Feather River Coordinated Resource Management
Watershed Monitoring Program

2008 Report

Indian Creek stream flow monitoring at Taylorsville Bridge. May 2008 (Photo J. Albietz)

Prepared by Plumas Corporation
Quincy, CA
Spring 2009

Introduction to FR-CRM Monitoring Program

2008 Monitoring Report Summary

The 2008 Water Year (October 1, 2007- September 30, 2008) was the second year of the current drought in the Feather River Basin, with only 68% of normal historic rainfall. This year Last Chance Creek and Lights Creek continued to be the most temperature impaired streams in the Upper Feather River Watershed. Despite this impairment, the Feather River Coordinated Resource Management (FR-CRM) is beginning to detect cooler water temperatures and augmented base flow on Last Chance Creek at Doyle Crossing. These water temperature improvements may be attributable to over ten miles of channel and approximately 1,500 acres of meadow that have been restored on Last Chance Creek upstream from Doyle Crossing. Water temperature improvements have also been seen on Red Clover Creek at Notson Bridge, downstream from the Red Clover/McReynolds Creek Restoration Project.

This year necessary maintenance was completed in November 2008 on three Continuous Recording Stations (CRS). Failed transducers on Indian Creek at DWR weir and on Red Clover Creek at Notson Bridge were replaced, and the Wolf Creek CRS was moved downstream to the Ball Field Bridge. This will hopefully reduce the amount of sediment deposited in the transducer box during the winter and spring high flows.

Most important findings in this monitoring report:

- Changes in late season water temperature and stream flow are starting to be seen on Last Chance Creek at Doyle Crossing. This change may be due to groundwater influence from the Last Chance project area.
- Groundwater influence from Clarks Creek Restoration Project is having a cooling affect on the water temperature below the project for a month after inflow ceases above the project.
- The number of days with water temperature above 75^{o} Fahrenheit on Red Clover Creek at Notson Bridge has decreased notably since 2006.
- A reduction in diurnal fluctuation of water temperature on Last Chance Creek at Doyle Crossing.

About the Feather River CRM

The FR-CRM group, a proactive consortium of 24 public agencies, private sector groups, and local landowners, was established in 1985 in response to widespread erosion and channel degradation in the Feather River watershed. One hundred and forty years of intensive resource use, including mining, grazing, timber harvesting, and railroad and road construction, have all contributed to a watershed-wide stream channel entrenchment process. FR-CRM was able to initiate systematized monitoring in the Feather River watershed in 1999 to establish baseline data for assessing long-term trends in watershed condition, and the potentially significant effects of restoration projects on watershed function. Most of the monitoring effort is concentrated in the Indian Creek subwatershed because of its highly degraded upper watershed condition, and high potential for benefit from restoration with many linear miles of alluvial channels. Monitoring site locations follow a nested approach. Please see the diagram at the end of the report that shows monitoring station locations with project locations.

Watershed Monitoring Program Background

Background information such as an overview of the watershed, monitoring program objectives, and protocols can be found in the FR-CRM Watershed Monitoring Reports from 2001, 2004, and 2005.

Reports (2005-07) can be found on the monitoring page of the FR-CRM website at www.feather-river-crm.org. The monitoring network was installed in 1999 and data have been collected from 2000-2008.

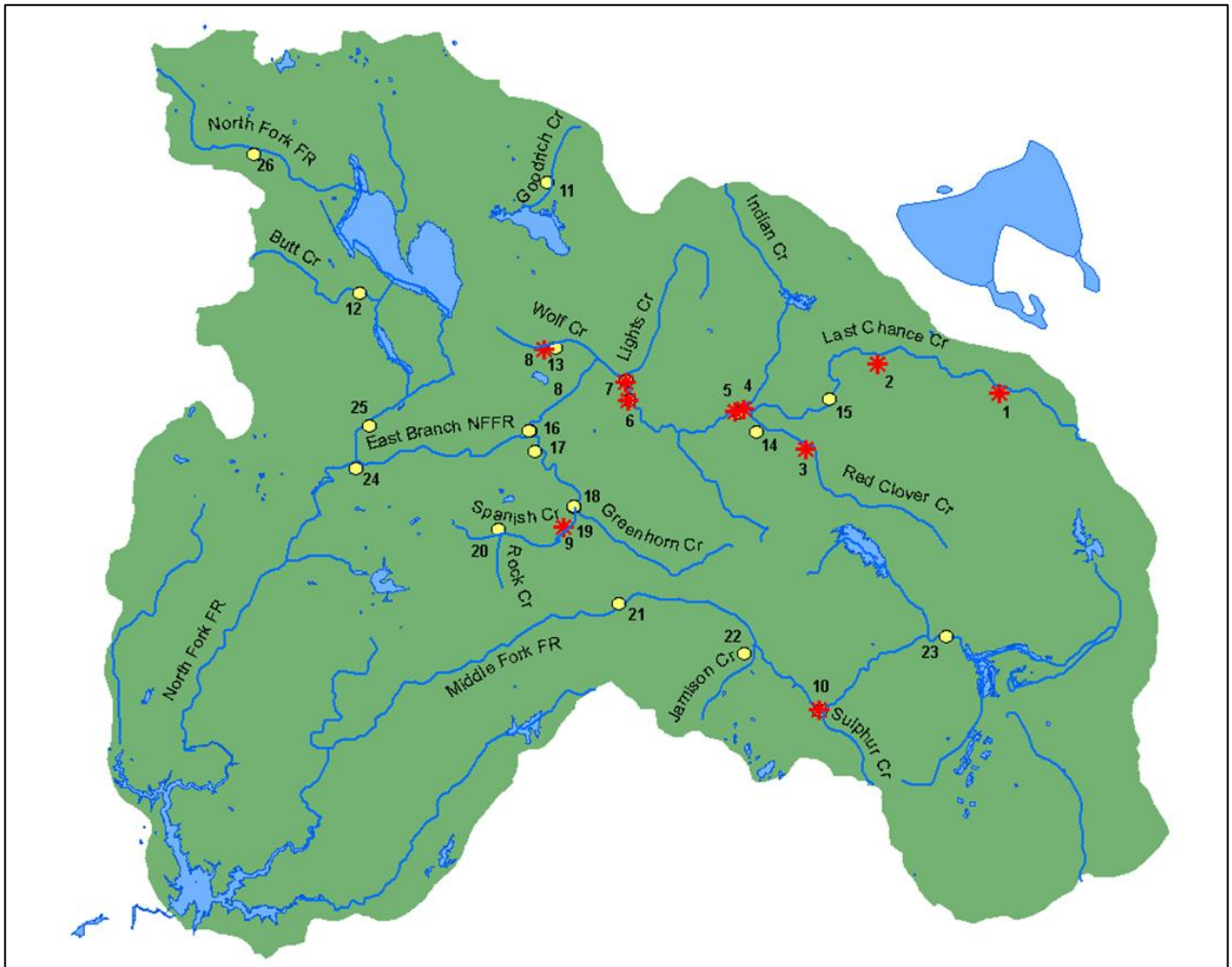
Initial funding for FR-CRM's monitoring program was provided by a Clean Water Act 319(h) grant (Aug 1998 to Dec 2000). Subsequent funding sources were: the California Surface Water Ambient Monitoring Program (SWAMP) from Oct 2000 to Dec 2003 and the Plumas Watershed Forum (2004 to 2006). Physical and biological surveys of FR-CRM's 20 Monitoring Reaches have not been conducted since 2003.

Monitoring Program Description

This report documents on-going monitoring data from the 2008 water year (October 1, 2007-September 30, 2008). Continuous Recording Station maintenance was continued this 2008 Water Year (WY). Funding from the UC Davis Indian Creek Watershed Modeling project funded the maintenance/replacement of 3 stations in the Indian Creek Watershed: Indian Creek @ DWR Weir, and Red Clover Creek @ Notson Br, and Wolf Creek @ Main St Bridge was moved to Wolf Creek @ Ball Field Bridge.

Three main subwatersheds of the Feather River are covered under this monitoring program:

- Indian Creek
- Spanish Creek } **East Branch North Fork Feather**
- Middle Fork Feather River
- North Fork Feather River



* Continuous Recording Stations

• Monitoring Reaches

1. Last Chance Creek @ Million Dollar Bridge
2. Last Chance Creek @ Doyle Crossing
3. Red Clover Creek @ Notson Bridge
4. Indian Creek @ DWR Weir
5. Indian Creek @ Flournoy Bridge
6. Indian Creek @ Taylorsville Bridge
7. Lights Creek @ Deadfall Lane Bridge
8. Wolf Creek @ Ball Field Bridge
9. Spanish Creek @ Dyrr Bank
10. Sulphur Creek @ Hwy 89 Bridge
11. Goodrich Creek
12. Butt Creek
13. Wolf Creek Abv Town Park
14. Red Clover Creek Blw Drum Bridge
15. Last Chance Creek Blw Murdock Crossing
16. Indian Creek Abv Spanish Creek
17. Spanish Creek Abv Indian Creek
18. Greenhorn Creek Mouth
19. Spanish Creek Abv Greenhorn Creek
20. Rock Creek Mouth
21. Middle Fork Feather River Abv Nelson Cr
22. Jamison Creek
23. Middle Fork Feather River @ Beckwourth
24. East Branch North Fork Feather River Abv North Fork Feather River
25. North Fork Feather River Abv East Branch North Fork Feather River
26. North Fork Feather River Abv Lake Almanor

Figure 1. Feather River CRM Continuous Recording & Monitoring Reach Locations

Table 1. Upper Feather River Watershed Monitoring Sites and Parameters Recorded

Map #	Monitoring Site by Subwatershed	Monitoring Type
	North Fork Feather River (NFFR) watershed	
26	NFFR @ Domingo Springs (abv Lake Almanor)	MR[∞]
25	NFFR @ acw[†] East Branch NFFR	MR
12	Butt Cr (abv 307 Br)	MR
11	Goodrich Cr	MR discontinued
24	**East Branch** mouth (acw NFFR)	MR
17	**Spanish** mouth (acw Indian)	MR
	Spanish Creek @ Keddie abv Blackhawk Cr.	CRS (USGS)
19	Spanish Cr acw Greenhorn	MR
18	Greenhorn Cr mouth	MR
9	Spanish @ Gansner Park (Hwy 70)	CRS[‡]
20	Rock Cr mouth	MR
16	**Indian Cr** blw Indian Falls (acw Spanish Cr)	CRS (DWR)
13	Wolf Cr @ Town Park	MR
8	Wolf Cr @ Main St Bridge moved to Ball Field Br.	CRS
7	Lights Cr @ Deadfall Lane Br	MR & CRS
6	Indian Cr @ Taylorsville (TAY)	MR & CRS & Weather Station (DWR)
5	Indian Cr @ Flournoy (bcw[§] Red Clover)	MR & CRS
4	Indian Cr @ DWR weir (acw Red Clover)	MR & CRS
	Red Clover Cr @ Chase Bridge	MR
	Thompson Valley (TVL)	Weather Station (DWR)
14	Red Clover Cr @ Drum Bridge	MR
3	Red Clover @ Notson Bridge	CRS
15	Last Chance (LC) Cr @ Murdock	MR
2	Last Chance (LC) Cr @ Doyle Crossing (DOY)	CRS & Weather Station (DWR)
	McClellan Cr	MR (DWR)
	Cottonwood Cr @ Big Flat	CRS abv & blw Big Flat
	Little Stoney Cr	MR (DWR)
	Willow Cr	MR (DWR)
	LC @ Alkali Flat low water crossing	MR (DWR)
	Ferris Cr	MR (DWR)
1	LC @ Million Dollar Bridge	CRS
	LC @ Bird-Jordan	MR (DWR)
	Jordan Peak (JDP)	Weather Station (DWR)
	Middle Fork Feather River (MFFR) watershed	
21	MFFR abv Nelson Cr	MR
	MFFR @ Sloat	staff gage
22	Jamison Cr @ 23N37 Br	MR
10	**Sulphur** Cr @ Hwy 89 (Clio)	MR & CRS
	Boulder Cr	staff gage
	Barry Cr	staff gage
	Sulphur @ Lower Loop Bridge	staff gage
	Sulphur @ Upper Loop Bridge	staff gage
23	MFFR blw A23 Br (Beckwourth)	MR
	MFFR near Portola (MFP)	CRS (DWR)

[∞] Monitoring Reaches (MR) refers to those surveyed by FR-CRM unless otherwise noted in parentheses. Long term monitoring of these sites is expected to give watershed managers a better understanding of processes and long term trends in these subwatersheds. Data collected at Monitoring Reach sites can be found in the SWAMP final report, with details on protocols in Appendix A.
[†] "acw" means "above confluence with"
[‡] Continuous Recording Stations (CRS) are maintained and operated by FR-CRM unless otherwise noted in parentheses.
[§] "bcw" means "below confluence with"

Data Collected at the Continuous Recording Stations (CRS):

- **Stage** (calibrated to flow)
- **Water Temperature**
- **Air Temperature** (except at Wolf Creek)
- **Turbidity** (NTU's) (currently Indian Cr. at Taylorsville & Spanish Cr. 2001-06)

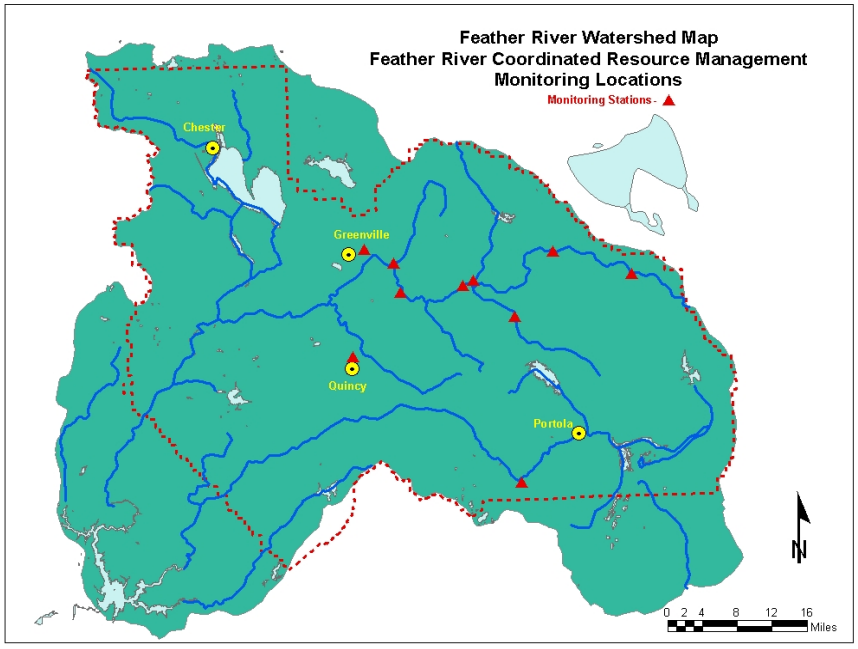


Figure 2. Location of FR-CRM Continuous Recording Stations (CRS)

Much of the FR-CRM restoration efforts are concentrated on restoring the function of meadow floodplains in the watershed to store winter and spring precipitation, and release it later in the year. Two metrics that indicate restored floodplain function are summer baseflow levels and summer water temperatures. Increased summer baseflow with concurrent decreased summer water temperatures would indicate that winter and spring runoff stored in the meadow soils was being released as late season flow.

Stream flow stage, air and water temperature are recorded every 15 minutes by Campbell CR10X data loggers at the following FR-CRM monitoring stations: Red Clover Creek at Notson Bridge; Last Chance Creek at Doyle Crossing and at Million Dollar Bridge; Cottonwood Creek above and below Big Flat (not on map); Indian Creek at the DWR weir (above the confluenceof Red Clover Creek), at the Flournoy Bridge (below the confluence of Red Clover Creek), and at the Taylorsville Bridge; Lights Creek at Deadfall Lane Br.; Wolf Creek at the Main Street Bridge in Greenville; Spanish Creek at Dyrr Bank near Gansner Park in Quincy; and on Sulphur Creek at the Highway 89 Bridge near Clio (temporarily disconnected).

The stage, air and water temperature readings are stored as hourly averages and then summarized into daily files at the end of each water year. To continuously record turbidity, an Analite 195 laser sensor (a nephelometric probe) was installed on Indian Creek at Taylorsville Br. in 2001 and on Spanish Creek (2001-06). The data loggers are capable of storing up to six months of data. FRCRM staff and contract technicians download data monthly to ensure reliable station operation. Because of periodic channel shifts at most of the stations monthly calibration measurements are required. FRCRM staff are also responsible for capturing discharge measurements over the range of flows experienced at each station in order to maintain/update the rating tables. Rating tables are reviewed and/or updated annually by Tim Sagraves of Sagraves Environmental Services.

DWR Flow & Weather Stations

The California Department of Water Resources (DWR) maintains four Weather Stations and two continuous recording flow stations in the Feather River watershed to assist in managing the water resources. The two DWR flow stations are on Indian Creek below Indian Falls (ICR) and on the Middle Fork Feather River near Portola (MFP). Four weather stations installed by DWR in the Indian Creek watershed include Doyle Crossing (DOY) in 2000, Jordan Peak (JDP) in 2005, Thompson Valley (TVL) in 2006 and Taylorsville (TAY) in 2007. All of the DWR weather and flow stations are

accessible on the DWR California Data Exchange Center (CDEC) website at cdec.water.ca.gov. Stream discharge and stage height are recorded at the DWR flow stations, while the DWR weather stations record rainfall, temperature, relative humidity, wind speed, wind direction, solar radiation and atmospheric pressure.

2008 Monitoring Program Findings

FR-CRM is continuously collecting data throughout the Upper Feather River Watershed. The 2008 Water Year experienced the third lowest annual precipitation in the last decade with 68% of historic average annual precipitation for the Feather River Basin (see Table 2).

Table 2. Precipitation averages

Water Year (10/1-9/30)	Percent of Historic Average annual precip for the entire Feather River Basin from CDEC*	Water Year (7/1-6/30)	Total annual precip (inches) at Indian Cr in Genesee (Wilcox data)
		1996	54.55
		1997	58.9
1998	144%	1998	60.70
1999	99%	1999	47.8
2000	101%	2000	43.65
2001	56%	2001	23.6
2002	77%	2002	33.6
2003	111%	2003	49.6
2004	83%	2004	42.8
2005	109%	2005	45.6
2006	154%	2006	68.2
2007	60%	2007	27.7
2008	68%	2008	27.75
			42.37 = Avg

* Averages derived by Ca. Dept. of Water Resources from the average of all reporting stations in the watershed. For 2004 there were 6/10 stations with averages (Sierraville, Vinton, Portola, Chester, Strawberry Valley, Brush Cr). For 2005, 9/10 stations were reporting (all of the above, plus Greenville, Quincy, and DeSabla). For 2006 data, 10 out of 10 stations were reporting. For 2007 8/10 stations were reporting averages (Plumas Eureka State Park, Sierraville, Vinton, Portola, Strawberry Valley, Greenville, Quincy, and DeSabla). For 2008 8/10 stations were reporting averages (Sierraville, Vinton, Portola, Chester, Strawberry Valley, Brush Creek, Quincy, and Nicolaus).

Water Temperature

Introduction

The Central Valley Regional Water Quality Control Board has identified water temperature as a water quality concern in the Feather River Watershed. A variety of water temperature parameters, which are a function of air temperature, duration of exposure to air temperature, volume of water, and surface exposure to insolation, were used to compare between sites and between years. Water temperatures were analyzed for seven continuous recording stations with usable low flow data (six in Indian Creek subwatershed, and one in Spanish Creek).

Data Issues

- The temperature sensor at Wolf Creek was buried in 2005 & 2006, and these years are not included.
- In 2007 Lights Creek and Indian Creek at Flournoy Bridge transducers were out of the water during low flows, so water temperature data was supplemented with data from HOBO temperature loggers placed in the stream near the station.
- Indian Creek at Taylorsville is not represented in the graphs, because the sensor was out of the water, only collecting high flow data, over most of the nine year period.
- Spanish Creek transducer does not include data from 2007, due to high flows from winter 2006 burying the transducer. The transducer was moved to a new location in summer 2007 from the Highway 70 Bridge upstream to the Dyrr bank.

Maximum (Max) daily water temperature

Figure 3 graphs the highest one hour-long temperature that was recorded during the annual sampling period. The Department of Water Resources (DWR) weir, above the confluence of Red Clover Creek, is consistently one of the coolest stations in the Indian Creek subwatershed. This is most likely due to the fact that Indian Creek above this location is primarily fed by cold water from the bottom of Antelope Lake. Figure 3 also shows that Red Clover Creek has a visible warming influence on Indian Creek below the confluence (at Flournoy Br.) from 2000-08, except in 2002. Most of the stations have reported a downward trend in the maximum daily water temperature over the past few years. 2008 temperatures warmed slightly from 2007, except at Doyle Crossing, Notson Bridge, and Wolf Creek. This general warming is probably due to the second low water year (WY) in a row. The similarity in water temperature between 2007WY and 2008WY at Doyle Crossing and Notson Bridge may be due to increased groundwater influence from restoration projects that occurred upstream. Ten miles of channel on Last Chance Creek, upstream of Doyle Crossing, has been treated since 1995, and three miles of channel treated on Red Clover Creek in 2006. Indian Creek at DWR weir maintained the lowest recorded maximum daily temperature in 2008, due to its cold water source from the bottom of Antelope Lake.

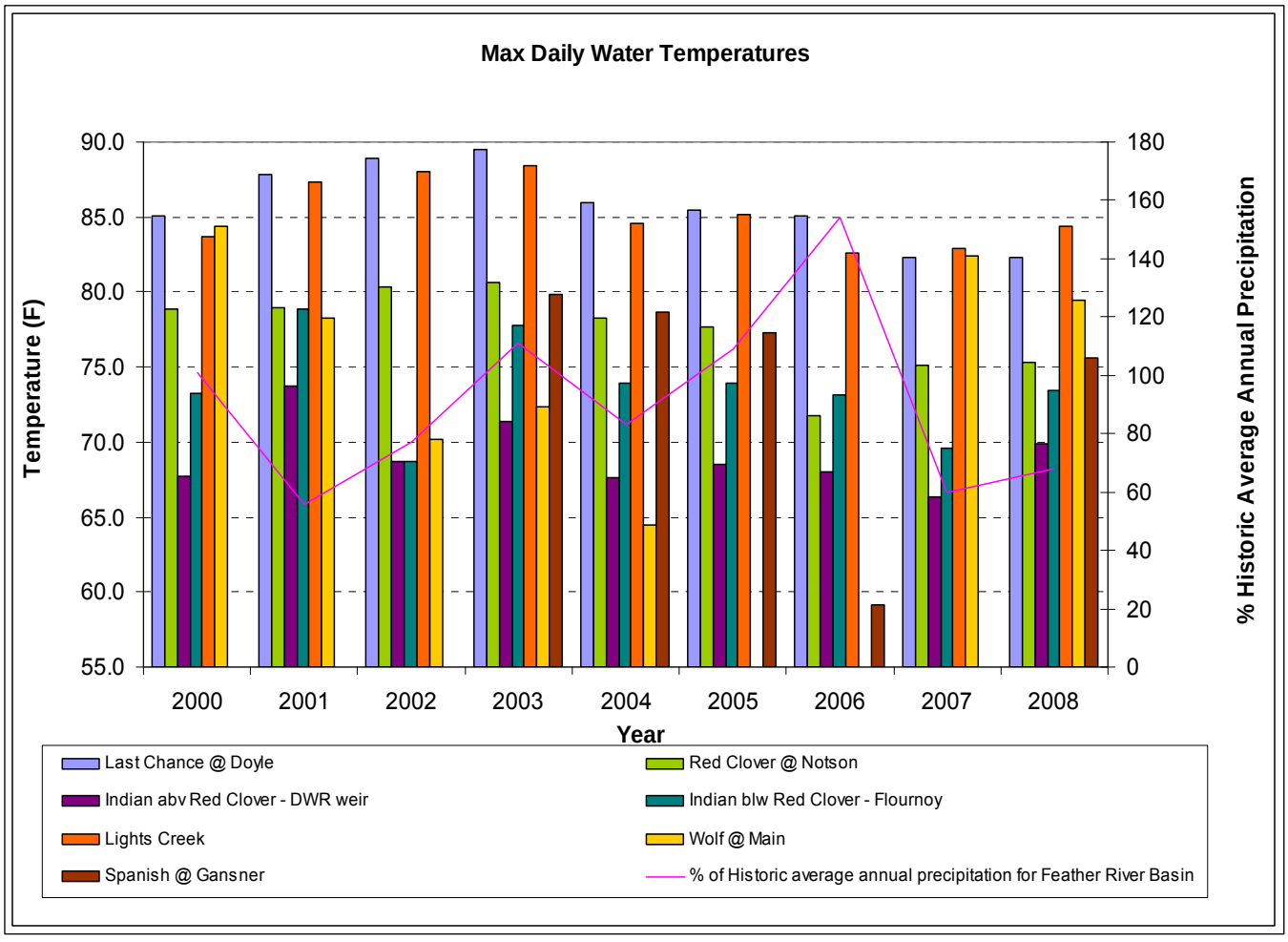


Figure 3. Maximum Daily Water Temperatures recorded 2000-08

Maximum weekly average water temperature

Maximum weekly average water temperature is calculated by taking a running seven day average of mean daily water temperature for the entire water year. Then, the maximum value of the averages is taken. Figure 4 shows Lights and Last Chance Creeks are consistently the two warmest channels. Last Chance Creek at Doyle Crossing and Red Clover Creek at Notson Bridge both experienced max weekly average water temperatures for the second year in a row that were much lower than in the high flow 2006 water year. In dry years there is more influence on water temperature from groundwater, because there is less surface water. Perhaps this cooling at Notson Bridge and Doyle Crossing is due to the greater influence of stored groundwater, not only because there were two drought years following a wet year, but because of the restored channel/floodplain upstream from these stations. The effect of decreased water temperatures out of Red Clover Creek can be seen on Indian Creek at Flournoy Bridge, with a smaller change in water temperature on Indian Creek from above to below the confluence of Red Clover Creek. The decrease in max weekly average water temperature on Last Chance Creek at Doyle Crossing from WY2006 may also be attributable to the ten miles of restoration upstream from Doyle Crossing.

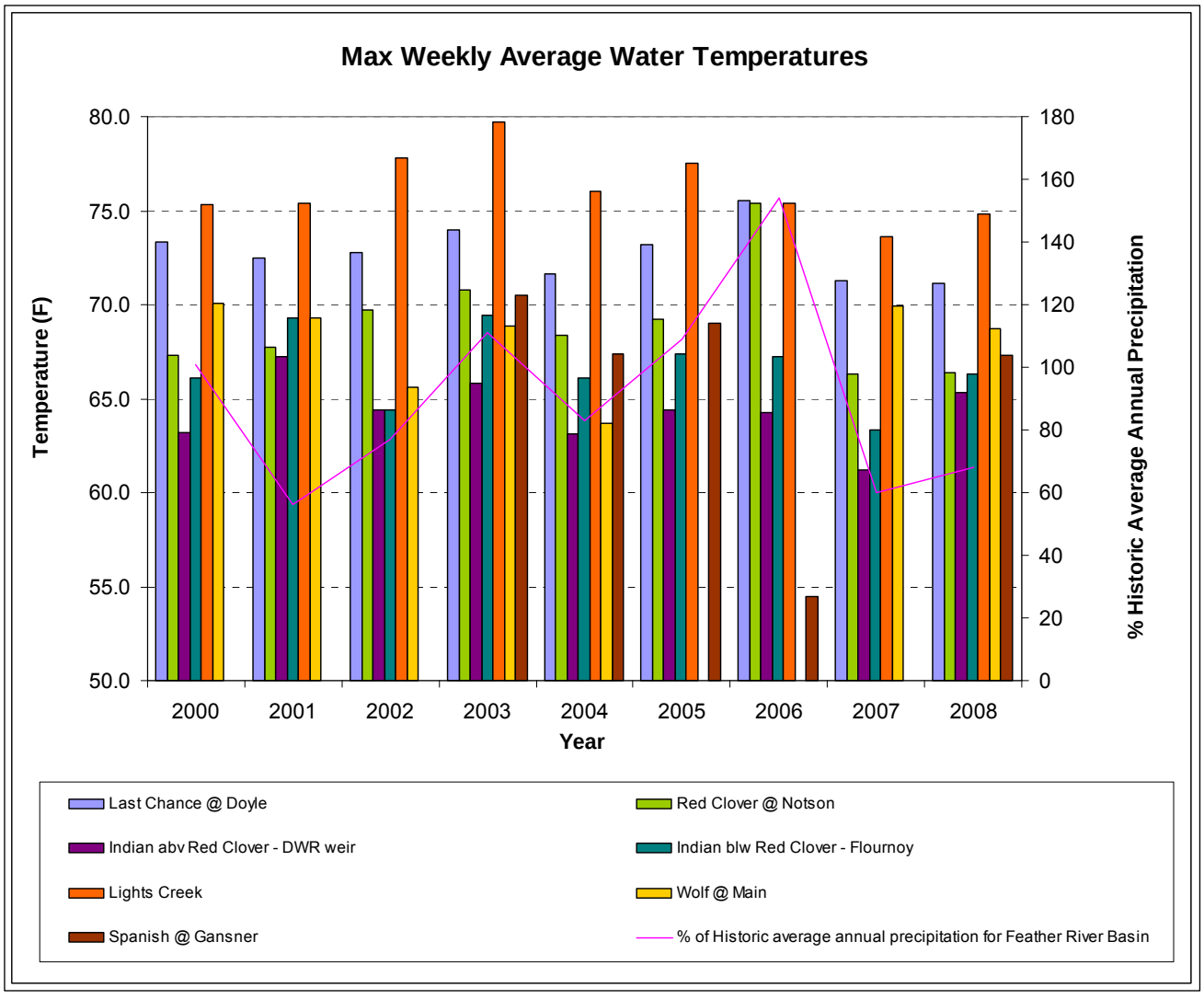


Figure 4. Maximum Weekly Average Water Temperature 2000-08 at Continuous Recording Stations

Daily Maximum Water Temperature >75°F

Figure 5 displays the number of days that had an absolute one-hour long temperature greater than 75°F among the seven continuous recording stations with usable low flow data from 2000-07. A reading greater than 75°F can be lethal to coldwater fish species, even if it is just a short-term maximum temperature reading. Last Chance and Lights Creeks are the most impaired creeks monitored in the Indian Creek watershed over the last nine years based on maximum water temperatures exceeding 75°F and maximum weekly average water temperatures greater than 66°F. Even though over 40 days were recorded on Last Chance Cr @ Doyle Crossing with maximum temperatures exceeding 75°F, the numbers have continued to decline since 2001, when most of the channel/flooplain restoration work on Last Chance Creek began. The increase from 2007WY to 2008WY is probably due to the effects of two drought years in a row. Despite the drought, Red Clover Creek at Notson Bridge and Spanish Creek both show only one day where the maximum water temperature exceeds 75°F. Red Clover Creek has also shown very few to no days above 75°F since 2006. This decrase in leath temperatures could be due to the influence of cool groundwater temperatures from the Red Clover/McReynolds Creek Restoration project, which was constructed in 2006.

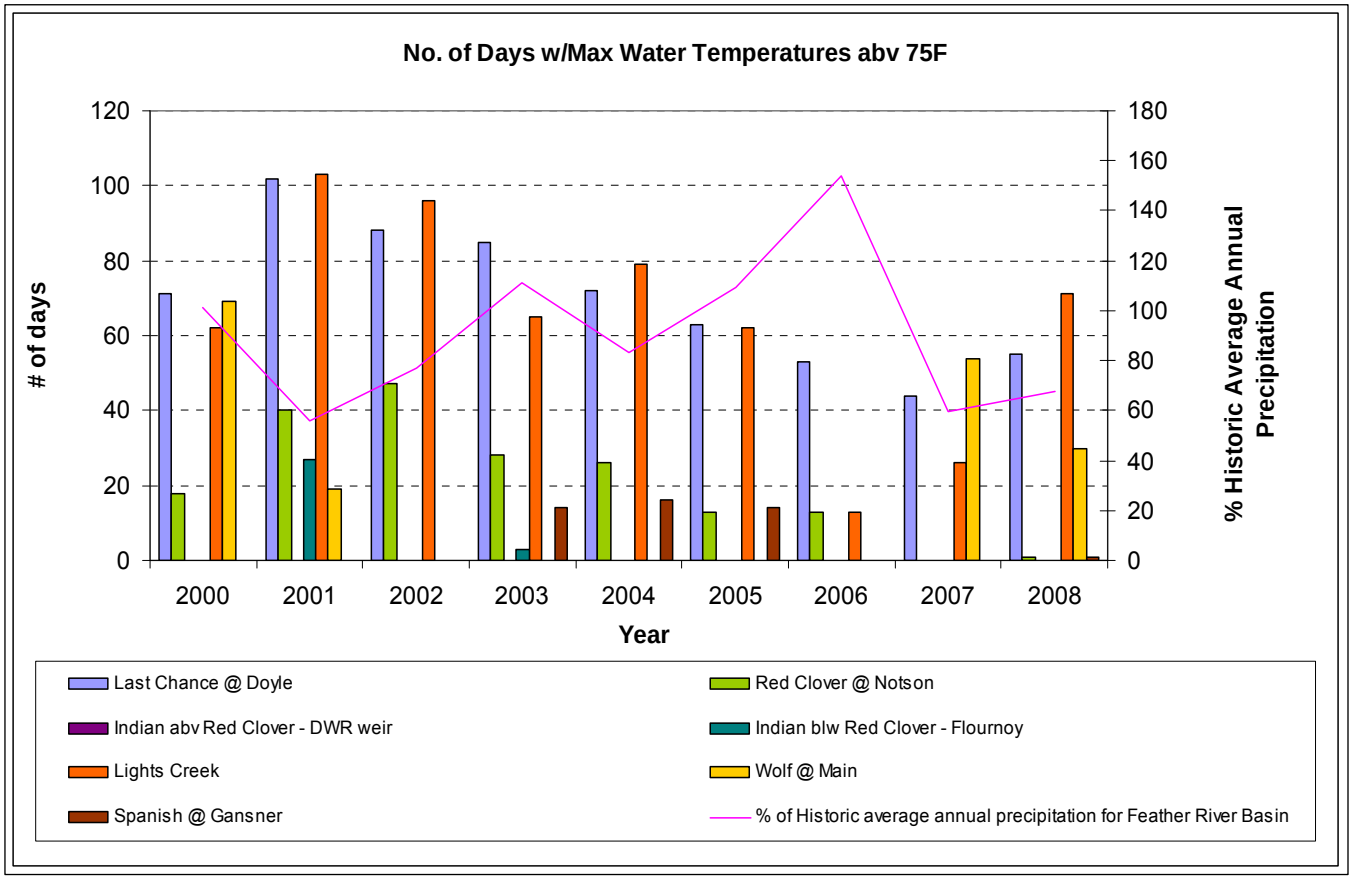


Figure 5. Number of days with maximum water temperature above 75F recorded from 2000-08

Maximum diurnal water temperature fluctuation

Figure 6 and 7 display the maximum and average diurnal water temperature fluctuation, respectively. This is calculated by finding the difference between the maximum and the minimum water temperature in a 24-hour period (diurnal fluctuation). Then, a running seven day average of the diurnal fluctuation is calculated for the entire water year. Afterward the maximum value (Figure 6) and average value (Figure 7) of the averages is taken. This parameter is heavily dependent on air temperatures and insolation. In both the charts Last Chance Creek at Doyle Crossing shows smaller diurnal fluctuations in the past three years, which could be due to the completion of 10 miles of restoration in the upper Last Chance watershed.

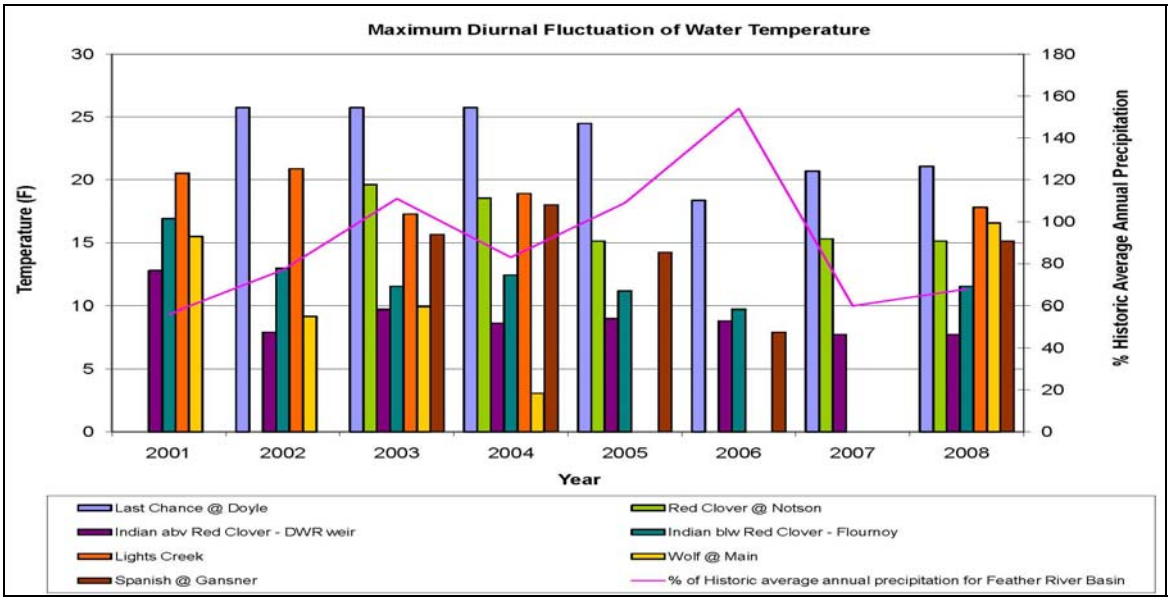


Figure 6. Maximum diurnal fluctuation of water temperature recorded from 2001-08

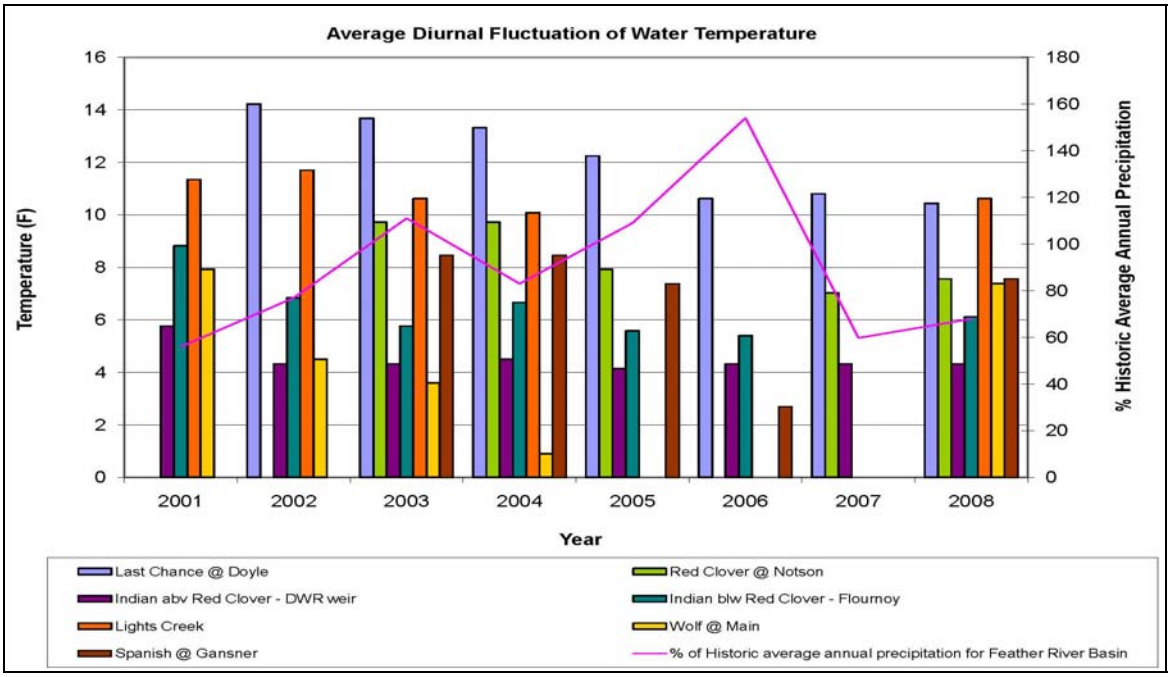


Figure 7. Average diurnal fluctuation of water temperature recorded from 2001-08

Project Influences on Water Temperature

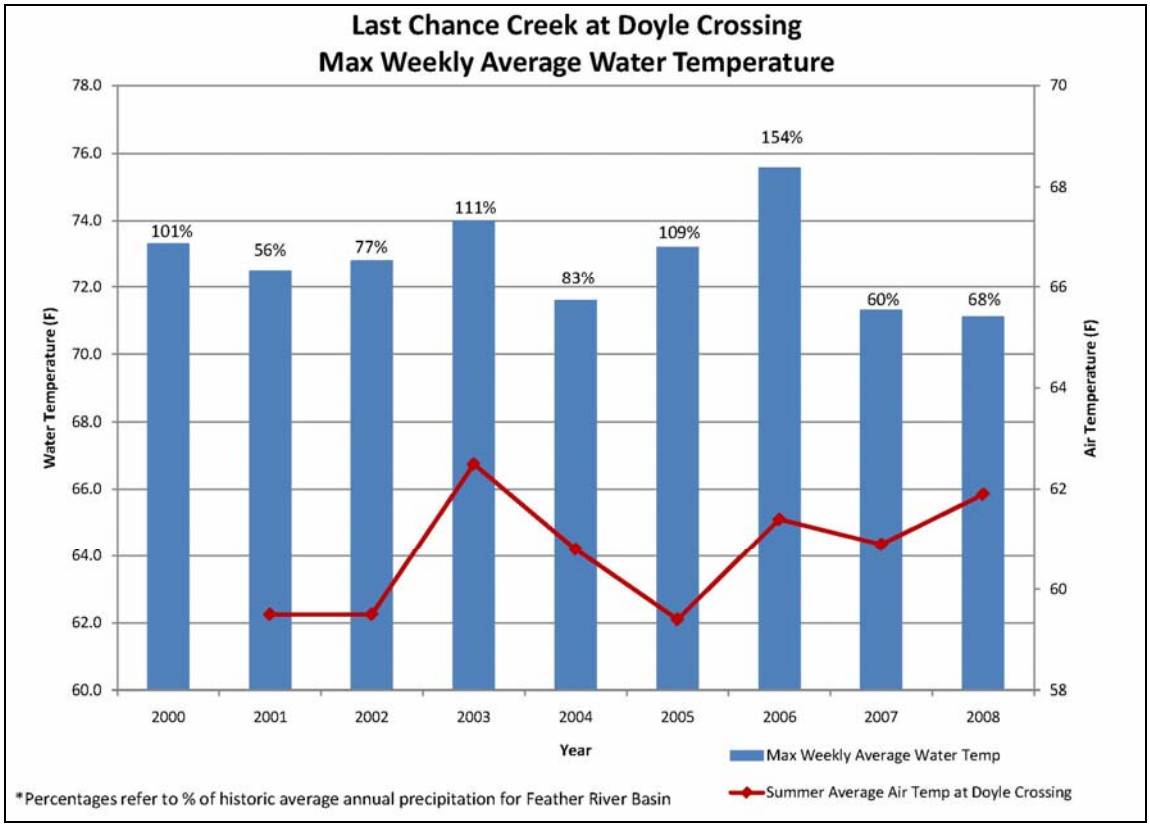


Figure 8: Maximum Weekly Average Water Temperature at Doyle Crossing for years 2000-2008

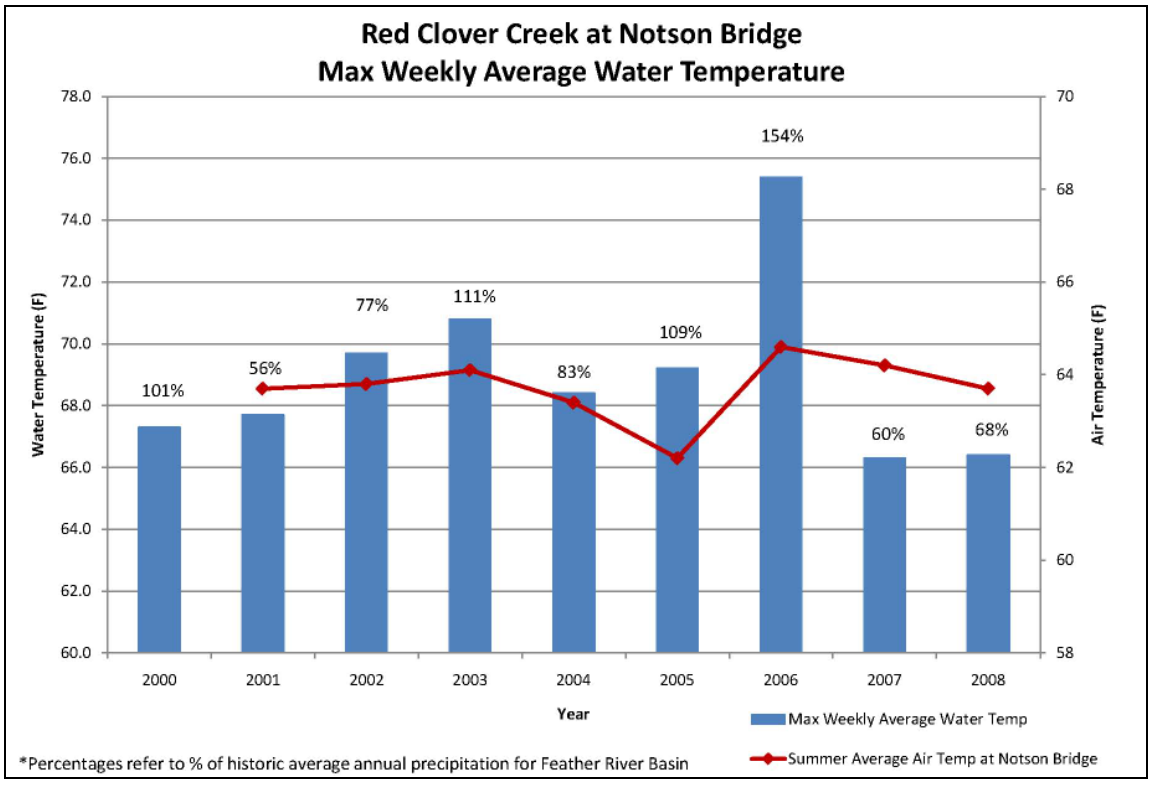


Figure 9: Maximum Weekly Average Water Temperature at Notson Bridge for years 2000-2008

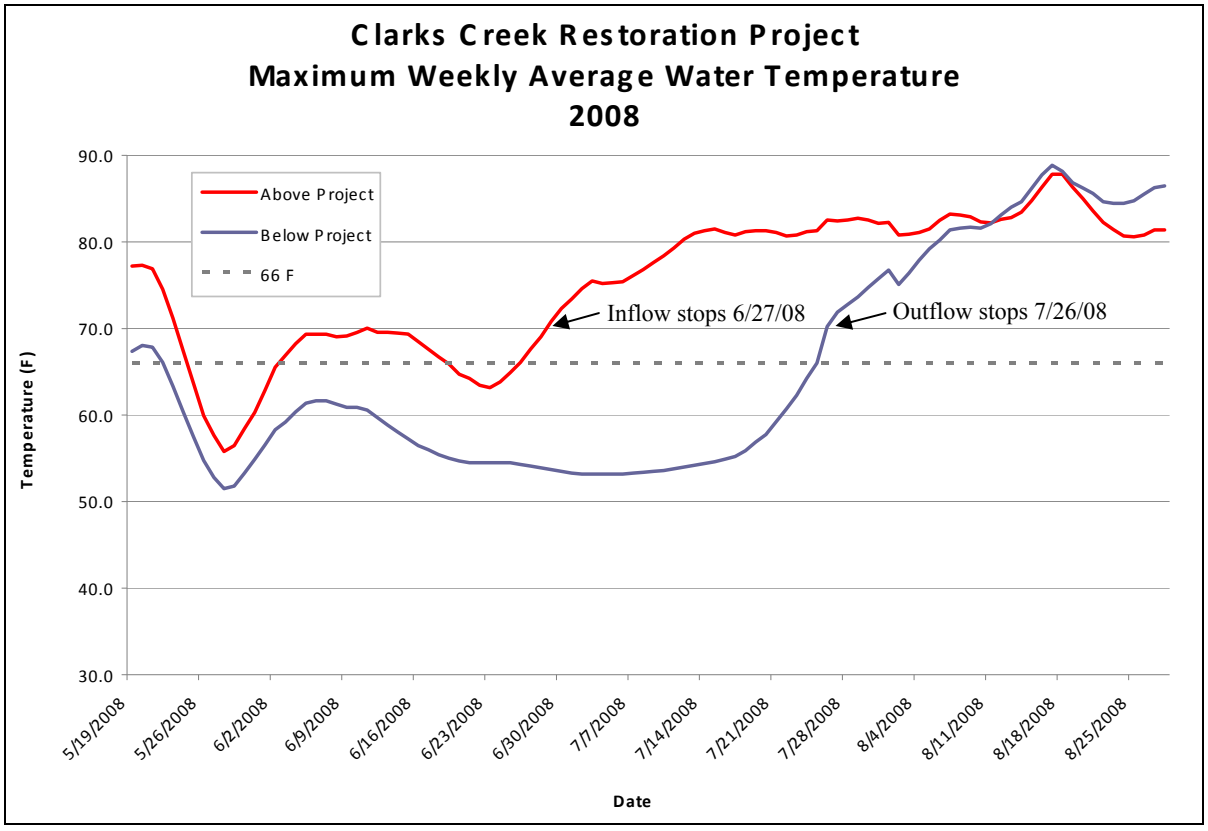


Figure 10: Maximum Weekly Average Water Temperature Above and Below Clarks Creek Restoration Project

Discussion

Last Chance Creek at Doyle Crossing and Lights Creek are consistently found to be the most heavily temperature impaired channels, followed by Wolf Creek, Red Clover Creek, and Spanish Creek. This temperature impairment of Red Clover, Wolf, Lights, and Spanish Creeks are assumed to be from the diminishment of groundwater recharge and release function of the watershed above these stations. The locally high temperature readings at Doyle Crossing on Last Chance Creek can be attributed to enhanced solar radiation from water sheeting over bedrock and a 400-foot long unshaded pool above the recording station. Although Red Clover Creek at Notson Bridge and Last Chance Creek at Doyle Crossing are still impaired channels, in the past two years there has been a noticeable decline in water temperatures, despite the low water years. This can be seen in Figures 8 and 9. Figure 8 displays maximum weekly average water temperature on Last Chance Creek at Doyle Crossing. In the Last Chance watershed the last major effort in restoration occurred in 2005, with the completion of Jordan Flat Supplemental and Dooley Creek restoration projects. The warmer water temperatures in the high precipitation year of 2006 may be due to high stream flows scouring out shade plants on the banks within the gullied channel; resulting in a high width to depth ratio, more insolation, and more surface water influence in the water temperatures. The warmer water temperatures in 2006 could also be due to meadows still filling after restoration. In 2007 and 2008 there is a significant decrease in water temperatures, despite over a 50% decrease in precipitation, and slightly warmer air temperatures in 2008 compared with 2006. It could be suggested that this decline in water temperature may be attributed to more groundwater influence from the upstream project areas, versus more groundwater release in subsequent dry years. The same reasoning could pertain to Figure 9, which displays maximum weekly average water temperature on Red Clover Creek at Notson Bridge. The difference in water temperature at Notson Bridge 2007 and 2008, is even larger than the difference seen at Doyle Crossing. Notson Bridge is located nine miles downstream of the Red Clover/McReynolds Creek Restoration Project, which was completed in 2006. Figure 10 displays the maximum weekly average water temperature for the 2008 runoff season above and below Clarks Creek Restoration Project. This

figure shows that the groundwater influence through the project maintains cool water temperatures below the project for almost a month after inflow to the top of the project ceases. Along with cooler water temperatures a longer low flow season can be seen out of the bottom of the Clarks Creek Restoration Project.

Stream Flows

The expectation is that detectable hydrologic response to watershed-scale restoration would be manifest in increased summer baseflows and decreased summer water temperatures. Restoration of a watershed's meadows and valleys would retain a portion of the annual runoff in the soil later into the summer/fall before being released back into the stream channel from bed and bank recharge.

Weekly Average Minimum Flow

Weekly average minimum flow is calculated by taking a running seven day average of the average daily water flow for the entire water year. Then, the minimum value of the averages is taken. Figure 11 shows the weekly average minimum flows (discharge in cubic feet per second (cfs)) across the seven continuous recording sites, six in the Indian Creek watershed and one station in the Spanish Creek watershed, from 2000-08. The Red Clover Creek station at Notson Bridge and the Indian Creek station at DWR weir are not included due to transducer failure in 2008WY. Spanish Creek is not included for 2007WY due to the transducer being buried in sediment from high flows in 2006. Most stations in Figure 12 recorded similar or lower minimum average flows from 2007WY to 2008WY, which would be expected in the second year of a drought. At Last Chance Creek at Doyle Crossing, however the second year of drought we were detecting higher baseflows at Doyle Crossing, perhaps due to the restoration projects on Last Chance Creek upstream from Doyle Crossing.

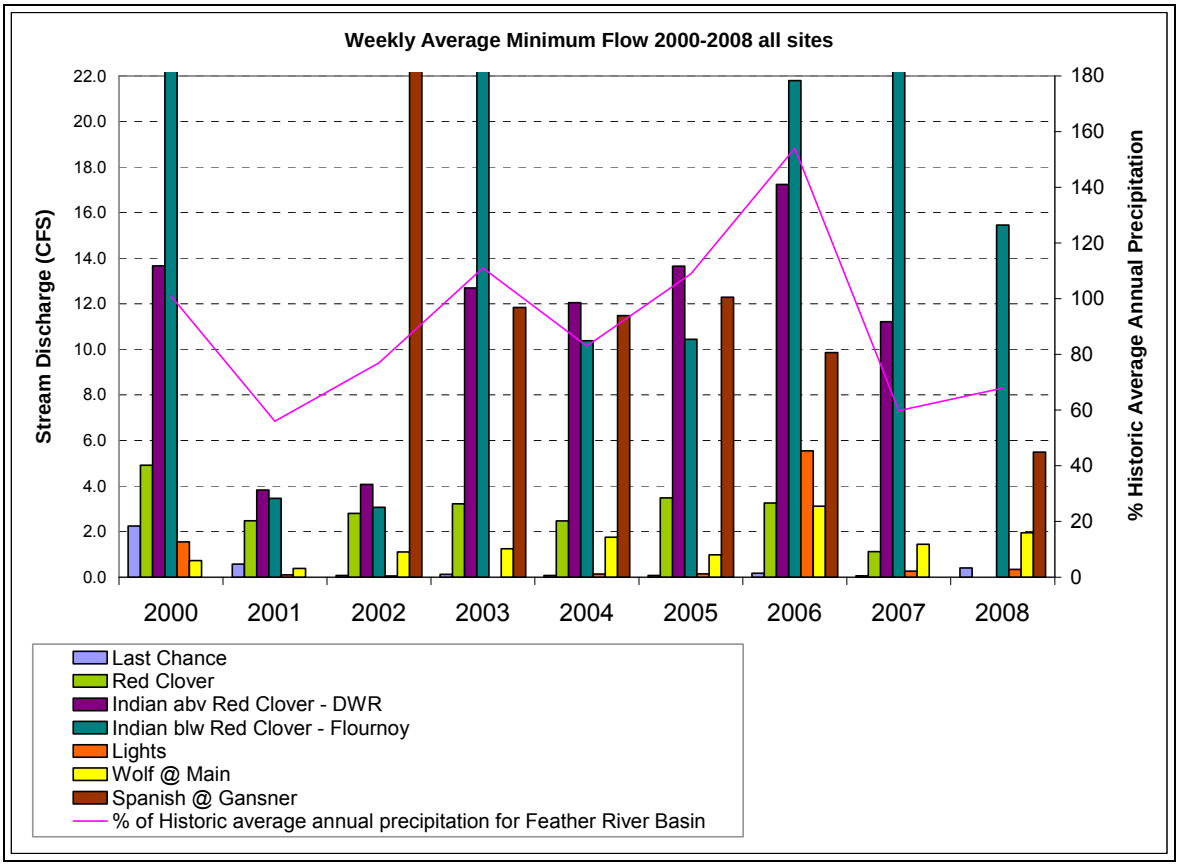


Figure 11. Weekly Average Minimum Flow from 2000-08 across CRS sites in Indian Creek Watershed

Project Influences on Flow

Figure 12 compares the spring hydrographs of Last Chance Creek at Doyle Crossing from May 1 until September for 2002 and 2008. 2002 and 2008 were chosen for their similarity in precipitation during the water year. 2002WY had a 77% of normal historic average annual precipitation for the Feather River Basin, while 2008WY had 68%. Figure 12 shows the base flows recorded on Last Chance Creek at Doyle Crossing in 2008 are greater than that of 2002 from May through September. This base flow in 2008 at Doyle Crossing remains greater than that of 2002, despite the fact that the 2002WY had more precipitation later in the season than 2008WY. This augmented base flow can assumed to be due to the restoration of ten miles of stream channel on Last Chance Creek upstream of Doyle Crossing, but is also a result of timing and intensity of precipitation.

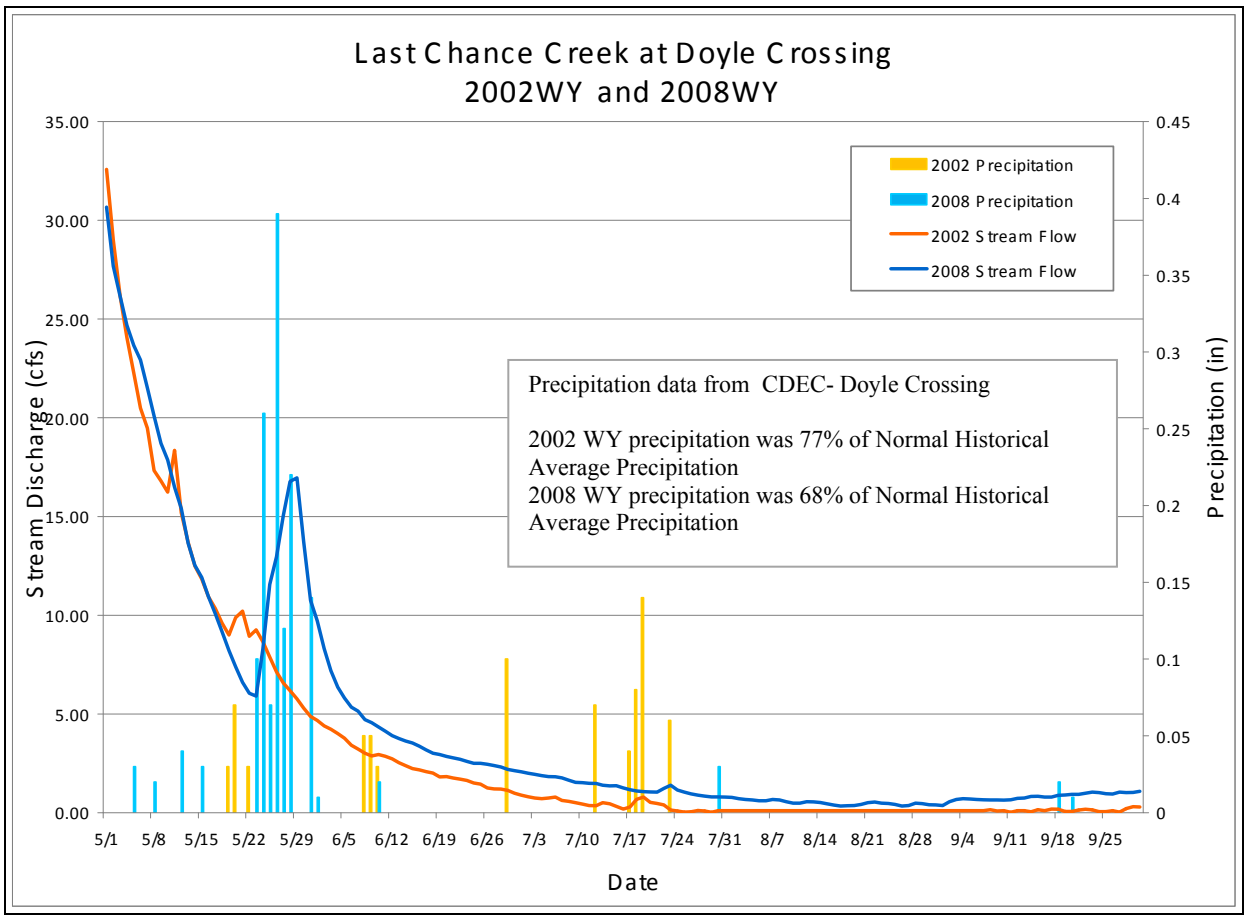
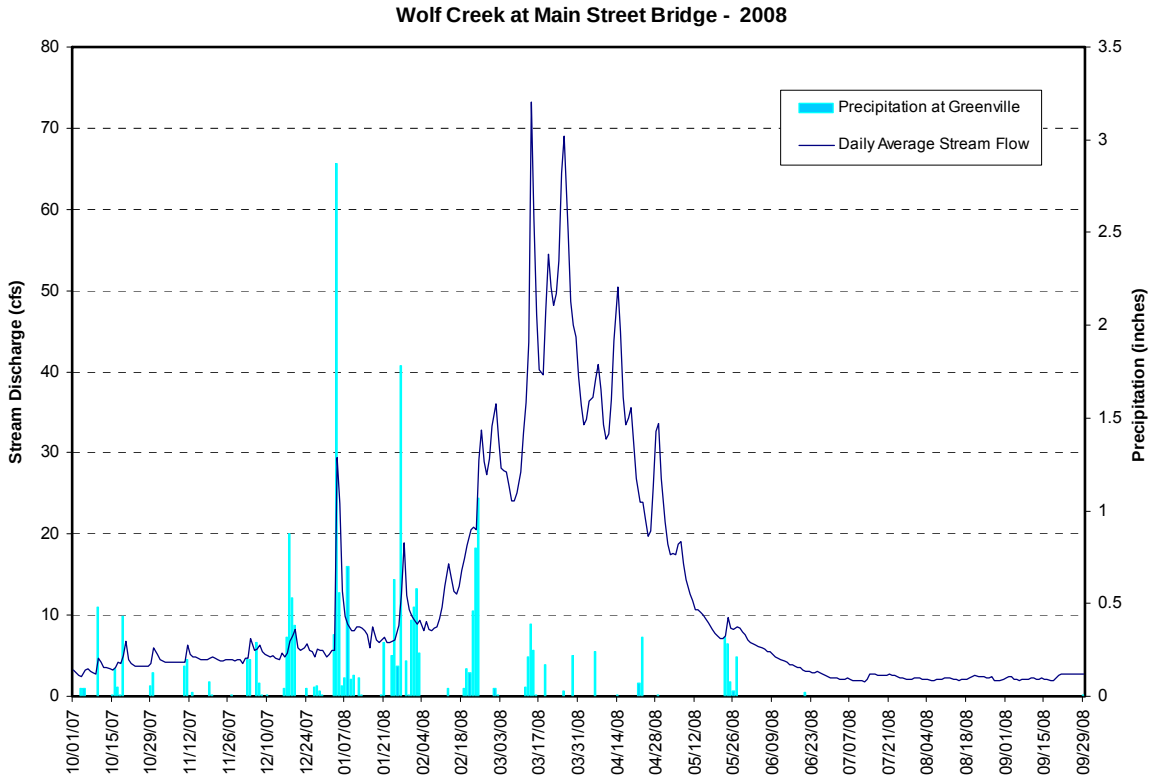
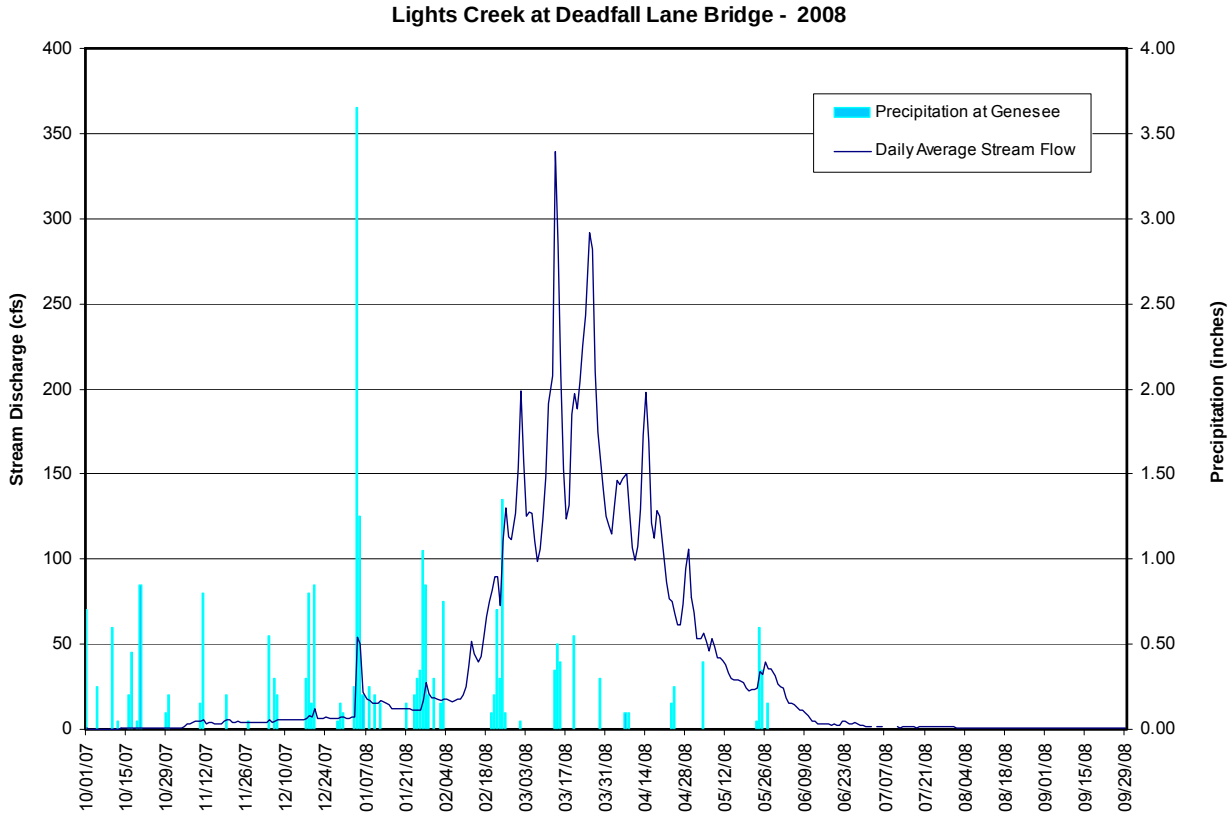
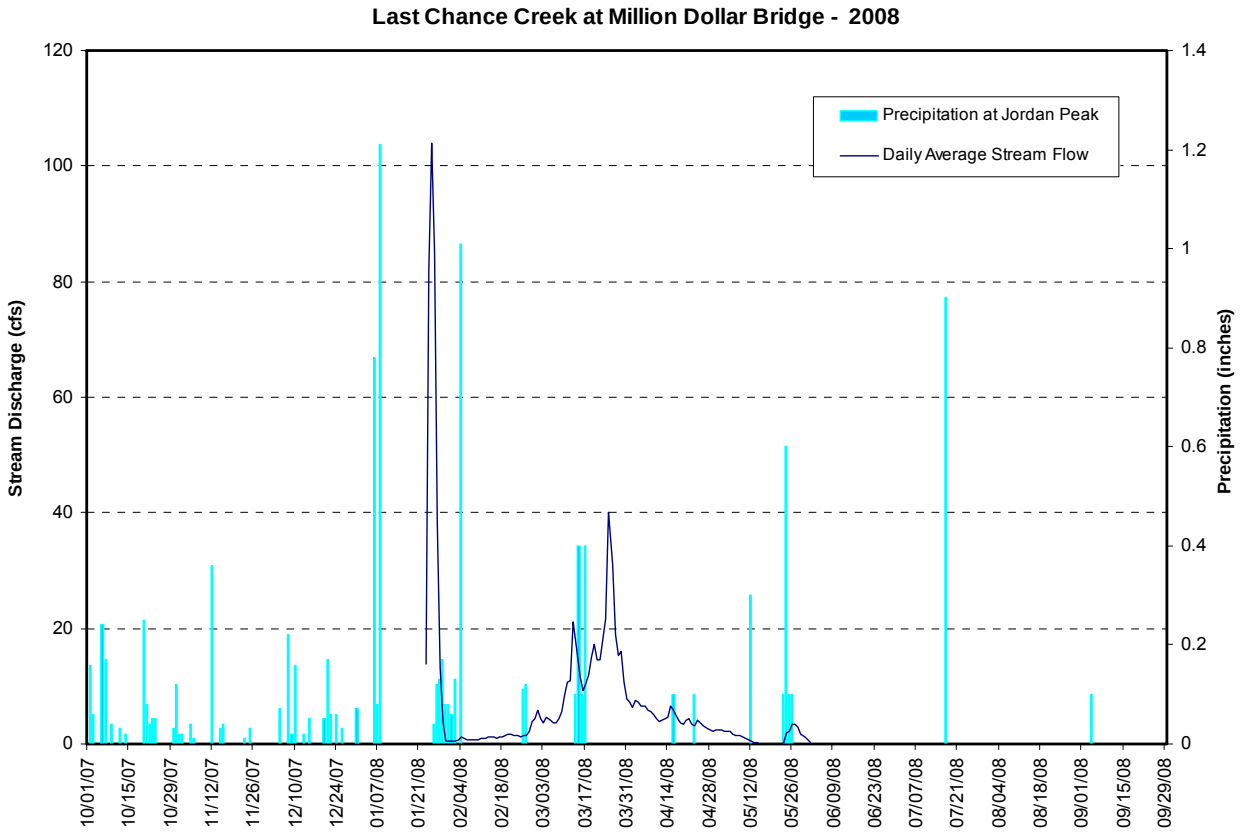


Figure 12: Spring recession stream flows in 2002WY and 2008WY at Doyle Crossing

Annual hydrographs for continuous recording stations WY2008 (precipitation data taken at nearby weather stations)






Last Chance Creek at Million Dollar Bridge - 2008
Precipitation at Jordan Peak
Daily Average Stream Flow
Stream Discharge (cfs)
Precipitation (inches)
0
20
40
60
80
100
120
0
0.2
0.4
0.6
0.8
1
1.2
1.4
10/01/07
10/15/07
10/29/07
11/12/07
11/26/07
12/10/07
12/24/07
01/07/08
01/21/08
02/04/08
02/18/08
03/03/08
03/17/08
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07/21/08
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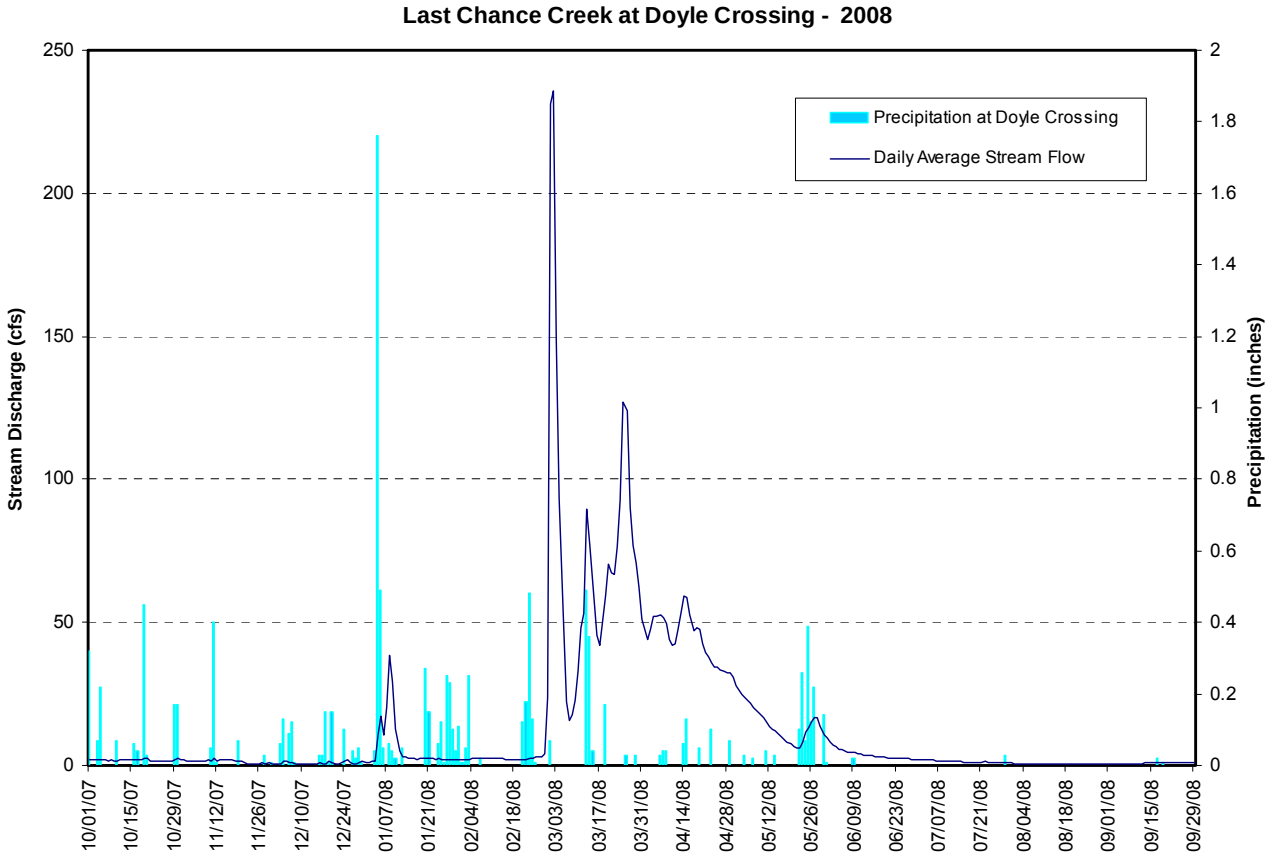
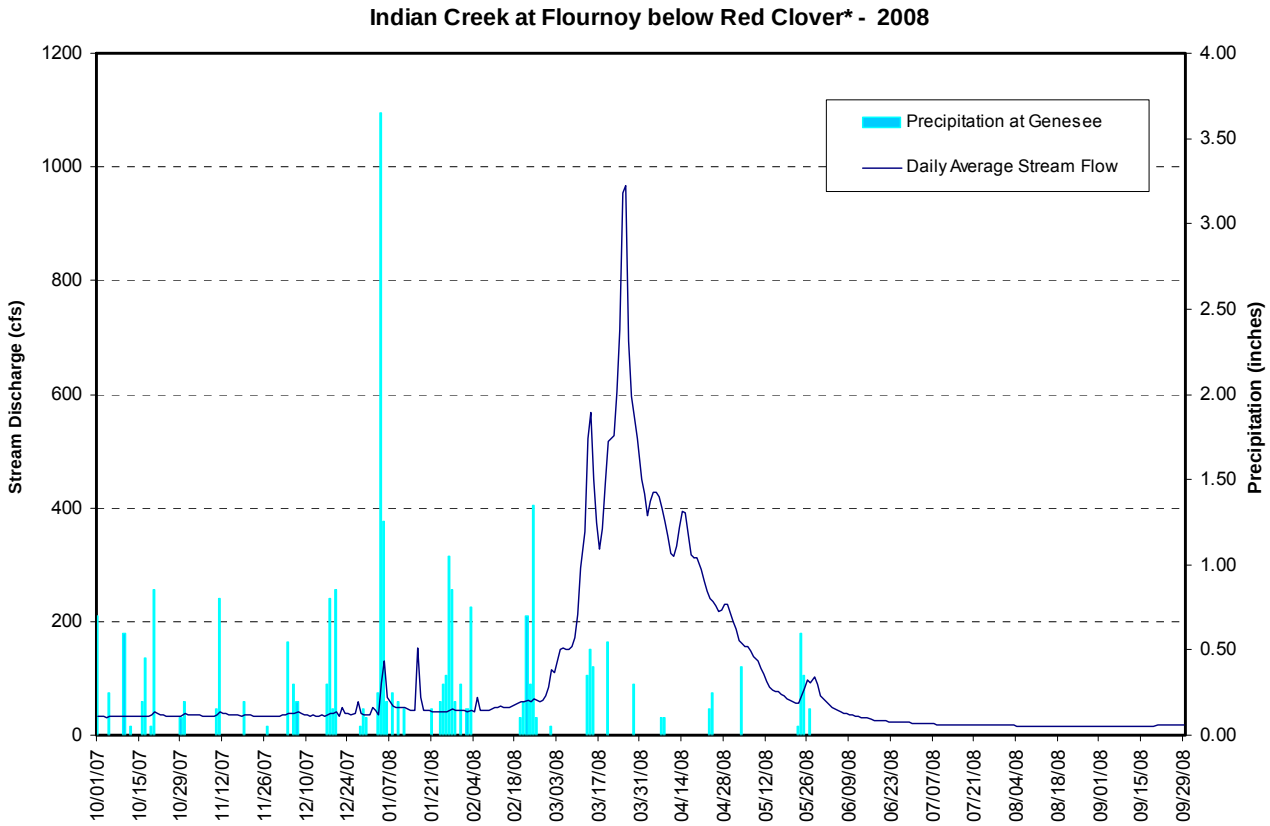
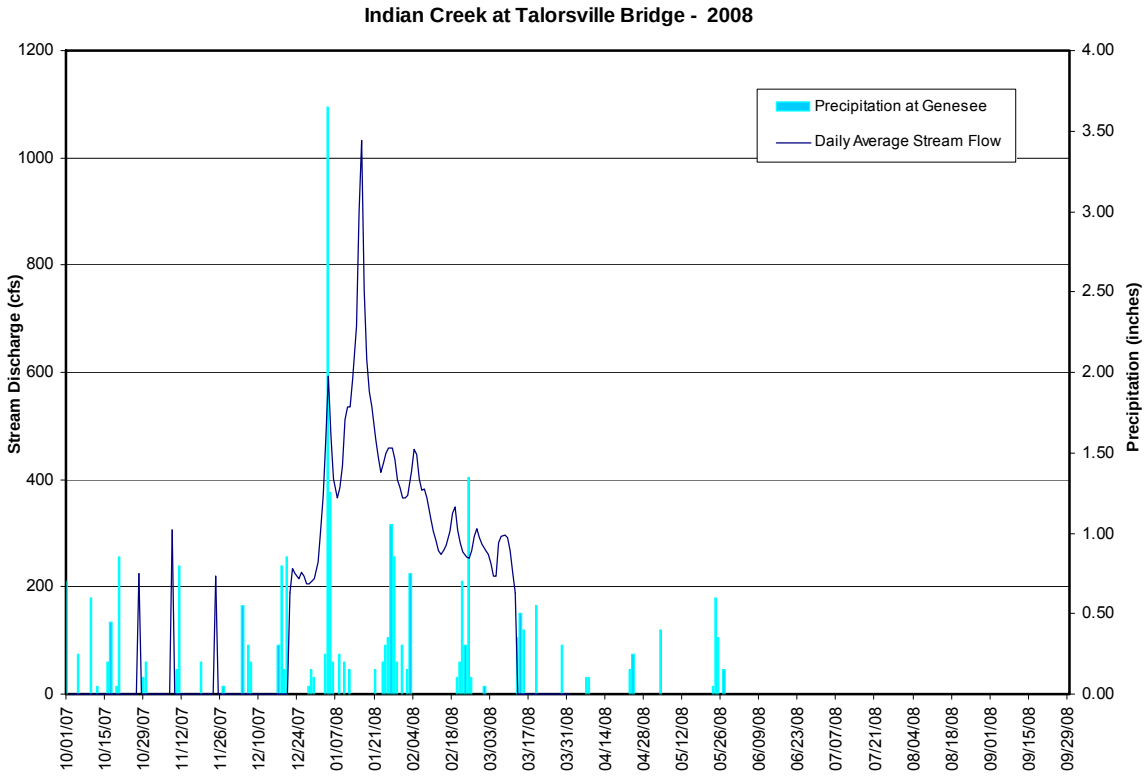
08/18/08
09/01/08
09/15/08
09/29/08


Last Chance Creek at Doyle Crossing - 2008
Precipitation at Doyle Crossing
Daily Average Stream Flow
Stream Discharge (cfs)
Precipitation (inches)
0
50
100
150
200
250
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
10/01/07
10/15/07
10/29/07
11/12/07
11/26/07
12/10/07
12/24/07
01/07/08
01/21/08
02/04/08
02/18/08
03/03/08
03/17/08
03/31/08
04/14/08
04/28/08
05/12/08
05/26/08
06/09/08
06/23/08
07/07/08
07/21/08
08/04/08
08/18/08
09/01/08
09/15/08
09/29/08


Indian Creek at Flournoy below Red Clover* - 2008
Precipitation at Genesee
Daily Average Stream Flow
Stream Discharge (cfs)
Precipitation (inches)
1200
1000
800
600
400
200
0
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
10/01/07
10/15/07
10/29/07
11/12/07
11/26/07
12/10/07
12/24/07
01/07/08
01/21/08
02/04/08
02/18/08
03/03/08
03/17/08
03/31/08
04/14/08
04/28/08
05/12/08
05/26/08
06/09/08
06/23/08
07/07/08
07/21/08
08/04/08
08/18/08
09/01/08
09/15/08
09/29/08


Indian Creek at Talorsville Bridge - 2008
Precipitation at Genesee
Daily Average Stream Flow
Stream Discharge (cfs)
Precipitation (inches)
1200
1000
800
600
400
200
0
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
10/01/07
10/15/07
10/29/07
11/12/07
11/26/07
12/10/07
12/24/07
01/07/08
01/21/08
02/04/08
02/18/08
03/03/08
03/17/08
03/31/08
04/14/08
04/28/08
05/12/08
05/26/08
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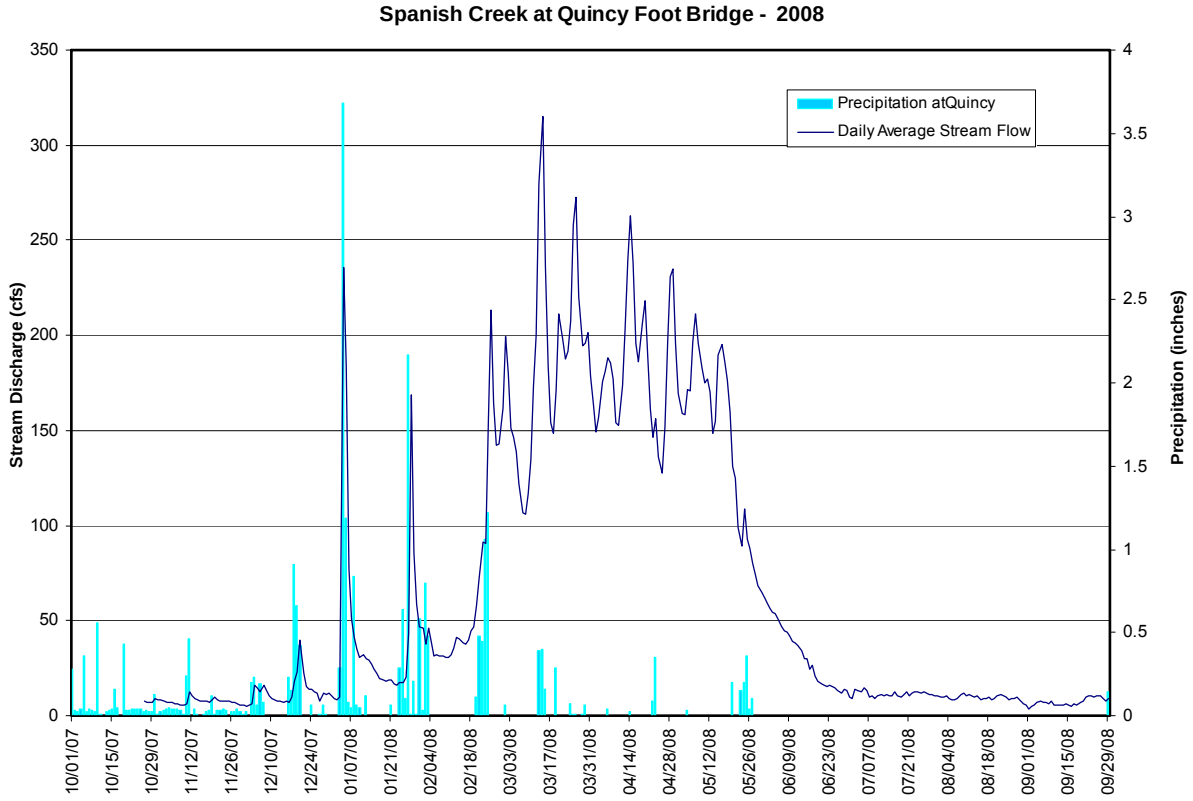
08/18/08
09/01/08
09/15/08
09/29/08



Citizen Monitoring

During the 2008WY the Feather River CRM had the help of ten Citizen Monitors, who collected turbidity samples and water temperatures during storm events at 16 different locations throughout the watershed. Figure 13 shows different turbidity measurements taken along Spanish Creek between Meadow Valley and American Valley. These data are being used to define and to develop a long-term pre-project data set for potential bank stabilization along Spanish Creek, as well as to quantify fine sediment in the system. Turbidity in these graphs is measured in Nephelometric Turbidity Units (NTUs). Figure 14 displays Sulphur Creek at the Lower Loop Rd Bridge, at the lower bridge in Whitehawk Ranch, and at the Hwy 89 bridge near Clio. These data were taken the winter/spring before the construction of Boulder Creek Restoration Project. Hopefully with the potential construction of Sulphur/Barry Creeks Restoration Project and the Sulphur Creek Bank Stabilization Project, and the completed 2008 Boulder Creek Restoration Project, we will see reduced turbidity measurements in the future. Further analysis of long term pre- and post-project turbidity data will also be discussed in the Middle Fork Complex Final Report, to be completed in 2010.

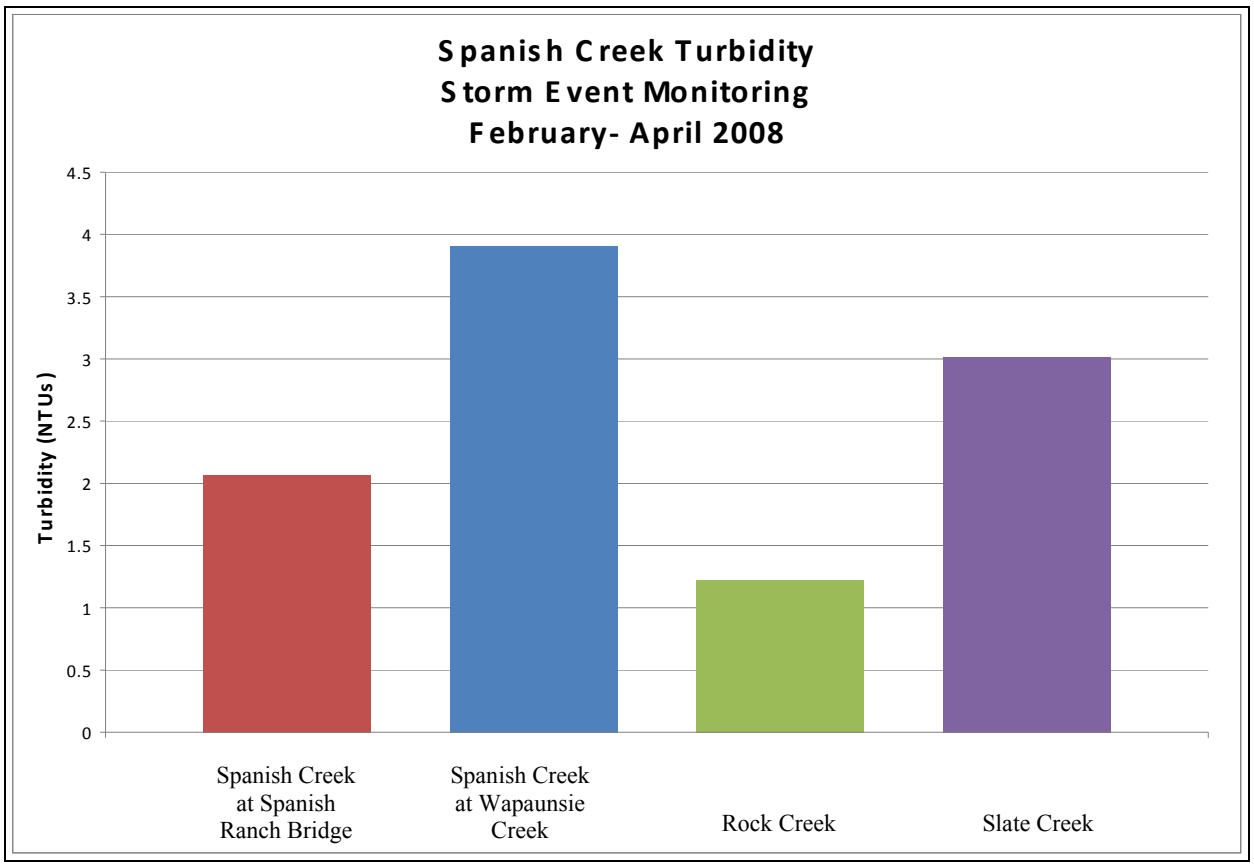


Figure 13: Storm Event Turbidity Monitoring on Spanish Creek

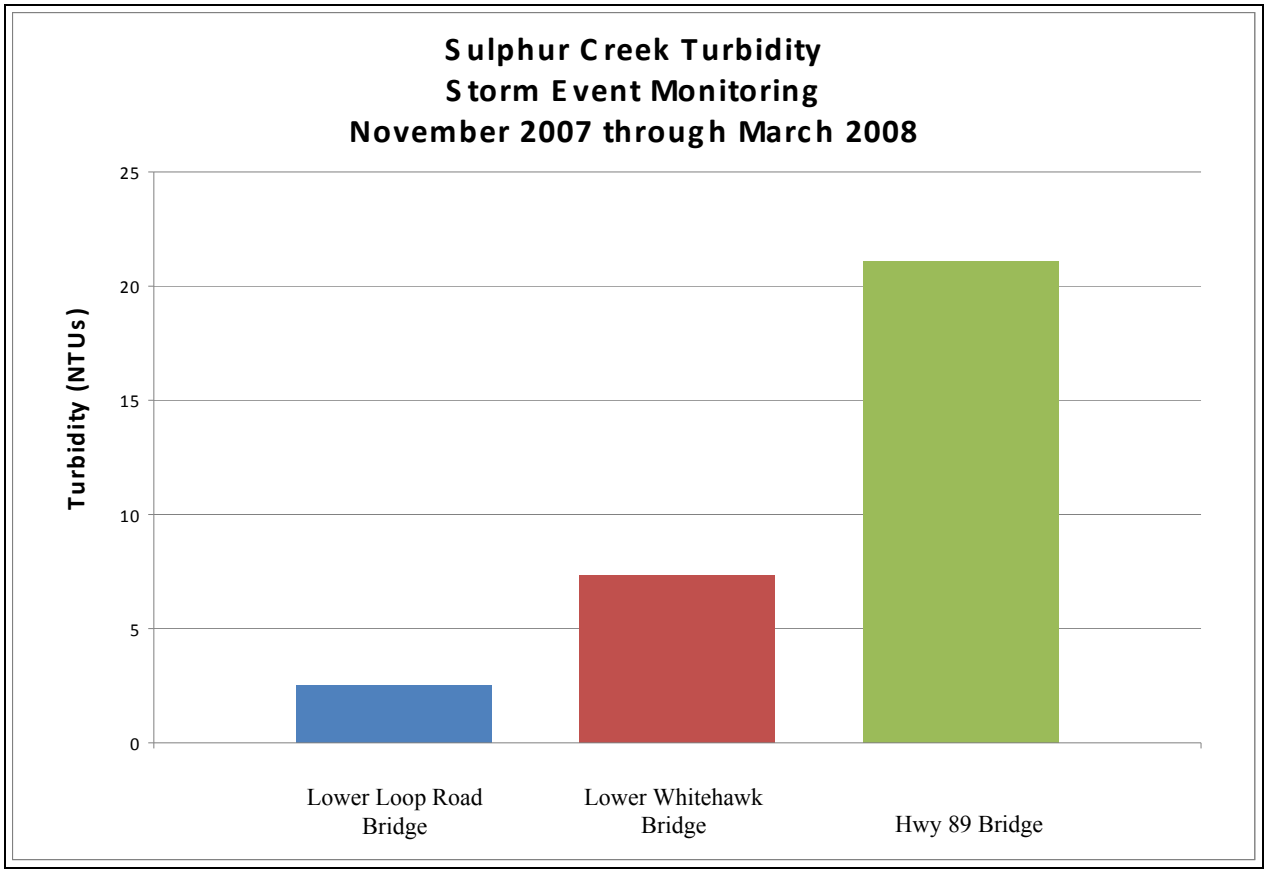
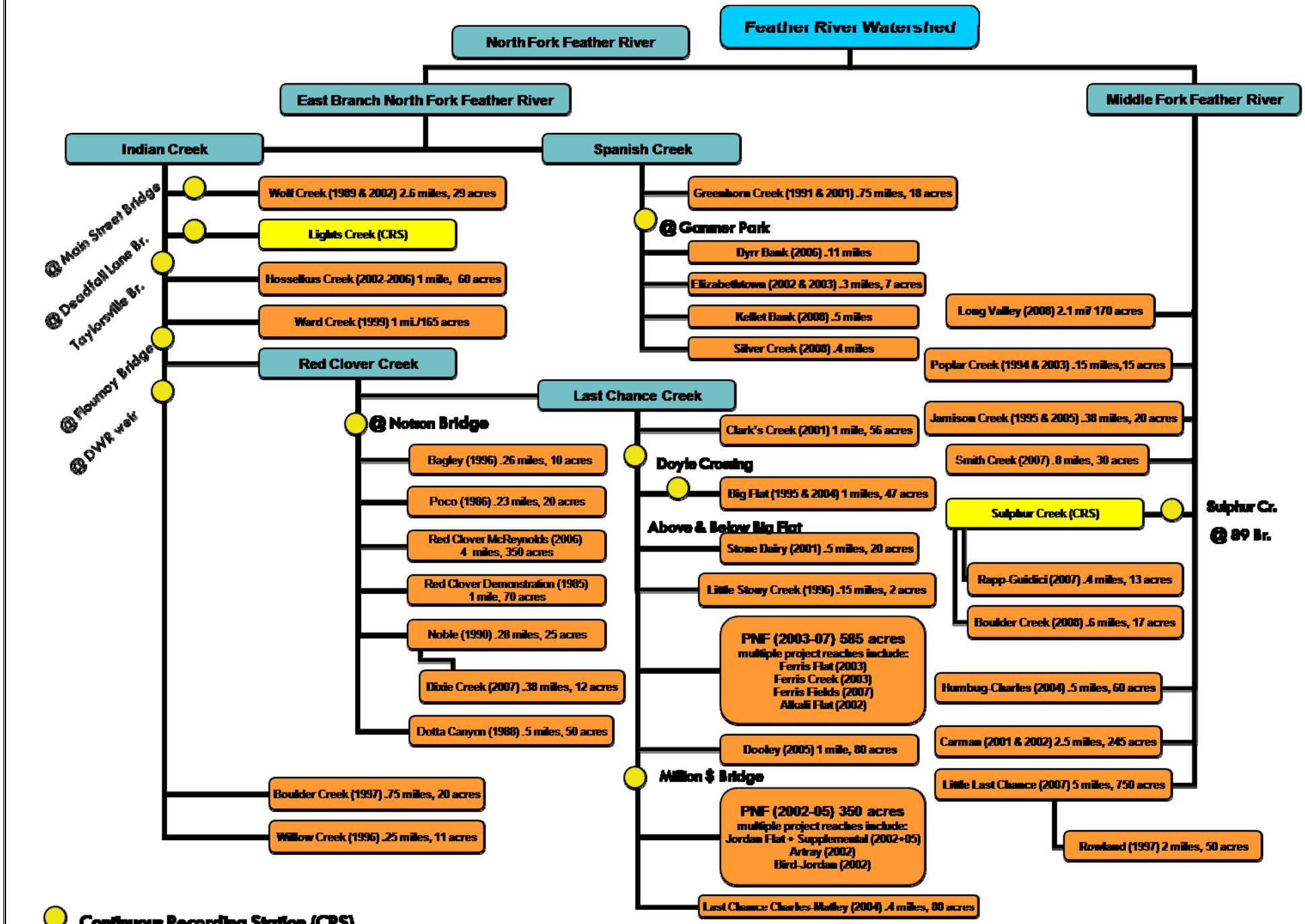


Figure 14: Storm Event Turbidity Monitoring on Sulphur Creek

Conclusion

The 2008 Water Year was the second year of a drought. With 68% of average historic precipitation falling in 2008 and 60% in 2007, this was a good water year for FR-CRM to analyze the response of the Feather River Watershed to low flows and summer temperatures. While Last Chance and Lights Creeks continued to be the most impaired streams for cold water fisheries that FR-CRM monitors, improvement in water temperatures were seen on Last Chance Creek at Doyle Crossing over the last 9 years of watershed monitoring data. Such water temperature improvements may be attributed to over 10 miles of channel and almost 1,500 acres of affected meadows that have been restored by FR-CRM on Last Chance Creek above Doyle Crossing. Eight more miles of restoration on Last Chance Creek above Doyle Crossing is planned for construction in 2010-2011 with Proposition 50 funds, and we hope to see more improvements in summer water temperatures and baseflow on Last Chance Creek at Doyle Crossing. There have also been improvements seen on Red Clover Creek at Notson Bridge in maximum weekly average water temperature and maximum summer water temperature diurnal fluctuation. These improvements may be due to the effect of the Red Clover/McReynolds Creek Restoration Project, which restored three miles of channel nine miles upstream of Notson Bridge.

Unlike the improvements on Last Chance Creek and Red Clover Creek, we foresee little improvement in summer water quality on Lights Creek, particularly with sediment contribution from fire and subsequent rehabilitation activities following the Moonlight fire in 2007. Wolf Creek water quality has improved since the first three phases of restoration, yet coldwater fisheries would benefit from more channel restoration upstream of Main Street between Setzer Road bridge and the Greenville Campground.


Feather River Watershed
North Fork Feather River
East Branch North Fork Feather River
Middle Fork Feather River
Indian Creek
Spanish Creek
@ Main Street Bridge
@ Deadfall Lane Br.
Taylorsville Br.
@ Flournoy Bridge
@ DWR weir
Wolf Creek (1989 & 2002) 2.6 miles, 29 acres
Lights Creek (CRS)
Hosselkus Creek (2002-2006) 1 mile, 60 acres
Ward Creek (1999) 1 mi./165 acres
Red Clover Creek
Boulder Creek (1997) .75 miles, 20 acres
Willow Creek (1996) .25 miles, 11 acres
Greenhorn Creek (1991 & 2001) .75 miles, 18 acres
@ Gansner Park
Dyrr Bank (2006) .11 miles
Elizabethtown (2002 & 2003) .3 miles, 7 acres
Kellet Bank (2008) .5 miles
Silver Creek (2008) .4 miles
Long Valley (2008) 2.1 mi/ 170 acres
Poplar Creek (1994 & 2003) .15 miles,15 acres
Last Chance Creek
@ Notson Bridge
Bagley (1996) .26 miles, 10 acres
Poco (1986) .23 miles, 20 acres
Red Clover McReynolds (2006)
4 miles, 350 acres
Red Clover Demonstration (1985)
1 mile, 70 acres
Noble (1990) .28 miles, 25 acres
Dixie Creek (2007) .38 miles, 12 acres
Dotta Canyon (1988) .5 miles, 50 acres
Clark's Creek (2001) 1 mile, 56 acres
Doyle Crossing
Big Flat (1995 & 2004) 1 miles, 47 acres
Above & Below Big Flat
Stone Dairy (2001) .5 miles, 20 acres
Little Stony Creek (1996) .15 miles, 2 acres
PNF (2003-07) 585 acres
multiple project reaches include:
Ferris Flat (2003)
Ferris Creek (2003)
Ferris Fields (2007)
Alkali Flat (2002)
Dooley (2005) 1 mile, 80 acres
Million $ Bridge
PNF (2002-05) 350 acres
multiple project reaches include:
Jordan Flat + Supplemental (2002+05)
Artray (2002)
Bird-Jordan (2002)
Last Chance Charles-Malley (2004) .4 miles, 80 acres
Jamison Creek (1995 & 2005) .38 miles, 20 acres
Smith Creek (2007) .8 miles, 30 acres
Sulphur Creek (CRS)
Sulphur Cr.
@ 89 Br.
Rapp-Guidici (2007) .4 miles, 13 acres
Boulder Creek (2008) .6 miles, 17 acres
Humbug-Charles (2004) .5 miles, 60 acres
Carman (2001 & 2002) 2.5 miles, 245 acres
Little Last Chance (2007) 5 miles, 750 acres
Rowland (1997) 2 miles, 50 acres
Continuous Recording Station (CRS)