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The Influence of Lewiston Dam Releases on Water Temperatures of the Trinity River  
and Lower Klamath River, CA, April to October, 2014.

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## **The Influence of Lewiston Dam Releases on Water Temperatures of the Trinity and Klamath Rivers, CA April to October 2014**

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*Abstract* — Water year 2014 was designated as “Critically Dry” in the Trinity River Basin, with 434,683 acre-feet of water released from Lewiston Dam to the Trinity River. This total water volume exceeded the Record of Decision prescribed volume of 369,000 acre-feet for a Critically Dry Water Year due to additional releases made in the fall to reduce the risk of a fish kill occurring in the lower Klamath River. Water temperatures were monitored at several locations along the Trinity and lower Klamath rivers from April to mid-October 2014 to evaluate the influence of Lewistown Dam releases on downstream water temperatures. We compare observed values to water temperature objectives specified in the Trinity River Flow Evaluation Study and adopted by the Trinity River Record of Decision, including the spring-summer water temperature targets established for outmigrating salmonids and the objectives for the 64-kilometer reach located downstream of Lewiston Dam to protect holding and spawning adult salmonids. Additionally, we document the influence of Lewiston Dam releases on water temperatures in the lower Klamath River downstream of the confluence of the Trinity River and summarize data from 2002 to 2014 during the augmented fall flow period. This document is the thirteenth consecutive annual water temperature report generated for the Trinity River Restoration Program.

### **Introduction**

Water temperature is one of the most important environmental variables affecting salmonid biology (Carter 2005). Water temperature influences feeding rates and growth (Hicks 1999; USEPA 2003), metabolism (Fry 1971; Beitinger and Fitzpatrick 1979), development (ODEQ 1995), timing of migration (Hicks 1999; USEPA 1999; Beeman et al. 2012), spawning and freshwater rearing (USEPA 2001a, 2003), and the availability of food (Ligon et al. 1999). Changes in temperature can also cause stress and mortality (Elliot 1981; Li et al. 1994; USEPA 1999; Myrick and Cech 2001; USEPA 2001b). Water temperatures in the lower Klamath River have been found to block upstream migration of salmon (CDFG 2004), stress fish (Bartholow 2005), and contribute to disease outbreaks in juvenile (True et al. 2010) and adult salmonids (Guillen 2003; Lynch and Riskey 2003; CDFG 2004). Discharge from Lewiston Dam can play an important role in regulating water temperatures downstream in the mainstem Trinity and lower Klamath rivers. Problems associated with decreased flows on the Trinity River after the construction of Trinity and Lewiston dams and other anthropogenic activities, led to the need for restoration efforts by the Trinity River Restoration Program (TRRP; USDOI 2000).

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The TRRP was authorized with the signing of the Record of Decision (ROD) of the Final Trinity River Mainstem Fishery Restoration Environmental Impact Statement in December of 2000 (USDOI 2000). Since the signing of the ROD, the TRRP has worked aggressively to achieve its over-arching goal of restoring natural production of salmon and steelhead below Lewiston Dam. As part of the TRRP's Adaptive Environmental Assessment and Management (AEAM) process, monitoring is conducted to evaluate progress towards achieving restoration objectives and to improve our understanding of the river's response to differing management actions (e.g. dam releases, mechanical channel rehabilitation, gravel augmentation). A major objective of the TRRP's flow management is to improve thermal regimes for all anadromous salmonid life stages that use the mainstem Trinity River. Specific temperature targets were developed for holding and spawning adult salmonids and for outmigrating juvenile salmonids by the Trinity River Flow Evaluation Study (TRFES; USFWS and HVT 1999) and adopted by the ROD.

Additionally, supplemental flows were released in August and September 2014 to improve conditions in the lower Klamath River to decrease the potential for an adult fish kill (USBR 2014a, 2014b). This report supports the AEAM process in that it briefly describes the influence that Lewiston Dam releases had on the downstream thermal environment during the spring, summer, and fall of 2014, whether or not the water temperature objectives identified in the TRFES were achieved (Table 1), and the potential influence of augmented fall flow releases on the thermal conditions in the lower Klamath River.

This report presents the temperature monitoring data collected for April to October during water year (WY) 2014, and beginning of WY 2015, and is the thirteenth consecutive year a report of this type has been written for the TRRP. Reports describing the thermal regimes for the years 2002 to 2013 (Zedonis 2003, 2004, and 2005; Zedonis and Turner 2006, 2007, and 2008; Zedonis 2009; Scheiff and Zedonis 2010, 2011, and 2012; Magneson 2013, and 2014) are available in electronic format from the TRRP or the Arcata Fish and Wildlife Office (AFWO) of the U.S. Fish and Wildlife Service (USFWS) (<http://www.fws.gov/arcata/fisheries>).

### **Study Area**

The Trinity River is located in northwestern California and is the largest tributary to the Klamath River (Figure 1). Trinity and Lewiston dams were constructed in the early 1960s (USFWS and HVT 1999). Trinity Dam creates Trinity Reservoir that can store up to 2.45 million acre-feet of water. Lewiston Reservoir is located immediately downstream of Trinity Dam, and is formed by Lewiston Dam, which serves as a re-regulating reservoir for flow to the Trinity River and diversion to the Sacramento River Basin. From Lewiston Dam, the Trinity River flows for approximately 180 river kilometers (rkm) before joining the Klamath River at Weitchpec, CA. From Weitchpec, the Klamath River flows for 70 rkm before entering the Pacific Ocean.

Table 1. Water temperature objectives for the Trinity River, California.

Water year type	Target area	Rkm	Dates	Temperature objective <sup>1</sup> (°C)
<b>Adult Salmonid Holding and Spawning Temperature Criteria<sup>2</sup></b>				
All types	Lewiston to Douglas City	178.2-148.5	Jul 01 - Sep 14	≤ 15.6
			Sep 15 - Sep 30	≤ 13.3
	Lewiston to confluence North Fork Trinity River	178.2-118.0	Oct 01 - Dec 31	≤ 13.3
<b>Outmigrant Salmonid Temperature Criteria<sup>3</sup></b>				
Normal and wetter	Lewiston to Weitchpec	178.2- 0.1	Apr 22 - May 22	≤ 13.0
			May 23 - Jun 04	≤ 15.0
			Jun 05 - Jul 09	≤ 17.0
Dry and critically dry	Lewiston to Weitchpec	178.2- 0.1	Apr 22 - May 22	≤ 15.0
			May 23 - Jun 04	≤ 17.0
			Jun 05 – July 9	≤ 20.0

<sup>1</sup> = Average daily water temperature in degrees Centigrade

<sup>2</sup> = Basin Plan for the North Coast Region (NCRWQCB 1994; USFWS and HVT 1999)

<sup>3</sup> = Spring-time objectives of the Trinity River Flow Evaluation Study adopted by the Record of Decision for the Trinity River EIS (USFWS and HVT 1999; USDOJ 2000).

### Methods

The influence of Lewiston Dam releases on downstream water temperature was assessed using water temperature data collected by telemetered gauging stations operated by the U.S. Geological Survey (USGS), the California Department of Water Resources (DWR), and from probes deployed by the AFWO, U.S. Bureau of Reclamation (USBR), and the Yurok Tribe’s Environmental Program (YTEP; Table 2). Data from telemetered gauging stations were downloaded from the California Data Exchange Center (CDEC) website available at <http://cdec.water.ca.gov>.

Data obtained from CDEC sites are labeled “preliminary and subject to revision”, meaning the accuracy of the data has not been verified by USGS. To correct for possible errors, we conducted graphic evaluations to identify potential erroneous data points that were subsequently deleted. These “preliminary” labeled data have been used in prior years (2004 thru 2013) as they have generally been shown to be accurate when compared to independent certified thermistors (Zedonis 2003).

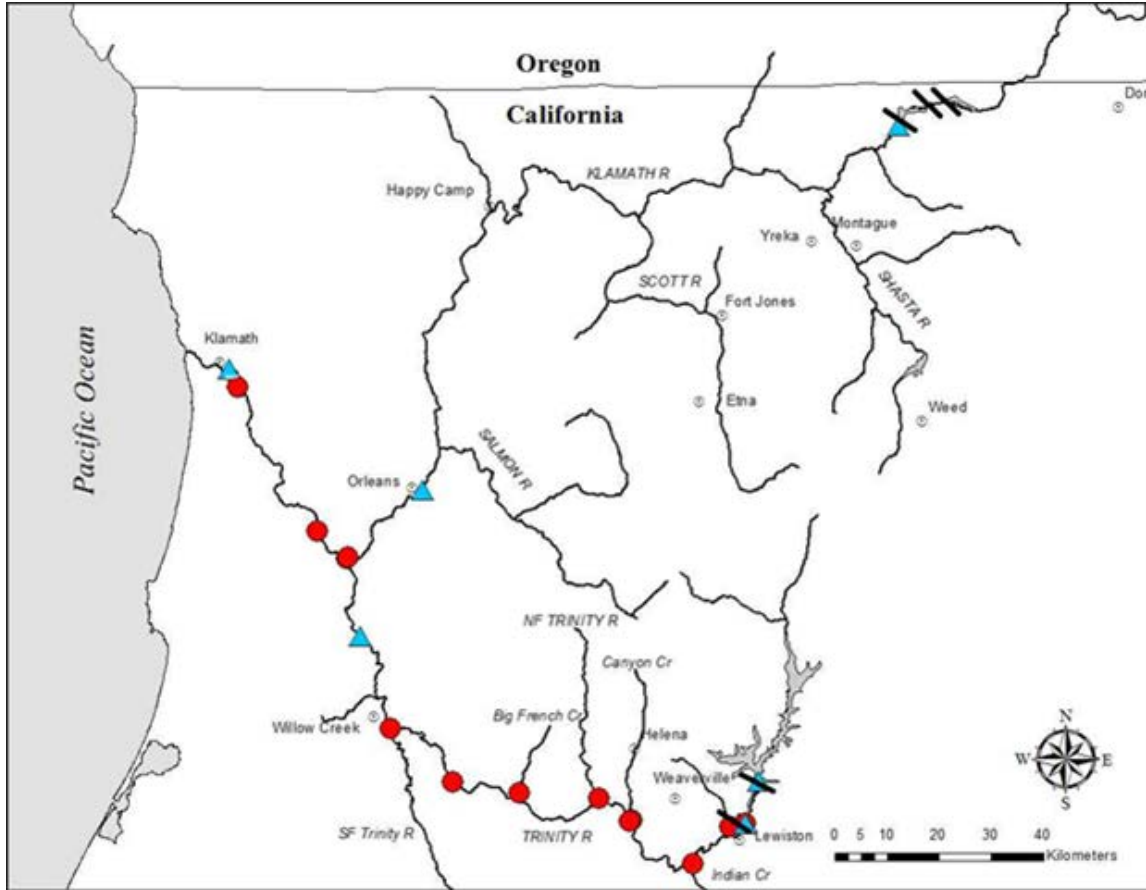


Figure 1. Location of water temperature monitoring sites of the Trinity River and lower Klamath River in 2014. Circles = water temperature sites, Triangles = discharge gauging sites, Bars = dams. Specific site information is presented in Table 2.

AFWO used temperature probes manufactured by Onset Computer Corporation® from April to October. Prior to and after deployment, each probe was subjected to a performance test to verify it was recording within the manufacturer’s accuracy specification of  $\pm 0.2$  degrees Celsius ( $^{\circ}\text{C}$ ). The instruments proved accurate and reliable for all tests conducted in 2014, and no adjustments to temperature data were necessary due to “probe drift” based on graphical evaluations. A copy of the AFWO quality assurance protocol is available upon request. Water temperatures at Terwer, CA (rkm 10.8) and Klamath River at Weitchpec (rkm 70.2) were measured and recorded during earlier years of this study with Hydrolab DataSonde 4a @ multiprobes (sondes) at 30-minute intervals or a Hobo® tidbit thermistor at 1-hr intervals. Prior to deployment, each instrument was calibrated. Sondes were calibrated using the manufacturer’s suggested methods (Hydrolab Corporation 1999).

Air temperature data were also obtained from the CDEC. These data were also labeled “preliminary and subject to revision” and were reviewed and corrected using the same standards established for downloaded water temperature data. Estimates of river flow of



Table 2. Water temperature monitoring sites of the Trinity River (TR) and the Klamath River (KR) below Weitchpec, 2014. Note: Not all data identified in this table are presented in the report but are available upon request.

<b>Mainstem Trinity River Water Temperature Monitoring Sites</b>			
<b>Site name (abbreviation)</b>	<b>Location (rkm)</b>	<b>Data source</b>	<b>Operator</b>
TR @ Lewiston Gauge (LWS)	178.2	CDEC	USGS and USBR
TR above Rush Ck (TRRC1)	173.0	USFWS	USFWS
TR@ Limekiln Gulch Gauge (TLK)	158.7	CDEC	USGS
TR @ Douglas City Gauge (TRDC2)	148.5	CDEC	USGS
TR above Canyon Ck (TRCN1)	127.4	USFWS	USFWS
TR above N.F. Trinity R. (NFH)	118.0	CDEC	USGS
TR above Big French Creek (TRBF1)	94.2	USFWS	USFWS
TR @ Burnt Ran. Trans Sta (TRBR1)	76.4	USFWS	USFWS
TR above S. Fork Trinity R. (TRSF1)	50.6	USFWS	USFWS
TR @ Willow Creek Trap (TRWC1)	34.1	USFWS	USFWS
TR @ Hoopa Gauge (HPA)	20.0	CDEC	USGS/DWR
TR @ Weitchpec (TRWE1)	0.1	USFWS/YTEP/USBR	USFWS/YTEP/USBR
<b>Mainstem Klamath River Water Temperature Monitoring Sites</b>			
KR at Weitchpec (KRWE1) <sup>a</sup>	70.2	YTEP/USFWS	USFWS/YTEP
KR below Weitchpec (KBW3)	68.7	YTEP/USFWS	USFWS/YTEP
KR near Klamath (KRTG2) <sup>b</sup>	13.0	YTEP/USFWS	USFWS/YTEP
KR @ Terwer (KRTG1)	10.8	USFWS	USFWS
<b>Trinity River Tributary Water Temperature Monitoring Sites</b>			
Indian Ck (ICTR1)	152.9 + 0.1	USFWS	USFWS
Canyon Ck (CNTR1)	127.3 + 0.1	USFWS	USFWS
N. F. Trinity R (NFTR1)	116.7 + 0.1	USFWS	USFWS
Big French Ck (BFTR1)	94.1 + 0.1	USFWS	USFWS
S. F. Trinity R (SFTR1)	50.5 + 0.1	USFWS	USFWS

a = This site is located immediately above the confluence of the Trinity River and refers to the distance from the Klamath River mouth.

b = Data are available from multiple sources.

the Trinity River at Lewiston (rkm 178.2) and at Hoopa (rkm 20.0); of the Klamath River at Iron Gate Dam (rkm 305.5) and Orleans (rkm 95.1) and of the lower Klamath River near Klamath (rkm 13.0) were obtained from the USGS website (<http://water.usgs.gov>). Efforts were made to use “final” flow data from USGS, which was dependent on the timing of its release in relation to the timing of completion of this report. Although water temperature data were collected from more locations than are presented, only key sampling locations will be discussed in this report.

## **Results and Discussion**

### **Hydrology**

Water year 2014 was designated as a Critically Dry WY in the Trinity Basin. A total of 434,683 acre-feet (AF) of water was released from Lewiston Dam to the Trinity River in WY 2014. This total exceeded the prescribed flow volume of 369,000 AF for a Critically Dry water year under the ROD (DOI 2000) due to the increased releases in the fall to prevent a fish kill (USBR 2014a, 2014b). Notable differences from a standard ROD critically dry hydrograph included: (1) two habitat monitoring benches during the descending limb of the peak spring flow and (2) the augmented flow from late August to late September (Figure 2). Detailed description of the decisions used to establish the flow pattern during the spring and summer period are provided in a Technical Brief titled *Trinity River Restoration Flow Release Schedule Design for Water Year 2014* released by the TRRP (2014).

Contributions of flow from Lewiston Dam to the lower Trinity River and Klamath River varied throughout WY 2014 (Figure 3; Appendix A). During early April, the contributions of flow from Lewiston Dam to the total discharge measured at the lower Klamath River gauge (rkm 13.0) were small (e.g. 3 %) due to low base flows (e.g. 315 cfs) from Lewiston and the comparatively high tributary accretions between these gauges. By late April, peak spring flow releases from Lewiston Dam resulted in a greater contribution of flow to the lower Trinity River (rkm 20.0) and lower Klamath River as compared to values for early April. The greatest contributions occurred in late April and May and again from late-August to late-September when Lewiston Dam releases comprised a very large proportion of the total discharge measured at the Klamath gauge (Appendix A). The large contribution during late-August to late September was due to the augmented fall flows described above.

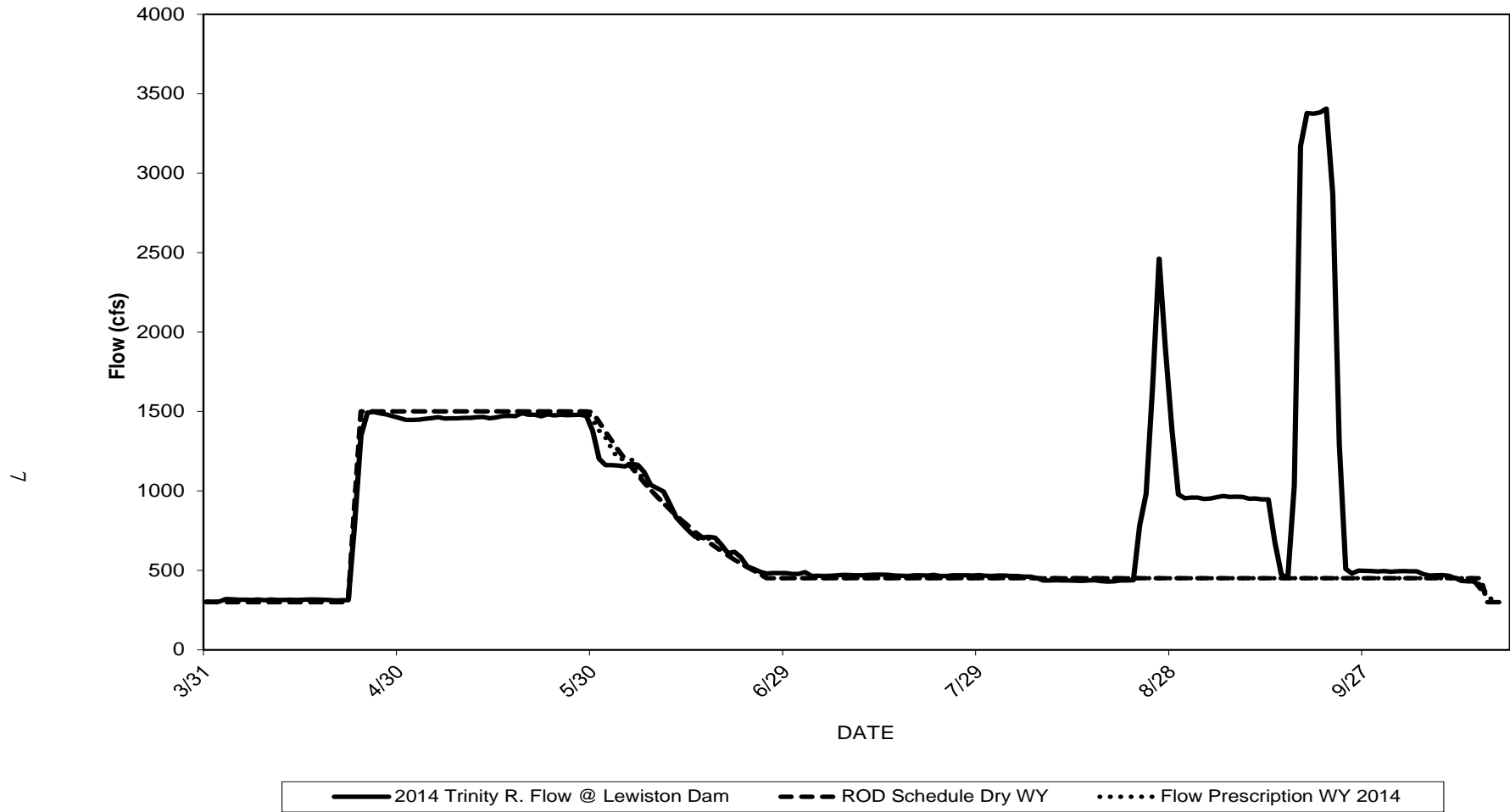


Figure 2. Spring and summer flow releases from Lewiston Dam (rkm 178.2) to the Trinity River in 2014 compared to the flow schedule for a critically dry hydrologic water year identified in the Record of Decision (USDOI 2000).

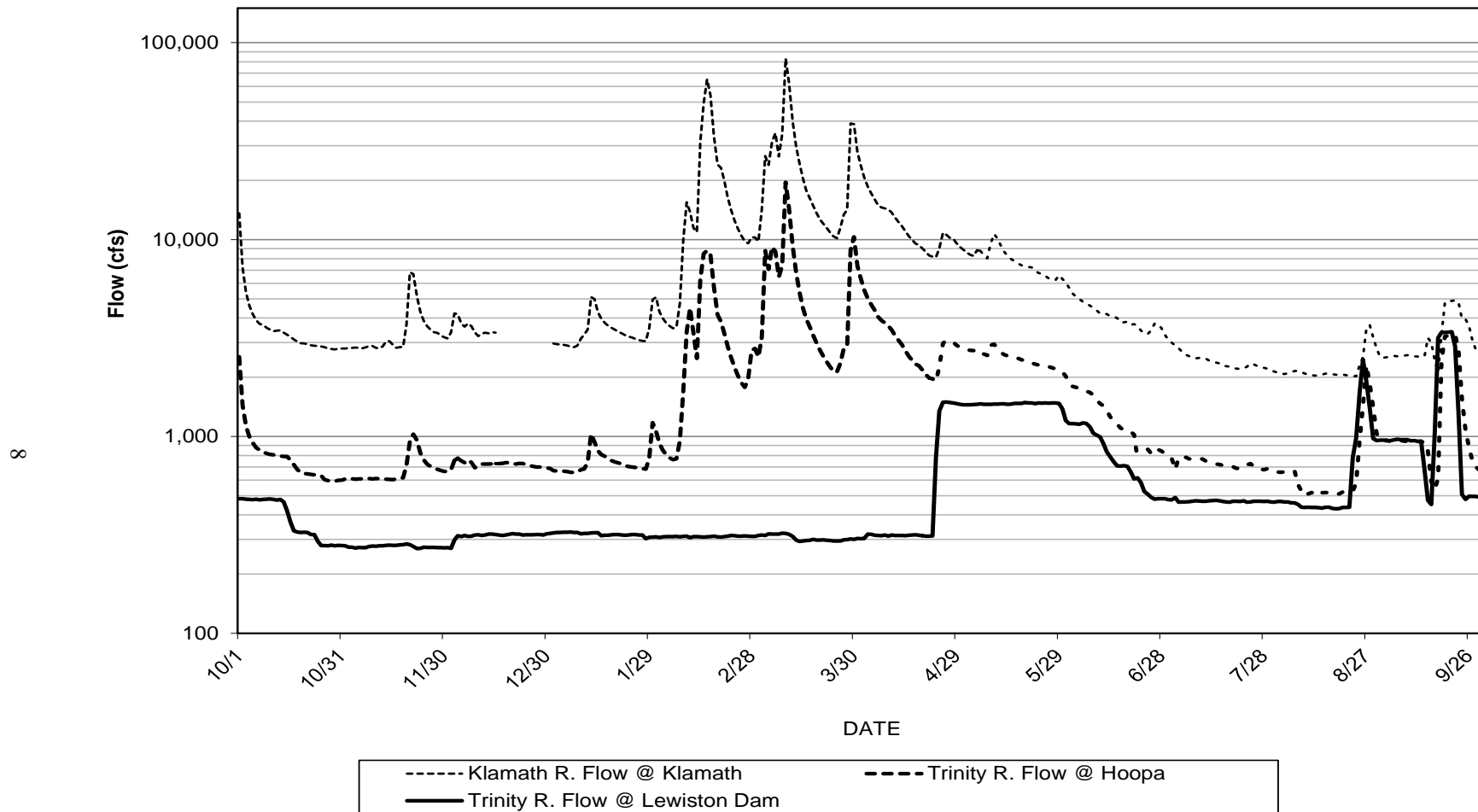


Figure 3. Average daily flow of the Trinity River at Lewiston gauge (rkm 178.2), the Hoopa gauge (rkm 20.0), and the Klamath River near Klamath gauge (rkm 13.0), WY 2014.

## **Water Temperatures of the Trinity River**

### *Lewiston Gauge (rkm 178.2)*

Average daily water temperatures of Lewiston Dam releases ranged between 9.2 °C and 12.8 °C between mid-April and mid-October (Figure 4). The warmest release temperatures occurred in late June to early July, late August to mid-September, and late September to early October. The late June to early July warming trend coincided with typical warming trends. The late August to mid-September and late September to early October warming trends coincided with a decrease in releases from Trinity Reservoir which increases the residence time and subsequent heating in Lewiston Reservoir prior to release into the Trinity River or diversion to the Sacramento River.

### *Douglas City Gauge (rkm148.5)*

Water temperatures at Douglas City ranged between 9.9 °C and 16.3 °C from mid-April to mid-October (Figure 5). Water temperature exceeded the water temperature objective (<15.6 °C and <13.3 °C) for the period when Douglas City is the compliance point for the summer/fall water temperature objectives (Table 1) eight times for a total of 19 days (by as much as 1.5°C). Water temperatures at this site exhibited an inverse relationship with discharge from Lewiston Dam, most notably during high flow periods from late April to mid-May and in late August. Water temperature was also influenced by air temperature, especially at lower flows.

### *Trinity above the North Fork Trinity (rkm 118)*

Average daily water temperatures of the Trinity River above the North Fork Trinity were warmer in comparison to the upstream Douglas City site, but exhibited similar relationships with flow and air temperature (Figure 6). Average daily temperatures at this site ranged from 10.5 to 20.1 °C and peaked on July 20. Temperatures exceeded the temperature objective of  $\leq 13.3$  °C (Table 1) two times (October 1 to October 12 and October 18 to October 20) at this point during the compliance period which extends from October 1 through December 31.

### *Above Big French Creek to Weitchpec (rkm 94.2 to 0.1)*

The peak daily average temperature was 22.6 °C measured just upstream of Big French Creek at rkm 94.2 and 25.6 °C at Weitchpec, rkm 0.1 (Figure 7). By late August water temperature at Weitchpec was as much as 5.4 °C warmer than water temperature above Big French Creek, largely due to thermal heating along the mainstem as well as warm water accretion from the South Fork Trinity River. Review of average daily water temperatures from previous years suggest that water temperatures typically peak between 24 °C and 25°C within this reach (Zedonis 2003, 2004, and 2005).

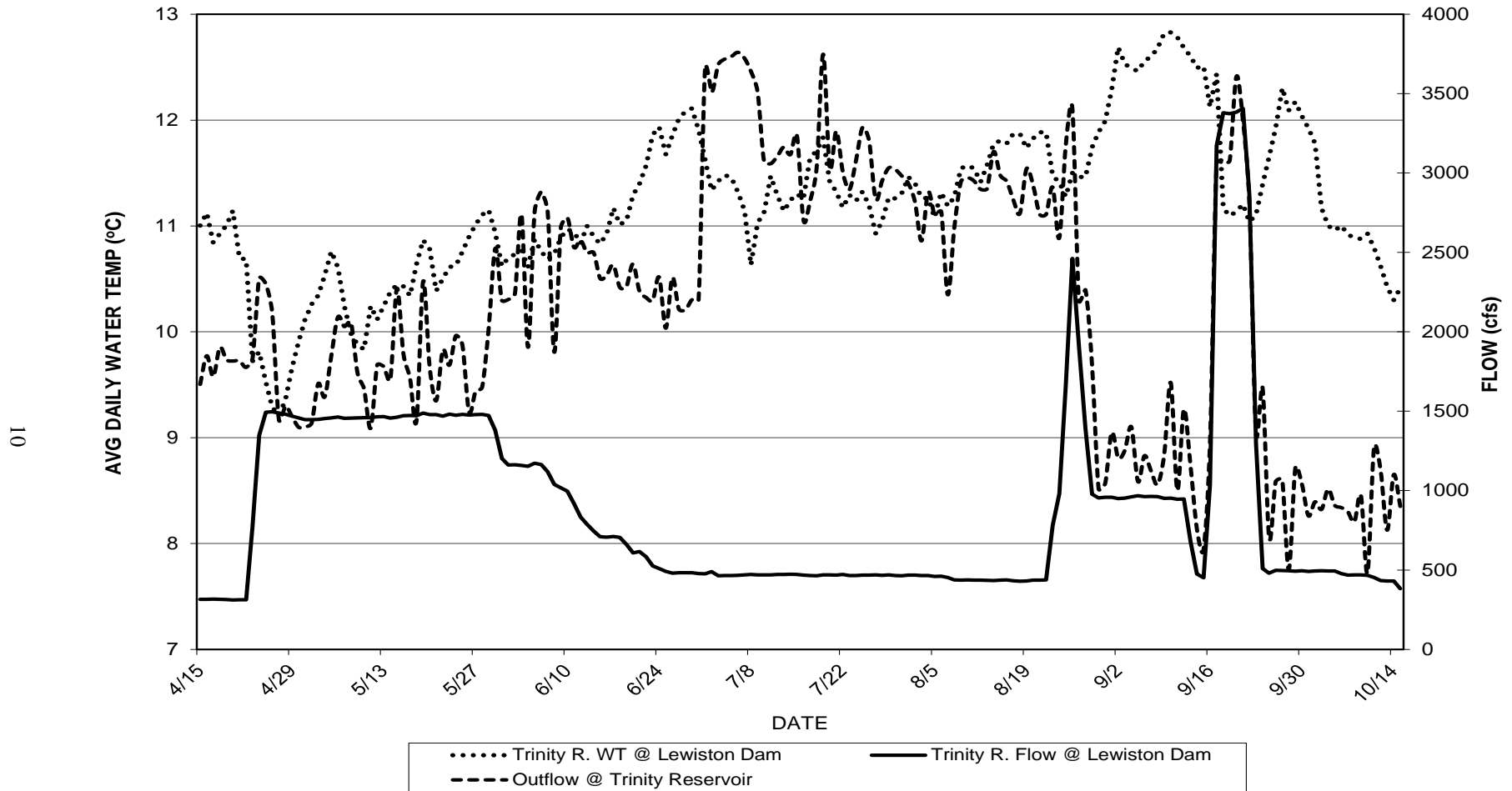


Figure 4. Water temperature (WT) and flow of the Trinity River at Lewiston (rkm 178.2) and Trinity Reservoir outflow in 2014. Trinity Reservoir outflow supplies water to the Trinity River and diversions to the Sacramento River Basin.

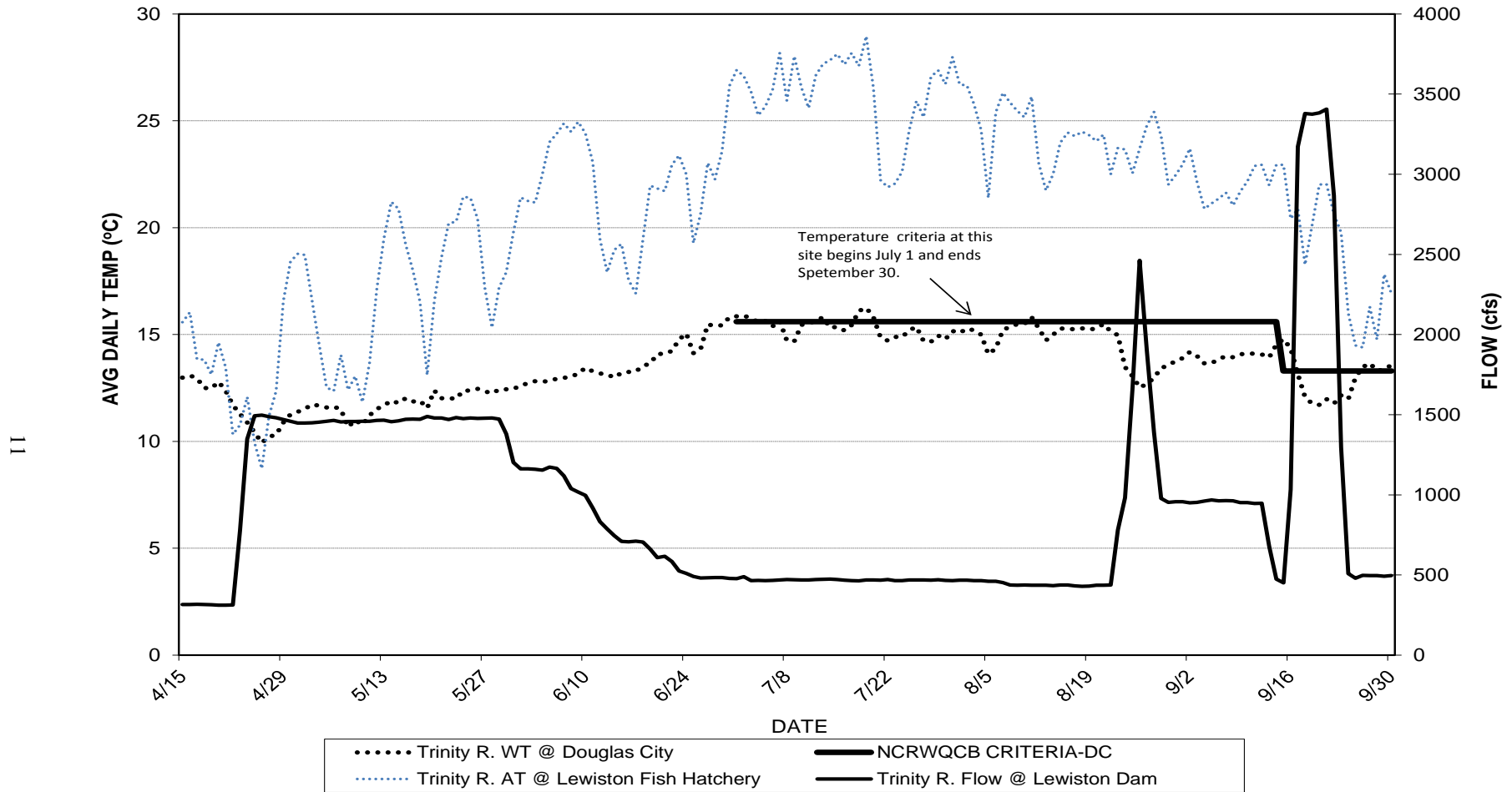


Figure 5. Comparison of average daily water temperatures (WT) of the Trinity River at the Douglas City gauge (rkm 148.5) in 2014 and the water temperature objectives of the North Coast Regional Water Quality Control Board (NCRWQCB Criteria-DC). Air temperature (AT) data are from the Lewiston Fish Hatchery (rkm 178).

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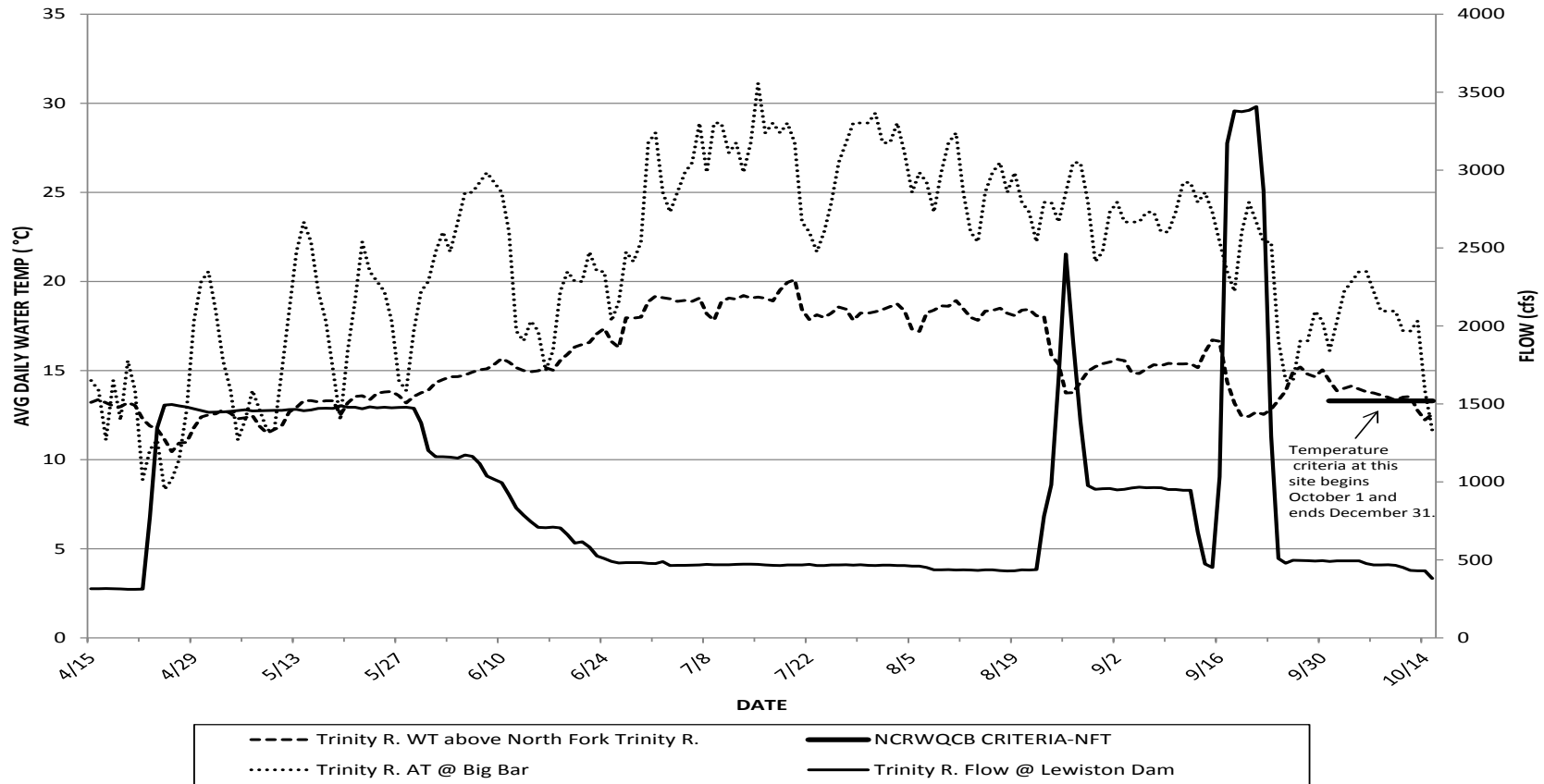


Figure 6. Comparisons of average daily water temperatures (WT) of the Trinity River above the confluence of the North Fork Trinity River (rkm 118.0) in 2014 and the water temperature objective of the North Coast Regional Water Quality Control Board (NCRWQCB-NFT). Air temperature (AT) data are from the Trinity River at Big Bar (rkm 109.5).



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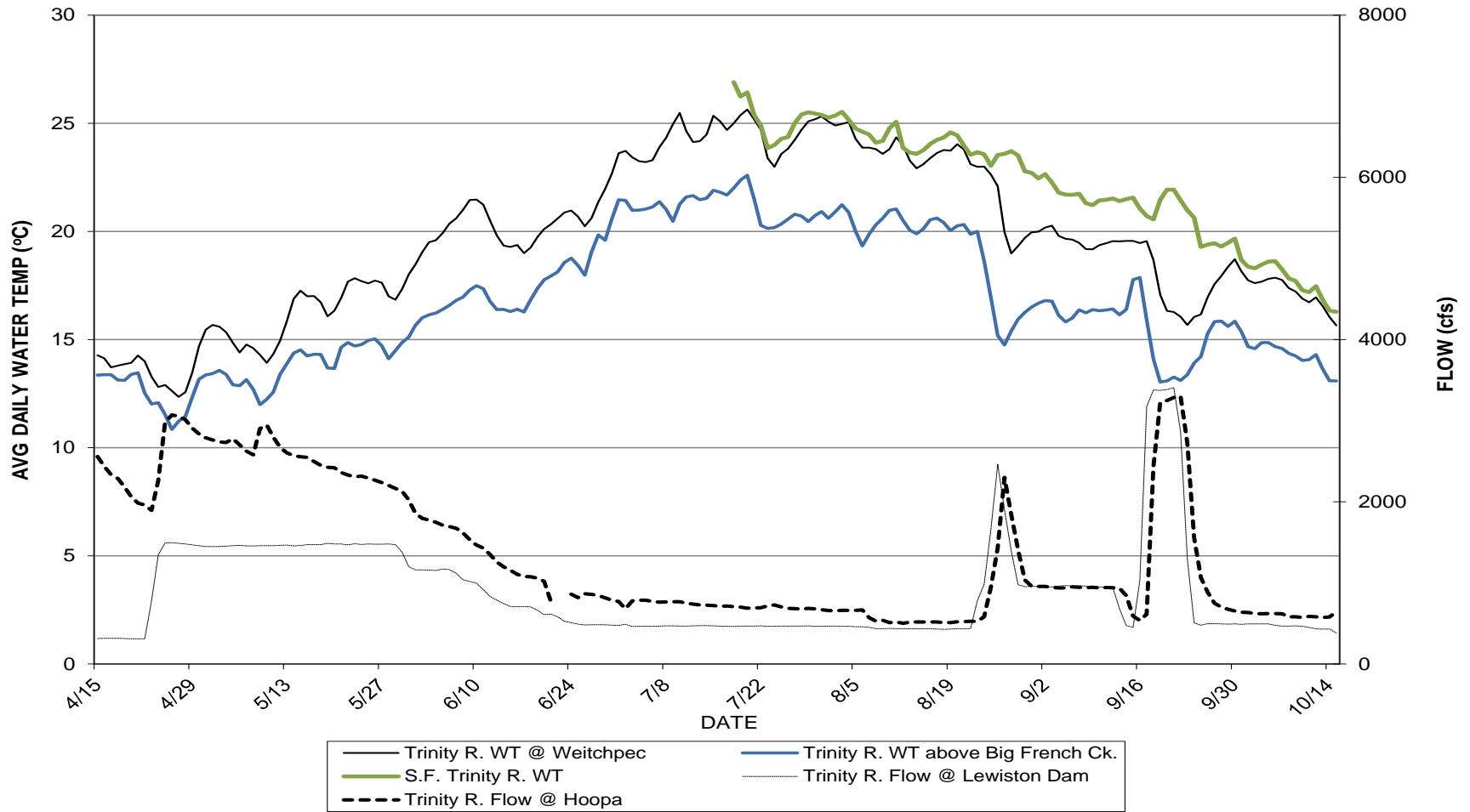


Figure 7. Comparisons of average daily water temperatures of the Trinity River above Big French Creek (rkm 94.0), and at Weitchpec (rkm 0.1), in the lower South Fork Trinity River (rkm 0.1) and flow at Lewiston (rkm 178.2) and Hoopa Gauge (rkm 20.0) in 2014.

### **Weitchpec- Outmigrant Temperature Objectives**

During Dry and Critically Dry Water Years, providing “marginal smolt temperatures” (MST) at Weitchpec is a management objective (USFWS and Hoopa Valley Tribe 1999). Between mid-April and May 22, 2014, daily average water temperatures recorded in the Trinity River at Weitchpec exceeded MST in early and late May for steelhead for a total of 14 days (Figure 8). MST during the Coho Salmon criteria period was exceeded during late May and early June for a total of 12 days. MST during the Chinook Salmon criteria period was exceeded in early June and late June and early July for a total of 27 days. Water temperature in the lower Trinity River exceeded MST five times between May 1 and July 9. Periods where MST was exceeded can be, at least in part, attributed to warming air temperatures coupled with decreasing flow from Lewiston Reservoir (Figure 9) and decreasing tributary accretion.

### **Temperatures of the Klamath River Above and Below the Trinity River Confluence**

Average daily water temperatures of the Trinity River at Weitchpec were generally cooler than the Klamath River at Weitchpec above the confluence with the Trinity River (109 of 184 days), except for ten time periods (Figure 10). From April 15 to May 15 the Trinity was warmer than the Klamath by as much as 1.4 °C. From the end of May through mid-August, water temperatures at these two sites were very similar. After August 26, the Trinity River was up to 4.9 °C cooler than the Klamath River. This cooling trend was related to the increase in flow from Lewiston Dam from August 23 to September 13, and from September 16 to September 23, which was intended to reduce the possibility of a fish kill. This temperature reduction was similar to that observed in 2009, 2011, and 2013 when peak flow releases from Lewiston Dam during this time period occurred for the biennial Hoopa Valley Tribal Boat Dance ceremony (Scheiff and Zedonis 2010 and 2012; Magneson 2014) and in 2012 and 2013 when augmented flows were made to reduce the possibility of a fish kill in the lower Klamath River (Magneson 2013 and 2014).

The difference between water temperatures and the magnitude of flows of the Trinity and Klamath rivers during the augmented flow had a noticeable influence on the thermal regime of the Klamath River below the confluence (Figure 10). The thermal dilution from cooler Trinity River resulted in average water temperature reductions of about 0.9 C just below Weitchpec (rkm 62.0) and 0.6 °C near Klamath, CA (rkm 13.0). Following the augmented flow, water temperature differences between the Trinity River at Weitchpec (rkm 0.1) and the Klamath River above Weitchpec (rkm 70.2) decreased back to less than 0.6 C until mid-October.

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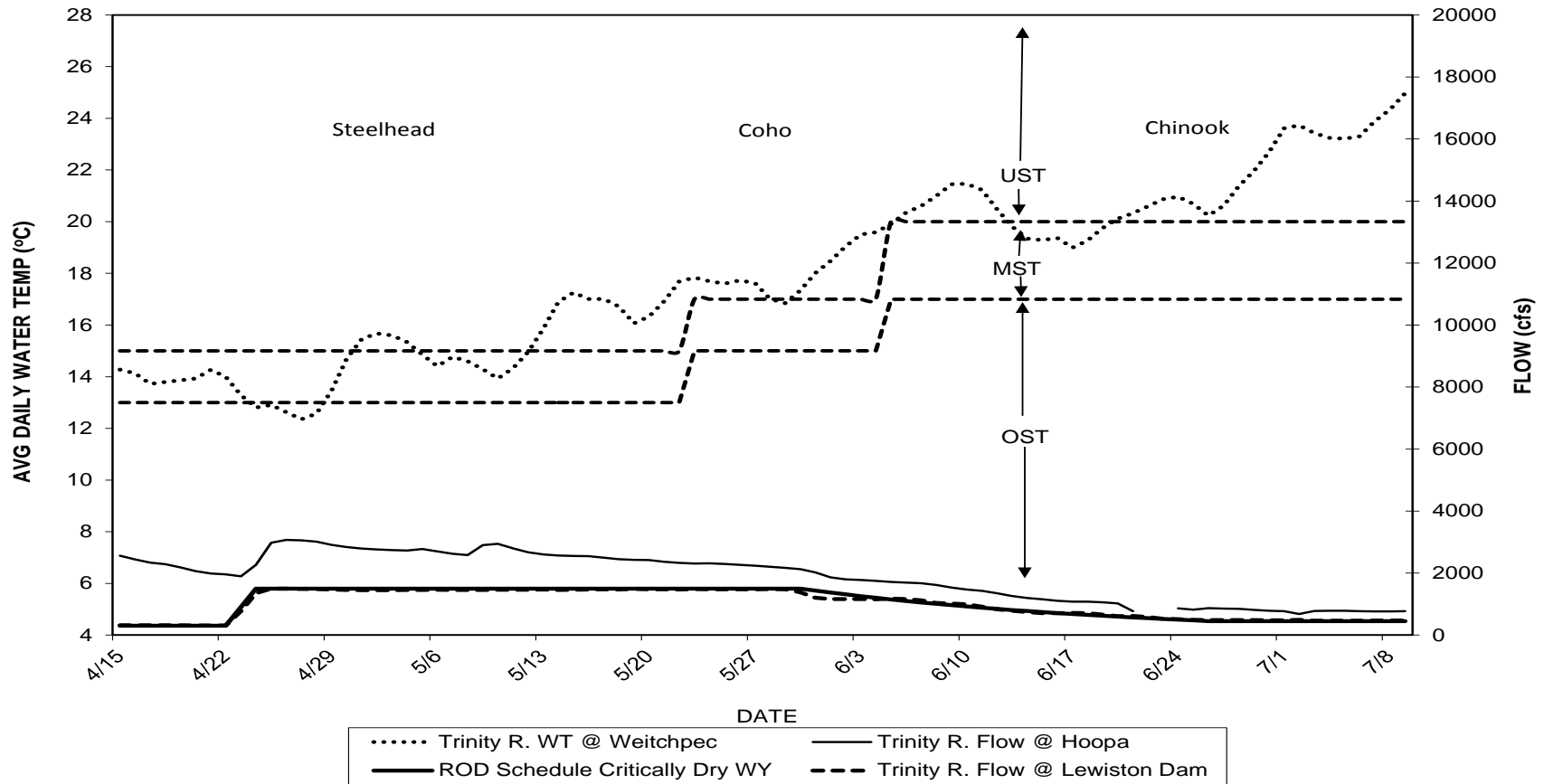


Figure 8. Average daily water temperatures (WT) of the Trinity River recorded at Weitchpec in 2014, with spring-time temperature objectives of the Trinity River Flow Evaluation Study (USFWS and Hoopa Valley Tribe 1999) for steelhead, Coho Salmon, and Chinook Salmon smolts. Smolt objectives: UST = unsuitable smolt temperatures; MST = marginal smolt temperatures, OST = optimal smolt temperatures. Marginal smolt temperatures are sought from April 22 to July 9 in water years classified as Critically Dry.

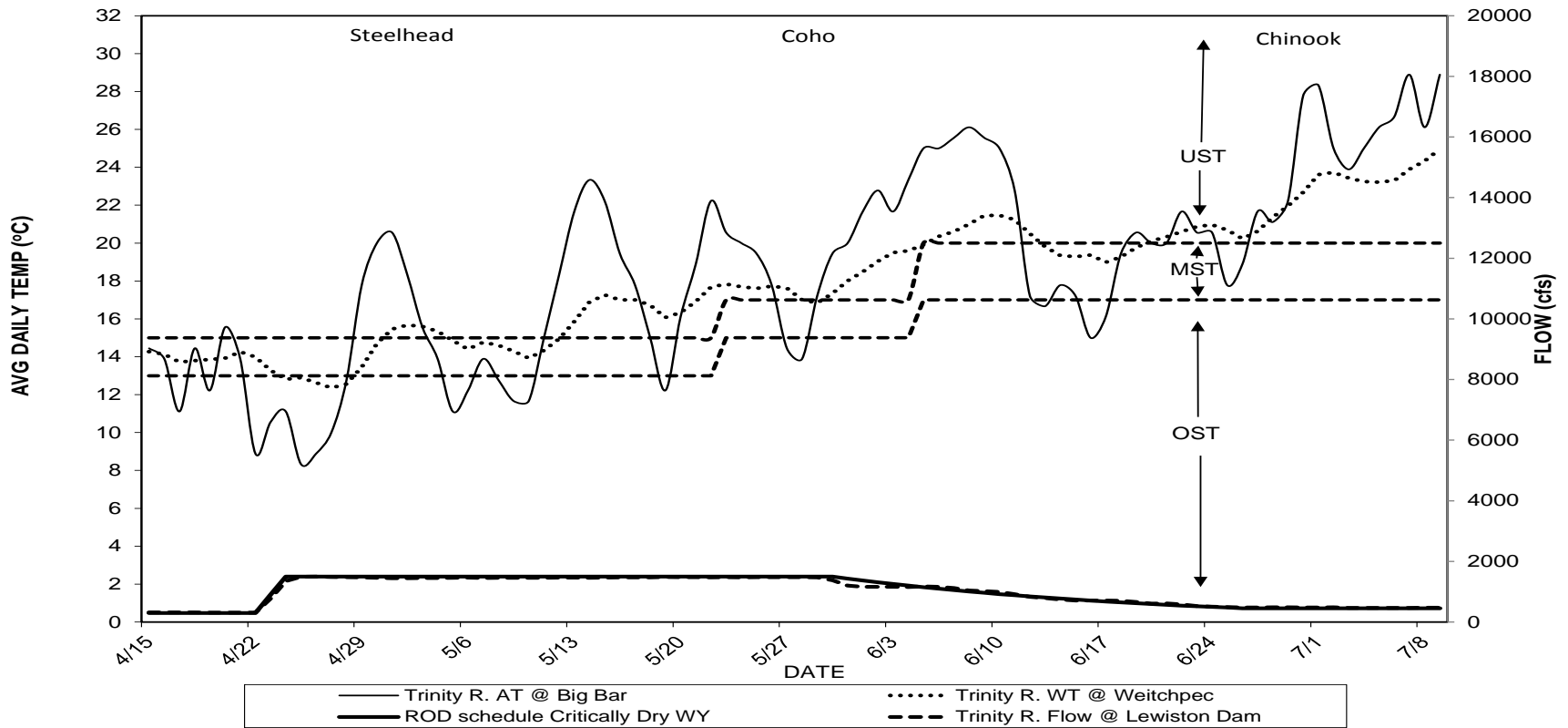


Figure 9. Air temperature (AT) and its influence on water temperature (WT) of the Trinity River at Weitchpec from April 15 to July 9, 2014, with spring-time water temperature objectives of the Trinity River Flow Evaluation Study (USFWS and Hoopa Valley Tribe 1999) for steelhead, Coho Salmon, and Chinook Salmon smolts. Smolt criteria: UST = unsuitable temperatures; MST = marginally suitable temperatures; OST = optimally suitable temperatures. Marginal smolt temperatures are sought from April 22 to July 9 in water years classified as Critically Dry. Air temperature (AT) data are from the Trinity River at Big Bar (rkm 109.5).

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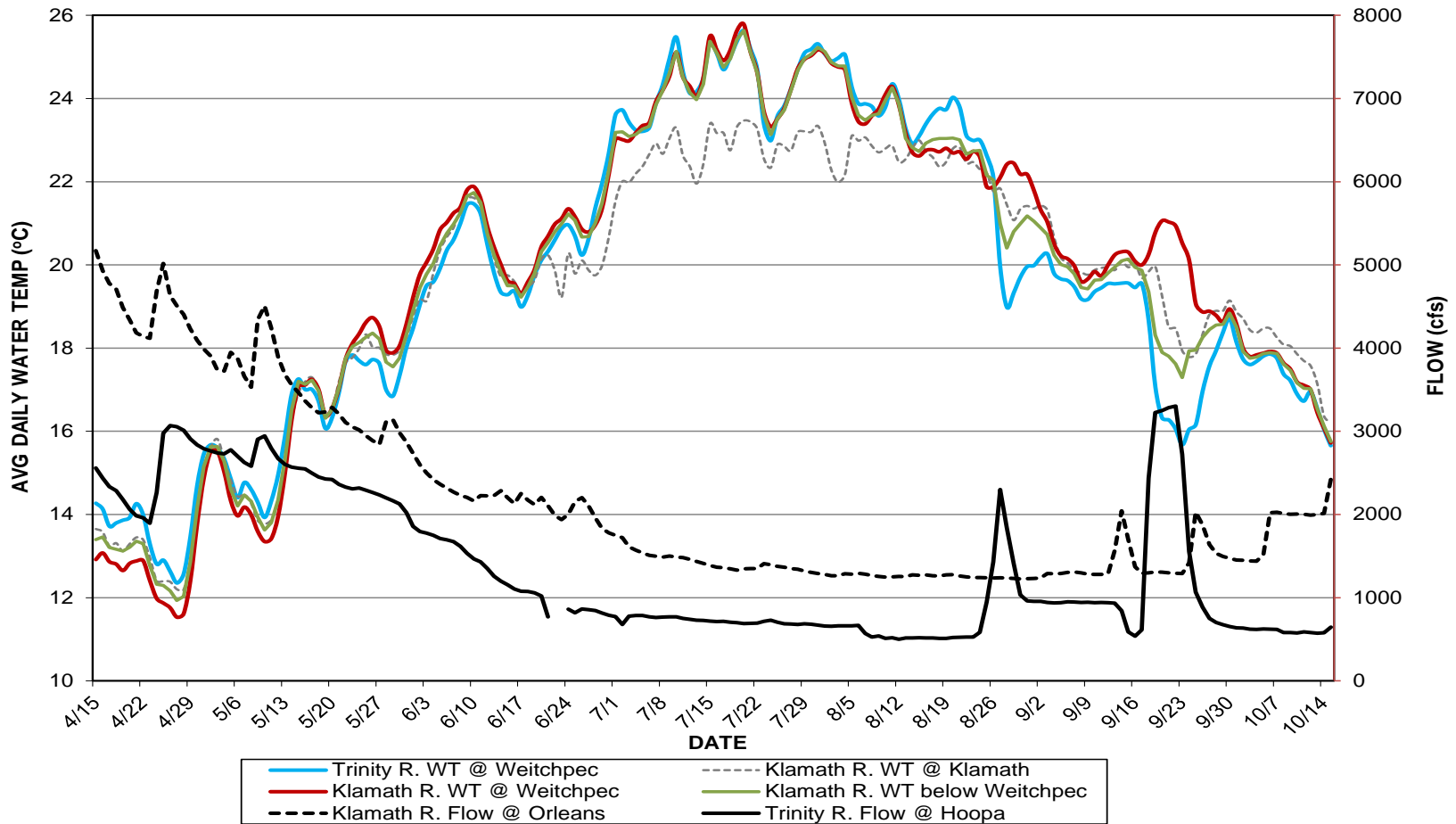


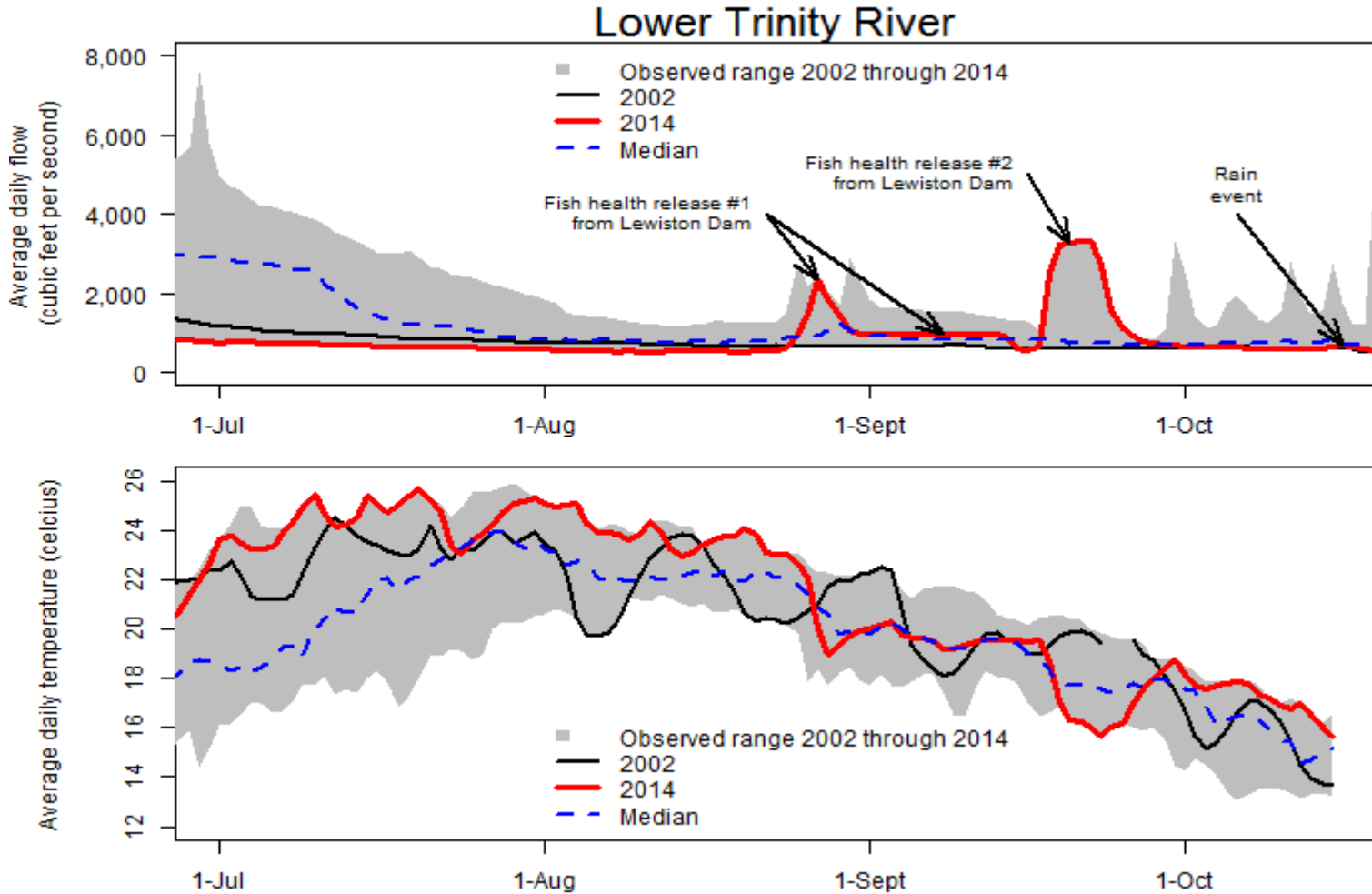
Figure 10. Comparison of water temperatures (WT) of the Trinity River at Weitchpec (rkm 0.1) and the Klamath River above (rkm 70.2) and below (rkm 62.0 and rkm 13.0) the confluence of the Trinity River relative to stream flow in 2014. See Appendix A in this report for daily information.

### **Augmented Flow Releases and Resulting Water Temperatures 2002 to 2014**

Late summer and early fall flows in lower Klamath River flows during the Critically Dry 2014 WY were anticipated to be among the lowest experienced in recent history, comparable or lower than in the designated Normal 2002 WY when a large fish kill occurred in the lower Klamath River (Guillen 2003; CDFG 2004). To improve flow, temperature and migration conditions for adult upstream migrant salmon and thereby reduce the risk of a fish kill, USBR provided an augmented flow release from Lewiston Dam from August 23 to September 14 (USBR 2014a). Shortly thereafter, high rates of fish heavily infected with *Ichthyophthirius multifiliis* were observed in the lower Klamath River (USFWS 2014) and USBR initiated an additional augmented release from Lewiston Dam September 16 to 23 (USBR 2014b), and USBR and PacifiCorp initiated one flow release from Iron Gate Dam October 4 to 15 (USBR 2014c).

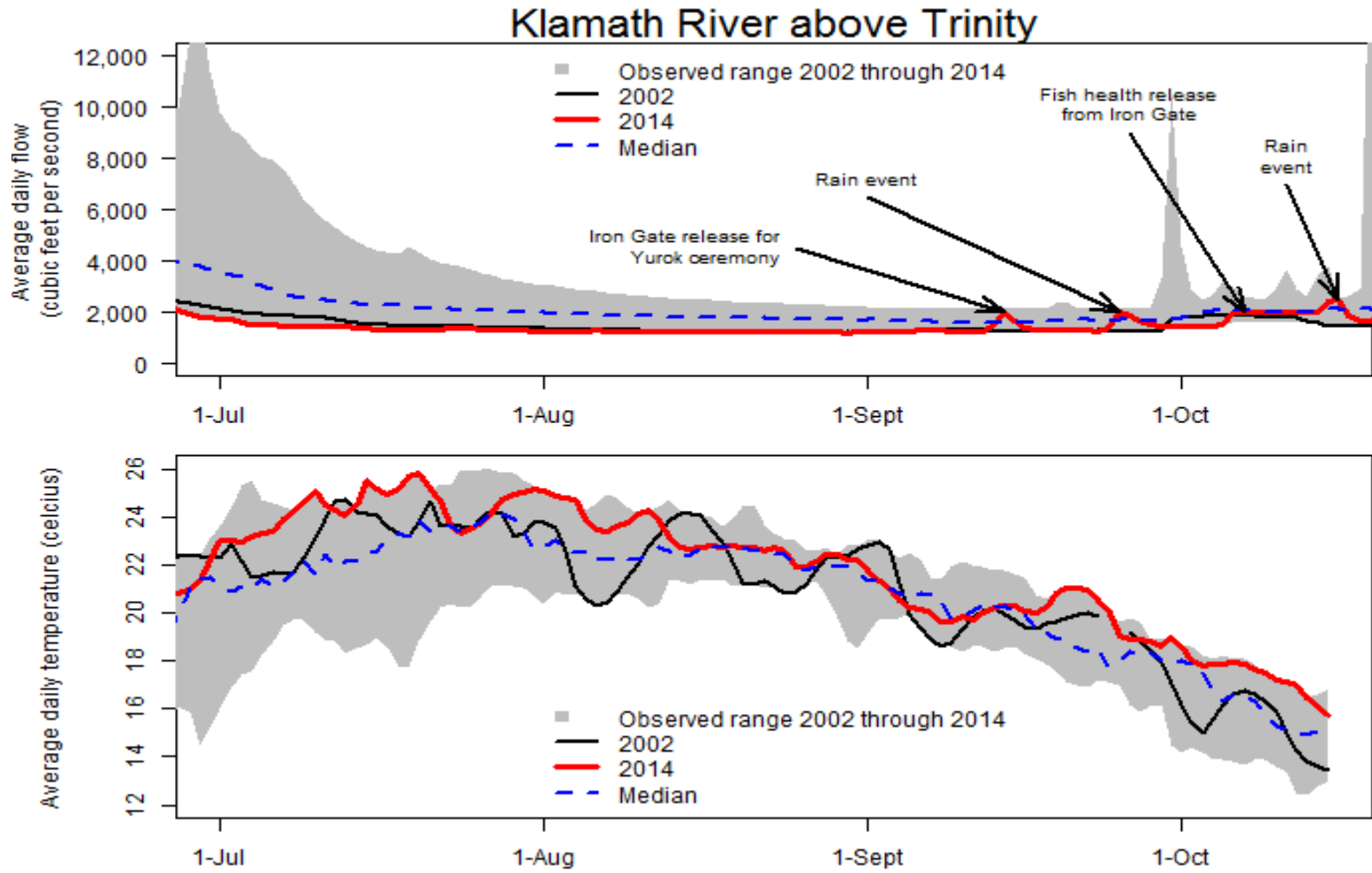
Flows on the Trinity River near Hoopa, the Klamath River near Orleans, and the Klamath River near Klamath for the period July 1-August 24, 2014 were the lowest recorded for the period of record 2002 to 2014 (Figure 11, Figure 12, Figure 13). Flows on the Klamath River near Orleans in 2014 continued to be the lowest recorded over the 2002-2014 period through September 13 when a short pulse flow released from Iron Gate Dam for the Yurok Tribal ceremonial purposes reached Orleans (Figure 12). Klamath River flows at Orleans remained at or near 2002 to 2014 minima except for small rain events that occurred on September 24 and October 15, and during the augmented flow release from Iron Gate Dam. Temperature of the Klamath River above the Trinity River near Weitchpec was generally higher for much of the summer-fall period in 2014 than in 2002, even though flows were similar (Figure 12).

Daily average water temperatures for the Klamath River at both Orleans and Klamath near Klamath were at or near their 2002 to 2014 maxima through much of July (Figure 12, Figure 13) until climactic events influenced temperatures, and large fires of the Happy Camp Complex reduced solar heating (USFS 2014). The first Trinity River augmented release reached the lower Klamath River around August 25 and the second augmented release reached the lower Klamath River around September 18. Temperature of the lower Klamath River remained at or near the median value for 2002 to 2014 period of record during the augmented Trinity River releases, then increased to at or near maxima shortly thereafter, even through the augmented Iron Gate Dam release.



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Figure 11. Average and median daily discharge (CFS) in the Trinity River at Hoopa (rkm 20.0) and average and median daily water temperature (°C) measured upstream (0.1 rkm) of the Klamath River at Weitchpec, CA from July 1 to October 15, 2002 to 2014.



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Figure 12. Average and median daily discharge (CFS) in the Klamath River at Orleans (rkm 95.1) and average and median daily water temperature (°C) measured upstream (0.2 rkm) of the Trinity River at Weitchpec (rkm 70.2), CA from July 1 to October 15, 2002 to 2014. Temperature data from 2007 are not available.



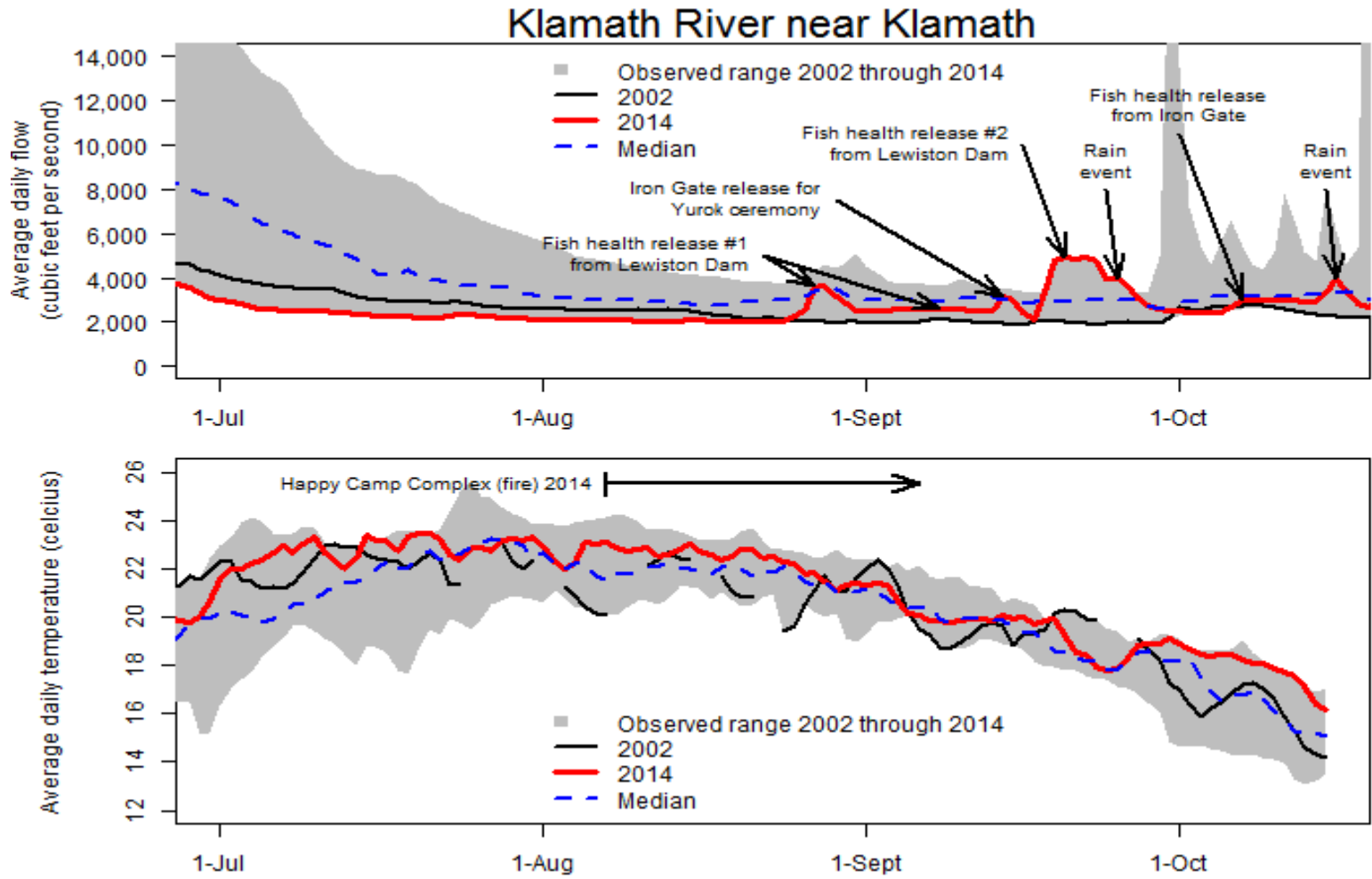


Figure 13. Average and median daily discharge (CFS) and water temperature (°C) in the Klamath River at Klamath (rkm 13.0 and rkm 8.6), CA from July 1 to October 15, 2002 to 2014. Water temperature data are available from July 1, 2003 and from July 19, 2004 through the end of each water year.

## Summary

Water year 2014 was designated as “Critically Dry” and 434,683 acre-feet of water was released from Lewiston Dam to the Trinity River. This total exceeded the ROD prescribed volume of 369,000 AF for a Critically Dry WY due to the additional releases in the fall aimed at reducing the risk of a fish kill in the lower Klamath River.

Basin Plan water temperature objectives for adult salmon set by the NCRWQCB (1994) were largely met, but were occasionally exceeded for the reach from Lewiston to Douglas City for July 1 to September 30 and for the reach from Lewiston to the North Fork Trinity River confluence from October 1 through October 14. Critically Dry WY spring time objectives of the Trinity River Flow Evaluation Study (USFWS and HVT 1999) regarding water temperatures for emigrating juvenile salmonids were likewise occasionally exceeded. Water temperature at Weitchpec exceeded the marginally-suitable range for steelhead smolts for 14 days, Coho Salmon smolts for 12 days, and Chinook Salmon smolts for 27 days.

Augmented flow releases from Lewiston Dam, August 24 to September 14, and September 16 to 23, significantly increased lower Klamath River flow and decreased lower Klamath River water temperatures. The augmented flow release from Iron Gate Dam October 4 to 15 increased flow in the lower Klamath River, but did not appear to influence temperature which remained at or near the maximum values for the period of record 2002-2014.

## Acknowledgements

We would like to thank Joe Polos and Nicholas Hetrick of the USFWS’s AFWO for providing comments on an earlier draft of this report. We would also like to thank Aaron David, Andrew Goodman, and Nick Van Vleet of AFWO for providing field assistance. Finally, we would like to thank Ken Fetcho, and Matt Hanington of the YTEP who provided water temperature data for several sites along the lower Trinity River and Klamath River.

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Appendix A. Water temperature and flow comparisons of the Trinity and Klamath rivers, April 15 to October 15, 2014. Station locations: TR = Trinity River, WE = Klamath River at Weitchpec, KBW = Klamath Below Weitchpec, and KNK = Klamath near Klamath (A = approved data for publication; P = provisional data subject to change).

Date	Flow (CFS)										Average Daily Water Temperatures (°C)				Differences in Water Temps (°C) of the Klamath R. at Rkm 70.2 and:		
	Trinity R.		Klamath R.					Contributions of Flow to the Klamath Gage (%) <sup>a</sup>			Trinity R.	Klamath R.			Trinity R.	Klamath R.	
	Lewiston (rkm 178.6)	Hoopa (rkm 20.0)	Iron Gate (rkm 305.5)	Orleans (rkm 95.1)	Klamath (rkm 13.0)	Lewiston Dam (rkm 178.2)	Hoopa (rkm 20.0)	Iron Gate Dam (rkm 305.5)	TR (rkm 0.1)	WE (rkm 70.2)	KBW (rkm 68.7)	KNK (rkm 13.0)	TR (rkm 0.1)	KBW (rkm 62.0)	KNK (rkm 13.0)		
04/15/14	315 A	2559 A	1337 A	5172 A	10439 A	3	25	13	14.3	12.9	13.4	13.7	-1.4	-0.5	-0.7		
04/16/14	316 A	2437 A	1335 A	4930 A	9959 A	3	24	13	14.1	13.1	13.5	13.6	-1.1	-0.4	-0.5		
04/17/14	317 A	2334 A	1332 A	4776 A	9549 A	3	24	14	13.7	12.9	13.2	13.2	-0.9	-0.3	-0.4		
04/18/14	315 A	2288 A	1336 A	4710 A	9378 A	3	24	14	13.8	12.8	13.2	13.3	-1.0	-0.4	-0.5		
04/19/14	314 A	2180 A	1330 A	4489 A	9036 A	3	24	15	13.9	12.7	13.1	13.1	-1.2	-0.5	-0.5		
04/20/14	311 A	2063 A	1322 A	4339 A	8671 A	4	24	15	13.9	12.8	13.2	13.3	-1.1	-0.4	-0.5		
04/21/14	312 A	1985 A	1325 A	4183 A	8310 A	4	24	16	14.3	12.9	13.4	13.4	-1.4	-0.5	-0.6		
04/22/14	313 A	1960 A	1341 A	4139 A	8199 A	4	24	16	14.0	12.9	13.3	13.4	-1.1	-0.4	-0.5		
04/23/14	777 A	1895 A	1328 A	4120 A	8122 A	10	23	16	13.3	12.4	12.8	13.0	-0.9	-0.4	-0.5		
04/24/14	1348 A	2264 A	1332 A	4686 A	9059 A	15	25	15	12.8	12.0	12.3	12.4	-0.8	-0.3	-0.4		
04/25/14	1494 A	2978 A	1335 A	5017 A	10819 A	14	28	12	12.9	11.9	12.3	12.4	-1.0	-0.4	-0.5		
04/26/14	1497 A	3070 A	1334 A	4631 A	10574 A	14	29	13	12.6	11.8	12.2	12.4	-0.9	-0.4	-0.6		
04/27/14	1488 A	3055 A	1335 A	4509 A	10205 A	15	30	13	12.4	11.5	11.9	12.2	-0.8	-0.4	-0.7		
04/28/14	1481 A	3013 A	1335 A	4403 A	10089 A	15	30	13	12.6	11.6	12.0	12.2	-1.0	-0.4	-0.6		
04/29/14	1469 A	2908 A	1335 A	4232 A	9576 A	15	30	14	13.5	12.4	12.9	12.9	-1.1	-0.4	-0.5		
04/30/14	1458 A	2836 A	1332 A	4094 A	9181 A	16	31	15	14.7	13.8	14.2	14.1	-0.9	-0.4	-0.3		
05/01/14	1447 A	2790 A	1282 A	3989 A	8878 A	16	31	14	15.5	14.9	15.1	15.0	-0.6	-0.3	-0.2		
05/02/14	1448 A	2763 A	1191 A	3905 A	8600 A	17	32	14	15.7	15.5	15.6	15.6	-0.2	-0.1	-0.1		
05/03/14	1449 A	2739 A	1198 A	3738 A	8374 A	17	33	14	15.6	15.5	15.6	15.8	-0.1	-0.1	-0.3		
05/04/14	1454 A	2730 A	1190 A	3725 A	8269 A	18	33	14	15.3	15.0	15.3	15.3	-0.3	-0.2	-0.3		
05/05/14	1458 A	2778 A	1191 A	3949 A	8833 A	17	31	13	14.8	14.3	14.6	14.8	-0.5	-0.3	-0.5		
05/06/14	1464 A	2700 A	1169 A	3876 A	8766 A	17	31	13	14.4	14.0	14.2	14.4	-0.4	-0.2	-0.5		
05/07/14	1455 A	2625 A	1153 A	3663 A	8330 A	17	32	14	14.8	14.2	14.5	14.5	-0.6	-0.3	-0.3		
05/08/14	1457 A	2579 A	1162 A	3530 A	8014 A	18	32	14	14.6	14.0	14.3	14.3	-0.6	-0.3	-0.3		
05/09/14	1458 A	2903 A	1169 A	4342 A	9539 A	15	30	12	14.3	13.6	13.9	13.9	-0.7	-0.3	-0.3		
05/10/14	1459 A	2946 A	1185 A	4508 A	10684 A	14	28	11	13.9	13.3	13.6	13.8	-0.6	-0.3	-0.4		
05/11/14	1459 A	2796 A	1176 A	4242 A	10132 A	14	28	12	14.3	13.4	13.8	13.9	-0.9	-0.4	-0.5		
05/12/14	1464 A	2671 A	1184 A	3894 A	9320 A	16	29	13	15.0	14.0	14.4	14.3	-1.0	-0.4	-0.4		
05/13/14	1466 A	2602 A	1175 A	3680 A	8669 A	17	30	14	15.9	15.0	15.3	15.2	-0.9	-0.3	-0.2		
05/14/14	1457 A	2568 A	1138 A	3560 A	8260 A	18	31	14	16.9	16.3	16.5	16.3	-0.6	-0.2	0.0		
05/15/14	1462 A	2555 A	1134 A	3466 A	7979 A	18	32	14	17.3	17.1	17.2	16.9	-0.2	-0.1	0.2		

Appendix A (Continued). Water temperature and flow comparisons of the Trinity and Klamath rivers, April 15 to October 15, 2014. Station locations: TR = Trinity River, WE = Klamath River at Weitchpec, KBW = Klamath Below Weitchpec, and KNK = Klamath near Klamath (A = approved data for publication; P = provisional data subject to change).

Date	Flow (CFS)									Average Daily Water Temperatures (°C)				Differences in Water Temps (°C) of the Klamath R. at Rkm 70.2 and:		
	Trinity R.			Klamath R.			Contributions of Flow to the Klamath Gage (%) <sup>a</sup>			Trinity R.	Klamath R.			Trinity R.	Klamath R.	
	Lewiston (rkm 178.6)	Hoopa (rkm 20.0)		Iron Gate (rkm 305.5)	Orleans (rkm 95.1)	Klamath (rkm 13.0)	Lewiston Dam (rkm 178.2)	Hoopa (rkm 20.0)	Iron Gate Dam (rkm 305.5)	TR (rkm 0.1)	WE (rkm 70.2)	KBW (rkm 68.7)	KNK (rkm 13.0)	TR (rkm 0.1)	KBW (rkm 62.0)	KNK (rkm 13.0)
05/16/14	1471 A	2547 A		1150 A	3367 A	7762 A	19	33	15	17.0	17.1	17.1	17.2	0.1	0.0	-0.1
05/17/14	1473 A	2496 A		1142 A	3281 A	7559 A	19	33	15	17.0	17.2	17.2	17.3	0.2	0.0	-0.1
05/18/14	1472 A	2450 A		1146 A	3224 A	7402 A	20	33	15	16.7	17.0	17.0	17.0	0.3	0.0	0.0
05/19/14	1489 A	2425 A		1170 A	3232 A	7351 A	20	33	16	16.1	16.4	16.3	16.4	0.3	0.1	0.0
05/20/14	1479 A	2420 A		1151 A	3288 A	7260 A	20	33	16	16.3	16.6	16.5	16.5	0.2	0.0	0.1
05/21/14	1479 A	2362 A		1148 A	3207 A	7220 A	20	33	16	16.9	17.0	17.1	17.2	0.1	0.0	-0.1
05/22/14	1469 A	2329 A		1154 A	3106 A	6927 A	21	34	17	17.7	17.7	17.7	17.6	0.1	0.0	0.1
05/23/14	1482 A	2309 A		1144 A	3051 A	6772 A	22	34	17	17.8	18.1	18.0	17.8	0.3	0.1	0.3
05/24/14	1475 A	2318 A		1144 A	3017 A	6676 A	22	35	17	17.7	18.3	18.1	18.0	0.6	0.2	0.4
05/25/14	1479 A	2292 A		1157 A	2946 A	6541 A	23	35	18	17.6	18.6	18.3	18.3	1.0	0.4	0.3
05/26/14	1476 A	2266 A		1153 A	2889 A	6349 A	23	36	18	17.7	18.7	18.4	18.0	1.0	0.4	0.7
05/27/14	1478 A	2235 A		1189 A	2842 A	6242 A	24	36	30	17.6	18.5	18.2	18.0	0.9	0.3	0.5
05/28/14	1480 A	2201 A		1695 A	3116 A	6231 A	24	35	27	17.0	17.9	17.7	17.9	0.9	0.3	0.1
05/29/14	1473 A	2165 A		1521 A	3138 A	6595 A	22	33	23	16.8	17.9	17.5	17.8	1.0	0.3	0.0
05/30/14	1379 A	2128 A		1399 A	2984 A	6315 A	22	34	22	17.3	18.1	17.8	17.9	0.7	0.3	0.1
05/31/14	1202 A	2023 A		1229 A	2869 A	6041 A	20	33	20	18.0	18.6	18.3	18.3	0.6	0.2	0.3
06/01/14	1162 A	1858 A		1080 A	2734 A	5691 A	20	33	19	18.5	19.2	18.9	18.8	0.7	0.3	0.5
06/02/14	1162 A	1795 A		1016 A	2598 A	5328 A	22	34	19	19.0	19.8	19.4	19.2	0.7	0.3	0.6
06/03/14	1159 A	1775 A		989 A	2498 A	5119 A	23	35	19	19.5	20.1	19.8	19.1	0.6	0.3	0.9
06/04/14	1153 A	1749 A		981 A	2419 A	4986 A	23	35	20	19.6	20.4	20.0	19.8	0.8	0.3	0.6
06/05/14	1173 A	1711 A		981 A	2365 A	4838 A	24	35	20	19.9	20.8	20.5	20.4	0.9	0.4	0.5
06/06/14	1164 A	1696 A		978 A	2317 A	4717 A	25	36	21	20.4	21.0	20.8	20.7	0.7	0.3	0.4
06/07/14	1118 A	1674 A		977 A	2269 A	4624 A	24	36	21	20.6	21.2	21.0	20.9	0.6	0.3	0.4
06/08/14	1038 A	1617 A		977 A	2230 A	4497 A	23	36	22	21.0	21.4	21.3	21.3	0.4	0.1	0.0
06/09/14	1017 A	1534 A		1061 A	2205 A	4373 A	23	35	24	21.4	21.8	21.7	21.6	0.3	0.1	0.2
06/10/14	996 A	1467 A		1159 A	2162 A	4208 A	24	35	28	21.5	21.9	21.7	21.6	0.4	0.1	0.3
06/11/14	918 A	1430 A		1173 A	2227 A	4184 A	22	34	28	21.2	21.6	21.5	21.4	0.4	0.1	0.2
06/12/14	833 A	1350 A		1257 A	2225 A	4187 A	20	32	30	20.5	20.9	20.7	20.9	0.4	0.2	0.0
06/13/14	787 A	1258 A		1248 A	2227 A	4070 A	19	31	31	19.8	20.4	20.2	20.2	0.6	0.2	0.2
06/14/14	745 A	1199 A		1100 A	2286 A	4052 A	18	30	27	19.3	20.0	19.8	19.7	0.7	0.2	0.3
06/15/14	710 A	1155 A		1201 A	2202 A	3997 A	18	29	30	19.3	19.6	19.5	19.8	0.3	0.1	-0.1



Appendix A (Continued). Water temperature and flow comparisons of the Trinity and Klamath rivers, April 15 to October 15, 2014. Station locations: TR = Trinity River, WE = Klamath River at Weitchpec, KBW = Klamath Below Weitchpec, and KNK = Klamath near Klamath (A = approved data for publication; P = provisional data subject to change).

Date	Flow (CFS)									Average Daily Water Temperatures (°C)				Differences in Water Temps (°C) of the Klamath R. at Rkm 70.2 and:		
	Trinity R.			Klamath R.			Contributions of Flow to the Klamath Gage (%) <sup>a</sup>			Trinity R.	Klamath R.			Trinity R.	Klamath R.	
	Lewiston (rkm 178.6)	Hoopa (rkm 20.0)	Iron Gate (rkm 305.5)	Orleans (rkm 95.1)	Klamath (rkm 13.0)	Lewiston Dam (rkm 178.2)	Hoopa (rkm 20.0)	Iron Gate Dam (rkm 305.5)	TR (rkm 0.1)	WE (rkm 70.2)	KBW (rkm 68.7)	KNK (rkm 13.0)	TR (rkm 0.1)	KBW (rkm 62.0)	KNK (rkm 13.0)	
06/16/14	707 A	1104 A	1268 A	2131 A	3799 A	19	29	33	19.4	19.6	19.5	19.6	0.2	0.1	-0.1	
06/17/14	711 A	1079 A	1163 A	2250 A	3804 A	19	28	31	19.0	19.3	19.2	19.3	0.3	0.1	0.0	
06/18/14	705 A	1075 A	1260 A	2172 A	3834 A	18	28	33	19.3	19.6	19.5	19.5	0.3	0.1	0.1	
06/19/14	662 A	1058 A	1290 A	2120 A	3701 A	18	29	35	19.8	19.9	19.8	19.6	0.1	0.1	0.3	
06/20/14	608 A	1021 A	1163 A	2205 A	3721 A	16	27	31	20.1	20.4	20.3	20.1	0.3	0.1	0.3	
06/21/14	617 A	770 A	1108 A	2107 A	3648 A	17	21	30	20.3	20.7	20.5	20.2	0.4	0.2	0.5	
06/22/14	584 A	A	1184 A	1989 A	3452 A	17	--	34	20.6	21.0	20.8	19.9	0.4	0.2	1.1	
06/23/14	525 A	A	1397 A	1938 A	3343 A	16	--	42	20.9	21.1	21.0	19.2	0.2	0.1	1.9	
06/24/14	509 A	860 A	1440 A	2004 A	3318 A	15	26	43	21.0	21.3	21.2	20.3	0.4	0.1	1.1	
06/25/14	491 A	819 A	1294 A	2154 A	3458 A	14	24	37	20.7	21.2	21.1	19.8	0.5	0.1	1.4	
06/26/14	481 A	865 A	1151 A	2203 A	3736 A	13	23	31	20.2	20.9	20.7	20.1	0.6	0.2	0.8	
06/27/14	483 A	857 A	1030 A	2106 A	3730 A	13	23	28	20.6	20.8	20.7	19.9	0.2	0.1	0.9	
06/28/14	483 A	845 A	976 A	1960 A	3549 A	14	24	28	21.4	21.0	21.0	19.7	-0.4	0.0	1.2	
06/29/14	483 A	816 A	973 A	1833 A	3279 A	15	25	30	22.0	21.4	21.5	20.0	-0.6	-0.1	1.4	
06/30/14	478 A	788 A	987 A	1780 A	3087 A	15	26	32	22.7	22.2	22.3	20.7	-0.5	-0.1	1.5	
07/01/14	477 A	771 A	921 A	1748 A	2988 A	16	26	31	23.6	23.0	23.2	21.5	-0.6	-0.2	1.5	
07/02/14	489 A	679 A	862 A	1721 A	2898 A	17	23	30	23.7	23.0	23.2	22.0	-0.7	-0.2	1.0	
07/03/14	464 A	778 A	859 A	1613 A	2804 A	17	28	31	23.4	23.0	23.1	22.0	-0.4	-0.1	1.0	
07/04/14	466 A	787 A	857 A	1570 A	2695 A	17	29	32	23.2	23.2	23.1	22.2	-0.1	0.0	1.0	
07/05/14	465 A	786 A	859 A	1539 A	2607 A	18	30	33	23.2	23.3	23.3	22.4	0.1	0.1	1.0	
07/06/14	466 A	770 A	860 A	1508 A	2560 A	18	30	34	23.3	23.4	23.3	22.7	0.1	0.1	0.8	
07/07/14	469 A	763 A	861 A	1500 A	2528 A	19	30	34	23.9	23.9	23.9	22.9	0.0	0.1	1.0	
07/08/14	472 A	766 A	859 A	1487 A	2493 A	19	31	34	24.3	24.2	24.2	22.7	-0.1	0.0	1.5	
07/09/14	470 A	769 A	861 A	1502 A	2505 A	19	31	34	25.0	24.5	24.6	23.0	-0.4	-0.1	1.5	
07/10/14	469 A	769 A	860 A	1488 A	2513 A	19	31	34	25.5	25.1	25.1	23.3	-0.4	0.0	1.8	
07/11/14	469 A	750 A	853 A	1482 A	2485 A	19	30	34	24.6	24.5	24.5	22.6	-0.1	0.0	1.9	
07/12/14	472 A	739 A	854 A	1462 A	2424 A	19	30	35	24.1	24.3	24.1	22.4	0.2	0.2	1.9	
07/13/14	473 A	729 A	853 A	1437 A	2406 A	20	30	35	24.2	24.1	24.0	22.0	-0.1	0.1	2.1	
07/14/14	474 A	726 A	852 A	1412 A	2378 A	20	31	36	24.5	24.5	24.3	22.4	0.0	0.1	2.1	
07/15/14	471 A	720 A	852 A	1389 A	2349 A	20	31	36	25.3	25.5	25.4	23.4	0.2	0.1	2.1	

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Appendix A (Continued). Water temperature and flow comparisons of the Trinity and Klamath rivers, April 15 to October 15, 2014. Station locations: TR = Trinity River, WE = Klamath River at Weitchpec, KBW = Klamath Below Weitchpec, and KNK = Klamath near Klamath (A = approved data for publication; P = provisional data subject to change).

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Date	Flow (CFS)									Average Daily Water Temperatures (°C)				Differences in Water Temps (°C) of the Klamath R. at Rkm 70.2 and:		
	Trinity R.			Klamath R.			Contributions of Flow to the Klamath Gage (%) <sup>a</sup>			Trinity R.	Klamath R.			Trinity R.	Klamath R.	
	Lewiston (rkm 178.6)	Hoopa (rkm 20.0)	Iron Gate (rkm 305.5)	Orleans (rkm 95.1)	Klamath (rkm 13.0)	Lewiston Dam (rkm 178.2)	Hoopa (rkm 20.0)	Iron Gate Dam (rkm 305.5)	TR (rkm 0.1)	WE (rkm 70.2)	KBW (rkm 68.7)	KNK (rkm 13.0)	TR (rkm 0.1)	KBW (rkm 62.0)	KNK (rkm 13.0)	
07/16/14	468 A	712 A	853 A	1365 A	2293 A	20	31	37	25.1	25.2	25.1	23.2	0.1	0.1	2.0	
07/17/14	465 A	715 A	852 A	1360 A	2277 A	20	31	37	24.7	24.9	24.8	23.2	0.2	0.2	1.7	
07/18/14	464 A	706 A	881 A	1347 A	2260 A	21	31	39	25.0	25.2	25.0	22.8	0.2	0.2	2.4	
07/19/14	469 A	701 A	903 A	1331 A	2242 A	21	31	40	25.4	25.6	25.4	23.3	0.3	0.2	2.3	
07/20/14	468 A	688 A	900 A	1348 A	2207 A	21	31	41	25.6	25.8	25.6	23.5	0.2	0.2	2.3	
07/21/14	468 A	691 A	901 A	1350 A	2211 A	21	31	41	25.2	25.1	25.1	23.4	-0.1	0.0	1.7	
07/22/14	472 A	695 A	902 A	1350 A	2217 A	21	31	41	24.7	24.6	24.6	23.3	-0.1	0.0	1.4	
07/23/14	465 A	717 A	902 A	1408 A	2263 A	21	32	40	23.4	23.7	23.6	22.6	0.3	0.1	1.1	
07/24/14	465 A	728 A	906 A	1396 A	2348 A	20	31	39	23.0	23.3	23.1	22.3	0.3	0.2	1.0	
07/25/14	468 A	705 A	910 A	1377 A	2325 A	20	30	39	23.6	23.5	23.5	22.9	-0.1	0.0	0.6	
07/26/14	468 A	687 A	909 A	1365 A	2279 A	21	30	40	23.8	23.8	23.7	22.9	-0.1	0.0	0.9	
07/27/14	469 A	684 A	906 A	1349 A	2251 A	21	30	40	24.2	24.2	24.2	22.7	0.0	0.0	1.5	
07/28/14	467 A	678 A	907 A	1343 A	2231 A	21	30	41	24.7	24.7	24.7	23.2	0.0	0.0	1.5	
07/29/14	469 A	686 A	901 A	1320 A	2207 A	21	31	41	25.1	24.9	25.0	23.2	-0.1	0.0	1.7	
07/30/14	465 A	680 A	894 A	1305 A	2162 A	22	31	41	25.2	25.0	25.1	23.2	-0.2	0.0	1.8	
07/31/14	464 A	669 A	882 A	1290 A	2139 A	22	31	41	25.3	25.2	25.2	23.3	-0.1	-0.1	1.8	
08/01/14	467 A	660 A	876 A	1279 A	2109 A	22	31	42	25.1	25.1	25.1	22.9	0.0	0.0	2.2	
08/02/14	467 A	658 A	896 A	1262 A	2082 A	22	32	43	24.9	24.8	24.9	22.3	-0.1	0.0	2.6	
08/03/14	465 A	661 A	893 A	1263 A	2074 A	22	32	43	25.0	24.8	24.8	22.0	-0.2	0.0	2.8	
08/04/14	465 A	663 A	886 A	1288 A	2092 A	22	32	42	25.1	24.7	24.8	22.2	-0.4	-0.1	2.5	
08/05/14	460 A	663 A	889 A	1282 A	2120 A	22	31	42	24.3	23.9	24.0	23.1	-0.4	-0.1	0.8	
08/06/14	460 A	667 A	887 A	1294 A	2148 A	21	31	41	23.9	23.4	23.6	23.0	-0.4	-0.2	0.5	
08/07/14	452 A	571 A	888 A	1283 A	2155 A	21	27	41	23.9	23.4	23.5	23.1	-0.5	-0.1	0.3	
08/08/14	437 A	528 A	888 A	1266 A	2121 A	21	25	42	23.8	23.6	23.6	22.9	-0.2	0.0	0.7	
08/09/14	436 A	539 A	889 A	1257 A	2087 A	21	26	43	23.6	23.7	23.6	22.7	0.2	0.1	1.0	
08/10/14	438 A	511 A	888 A	1246 A	2055 A	21	25	43	23.8	24.1	24.0	22.8	0.3	0.1	1.3	
08/11/14	436 A	519 A	884 A	1251 A	2047 A	21	25	43	24.4	24.3	24.3	22.9	-0.1	0.0	1.4	
08/12/14	437 A	501 A	878 A	1256 A	2036 A	21	25	43	24.0	23.8	23.9	22.5	-0.1	0.0	1.4	
08/13/14	435 A	515 A	879 A	1252 A	2043 A	21	25	43	23.3	23.2	23.0	22.5	-0.1	0.1	0.6	
08/14/14	433 A	517 A	894 A	1274 A	2062 A	21	25	43	22.9	22.7	22.8	22.8	-0.2	-0.1	-0.1	
08/15/14	437 A	519 A	902 A	1269 A	2086 A	21	25	43	23.1	22.6	22.7	23.0	-0.5	-0.1	-0.4	

Appendix A (Continued). Water temperature and flow comparisons of the Trinity and Klamath rivers, April 15 to October 15, 2014. Station locations: TR = Trinity River, WE = Klamath River at Weitchpec, KBW = Klamath Below Weitchpec, and KNK = Klamath near Klamath (A = approved data for publication; P = provisional data subject to change).

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Date	Flow (CFS)									Average Daily Water Temperatures (°C)				Differences in Water Temps (°C) of the Klamath R. at Rkm 70.2 and:		
	Trinity R.			Klamath R.			Contributions of Flow to the Klamath Gage (%) <sup>a</sup>			Trinity R.	Klamath R.			Trinity R.	Klamath R.	
	Lewiston (rkm 178.6)	Hoopa (rkm 20.0)	Iron Gate (rkm 305.5)	Orleans (rkm 95.1)	Klamath (rkm 13.0)	Lewiston Dam (rkm 178.2)	Hoopa (rkm 20.0)	Iron Gate Dam (rkm 305.5)	TR (rkm 0.1)	WE (rkm 70.2)	KBW (rkm 68.7)	KNK (rkm 13.0)	TR (rkm 0.1)	KBW (rkm 62.0)	KNK (rkm 13.0)	
08/16/14	437 A	517 A	906 A	1274 A	2078 A	21	25	44	23.4	22.8	22.9	22.7	-0.6	-0.2	0.0	
08/17/14	432 A	518 A	908 A	1264 A	2071 A	21	25	44	23.6	22.8	22.9	22.6	-0.9	-0.2	0.2	
08/18/14	429 A	511 A	907 A	1261 A	2058 A	21	25	44	23.8	22.7	23.0	22.4	-1.0	-0.3	0.4	
08/19/14	430 A	511 A	907 A	1275 A	2053 A	21	25	44	23.7	22.8	23.0	22.5	-0.9	-0.2	0.3	
08/20/14	436 A	522 A	907 A	1278 A	2065 A	21	25	44	24.0	22.7	23.0	22.8	-1.3	-0.4	-0.1	
08/21/14	436 A	525 A	905 A	1260 A	2050 A	21	26	44	23.8	22.7	23.0	22.8	-1.1	-0.3	-0.1	
08/22/14	438 A	526 A	905 A	1251 A	2033 A	22	26	45	23.1	22.5	22.7	22.4	-0.6	-0.1	0.1	
08/23/14	781 A	526 A	904 A	1242 A	2026 A	39	26	45	23.0	22.7	22.7	22.5	-0.3	0.0	0.3	
08/24/14	982 A	583 A	904 A	1243 A	2022 A	49	29	45	23.0	22.6	22.8	22.3	-0.4	-0.2	0.3	
08/25/14	1659 A	948 A	905 A	1240 A	2294 A	72	41	39	22.6	21.9	22.2	22.2	-0.8	-0.3	-0.3	
08/26/14	2462 A	1432 A	905 A	1237 A	2535 A	97	56	36	22.1	21.9	22.0	21.8	-0.2	-0.2	0.1	
08/27/14	1901 A	2301 A	905 A	1240 A	3538 A	54	65	26	20.0	22.1	21.0	21.8	2.1	1.1	0.3	
08/28/14	1392 A	1842 A	904 A	1237 A	3679 A	38	50	25	19.0	22.4	20.4	21.4	3.4	2.0	1.0	
08/29/14	977 A	1412 A	904 A	1231 A	3186 A	31	44	28	19.3	22.4	20.8	21.1	3.1	1.6	1.4	
08/30/14	953 A	1036 A	904 A	1226 A	2807 A	34	37	32	19.7	22.2	21.0	21.3	2.5	1.2	0.8	
08/31/14	957 A	960 A	906 A	1228 A	2540 A	38	38	36	20.0	22.2	21.2	21.4	2.2	1.0	0.8	
09/01/14	958 A	957 A	968 A	1232 A	2515 A	38	38	38	20.0	21.8	21.1	21.4	1.8	0.7	0.4	
09/02/14	950 A	957 A	1015 A	1236 A	2528 A	38	38	40	20.2	21.3	20.9	21.4	1.2	0.4	-0.1	
09/03/14	953 A	944 A	1020 A	1291 A	2540 A	37	37	40	20.3	21.0	20.7	21.3	0.8	0.3	-0.3	
09/04/14	961 A	938 A	1021 A	1289 A	2565 A	37	37	40	19.8	20.5	20.2	20.7	0.7	0.3	-0.2	
09/05/14	967 A	939 A	1024 A	1291 A	2557 A	38	37	40	19.7	20.2	20.0	20.2	0.6	0.2	0.0	
09/06/14	963 A	952 A	1021 A	1303 A	2570 A	37	37	40	19.6	20.1	20.0	20.0	0.5	0.2	0.1	
09/07/14	964 A	947 A	990 A	1309 A	2573 A	37	37	38	19.5	20.0	19.8	19.9	0.5	0.2	0.1	
09/08/14	963 A	942 A	993 A	1300 A	2587 A	37	36	38	19.2	19.6	19.5	19.8	0.4	0.1	-0.2	
09/09/14	951 A	946 A	994 A	1282 A	2562 A	37	37	39	19.2	19.7	19.4	19.8	0.5	0.2	-0.1	
09/10/14	952 A	939 A	991 A	1280 A	2555 A	37	37	39	19.4	19.8	19.6	19.9	0.5	0.2	0.0	
09/11/14	946 A	943 A	1016 A	1280 A	2548 A	37	37	40	19.4	19.7	19.6	19.9	0.3	0.1	-0.2	
09/12/14	947 A	940 A	1820 A	1287 A	2553 A	37	37	71	19.6	20.0	19.8	19.9	0.4	0.2	0.1	
09/13/14	680 A	936 A	1808 A	1569 A	2551 A	27	37	71	19.5	20.2	19.9	19.9	0.7	0.3	0.4	
09/14/14	475 A	842 A	1272 A	2045 A	3162 A	15	27	40	19.6	20.3	20.1	20.1	0.8	0.2	0.2	
09/15/14	451 A	590 A	1002 A	1701 A	3003 A	15	20	33	19.6	20.3	20.1	19.9	0.7	0.2	0.4	

Appendix A (Continued). Water temperature and flow comparisons of the Trinity and Klamath rivers, April 15 to October 15, 2014. Station locations: TR = Trinity River, WE = Klamath River at Weitchpec, KBW = Klamath Below Weitchpec, and KNK = Klamath near Klamath (A = approved data for publication; P = provisional data subject to change).

Date	Flow (CFS)									Average Daily Water Temperatures (°C)				Differences in Water Temps (°C) of the Klamath R. at Rkm 70.2 and:		
	Trinity R.			Klamath R.			Contributions of Flow to the Klamath Gage (%) <sup>a</sup>			Trinity R.	Klamath R.			Trinity R.	Klamath R.	
	Lewiston (rkm 178.6)	Hoopa (rkm 20.0)		Iron Gate (rkm 305.5)	Orleans (rkm 95.1)	Klamath (rkm 13.0)	Lewiston Dam (rkm 178.2)	Hoopa (rkm 20.0)	Iron Gate Dam (rkm 305.5)	TR (rkm 0.1)	WE (rkm 70.2)	KBW (rkm 68.7)	KNK (rkm 13.0)	TR (rkm 0.1)	KBW (rkm 62.0)	KNK (rkm 13.0)
09/16/14	1033 A	538 A		1008 A	1371 A	2439 A	42	22	41	19.5	20.1	19.9	20.0	0.6	0.1	0.1
09/17/14	3172 A	613 A		1010 A	1294 A	2128 A	149	29	47	19.6	20.0	19.9	19.7	0.4	0.1	0.3
09/18/14	3379 A	2433 A		1006 A	1298 A	3305 A	102	74	30	18.7	20.2	19.4	19.8	1.6	0.9	0.4
09/19/14	3374 A	3225 A		1001 A	1309 A	4792 A	70	67	21	17.1	20.8	18.3	20.0	3.7	2.5	0.8
09/20/14	3383 A	3248 A		998 A	1308 A	4887 A	69	66	20	16.3	21.1	17.9	19.3	4.7	3.2	1.8
09/21/14	3407 A	3285 A		998 A	1299 A	4874 A	69	67	20	16.3	21.0	17.8	18.5	4.8	3.2	2.5
09/22/14	2866 A	3303 A		1000 A	1294 A	4921 A	73	84	25	16.1	20.9	17.6	18.5	4.9	3.3	2.5
09/23/14	1296 A	2722 A		996 A	1290 A	4799 A	36	75	27	15.7	20.5	17.3	17.9	4.8	3.2	2.6
09/24/14	509 A	1556 A		1004 A	1418 A	3968 A	17	51	33	16.0	20.1	17.9	17.8	4.1	2.2	2.3
09/25/14	480 A	1066 A		1004 A	2030 A	3936 A	17	39	36	16.2	19.1	17.9	17.9	2.9	1.1	1.2
09/26/14	498 A	885 A		1002 A	1873 A	3640 A	19	34	38	17.0	18.9	18.3	18.3	1.9	0.6	0.5
09/27/14	496 A	750 A		998 A	1639 A	3079 A	19	29	39	17.6	18.9	18.4	18.8	1.3	0.4	0.1
09/28/14	496 A	701 A		997 A	1535 A	2763 A	20	28	40	17.9	18.8	18.6	18.9	0.8	0.2	-0.1
09/29/14	493 A	675 A		996 A	1496 A	2613 A	20	28	41	18.4	18.6	18.6	18.9	0.3	0.1	-0.3
09/30/14	496 A	653 A		996 A	1474 A	2550 A	20	27	41	18.7	18.9	18.8	19.1	0.2	0.1	-0.2
10/01/14	491 A	638 A		994 A	1452 A	2485 A	20	27	41	18.2	18.6	18.5	18.9	0.4	0.1	-0.3
10/02/14	494 A	636 A		994 A	1449 A	2447 A	21	27	42	17.7	18.0	17.9	18.7	0.3	0.1	-0.7
10/03/14	495 A	621 A		1000 A	1443 A	2426 A	18	23	37	17.6	17.8	17.8	18.4	0.2	0.0	-0.6
10/04/14	494 A	620 A		1393 A	1440 A	2406 A	16	21	46	17.7	17.8	17.8	18.4	0.2	0.1	-0.5
10/05/14	494 A	623 A		1709 A	1520 A	2393 A	16	21	57	17.8	17.9	17.9	18.5	0.1	0.0	-0.6
10/06/14	477 A	622 A		1699 A	2023 P	2702 A	16	21	57	17.9	17.9	17.9	18.5	0.1	0.0	-0.6
10/07/14	468 A	619 P		1688 A	2028 P	3019 P	16	21	57	17.8	17.9	17.9	18.3	0.1	0.0	-0.4
10/08/14	468 A	582 P		1680 A	2012 P	3003 P	16	20	57	17.4	17.6	17.6	18.1	0.3	0.0	-0.4
10/09/14	470 A	582 P		1679 A	2004 P	2969 P	16	20	57	17.2	17.5	17.5	18.0	0.3	0.0	-0.6
10/10/14	466 A	576 P		1678 A	2005 P	2966 P	16	20	57	16.9	17.2	17.2	17.9	0.3	0.0	-0.7
10/11/14	452 A	588 P		1683 A	2003 P	2966 P	15	20	57	16.7	17.1	17.0	17.7	0.4	0.1	-0.6
10/12/14	433 A	582 P		1686 A	1992 P	2964 P	13	18	51	16.9	17.0	17.0	17.6	0.0	0.0	-0.6
10/13/14	430 A	574 P		1685 A	2001 P	2946 P	15	19	57	16.5	16.5	16.5	17.1	-0.1	-0.1	-0.7
10/14/14	431 A	579 P		1691 A	2013 P	2948 P	15	20	57	16.0	16.1	16.1	16.4	0.0	0.0	-0.3
10/15/14	382 A	645 P		1512 A	2426 P	3309 P	12	19	46	15.7	15.7	15.8	16.2	0.1	0.0	-0.5

<sup>a</sup> The percent contribution estimates are most accurate during periods of stable flow. The calculated percent contribution of dam-released flow to the total flow of the Klamath River at Klamath is predicated assuming an instantaneous response of dam-released flow to the Klamath gauge (rkm 17). During periods of varying flows, the accuracy of the estimates are diminished since it takes time (up to a few days) for a change in dam-released flow from either Lewiston or Iron Gate Dam to reach the USGS Gauge at Klamath. As such, estimates of dam-release contributions presented here may be in error during period of highly variable flows.