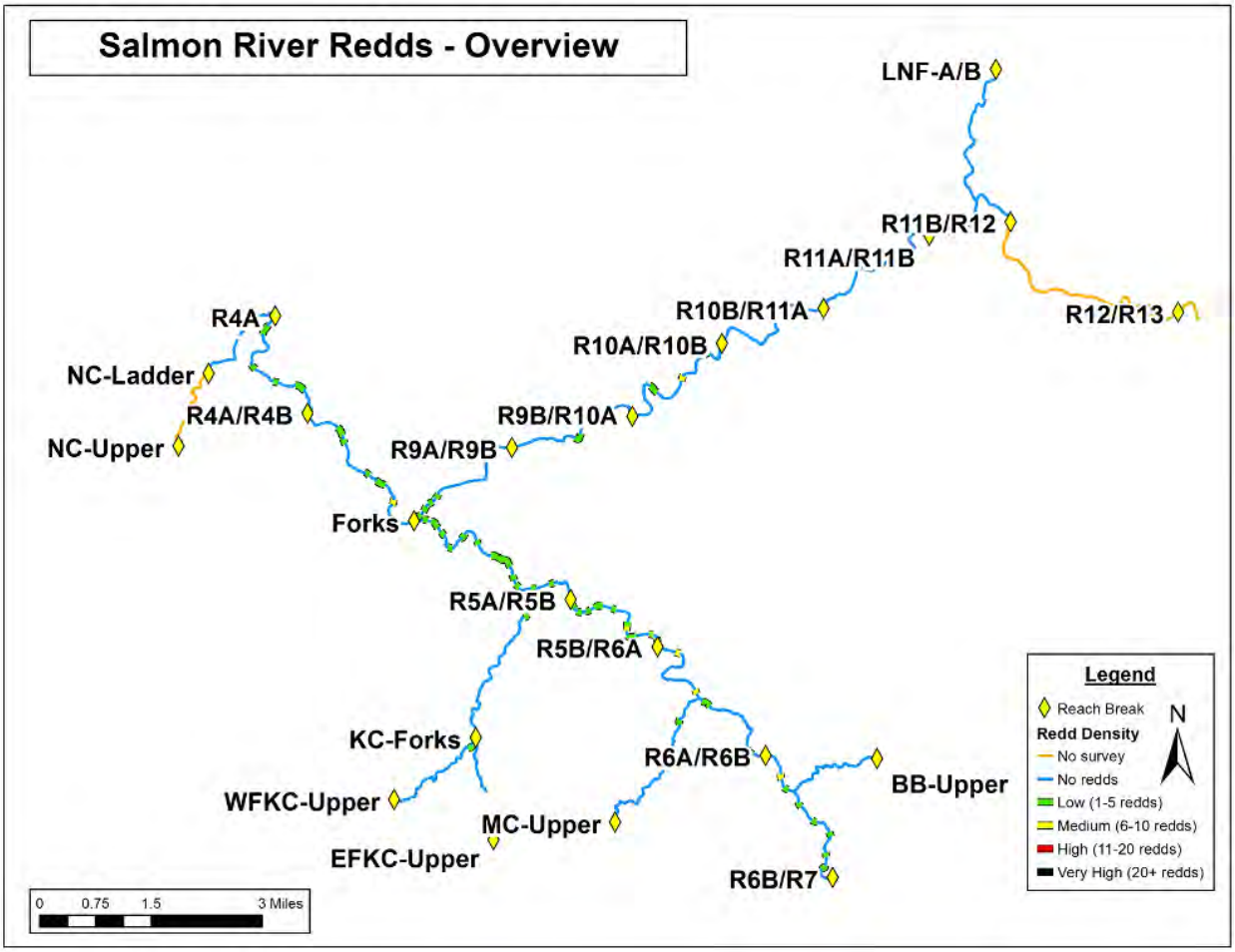


Figure D-SA1. General overview of redd distribution and density for Salmon River surveys. Map is of survey area only and does not include roads, hillslopes, or other landmarks.

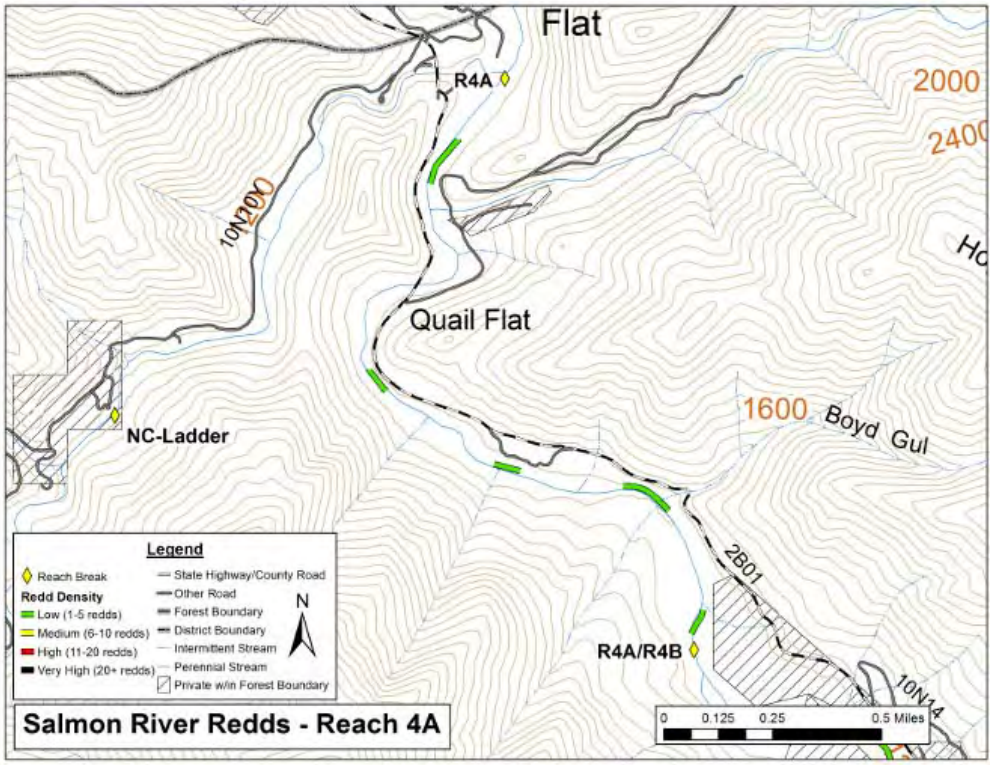


Figure D-SA2. Redd distribution and density for mainstem Salmon River, Reach 4A.

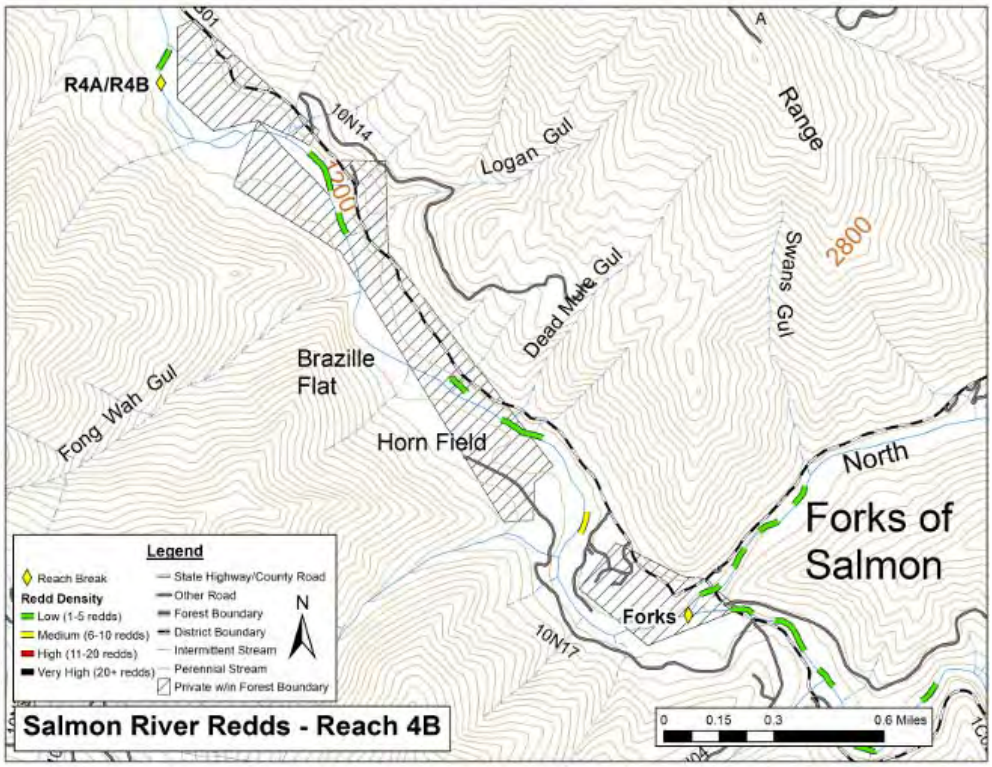


Figure D-SA3. Redd distribution and density for mainstem Salmon River, Reach 4B.

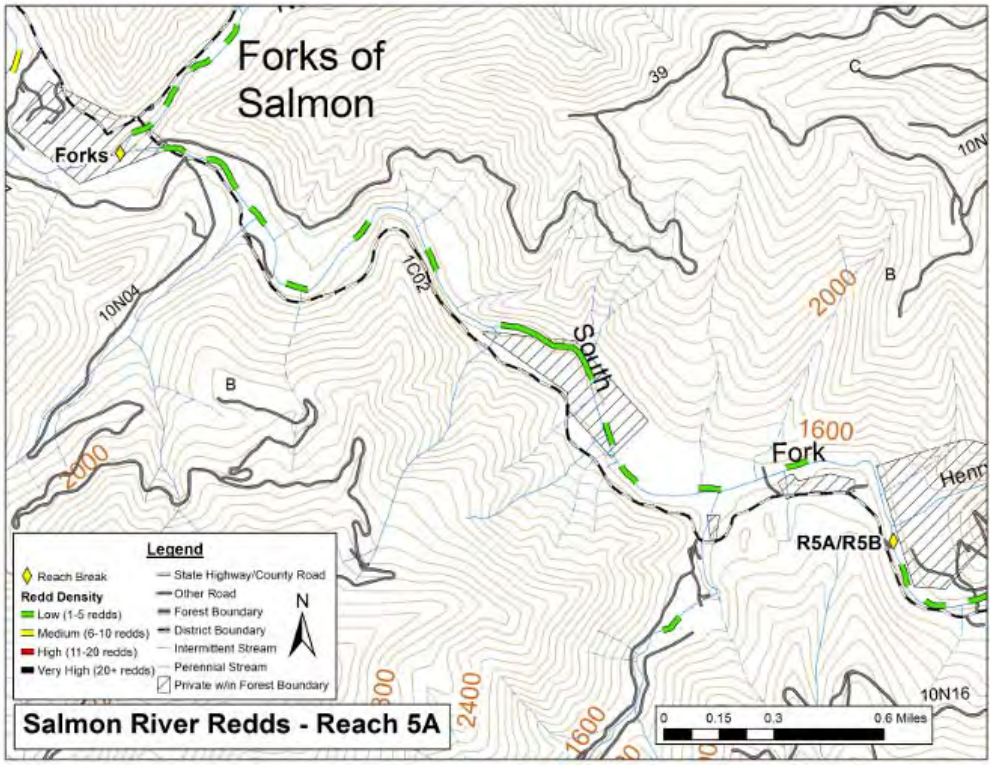


Figure D-SA4. Redd distribution and density for SF Salmon River, Reach 5A.

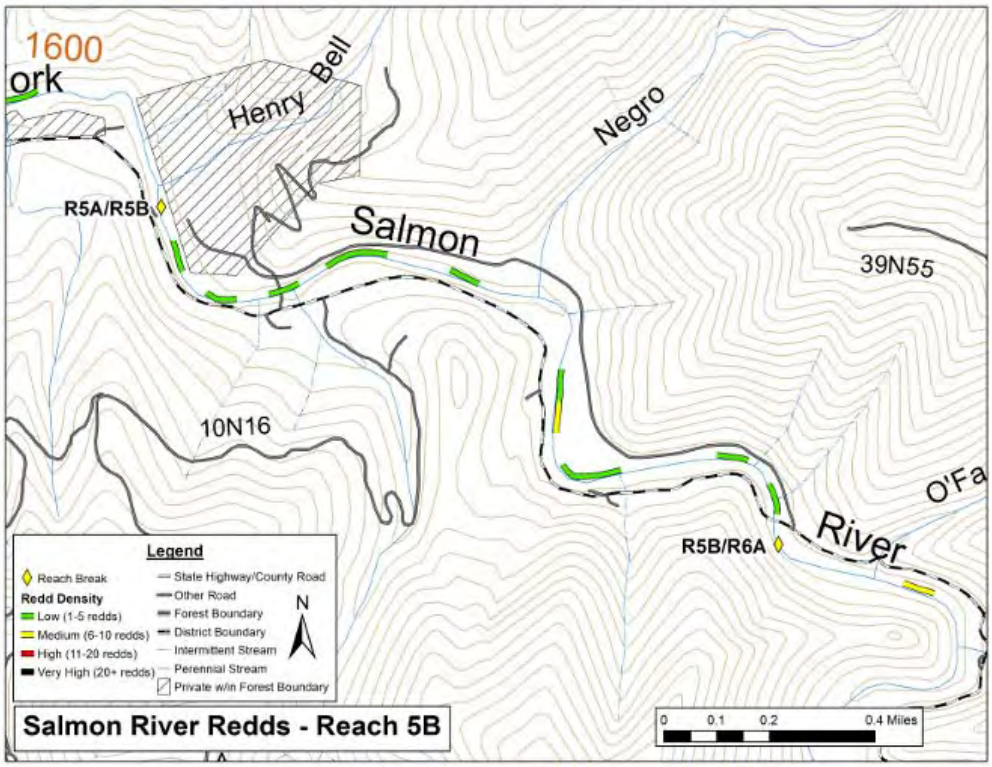


Figure D-SA5. Redd distribution and density for SF Salmon River, Reach 5B.

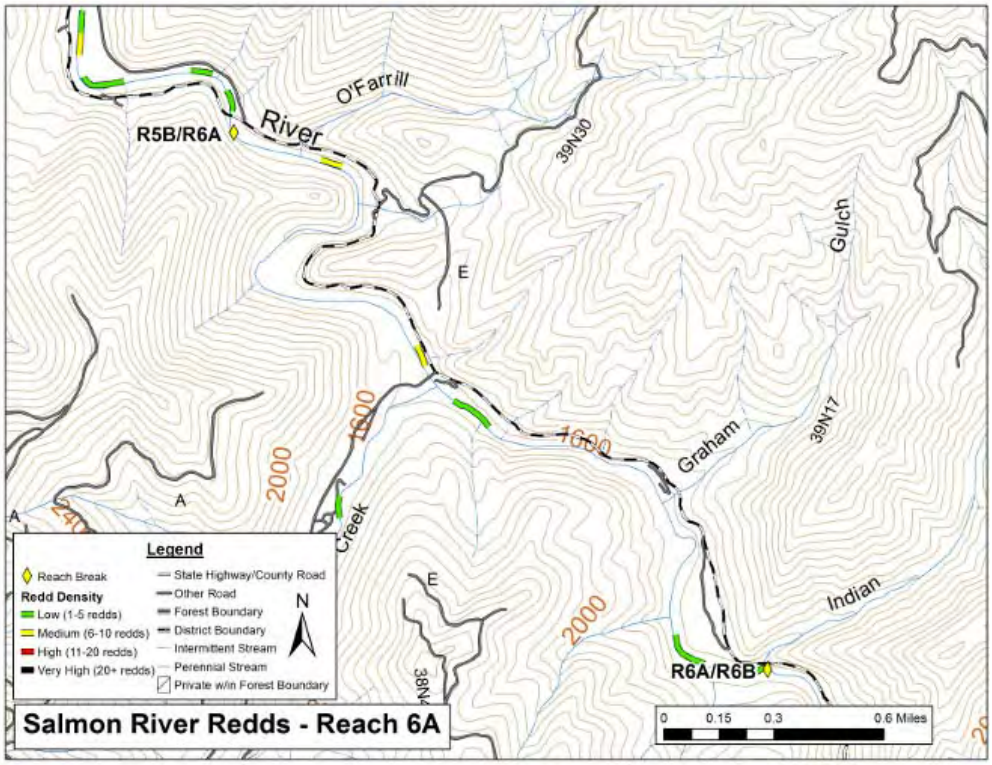


Figure D-SA6. Redd distribution and density for SF Salmon River, Reach 6A.

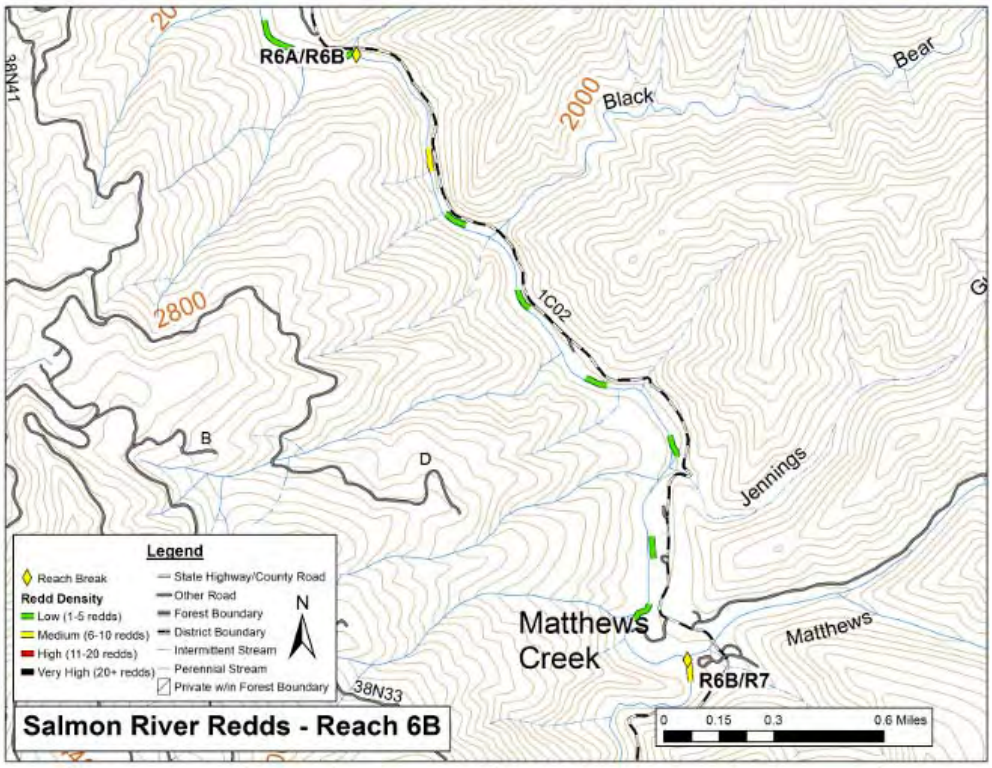


Figure D-SA7. Redd distribution and density for SF Salmon River, Reach 6B.

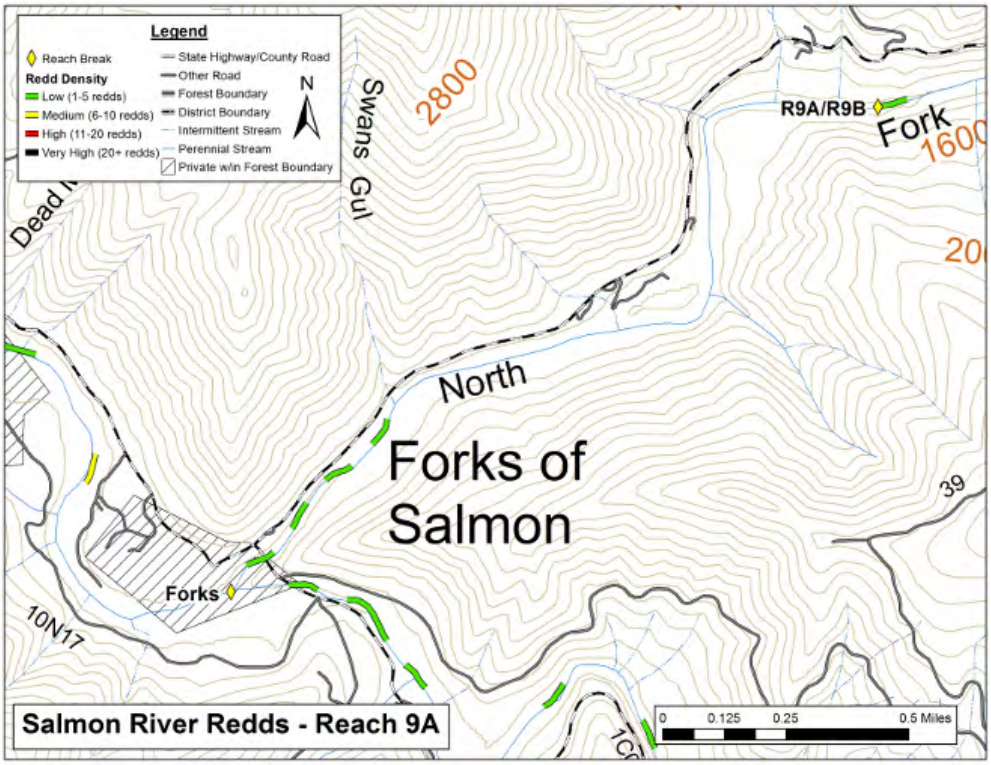


Figure D-SA8. Redd distribution and density for NF Salmon River, Reach 9A.

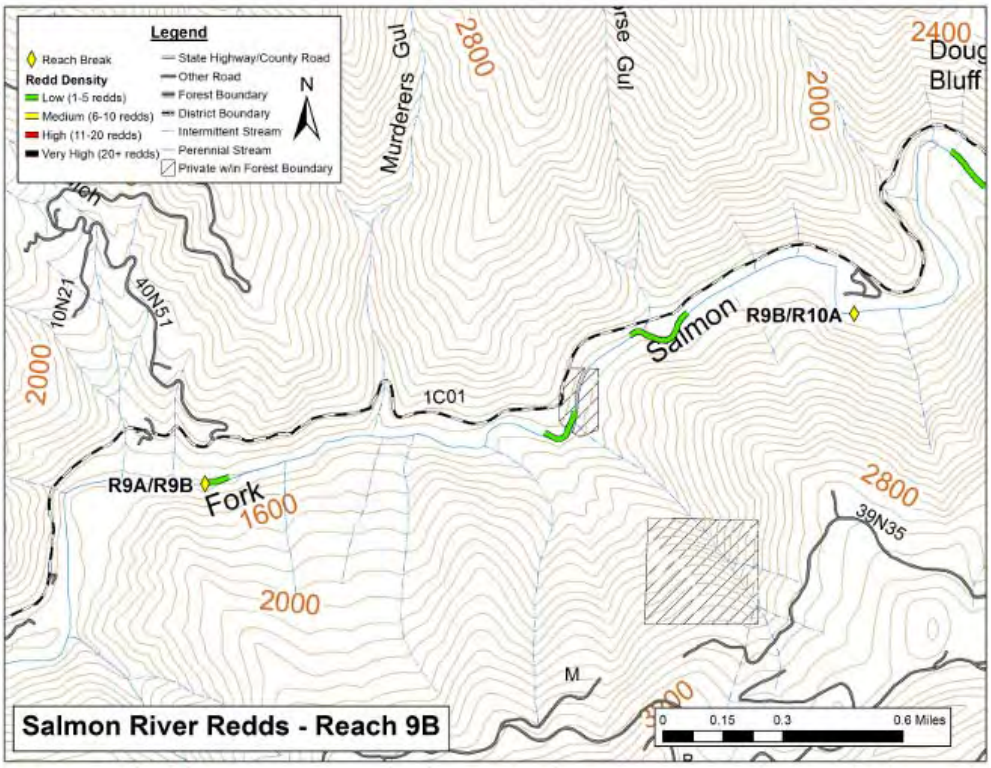


Figure D-SA9. Redd distribution and density for NF Salmon River, Reach 9B.

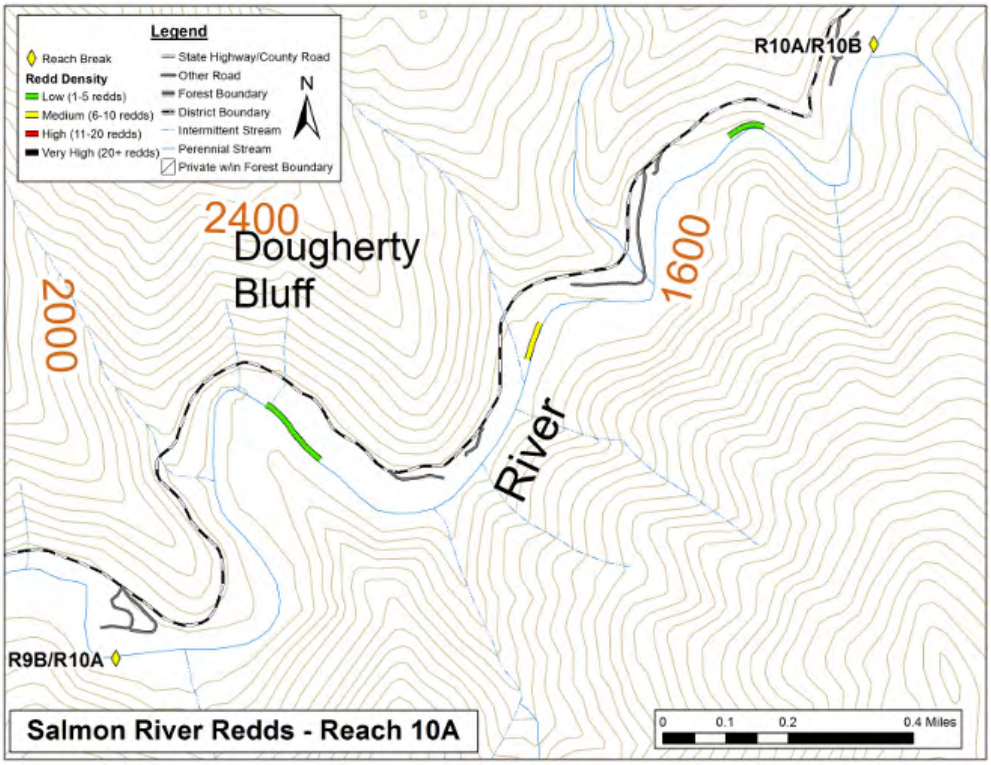


Figure D-SA10. Redd distribution and density for NF Salmon River, Reach 10A.

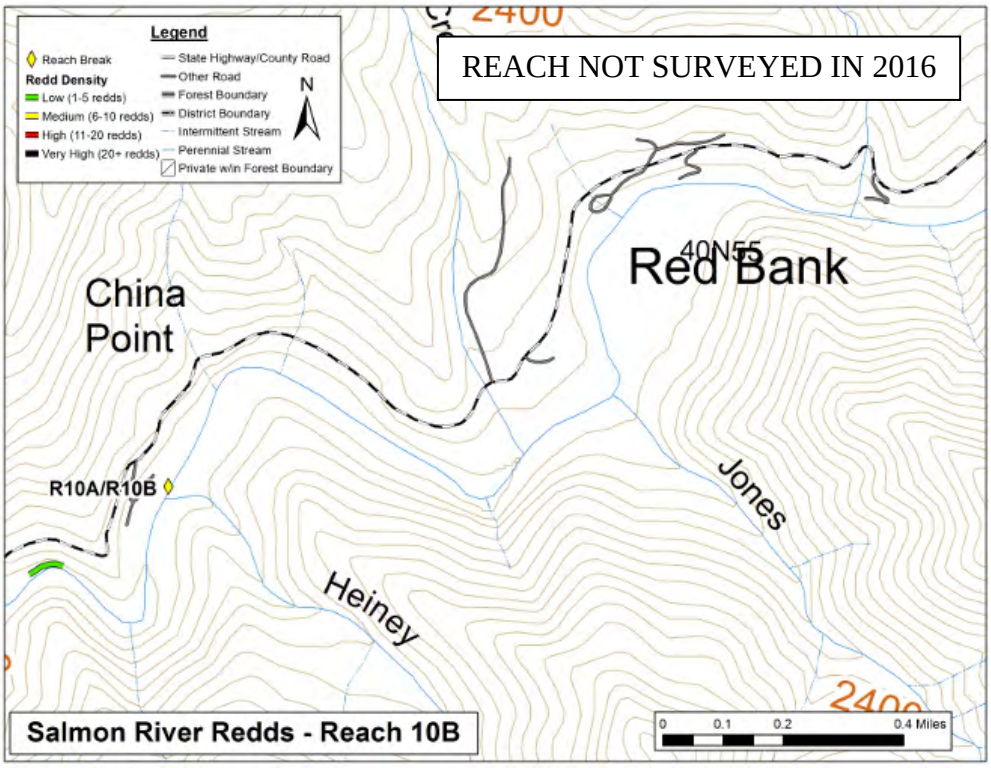


Figure D-SA11. Redd distribution and density for NF Salmon River, Reach 10B.

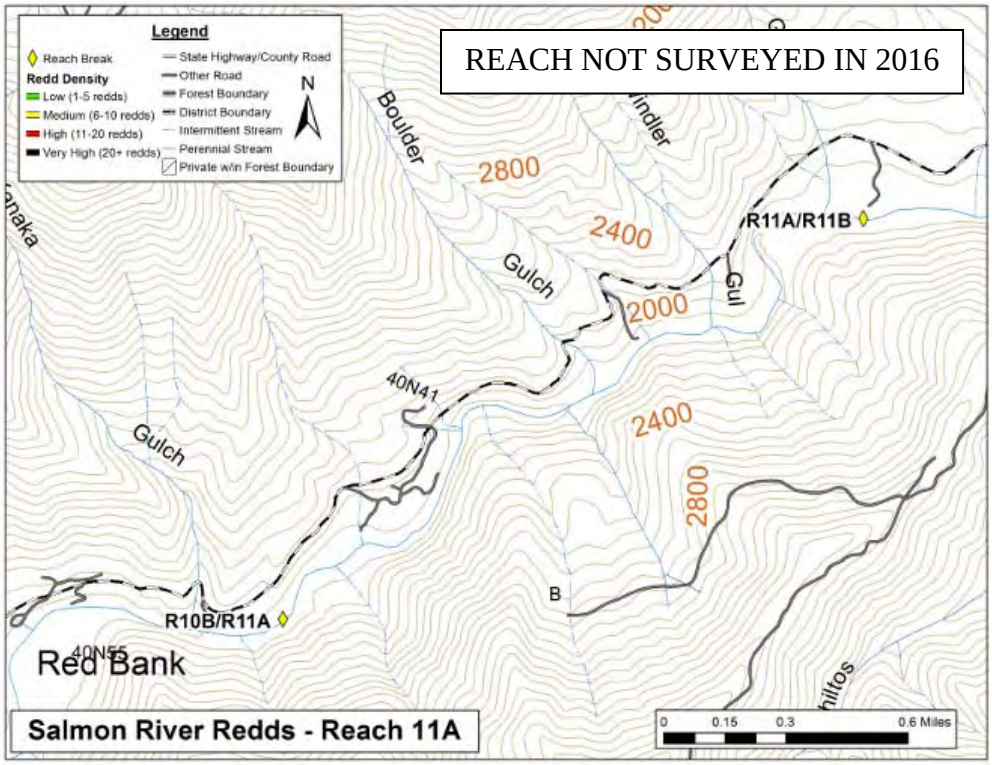


Figure D-SA12. Redd distribution and density for NF Salmon River, Reach 11A.

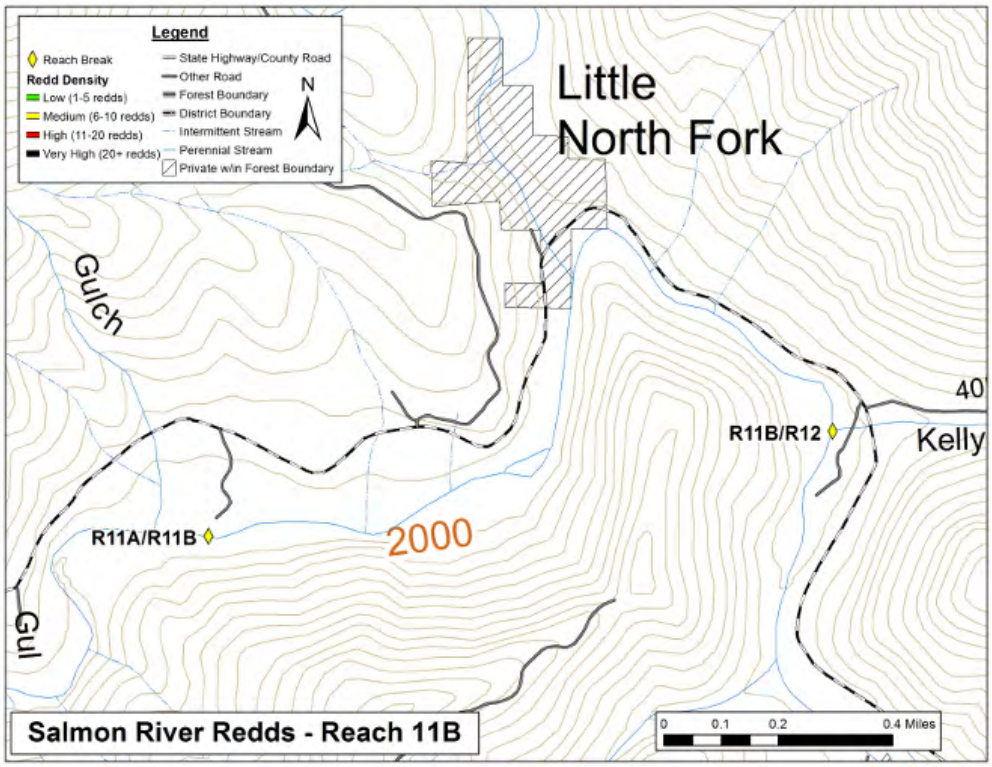


Figure D-SA13. Redd distribution and density for NF Salmon River, Reach 11B

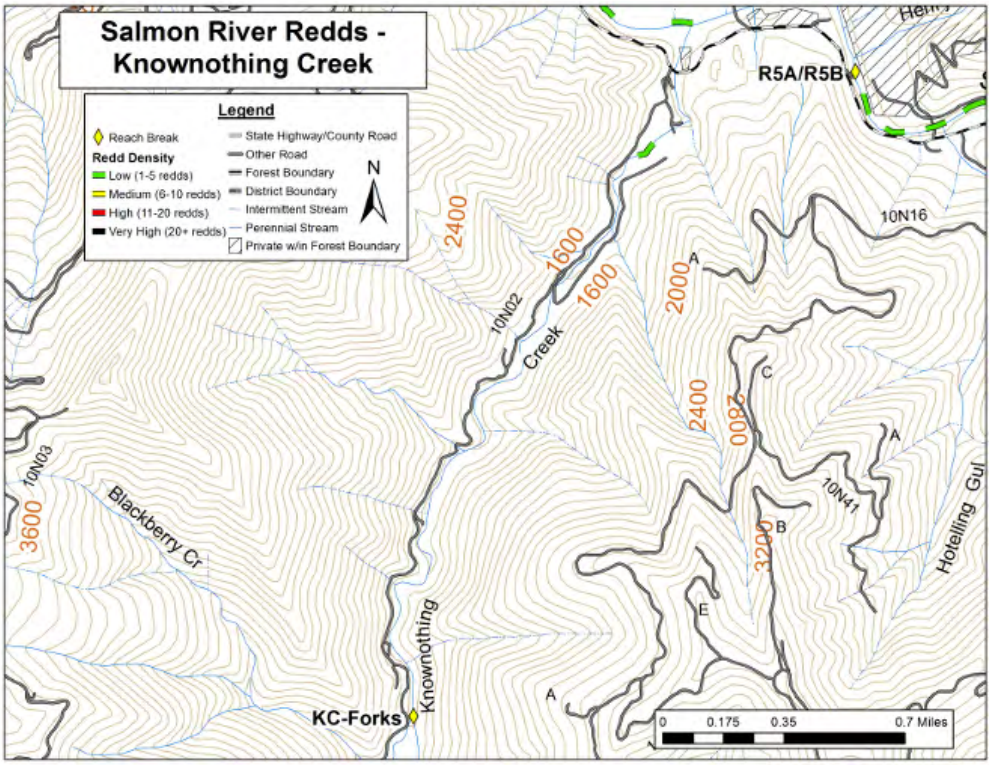


Figure D-SA14. Redd distribution and density for Knownothing Creek.

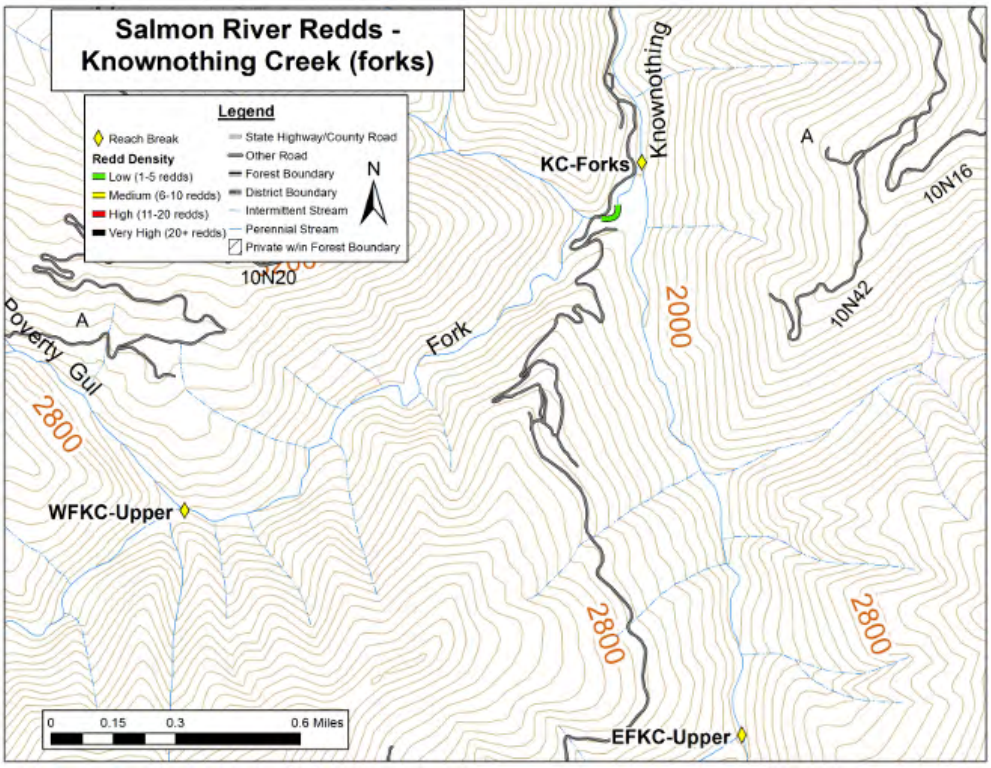


Figure D-SA15. Redd distribution and density for WF Knownothing Creek.

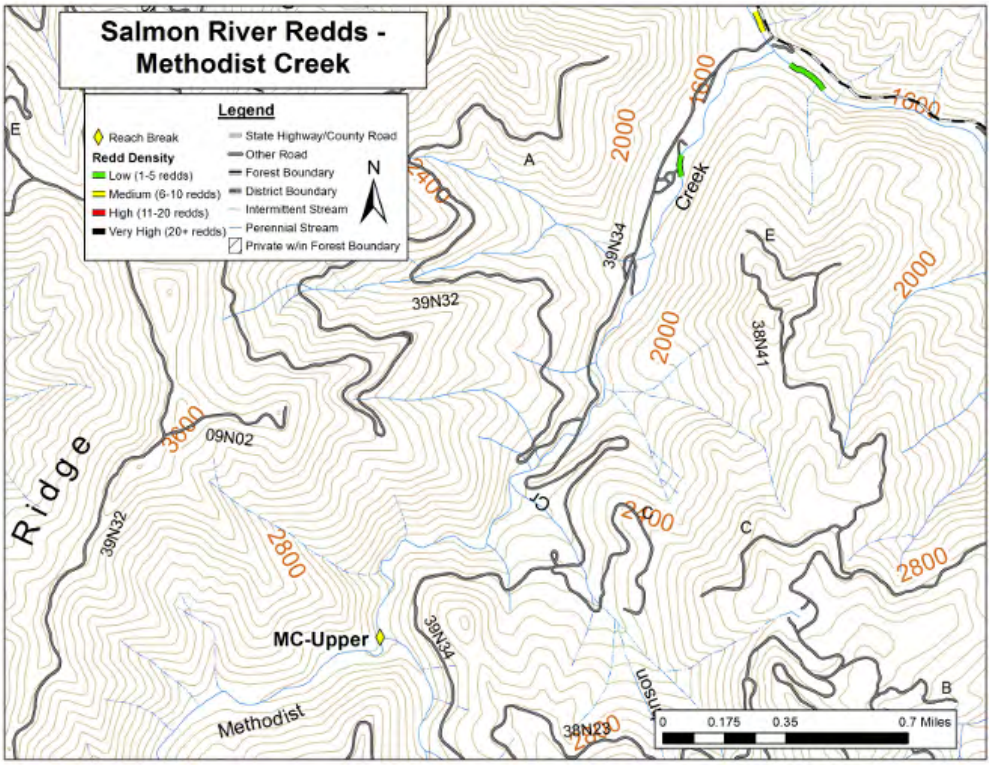


Figure D-SA16. Redd distribution and density for Methodist Creek.

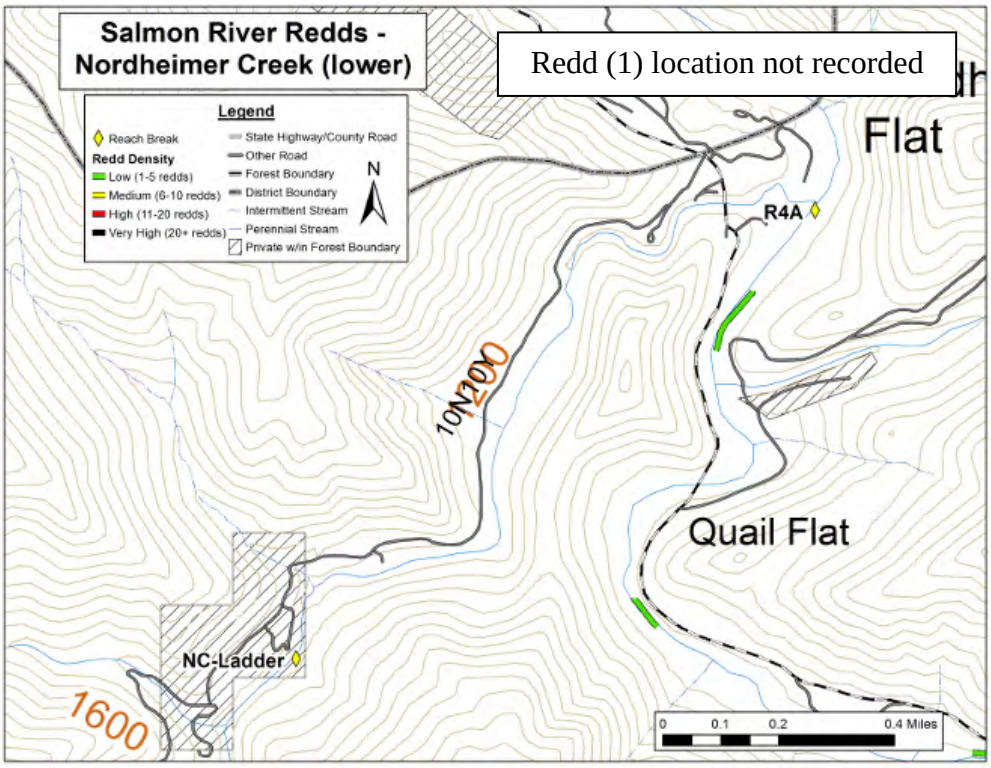


Figure D-SA17. Redd distribution and density for Nordheimer Creek (lower).

Scott River Data

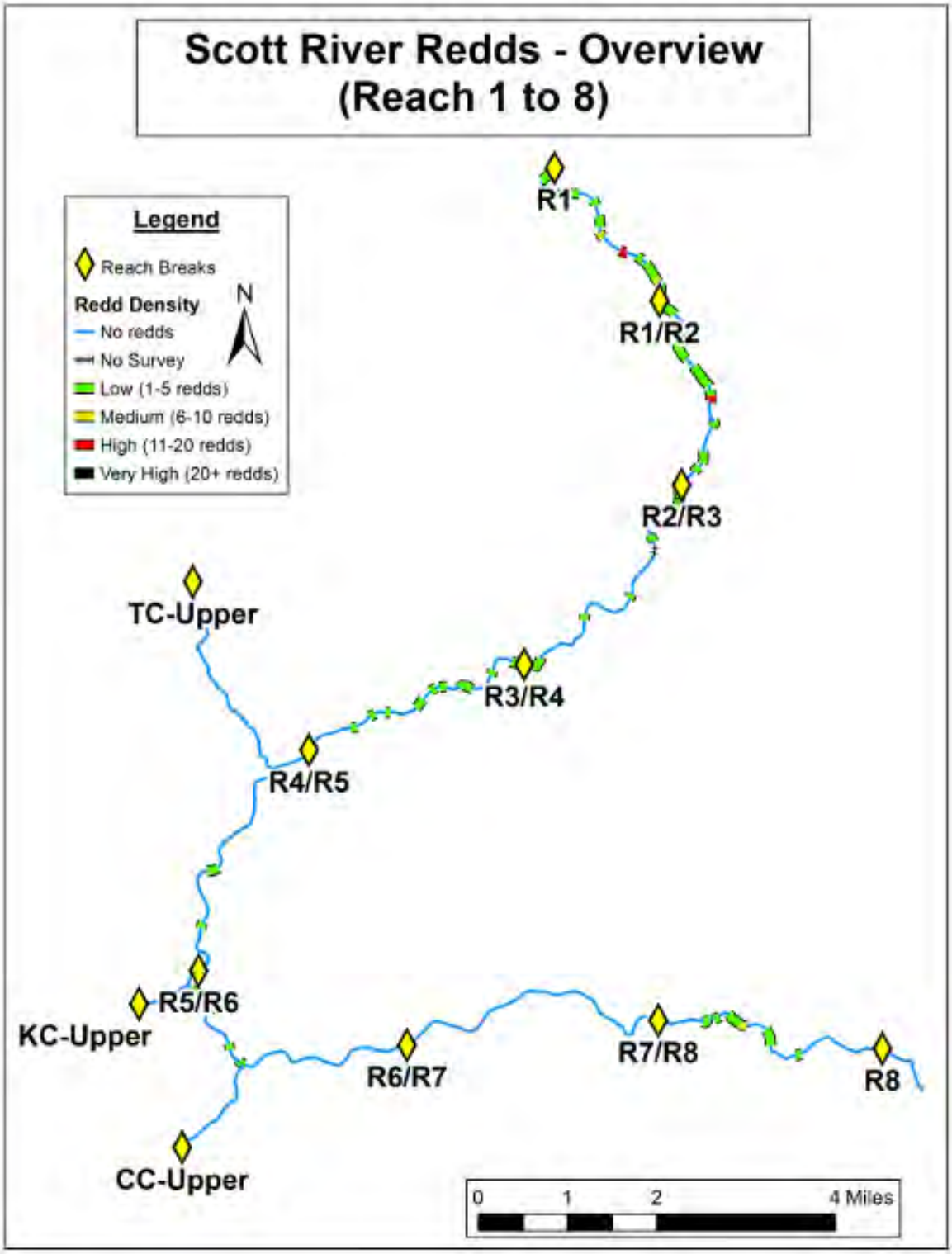


Figure D-SC1. General overview of redd distribution and density for Scott River surveys, Reach 1 through Reach 8. Map is of survey area only and does not include roads, hillslopes, or other landmarks.

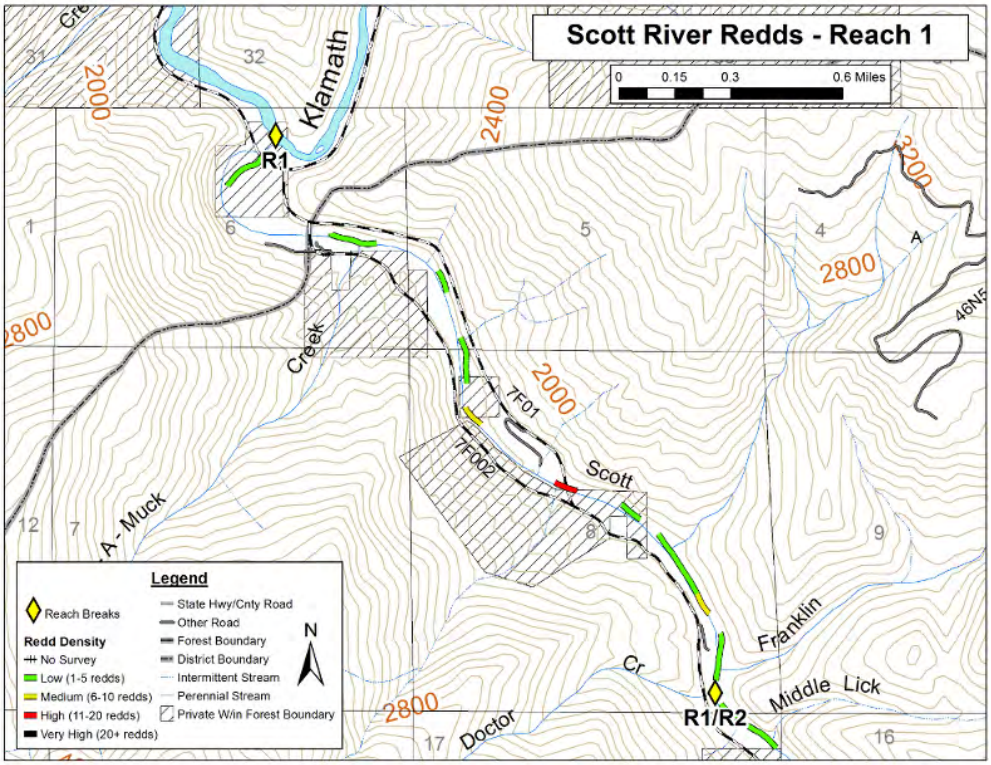


Figure D-SC2. Redd distribution and density for Scott River, Reach 1.

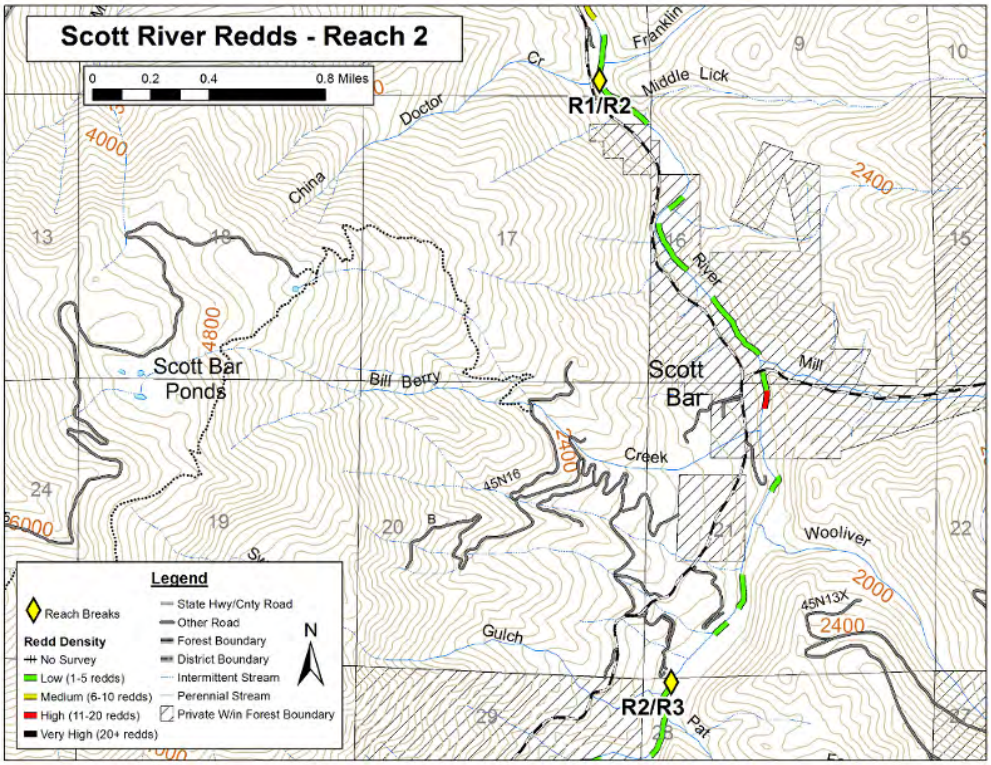


Figure D-SC3. Redd distribution and density for Scott River, Reach 2.

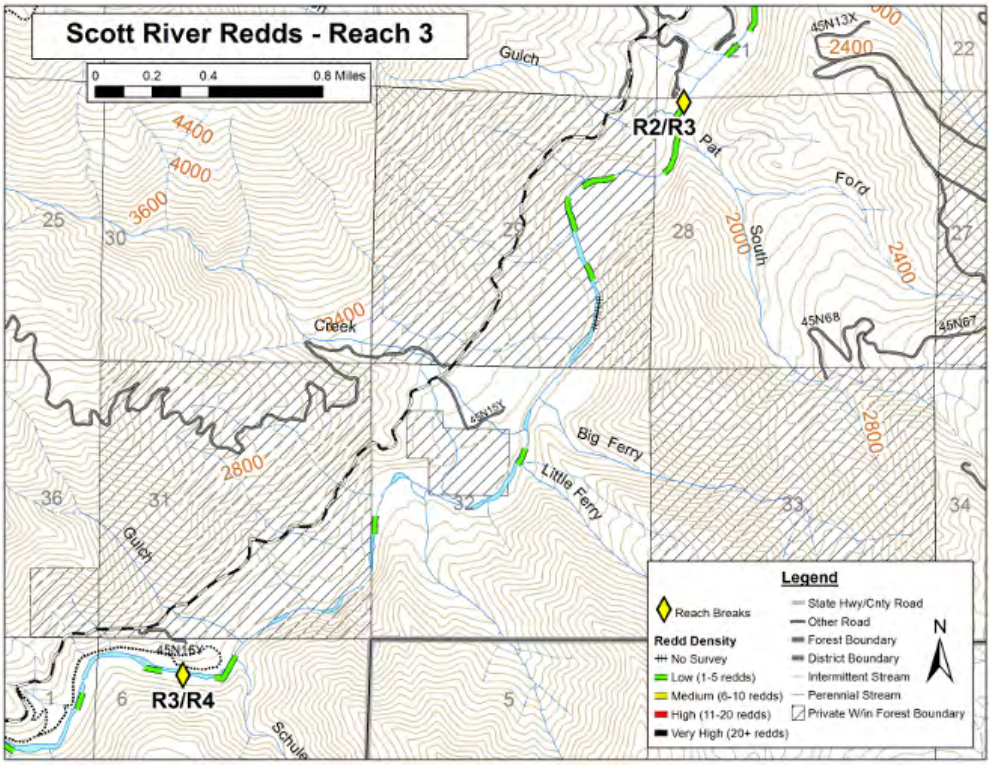


Figure D-SC4. Redd distribution and density for Scott River, Reach 3.

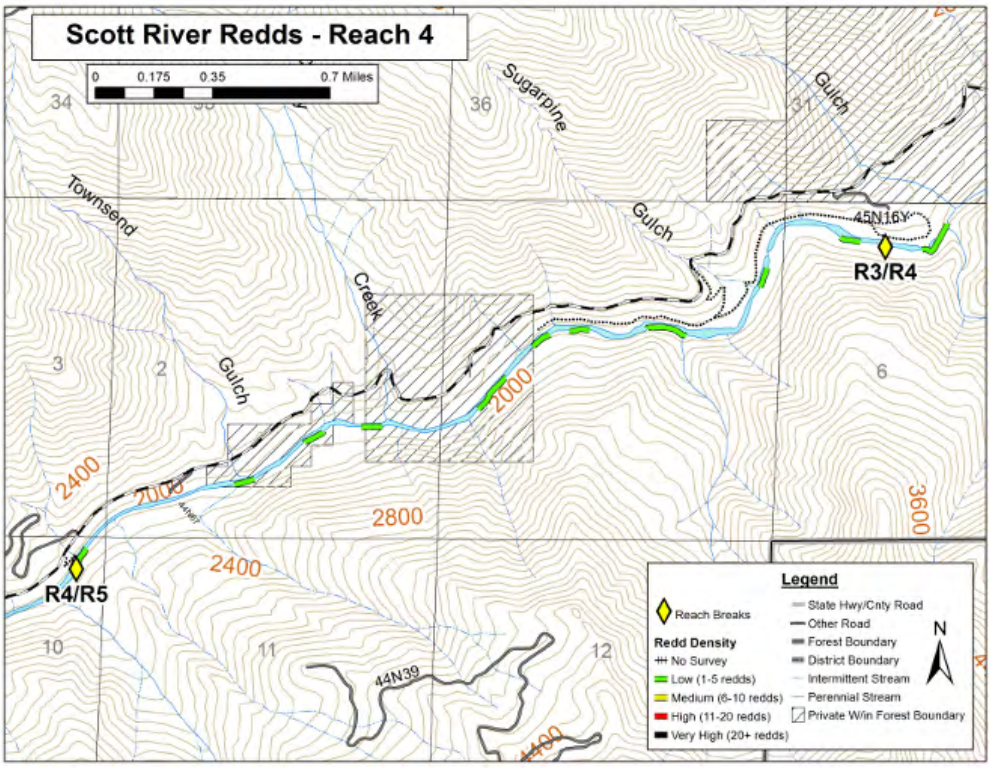


Figure D-SC5. Redd distribution and density for Scott River, Reach 4.

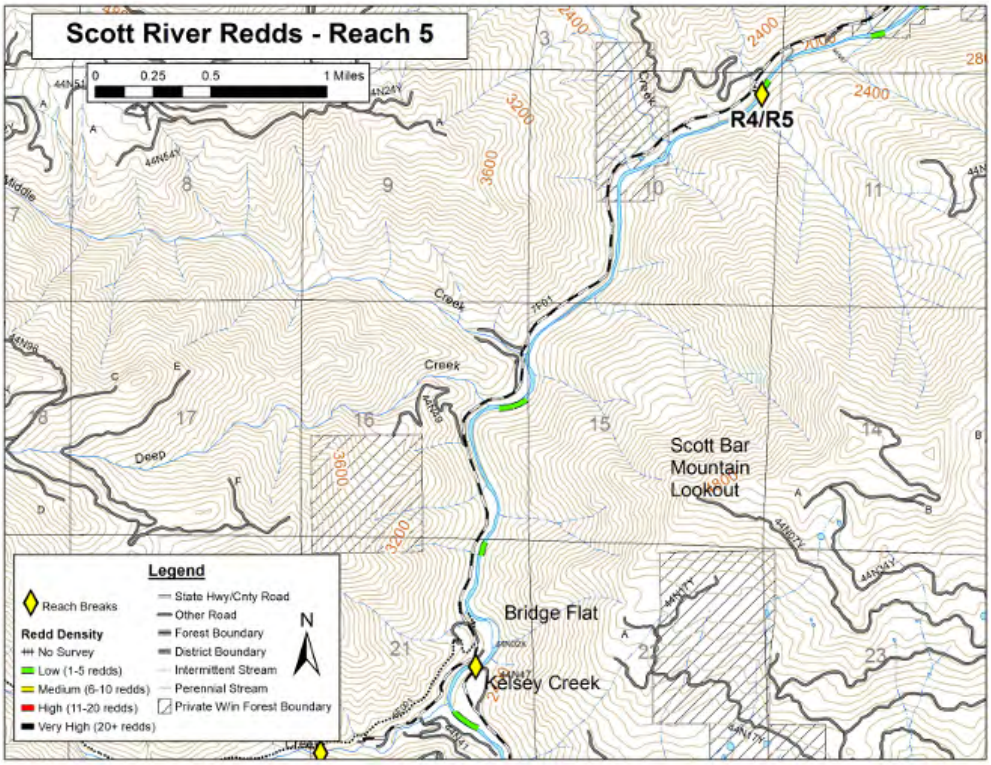


Figure D-SC6. Redd distribution and density for Scott River, Reach 5.

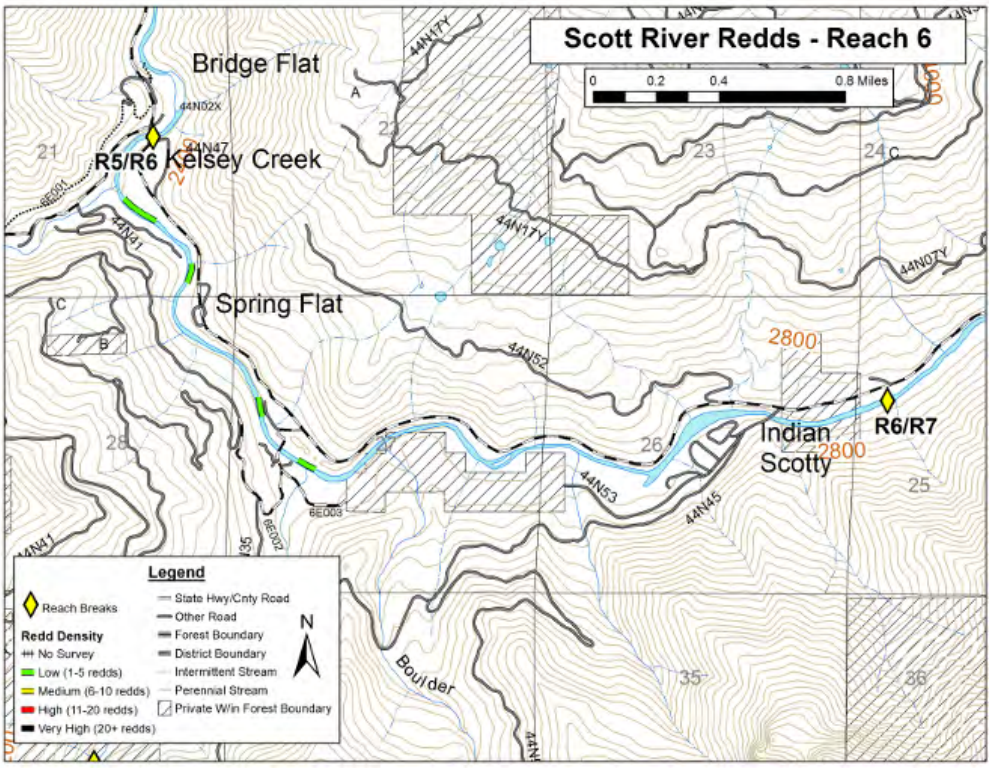


Figure D-SC7. Redd distribution and density for Scott River, Reach 6.

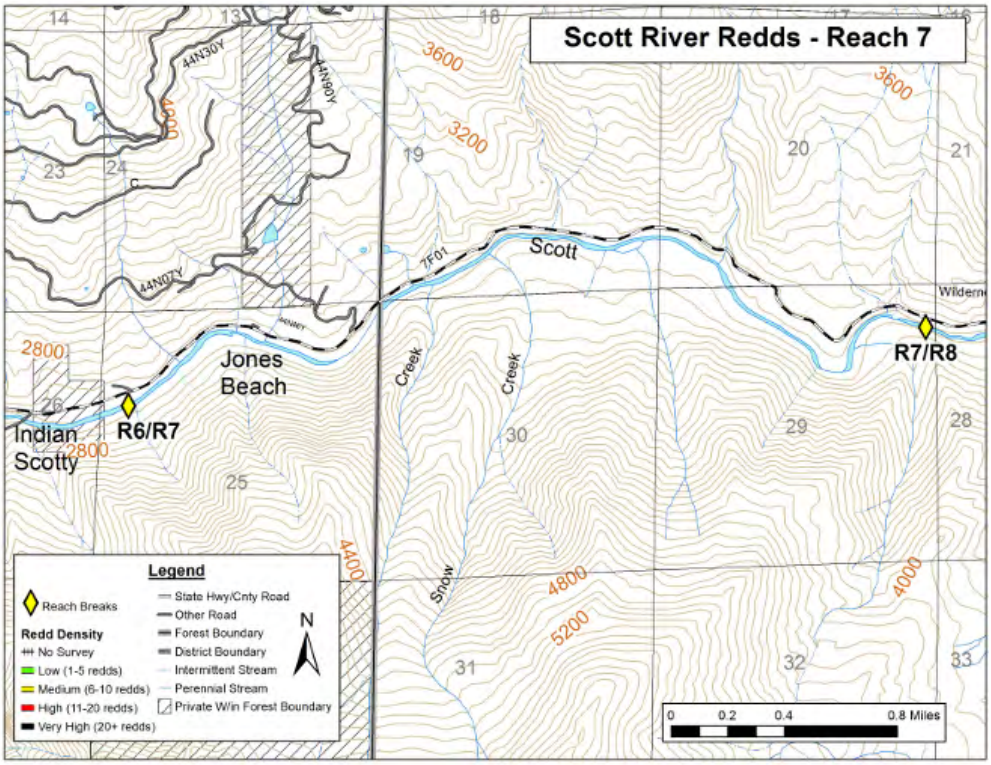


Figure D-SC8. Redd distribution and density for Scott River, Reach 7.

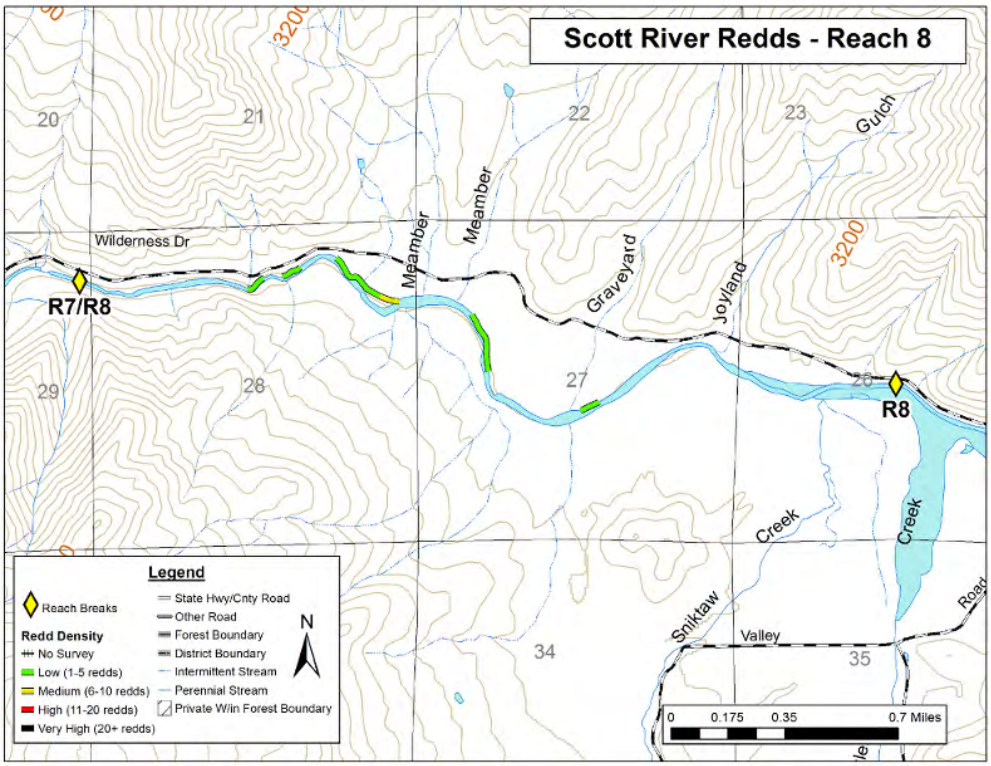


Figure D-SC9. Redd distribution and density for Scott River, Reach 8.

Appendix E – List of Cooperators and Contributions

Federal
U.S. Fish and Wildlife Service

U.S. Forest Service
-Klamath National Forest
-Six Rivers National Forest

State
California Department of Fish and Wildlife
-Arcata Office
-Yreka Office

Tribal
Karuk Tribe
Yurok Tribe
Quartz Valley Indian Reservation

Other
Local volunteers
Junction School District
Mid-Klamath Watershed Council
Northern California Resource Center
Salmon River Restoration Council
Siskiyou Resource Conservation District