**Crane Valley Hydroelectric Project, FERC No. 1354**

**Crane Valley Water Temperature Monitoring Results – 2005**

**Addressing License Article 405 and U. S. Forest Service Condition No. 5**

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**TES Report No. 026.11.05.24**



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# 1 INTRODUCTION

## 1.1 Objective

The Crane Valley Water Temperature Monitoring Program was initiated to determine the water temperature conditions in the Crane Valley Project area under licensed operating conditions and ambient hydrological and meteorological conditions.

## 1.2 FERC License Article 405 and U. S. Forest Service Condition No. 5

Pacific Gas and Electric Company (PG&E) filed with the Federal Energy Regulatory Commission (FERC) a water temperature monitoring plan on September 24, 2004 that was prepared in consultation with the California Department of Fish and Game (CDFG), the U.S. Fish and Wildlife Service (USFWS), the U.S. Forest Service (USFS), and the State Water Resources Control Board (SWRCB) (PG&E 2004). The water temperature monitoring plan was verbally approved by the USFS on September 17, 2004 pursuant to USFS Condition No. 5. An Order was issued by FERC on January 18, 2005 approving the water temperature monitoring plan pursuant to Article 405 and subject to the modifications outlined in the Order (FERC 2005).

## 1.3 Project Area

The Crane Valley Hydroelectric Project (Project), FERC No. 1354, includes the North Fork Willow Creek (NFWC), the South Fork Willow Creek (SFWC), mainstem Willow Creek, two major tributaries (Peckinpah Creek and Whiskey Creek), and four lakes (Bass Lake, Manzanita Lake, Chilkoot Lake, and Corrine Lake) in Madera County (Figure 1.1-1). The Project was constructed between 1895 and 1920 by the San Joaquin Electric Company and later the San Joaquin Power and Light Corporation (Studley et al. 1995). FERC issued a new license to PG&E for the continued operation of the Project on September 16, 2003 (FERC 2003). Project elevations range from 966 ft at Wishon Powerhouse on the San Joaquin River to 7,497 ft at Chilkoot Lake.

Bass Lake is the main storage reservoir for the Project and has a drainage area of 50.4 square miles and a maximum water surface elevation of 3,377 ft. Bass Lake is formed by Crane Valley Dam and is approximately 4 miles long. Bass Lake receives inflow from the NFWC, the SFWC (through the 2-mile long Browns Creek conduit), and other smaller streams.

Upstream of Bass Lake, Chilkoot Dam is located on Chilkoot Creek and creates Chilkoot Lake. The Chilkoot Lake Pick-Up Ditch collects water, primarily spring runoff, and delivers it to Chilkoot Lake. When the water stored in Chilkoot Lake is released, it flows down Chilkoot Creek to the NFWC and then into Bass Lake.

Water from Bass Lake enters a tunnel beneath the lakes' floor and passes through the dam to the Crane Valley Powerhouse. Outflow from the powerhouse travels approximately 3.5 miles through the No. 3 Conduit to a forebay upstream of the San Joaquin No. 3 Powerhouse. Outflow from this powerhouse enters the NFWC at the upper end of Manzanita Lake and is diverted again at Manzanita Lake Dam into the No. 2 Conduit, which carries water approximately 3 miles to the No. 2 Forebay. Water then travels approximately 0.75 miles through a penstock to the San Joaquin No. 2 Powerhouse.

Water from the San Joaquin No. 2 Powerhouse combined with water diverted from NFWC (including water diverted from the SFWC into NFWC) travels to the San Joaquin No. 1A Powerhouse via approximately 5 miles of conduit. Water released from the powerhouse flows into Corrine Lake, which is the forebay for the A. G. Wishon Powerhouse. Water is released from the A. G. Wishon Powerhouse into the San Joaquin River.

## 2 METHODS

### 2.1 Sample Location

Water temperature was measured at twelve (12) historic stream locations from May 1 to November 1, 2005. Waters associated with the Crane Valley Project include the NFWC, SFWC, mainstem Willow Creek, and Bass Lake. The twelve water temperature monitoring stations are listed below.

- NFWC below Bass Lake at the Crane Valley Powerhouse tailrace (T1)
- NFWC below Bass Lake at river mile 7.13 (T2)
- NFWC upstream of Manzanita Lake at river mile 4.39 (T3)
- NFWC at the Manzanita Lake diversion dam (T4)
- NFWC downstream of Manzanita Lake at river mile 3.00 (T5)
- NFWC upstream of the North Fork diversion dam at river mile 0.25 (T6)
- SFWC upstream of the Browns Creek diversion dam at river mile 6.59 (T7)
- SFWC downstream of the Browns Creek diversion dam at river mile 6.5 (T8)
- SFWC above the South Fork diversion dam at river mile 0.1 (T9)
- Willow Creek at Gage W-26, river mile 4.3 (T10)
- Willow Creek at Whiskey Creek, river mile 1.8 (T11)
- Willow Creek at USGS Gage 2465, river mile 0.37 (T12)

Table 2.1-1 presents a list of the sampling locations and the rationale for their selection. The spatial locations of the sampling sites are presented in Figure 2.1-1.

In addition to the twelve stream temperature monitoring stations, water temperature profiles were collected on a monthly basis (May-October 2005) from Bass Lake from one location near the outlet structure.

An additional water temperature monitoring station will be added below the confluence of the NFWC and the SFWC after the Licensee makes the necessary modifications to the current facilities to release water into this area.

### 2.2 Water Temperature

Stream temperatures were automatically measured *in situ* at 20-minute intervals from May 1 through October 31, 2005 using VEMCO MiniLog 12 TR digital thermographs at the 12 water temperature stations to determine daily maximum, minimum, and average water temperatures. Redundant temperature recorders were installed at all stations to reduce the risk of loss of water temperature data due to recorder malfunction or due to periods of low flow which leave the recorders out of water. The MiniLog 12 TR is a miniature microprocessor controlled temperature logger that stores data in non-volatile memory. The

MiniLog 12 TR has an accuracy of ±0.1°C between 5 and 40°C. Data were downloaded to a laboratory computer and stored to disk at bi-weekly intervals.

Redundant temperature recorders were deployed at each station in protective metal housings that were fixed to the stream bank using a metal chain to minimize the potential for theft and vandalism. Each temperature recorder was deployed in an accessible portion of the stream that is thermally homogenous and representative.

In addition to the 12 stream water temperature stations, water temperature profiles were collected on a monthly basis using a TSK MICOM Bathythermograph (BT). The BT is a microprocessor-controlled depth and temperature logger with an accuracy of approximately ±0.1°C between -2 and 38°C. Data were downloaded and stored to disk in the field. The location of the reservoir sampling site was recorded using GPS.

### 2.3 Stream Flow

In addition to water quality, stream flow was measured continuously at twenty (20) existing PG&E maintained and two U.S. Geological Survey (USGS) maintained locations during the monitoring program. A complete list of the stream flow monitoring stations is listed below. Spatial locations of the stream flow monitoring stations is presented in Figure 2.3-1.

- North Fork Willow Creek near Sugar Pine (W24), USGS maintained location
- Browns Creek Diversion Dam Spill (W22)
- Browns Creek Canal at Bass Lake (W1)
- Bass Lake Storage (W2)
- Crane Valley Powerhouse (W19)
- North Fork Willow Creek near Bass Lake (W3)
- Conduit #3 Near Bass Lake (W4)
- San Joaquin #3 Powerhouse (W6)
- Manzanita Lake Spill (W8)
- #2 Conduit (W9)
- San Joaquin Powerhouse #2 (W11)
- South Fork Willow Creek Canal above North Fork Willow Creek (W12)
- Spill over North Fork Diversion Dam (W15)
- Spill over South Fork Diversion Dam (W13)
- Willow Creek Diversion to #1 Conduit (W14)
- #1 Conduit Spillway at San Joaquin #2 Powerhouse (W27)
- Willow Creek below Confluence of North and South Forks (W26)
- Willow Creek at Mouth (USGS- Southern California Edison (SCE) gage 2465)

- #1 Conduit below Bass Lake (W25)
- San Joaquin #1A Powerhouse (W16)
- Corrine Lake Storage (W17)
- A. G. Wishon Powerhouse (W18)

All stream flow data is presented as daily average flow data in cubic feet per second (cfs) and storage data are presented in thousand acre feet (TAF).

### 2.4 Meteorological Stations

In order to collect data on ambient weather conditions during the sampling periods, two meteorological stations were monitored within the Project area. The meteorological stations were located near the Crane Valley Powerhouse (at an elevation of 3,400 ft) and at the A. G. Wishon Powerhouse (at an elevation of 990 ft). Date, time, and hourly average air temperatures were recorded at the meteorological stations. Relative humidity and solar radiation were also measured for model calibration. Daily average and daily maximum air temperatures are presented in Appendix C for both meteorological stations during the 2005 monitoring program period (May-October).

## 3 RESULTS

### 3.1 Water Temperature

Water temperature was measured at 20-minute intervals at twelve locations in the NFWC, SFWC, and mainstem Willow Creek from May 1 through October 31, 2005. Water temperature data are reported as daily averages, minimum, and maximum for all stations (Figures 3.2-1 to 3.2-12) and as daily average and daily maximum water temperature compared with daily maximum and average air temperature (Figures 3.2-13—3.2-24). The twenty-minute water temperature data is presented in Appendix A (on CD).

The data from the redundant temperature recorders were compared at each station using a T-test. Small differences were observed in a majority of the duplicate recorders. With the data sets from the redundant temperature recorders at many stations being consistent with each other one complete data set was chosen from each unique station and was used for the data analysis presented in this report. There were a few recorders (one or both redundant recorder(s) from select stations) that either malfunctioned or were out of the water for a period of time rendering the data incomplete and inaccurate at those stations. Water temperature data were discarded if the recorder was out of the water. In most cases, the data from the backup recorder was used to fill any gaps resulting from lost data when only one of the two recorders was out of the water or when a recorder malfunctioned. However, at times, both recorders (for stations T3, T6, T9, T10, T11, and T12) were subject to data loss (out of the water, recorder malfunction, limited site access, and vandalism) during the same period, therefore no water temperature data are available during those periods of time.

The monthly average, minimum and maximum water temperatures measured during the monitoring period are presented in Table 3.2-1. The monthly statistics are based on daily average data, and represent the maximum, minimum, and mean of the daily average water temperatures recorded in each month. The daily average water temperature data are based on hourly average water temperatures recorded during each day.

In general, water temperature increased as the water moved downstream. The highest monthly average water temperatures observed during the monitoring program during the summer were measured at the most downstream station on Willow Creek, at river mile 0.37 at U. S. Geological Survey (USGS) gage 2465 (station T12) (Figure 3.2-13).

Water temperatures observed at stations T7 and T8, on the SFWC upstream and downstream of the Browns Diversion Dam were similar to each other, respectively (Figures 3.2-14 and 3.2-15, respectively).

Water temperatures of water released through Crane Valley Powerhouse (T1) show a distinct decrease in temperatures of approximately 4°C during a scheduled outage for maintenance activities from July 10 to

August 18 (Figure 3.2-4). Conversely, water temperatures in NFWC at stations T2 and T3 below Bass Lake and above Manzanita Lake show an increase in water temperatures during the scheduled outage (Figures 3.2-5 and 3.2-6, respectively). Water temperatures downstream of Manzanita Lake (stations T4, T5, and T6) show increased water temperatures during the scheduled outage (July 10 to August 18). It appears that the water released from Manzanita Lake is warmer during the outage providing an increase in water temperature at stations T4 and T5 on average of 10-11°C (Figures 3.2-7 and 3.2-8, respectively).

Water temperatures measured in the NFWC, river mile 0.25 upstream of the NFWC Diversion Dam (T6), were slightly elevated compared to water temperatures measured at the SFWC, river mile 0.1 upstream of the SFWC Diversion Dam (T9) (Figures 3.2-9 and 3.2-10, respectively). Stations T10 and T11 showed similar trends in water temperature during the monitoring program with the warmest temperatures in July and August (corresponding to the scheduled outage) (Figures 3.2-11 and 3.2-12, respectively). Daily average water temperatures at stations T10 and T11 differed by approximately 1°C or less (Table 3.2-1). The earliest date that water temperature recorders could be installed at station T11 was May 18 due to limited access to private property (permission was not received from the landowner until after May 1).

Mean daily average water temperatures were above 20°C at stations T2 (August), T3 (July and August), T5 (July), T6 (August), T10 (July and August), T11 (July and August), and T12 (July, August, and September) (Table 3.2-1). A scheduled outage for maintenance activities occurred from July 10 through August 18, which corresponds to the period time when temperatures were the highest at the stations listed above.

In addition to the stream water temperature data, water temperature profiles were collected from Bass Lake monthly during the monitoring program. Bass Lake temperature profiles are presented in Figure 3.2-1. Bass Lake was thermally stratified with a distinct thermocline during July, August, September, and October. A weak thermocline was present during May and June. Surface water temperatures were above 20°C in July, August, and September with the highest surface water temperatures recorded in July up to 28°C. Bottom waters (around 12 meters and lower) ranged from less than 10°C (May) to 16°C (October).

Comparison of previous temperature data (1984 and 1986-1992) collected on the SFWC below Browns Diversion, SFWC below the Forest Service Road, and NFWC below Bass Lake (Studley et al 1995) with the 2005 monitoring year data indicates similar trends in water temperatures at these locations from May through October. Water temperatures tend to warm in June and July with maximum water temperatures occurring in late July and early August. Water temperatures begin to decrease from mid-August through October.

### 3.2 Stream Flow

Flow or storage is monitored at twenty-two gage stations in the Project area. Data from all stations are presented as a summary of monthly average flows in Table 3.3-1. Only flow data for the period May 1 through October 31 are discussed in detail as the data pertains to the water temperature monitoring program. A discussion and available data are presented in Appendices B1 and B2. Plots of daily average flows are also presented in Appendix B2.

### 3.3 Discussion of Results

During the 2005 water temperature monitoring program some of the temperature recorders were found in very shallow water (T1, T2, T6, T8, T9, T10, and T11), were subject to vandalism (T3), or had malfunctioned (T7 [lost calibration] and T12 [battery died]) resulting in complete data loss for those time periods between servicing. Redundant recorders often provided sufficient backup for data during such events. However, in select instances (at stations T3, T6, T9, T10, T11, and T12) both recorders were subject to data loss. In future years attention will be paid to placement of the temperature recorders in the thalweg of the stream reach to ensure that data is not lost due to recorders ending up out of the water during changes in stream flow. Often, these recorders were moved to deeper pools upon inspection and servicing in the field. Therefore, it is important to place the recorders in an appropriate location each month they are serviced. Water temperature recorders are initially placed in the stream during high flow conditions (May); placement of the recorders needs to be adjusted as stream flows attenuate through the remainder of the year to ensure that the recorders will be under water.

Additionally, it is recommended that *in situ* water temperature be measured during each field visit using a hand-held electronic temperature instrument. This *in situ* measurement will provide additional information that can be used to determine whether a specific temperature recorder may be malfunctioning and will prevent its use in future monitoring until any problems are resolved.

Currently, the monitoring program provides an indication of the blended temperature at the confluence of Whiskey and Willow creeks. An additional water temperature recorder could be placed in Whiskey Creek so that late summer benefits of that unimpeded stream on the lower section of Willow Creek can be monitored. There also seems to be a thermal influence in mid summer due to the scheduled outage. Manzanita Lake appears to heat up and provide warmer water further down stream during the outage. It may be desirable in the future for any planned outages to occur at a different time or for more water to be routed through the bypass reaches during the outages. A majority of the warmest temperatures recorded during the monitoring program occurred during the scheduled outage. Many stations returned to cooler temperatures upon completion of the outage, and this is most evident at stations T4 and T5 (Figures 3.2-4 and 3.2-5).

## 4 REFERENCES

Federal Energy Regulatory Commission (FERC) 2002. *Supplemental Environmental Assessment for Hydropower License, Crane Valley Project, FERC No. 1354.*

FERC 2003. *Pacific Gas and Electric Company Project No. 1354-005, Order Issuing New License*.

FERC 2005. *Pacific Gas and Electric Company Project No. 1354-041, Order Approving Water Temperature Monitoring Plan*, January 18.

Pacific Gas and Electric Company (PG&E) 2002. *Crane Valley Hydroelectric Project (FERC No. 1354), Amended Application for New License*. PG&E. San Francisco, California.

PG&E 2004. *Crane Valley Project, FERC No. 1354, Article 405 and Condition No. 5, Water Temperature Monitoring Plan*. PG&E. San Ramon, California.

Studley et al., 1995. *Response of Fish Populations to Altered Flows Project, Volume 1: Predicting Trout Populations from Streamflow and Habitat Variables*. PG&E. San Ramon, California.

**Table 2.1-1 Sample locations and the rationale for selection**

| Station ID | Station Location | Monitoring Activity | Rationale |
|---|---|---|---|
| Profiles | Bass Lake | TP | Determine temperature changes in the water column of Bass Lake |
| Meteorology | Crane Valley Powerhouse | Met | Characterize ambient conditions within the Project near Crane Valley PH |
| T1 | NFWC downstream of Bass Lake at the Crane Valley PH Tailrace | TR | Determine temperature of water released through Crane Valley PH |
| T2 | NFWC River Mile 7.13, below Bass Lake | TR | Determine stream temperature at the start of the stream reach |
| T3 | NFWC River Mile 4.39, upstream of Manzanita Lake | TR | Determine stream temperature entering a Project reservoir |
| T4 | Manzanita Lake at the Project Diversion | TR | Determine the temperature of water in Manzanita Lake |
| T5 | NFWC River Mile 3.00, downstream of Manzanita Lake | TR | Determine temperature of water released from Manzanita Lake |
| T6 | NFWC River Mile 0.25, upstream of the NFWC Diversion Dam | TR | Determine water temperature of stream above Project diversion |
| T7 | SFWC River Mile 6.59, upstream of Browns Creek Diversion Dam | TR | Determine water temperature of stream above Project diversion |
| T8 | SFWC River Mile 6.5, downstream of the Browns Creek Diversion Dam | TR | Determine water temperature of stream below Project diversion at the start of the stream reach |
| T9 | SFWC River Mile 0.1, upstream of the SFWC Diversion Dam | TR | Determine water temperature of stream above Project diversion |
| T10 | Willow Creek River Mile 4.3, at Gage W-26 | TR | Determine water temperature below the confluence of NFWC and SFWC |
| T11 | Willow Creek River Mile 1.80, at the mouth of Whiskey Creek | TR | Determine water temperature at the confluence of a major tributary |
| T12 | Willow Creek River Mile 0.37, at USGS Gage 2465 | TR | Determine water temperature at the end of the Project Reach |
| Meteorology | A.G. Whishon Powerhouse | Met | Characterize ambient conditions within the Project near A.G. Wishon PH |

NFWC = North Fork Willow Creek     SFWC = South Fork Willow Creek

Activity Key: TR = temperature recorder; Met = meteorological station; TP = temperature profiles

Table 3.2-1 Monthly average, minimum daily average, and maximum daily average water temperatures observed during the monitoring program (5/1/2005 – 10/31/2005) by station

| Station ID | Station Location | Month during 2005 | Data Days | Water Temperature (°C) Min | Mean | Max |
|---|---|---|---|---|---|---|
| **T1** | NFWC d/s of Bass Lake at the Crane Valley PH Tailrace | May | 31 | 8.4 | 9 | 9.7 |
| | | June | 30 | 9.8 | 10.5 | 11.5 |
| | | July | 31 | 8 | 9.1 | 12 |
| | | August | 31 | 8.1 | 10.3 | 13.2 |
| | | September | 30 | 13.1 | 14 | 15.7 |
| | | October | 31 | 15.4 | 16.3 | 17 |
| **T2** | NFWC River Mile 7.13, below Bass Lake | May | 31 | 9 | 13.9 | 20.2 |
| | | June | 30 | 11.7 | 13.6 | 15.7 |
| | | July | 31 | 12.7 | 19.9 | 27.1 |
| | | August | 31 | 18.5 | 21.8 | 25.2 |
| | | September | 30 | 15.4 | 17 | 20.3 |
| | | October | 31 | 14..2 | 15.1 | 15.8 |
| **T3** | NFWC River Mile 4.39, u/s of Manzanita Lake | May | 31 | 9.6 | 14.1 | 20.1 |
| | | June | 30 | 12.6 | 14.1 | 16.2 |
| | | July | 31 | 13.7 | 20.7 | 26.8 |
| | | August | 31 | 18.9 | 21.8 | 24.3 |
| | | September | 30 | 14.8 | 16.2 | 18.7 |
| | | October | 31 | 11.8 | 13.1 | 15.7 |
| **T4** | Manzanita Lake at the Project Diversion | May | 31 | 9.2 | 12.6 | 17.6 |
| | | June | 30 | 11.8 | 12.9 | 13.5 |
| | | July | 31 | 12.9 | 18.8 | 25.1 |
| | | August | 31 | 13.6 | 18.7 | 23.5 |
| | | September | 30 | 14 | 14.7 | 16.2 |
| | | October | 31 | 15.3 | 16.3 | 17 |
| **T5** | NFWC River Mile 3.00, d/s of Manzanita Lake | May | 31 | 9.2 | 12.6 | 17.6 |
| | | June | 30 | 11.9 | 13 | 13.7 |
| | | July | 31 | 13.8 | 21.7 | 27 |
| | | August | 31 | 14.1 | 19.7 | 25 |
| | | September | 30 | 14.3 | 15 | 16.3 |
| | | October | 31 | 15.3 | 16.2 | 16.9 |
| **T6** | NFWC River Mile 0.25, u/s of the NFWC Diversion Dam | May | 31 | 8 | 12.6 | 17.7 |
| | | June | 29 | 11.3 | 13.9 | 16.2 |
| | | July | 17 | 16.2 | 19.8 | 24.1 |
| | | August | 31 | 18.1 | 21.5 | 24.5 |
| | | September | 30 | 13.7 | 15.3 | 17.9 |
| | | October | 31 | 10.9 | 12.4 | 15.2 |

Table 3.2-1 Continued

| Station ID | Station Location | Month during 2005 | Data Days | Water Temperature (°C) Min | Mean | Max |
|---|---|---|---|---|---|---|
| **T7** | SFWC River Mile 6.59, u/s of the Browns Creek Diversion Dam | May | 31 | 4.8 | 7.7 | 10.1 |
| | | June | 30 | 7.7 | 10.7 | 13.8 |
| | | July | 31 | 14 | 16.3 | 18.3 |
| | | August | 31 | 14.5 | 15.8 | 17.7 |
| | | September | 30 | 10.9 | 12.5 | 14.7 |
| | | October | 31 | 8.8 | 10.1 | 12.5 |
| **T8** | SFWC River Mile 6.5, d/s of the Browns Creek Diversion Dam | May | 31 | 4.8 | 7.8 | 10.2 |
| | | June | 27 | 7.7 | 10.4 | 12.3 |
| | | July | 28 | 14.8 | 16.5 | 18.3 |
| | | August | 31 | 14.7 | 15.8 | 17.5 |
| | | September | 30 | 10.8 | 12.5 | 14.6 |
| | | October | 31 | 8.7 | 10 | 12.5 |
| **T9** | SFWC River Mile 0.1, u/s of the SFWC Diversion Dam | May | 31 | 6.2 | 9.5 | 12.1 |
| | | June | 27 | 10.2 | 13.2 | 16.7 |
| | | July | 17 | 14.1 | 18.7 | 20.6 |
| | | August | 31 | 17.8 | 18.9 | 20.7 |
| | | September | 30 | 13.5 | 15.1 | 17.6 |
| | | October | 31 | 10.5 | 12 | 15 |
| **T10** | Willow Creek River Mile 4.3, at Gage W-26 | May | 31 | 7 | 10.9 | 14.7 |
| | | June | 30 | 11 | 14.2 | 19.5 |
| | | July | 31 | 17.9 | 21.6 | 25 |
| | | August | 31 | 19.5 | 21.3 | 23.5 |
| | | September | 30 | 15.7 | 17.6 | 20.7 |
| | | October | 31 | 12.3 | 13.6 | 17.6 |
| **T11** | Willow Creek River Mile 1.80, at the mouth of Whiskey Creek | May | 14 | 10.1 | 11.7 | 13.5 |
| | | June | 30 | 9.1 | 14 | 18.8 |
| | | July | 31 | 19.1 | 22.1 | 25 |
| | | August | 31 | 19.7 | 21.5 | 23.8 |
| | | September | 30 | 15.2 | 16.9 | 19.6 |
| | | October | 31 | 11.8 | 13.8 | 16.3 |
| **T12** | Willow Creek River Mile 0.37, at USGS Gage 2465 | May | 31 | 8.8 | 12.1 | 15.8 |
| | | June | 30 | 12 | 15.5 | 19.5 |
| | | July | 31 | 19.9 | 22.5 | 25.2 |
| | | August | 31 | 21 | 22.1 | 24.1 |
| | | September | 8 | 19.2 | 20.2 | 21.1 |
| | | October | 28 | 12.8 | 14.5 | 15.6 |

Monthly values are based on daily average data, and represent the maximum, minimum, and mean of the daily average water temperatures recorded in each month. The daily average is based on hourly average water temperatures recorded during each day.

**Table 3.3-1 Summary of 2005 stream flow (cfs) monitoring and reservoir storage (TAF) at Pacific Gas and Electric Company (PG&E) and USGS Maintained Stations.**

| Station | Month | Data Days | Daily Average Flow (cfs) or Storage (TAF) min | mean | max |
|---|---|---|---|---|---|
| **USGS Gage W24** North Fork Willow Creek near Sugar Pine (data provided by Madera Irrigation District [MID]) | May | 31 | 84 | | 390 |
| | June | 30 | 79 | | 214 |
| | July | 31 | 15 | | 77 |
| | August | 31 | 6.7 | | 15 |
| | September | 30 | 4.8 | | 9.6 |
| | October | 31 | 4.2 | | 9.4 |
| **W22** Browns Creek Diversion Dam Spill | May | 31 | 36 | 294.8 | 779 |
| | June | 30 | 0 | 107.8 | 254 |
| | July | 31 | 0 | 0 | 0 |
| | August | 31 | 0 | 1 | 16 |
| | September | 30 | 10 | 13.6 | 18 |
| | October | 31 | 0 | 13.7 | 20 |
| **W1** Browns Creek Canal at Bass Lake | May | 31 | 0 | 31.2 | 63.3 |
| | June | 30 | 0 | 28.7 | 70.6 |
| | July | 31 | 0 | 16.6 | 47.1 |
| | August | 31 | 0 | 0.6 | 4.9 |
| | September | 30 | 0 | 0 | 0 |
| | October | 31 | 0 | 0 | 0 |
| **W2** Bass Lake Storage (TAF) | May | 31 | 36.9 | 40.8 | 42.5 |
| | June | 30 | 42.7 | 44.2 | 44.9 |
| | July | 31 | 44.5 | 44.9 | 45.2 |
| | August | 31 | 41.3 | 43.8 | 45.1 |
| | September | 30 | 35.3 | 38.2 | 41.2 |
| | October | 31 | 28.2 | 31.7 | 35.2 |
| **W19** Crane Valley Powerhouse | May | 31 | 84.6 | 140.4 | 148.5 |
| | June | 30 | 109 | 143.9 | 148.7 |
| | July | 31 | 0 | 30.6 | 149.0 |
| | August | 31 | 0 | 54.8 | 149.2 |
| | September | 30 | 98.8 | 110.4 | 117.4 |
| | October | 31 | 105.3 | 127.2 | 138.8 |
| **W3** North Fork Willow Creek near Bass Lake | May | 31 | 20.8 | 174.2 | 424.8 |
| | June | 30 | 18.8 | 77.9 | 106.2 |
| | July | 31 | 7 | 28.7 | 65.3 |
| | August | 31 | 2.3 | 17.7 | 43.9 |
| | September | 30 | 2 | 2.2 | 2.6 |
| | October | 31 | 2 | 2 | 2 |

**Table 3.3-1 Continued**

| Station | Month | Data Days | Daily Average Flow (cfs) or Storage (TAF) min | mean | max |
|---|---|---|---|---|---|
| **W4** Conduit #3 near Bass Lake | May | 31 | 103.2 | 133.7 | 137 |
| | June | 30 | 115.4 | 121.3 | 131.5 |
| | July | 31 | 0.1 | 32.2 | 127.6 |
| | August | 31 | 0.1 | 62 | 144.8 |
| | September | 30 | 116 | 117.1 | 119.6 |
| | October | No data available for October | | | |
| **W6** San Joaquin #3 Powerhouse | May | 31 | 60.7 | 107.3 | 117.9 |
| | June | 30 | 84.2 | 94.9 | 111.6 |
| | July | 31 | 0 | 25.1 | 93.7 |
| | August | 31 | 0 | 43.9 | 120.1 |
| | September | 30 | 82.3 | 88.9 | 95.3 |
| | October | 31 | 84.2 | 105.2 | 128.6 |
| **W8** Manzanita Lake Spill | May | 31 | 0 | 123.8 | 388 |
| | June | 30 | 0 | 0 | 0 |
| | July | 31 | 0 | 0.7 | 8 |
| | August | 31 | 0 | 1.3 | 5 |
| | September | 30 | 0 | 0 | 0 |
| | October | 31 | 2 | 3.9 | 32 |
| **W9** #2 Conduit | May | 31 | 153 | 154.5 | 157 |
| | June | 30 | 101 | 150.4 | 155 |
| | July | 31 | 0 | 35.2 | 151 |
| | August | 31 | 0 | 64.5 | 158 |
| | September | 30 | 107 | 120.2 | 123 |
| | October | 31 | 108 | 141.1 | 153 |
| **W11** San Joaquin Powerhouse #2 | May | 31 | 72.4 | 136.5 | 148.6 |
| | June | 30 | 105.2 | 134.1 | 157.5 |
| | July | 31 | 0 | 31.8 | 133.7 |
| | August | 31 | 0 | 53.6 | 133.7 |
| | September | 30 | 93.7 | 102.1 | 108.7 |
| | October | 31 | 90.3 | 117.9 | 130.1 |

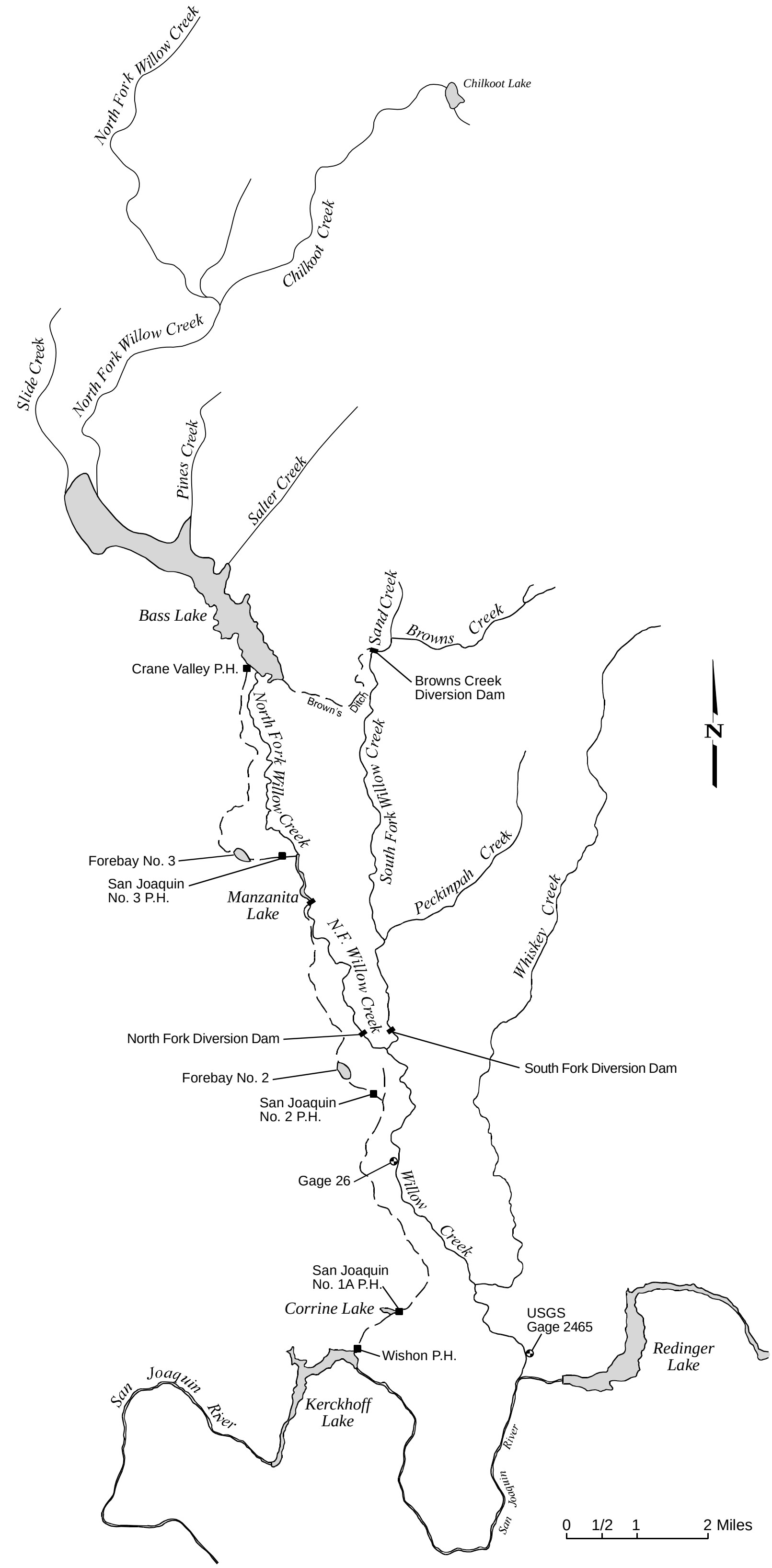
**Table 3.3-1 Continued**

| Station | Month | Data Days | Daily Average Flow (cfs) or Storage (TAF) min | mean | max |
|---|---|---|---|---|---|
| **W12** South Fork Willow Creek Canal above North Fork Willow Creek | May | 31 | 0 | 41.3 | 86 |
| | June | 30 | 0 | 27.2 | 101 |
| | July | 31 | 0 | 2.6 | 12 |
| | August | 31 | 0 | 1.3 | 11 |
| | September | 30 | 0 | 0 | 0 |
| | October | 31 | 6 | 8.4 | 16 |
| **W15** Spill over North Fork Diversion Dam | May | 31 | 7.7 | 72.4 | 127 |
| | June | 30 | 0 | 7.7 | 51 |
| | July | 31 | 0 | 0 | 0 |
| | August | 31 | 0 | 0 | 0 |
| | September | 30 | 0 | 0 | 0 |
| | October | 31 | 0 | 0 | 0 |
| **W13** Spill over South Fork Diversion Dam | May | 31 | 33 | 194.8 | 865 |
| | June | 30 | 0 | 22.5 | 168 |
| | July | 31 | 0 | 0 | 0 |
| | August | 31 | 0 | 0 | 0 |
| | September | 30 | 0 | 0 | 0 |
| | October | 31 | 0 | 0 | 0 |
| **W14** Willow Creek Diversion to #1 Conduit | May | 31 | 40 | 87.5 | 95 |
| | June | 30 | 58 | 85.8 | 98 |
| | July | 31 | 37 | 76.5 | 109 |
| | August | 31 | 0 | 4.8 | 40 |
| | September | 30 | 0 | 2.8 | 13 |
| | October | 31 | 8 | 11.6 | 38 |
| **W27** #1 Conduit Spillway at San Joaquin #2 Powerhouse | May | 31 | 19 | 26.4 | 38 |
| | June | 30 | 0 | 19.5 | 52 |
| | July | 31 | 0 | 0 | 0 |
| | August | 31 | 0 | 0 | 0 |
| | September | 30 | 0 | 0 | 0 |
| | October | 31 | 0 | 0 | 0 |
| **W26** Willow Creek below Confluence of North and South Forks | May | 31 | 144.9 | 445.5 | 712.5 |
| | June | 30 | 2 | 129.8 | 295.7 |
| | July | 31 | 11.1 | 46.9 | 133.3 |
| | August | 31 | 0.5 | 31.8 | 76.1 |
| | September | 30 | 0.6 | 0.7 | 0.9 |
| | October | 31 | 0.5 | 2.2 | 26.5 |

**Table 3.3-1 Continued**

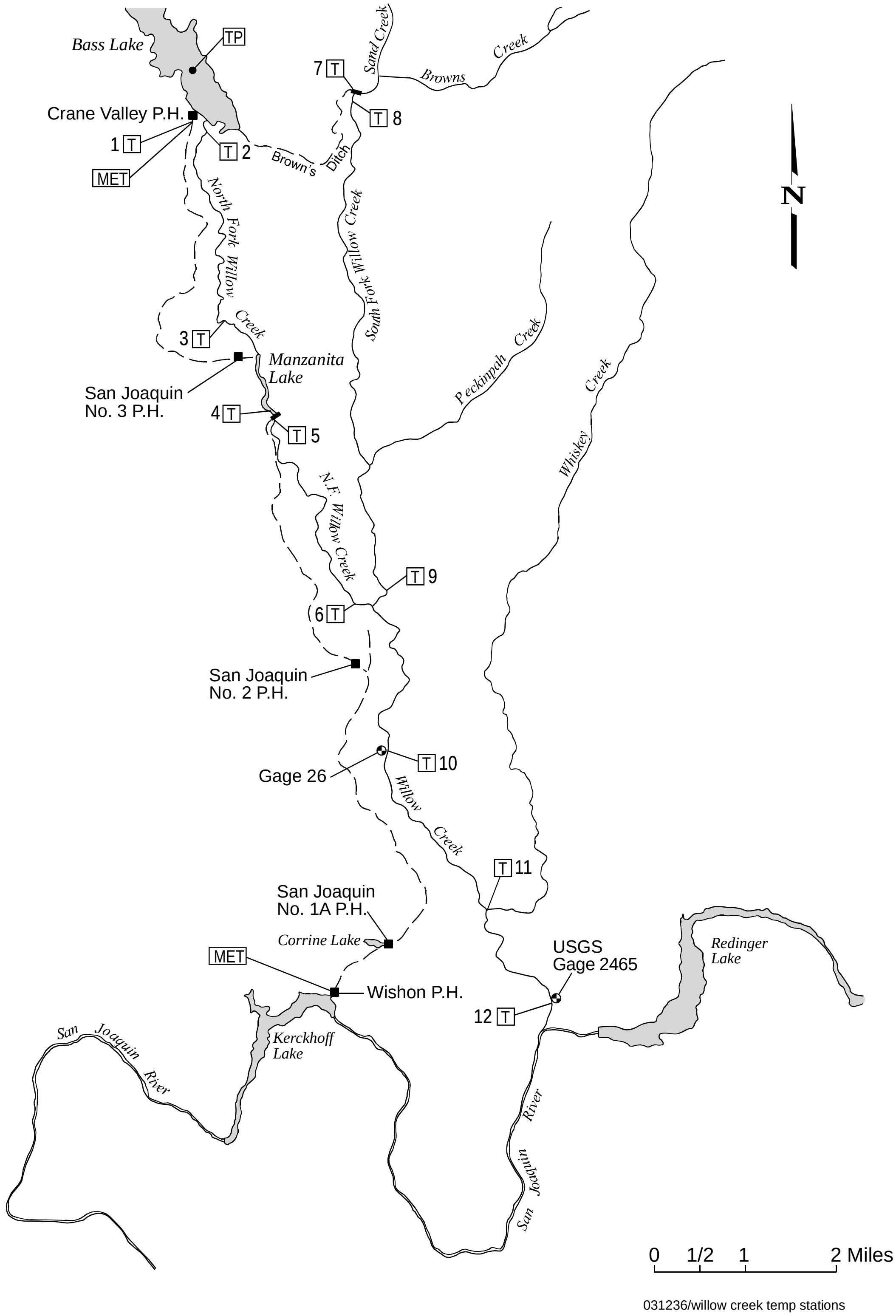
| Station | Month | Data Days | Daily Average Flow (cfs) or Storage (TAF) min | mean | max |
|---|---|---|---|---|---|
| **USGS Gage 2465** Willow Creek at Mouth (Southern California Edison [SCE] maintained) | May | 31 | 235 | 605.4 | 1080 |
| | June | 30 | 29 | 135.6 | 341 |
| | July | 31 | 16 | 48.6 | 109 |
| | August | 31 | 3 | 30.7 | 68 |
| | September | 30 | 1.9 | 2.9 | 3.7 |
| | October | 31 | 1.7 | 4 | 23 |
| **W25** #1 Conduit below Bass Lake | May | 31 | 143.5 | 195.6 | 201.7 |
| | June | 30 | 168.1 | 195.4 | 203.2 |
| | July | 31 | 0 | 41.2 | 176.5 |
| | August | 31 | 0 | 59.9 | 148.1 |
| | September | 30 | 116.9 | 119.6 | 124.3 |
| | October | 31 | 119 | 137.6 | 150 |
| **W16** San Joaquin #1A Powerhouse | May | 31 | 0 | 0 | 0 |
| | June | 30 | 0 | 0 | 0 |
| | July | 31 | 0 | 0 | 0 |
| | August | 31 | 0 | 0 | 0 |
| | September | 30 | 0 | 0 | 0 |
| | October | 31 | 0 | 0 | 0 |
| **W17** Corrine Lake Storage (TAF) | May | 31 | 0.034 | 0.043 | 0.051 |
| | June | 30 | 0.041 | 0.042 | 0.048 |
| | July | 31 | 0.037 | 0.05 | 0.063 |
| | August | 31 | 0.027 | 0.046 | 0.069 |
| | September | 30 | 0.048 | 0.051 | 0.057 |
| | October | 31 | 0.05 | 0.053 | 0.064 |
| **W18** A.G. Wishon Powerhouse | May | 31 | 118.3 | 188 | 212.9 |
| | June | 30 | 163.4 | 194.2 | 204.5 |
| | July | 31 | 0 | 40.7 | 182.5 |
| | August | 31 | 0 | 59.1 | 156 |
| | September | 30 | 115 | 121.1 | 133.6 |
| | October | 31 | 115 | 137 | 155.1 |

## Figure 1.1-1 Crane Valley Project area map




031236/crane valley project

**Figure 2.1-1 Spatial representation of water temperature sampling locations.**




T Temperature Monitoring Station

TP Reservoir Temperature Profile

MET Meteorological Station

**Figure 2.3-1 Spatial representation of stream flow monitoring stations.**

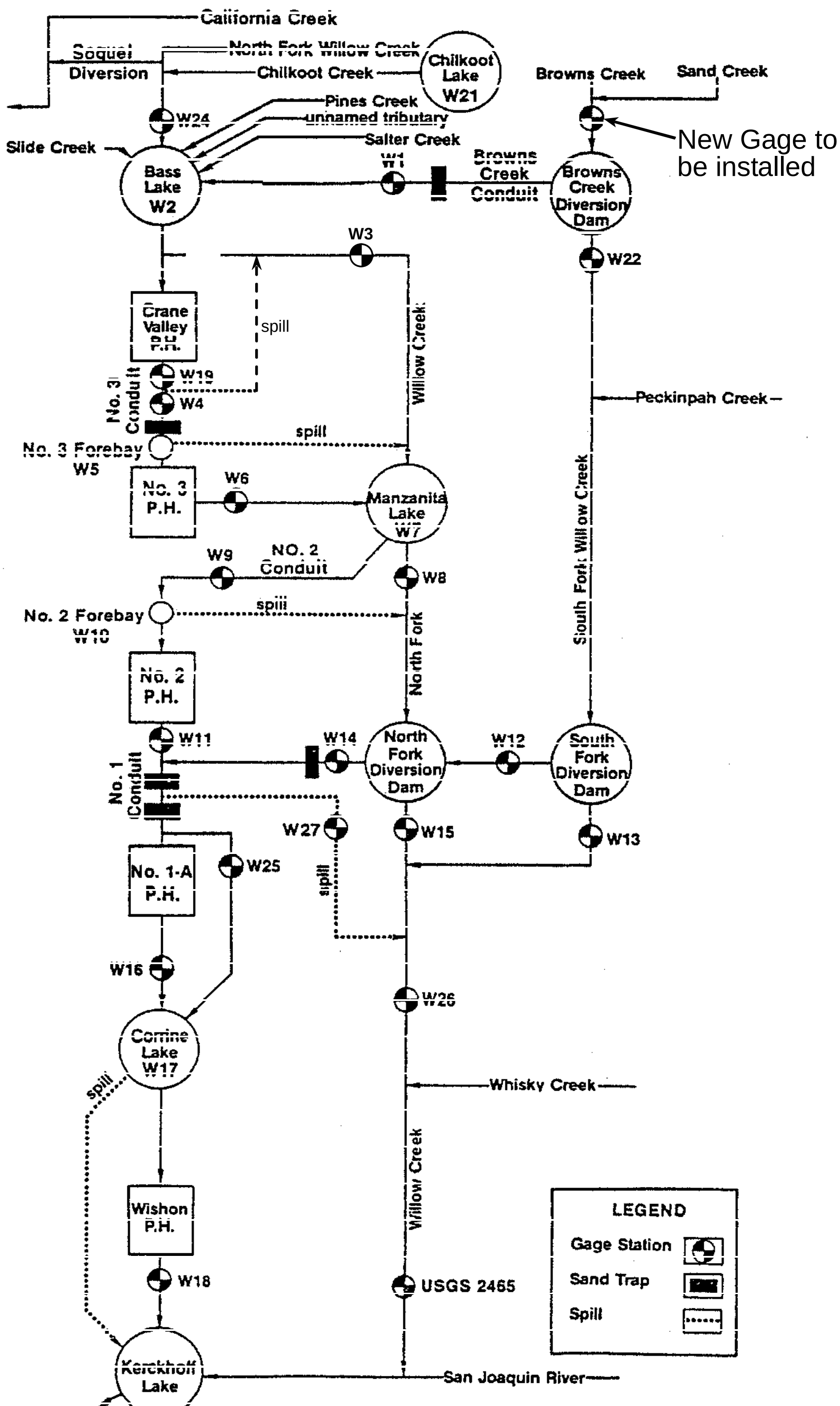


**Figure 3.2-1**
**Bass Lake Water Temperature Profiles, May through October 2005**

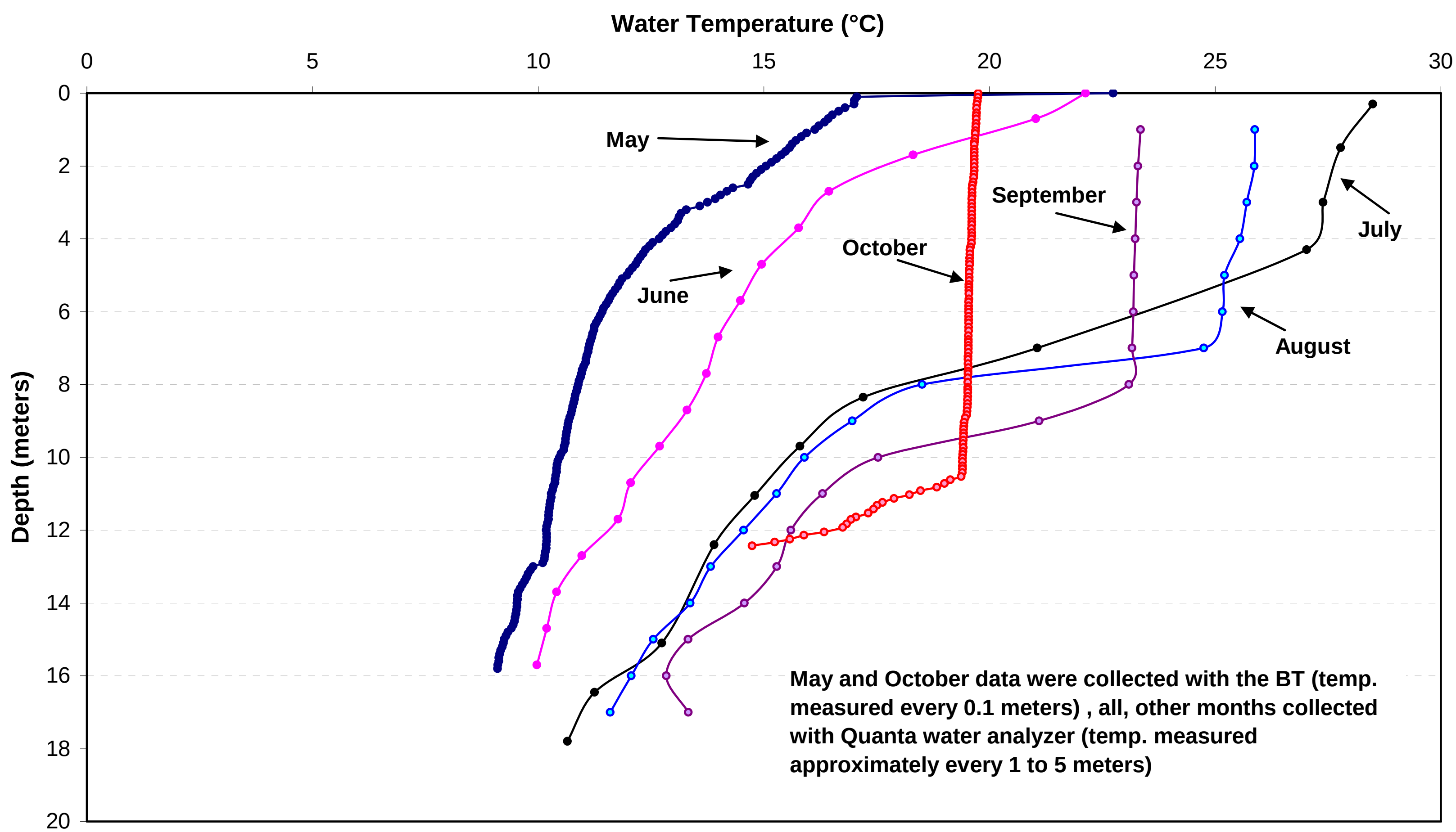


**Figure 3.2-2**
**Station T7, SFWC River Mile 6.59, upstream of the Browns Creek Diversion Dam**
**Daily Average, Minimum, and Maximum Water Temperatures (°C)**

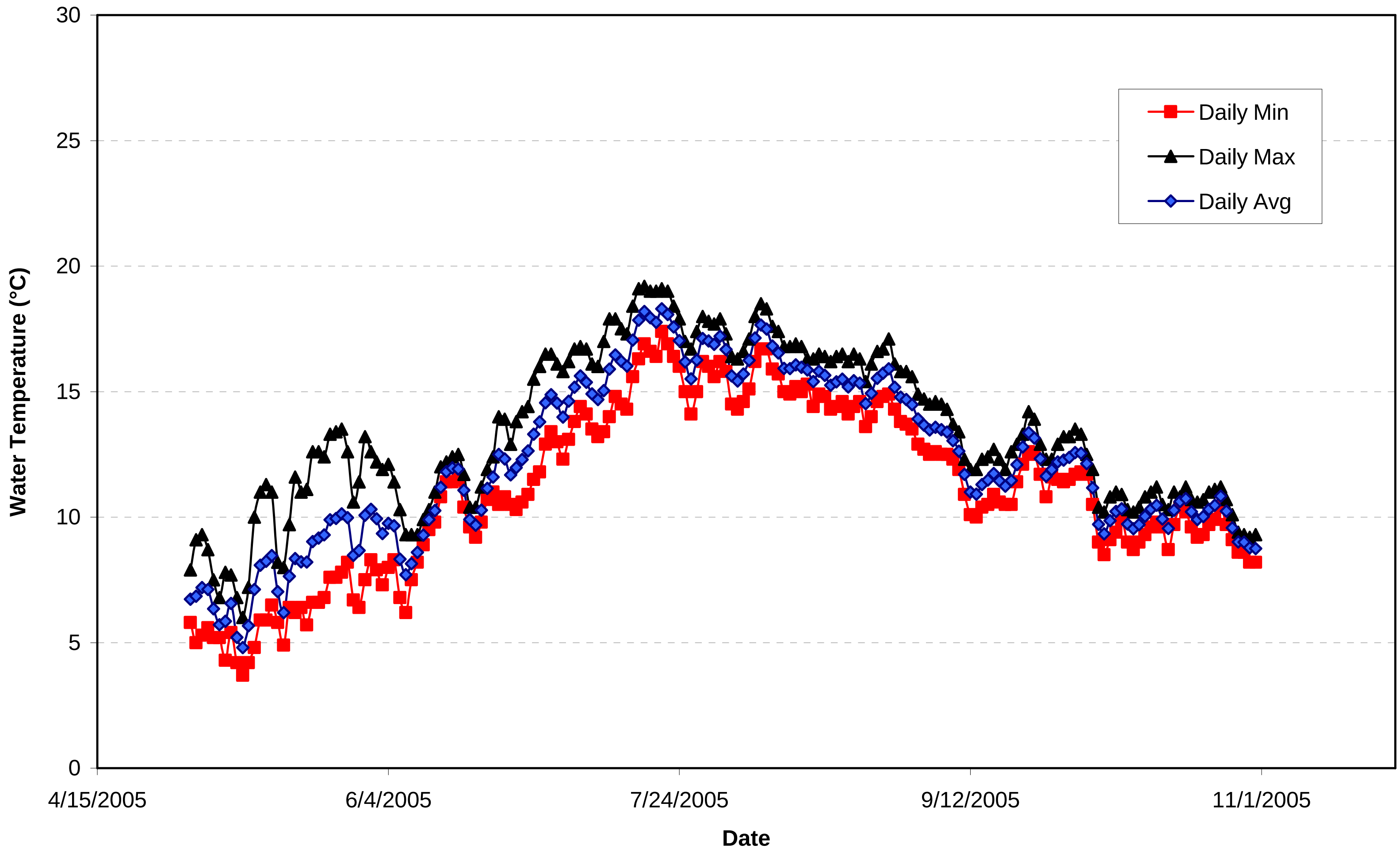


**Figure 3.2-3**
**Station T8, SFWC River Mile 6.5, downstream of the Browns Creek Diversion Dam**
**Daily Average, Minimum, and Maximum Water Temperatures (°C)**
**and streamflow at gage W22 (cfs)**

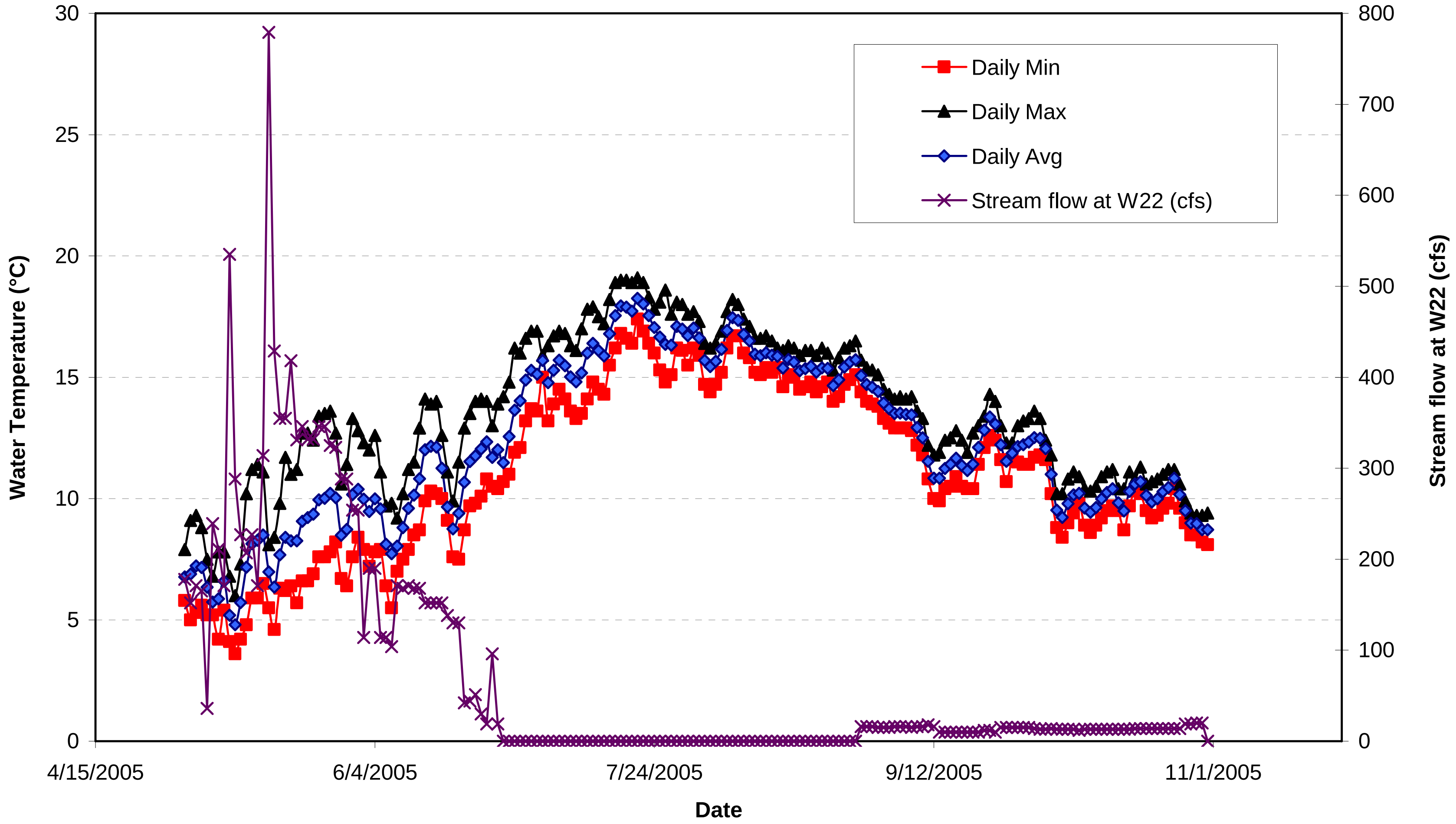


**Figure 3.2-4**
**Station T1, NFWC downstream of Bass Lake at the Crane Valley PH Tailrace**
**Daily Average, Minimum, and Maximum Water Temperatures (°C)**

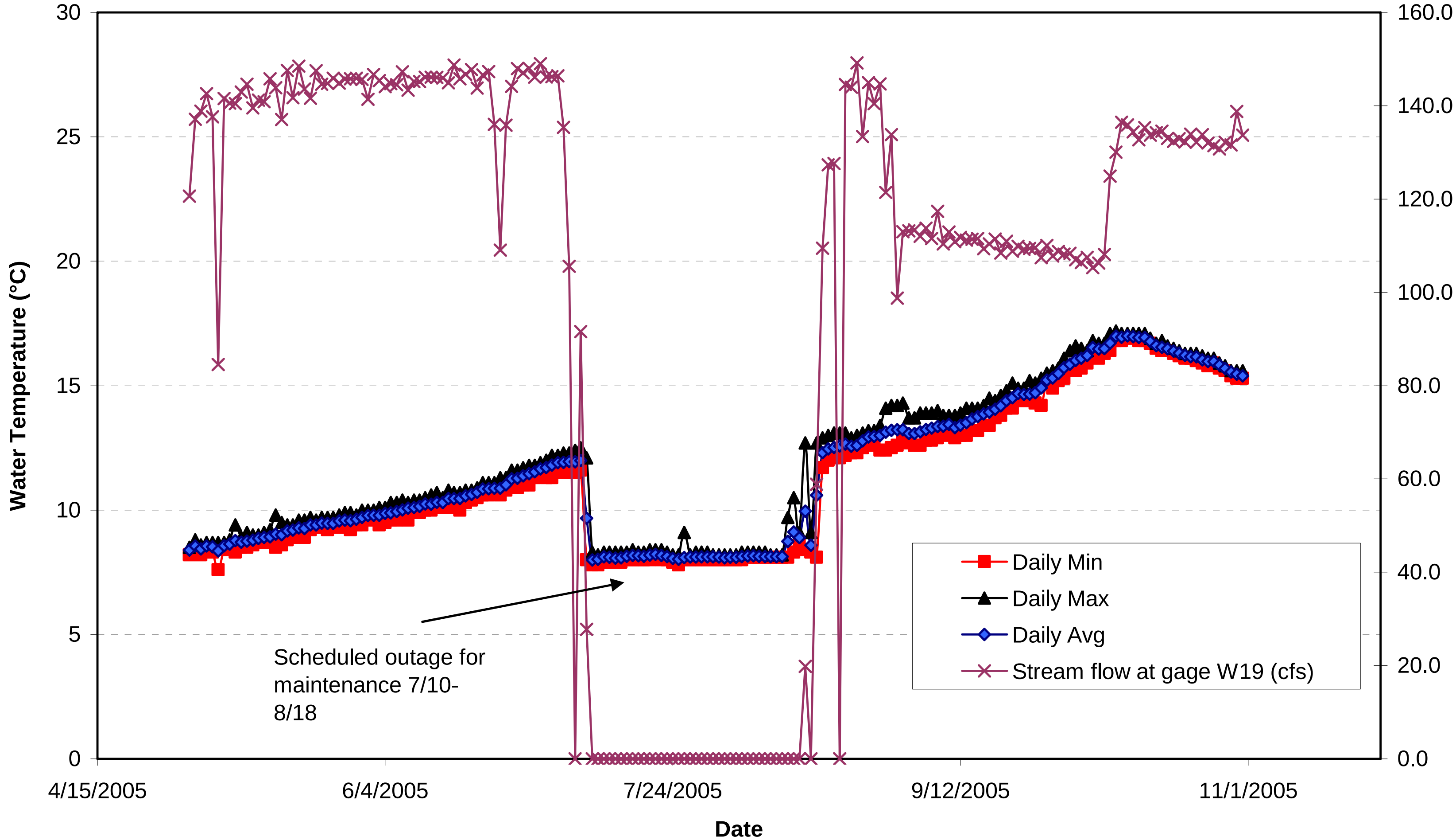


**Figure 3.2-5**
**Station T2, NFWC River Mile 7.13 below Bass Lake**
**Daily Average, Minimum, and Maximum Water Temperatures (°C) and stream flow at gage W3 (cfs)**

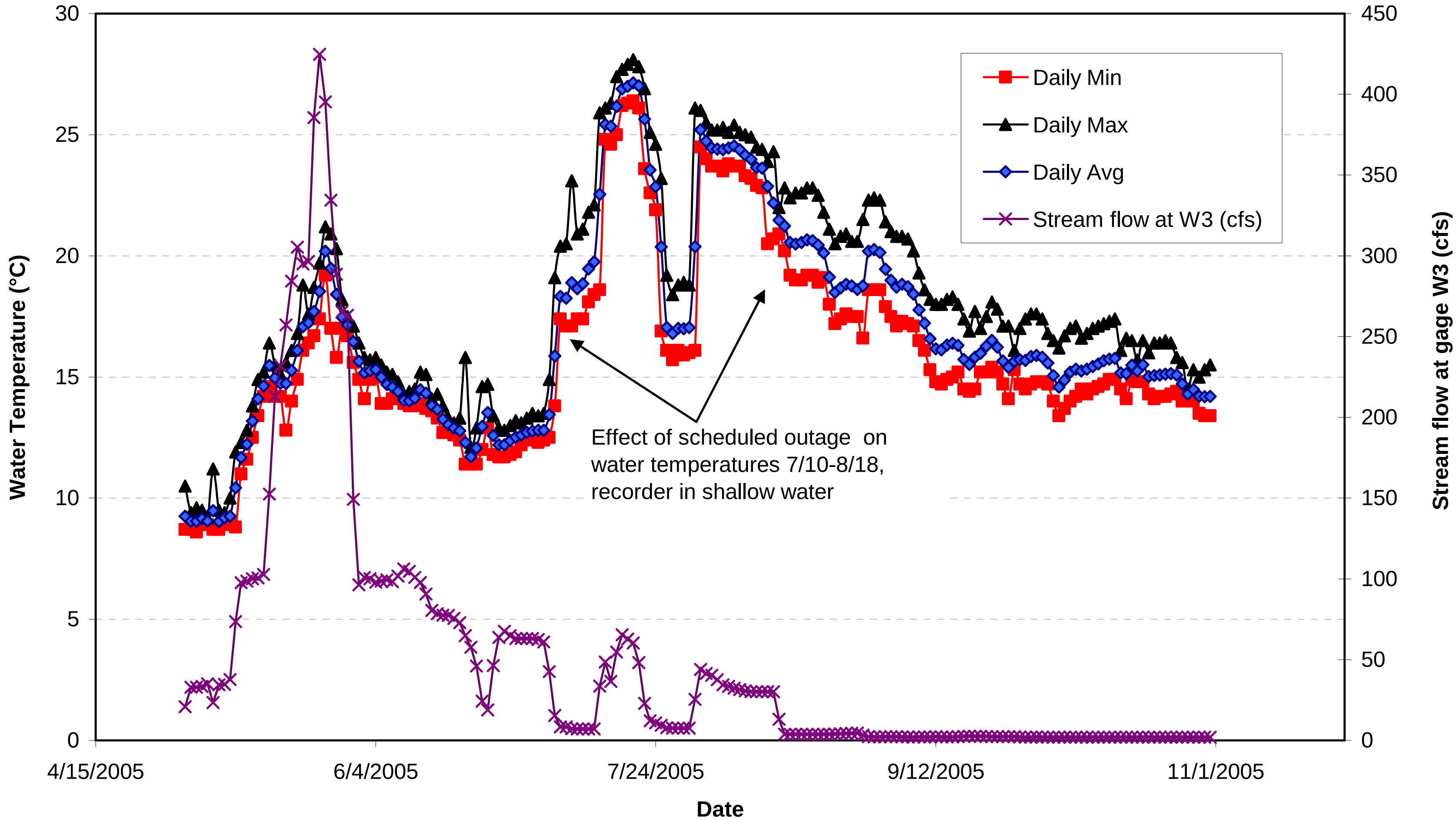


**Figure 3.2-6**
**Station T3, NFWC River Mile 4.39, upstream of Manzanita Lake**
**Daily Average, Minimum, and Maximum Water Temperatures (°C) and stream flow at gage W3 (cfs)**

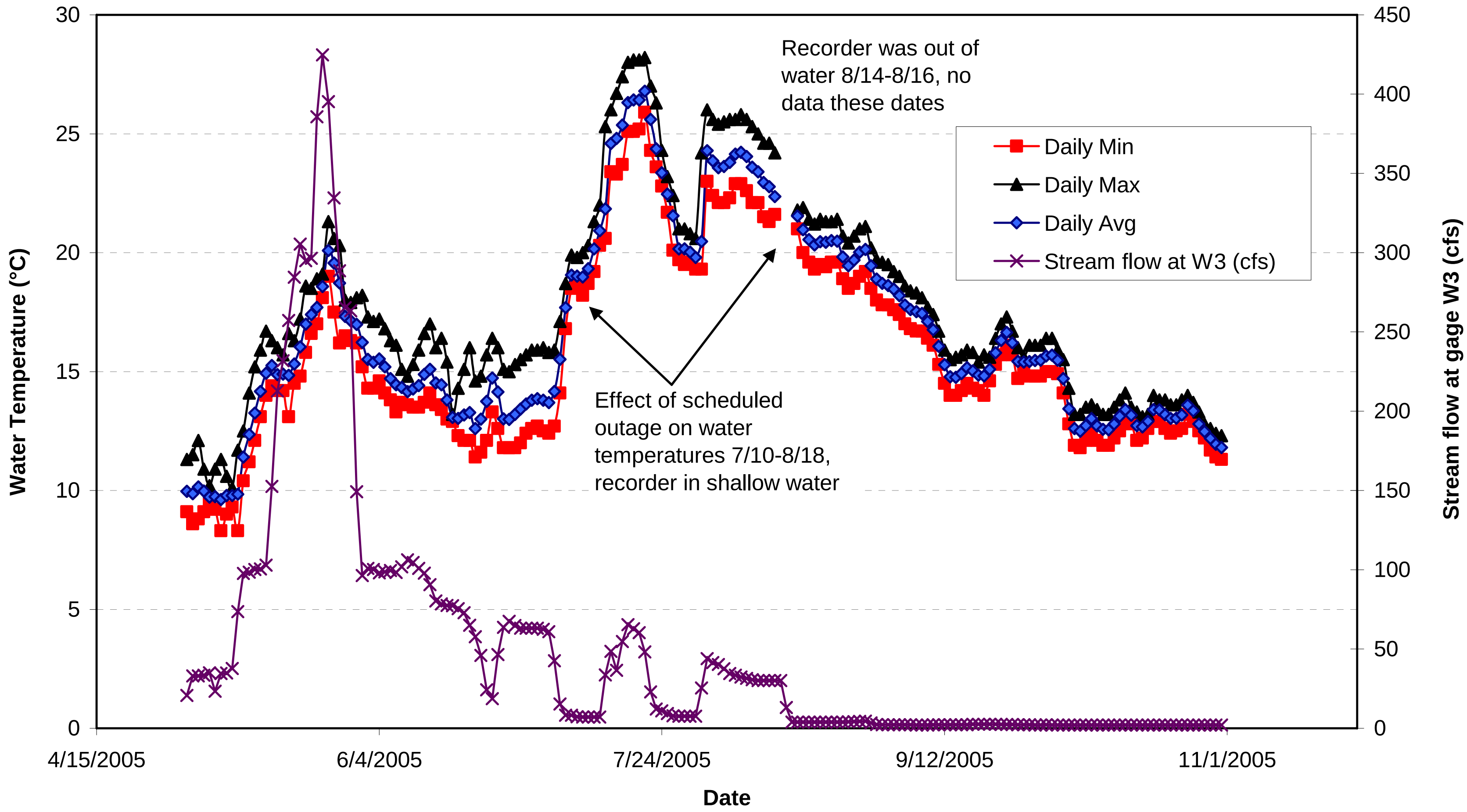


**Figure 3.2-7**
**Station T4, Manzanita Lake at the Project Diversion**
**Daily Average, Minimum, and Maximum Water Temperatures (°C)**

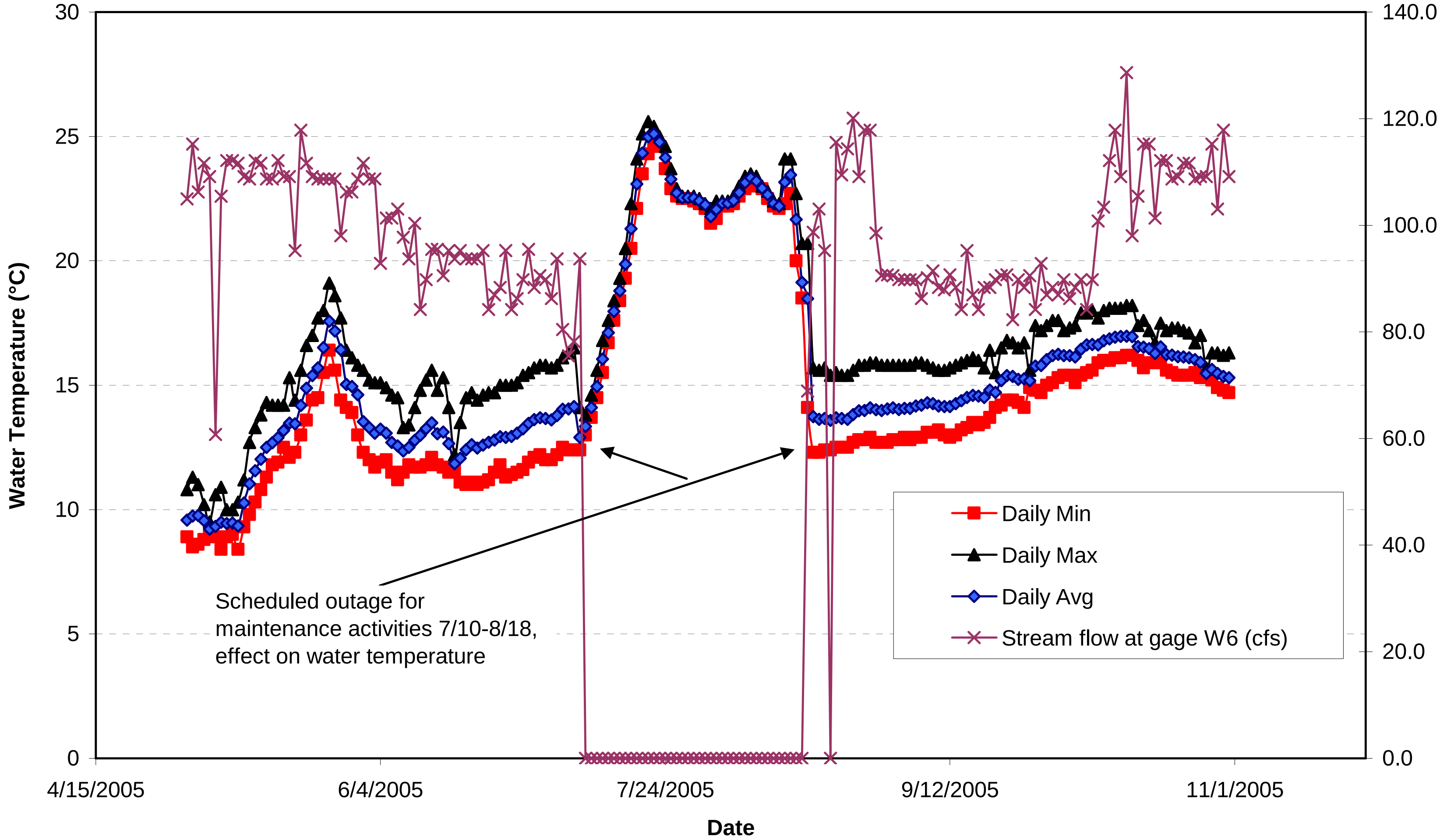


**Figure 3.2-8**
**Station T5, NFWC River Mile 3.00, downstream of Manzanita Lake**
**Daily Average, Minimum, and Maximum Water Temperatures (°C)**

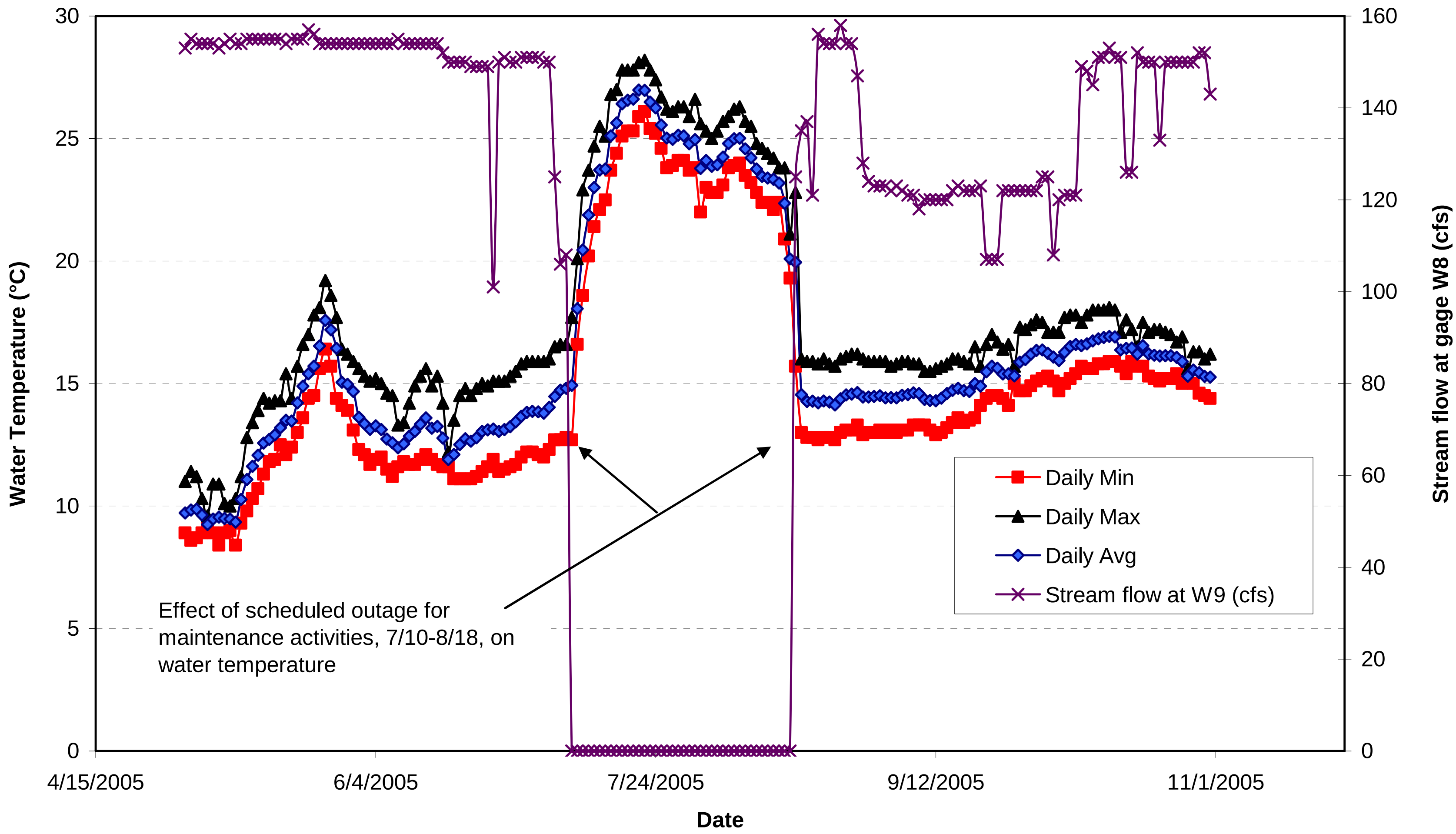


**Figure 3.2-9**
**Station T6, NFWC River Mile 0.25, upstream of the NFWC Diversion Dam**
**Daily Average, Minimum, and Maximum Water Temperatures (°C)**

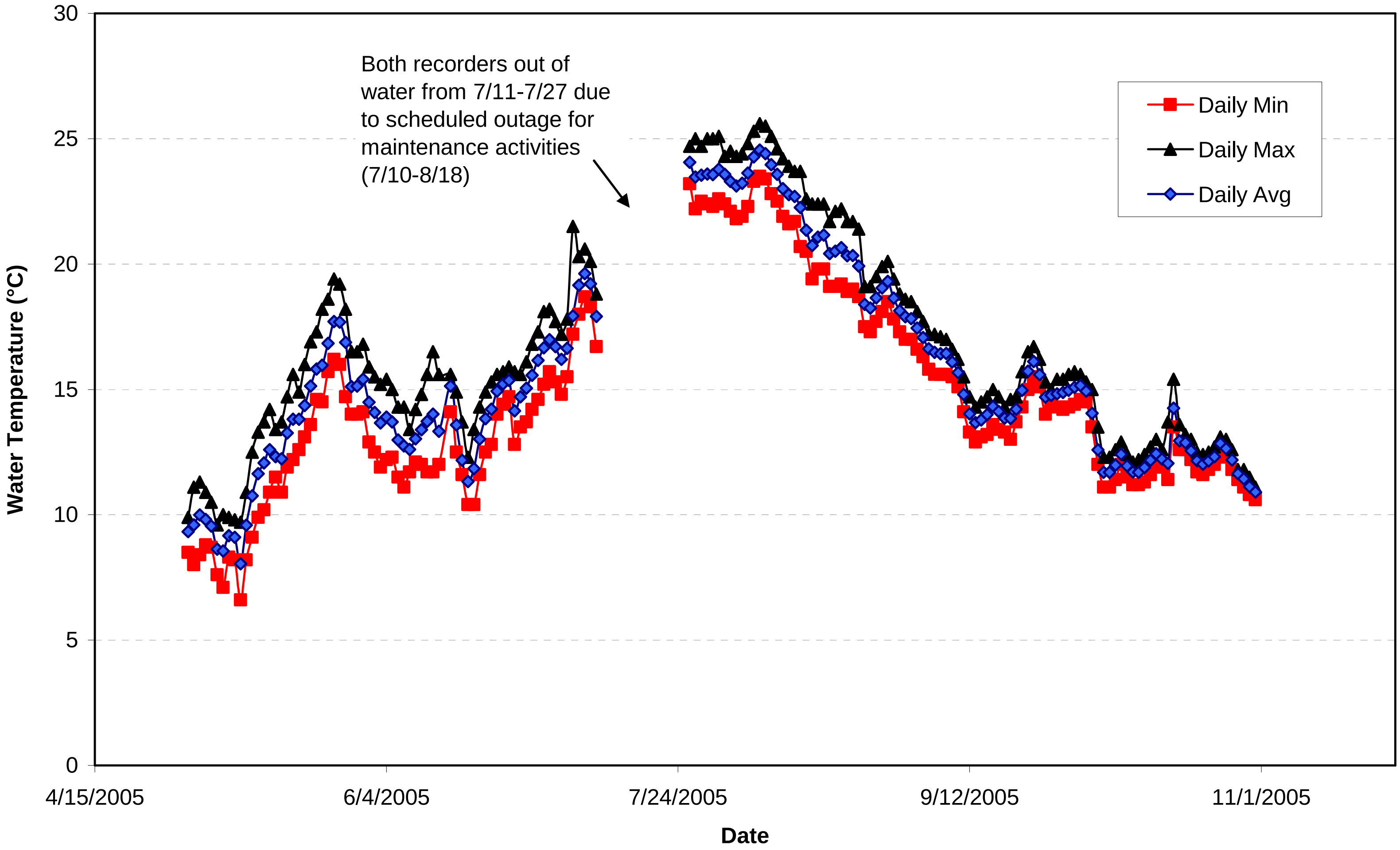


**Figure 3.2-10**
**Station T9, SFWC River Mile 0.1, upstream of the SFWC Diversion Dam**
**Daily Average, Minimum, and Maximum Water Temperatures (°C) and stream flow at gage W13 (cfs)**

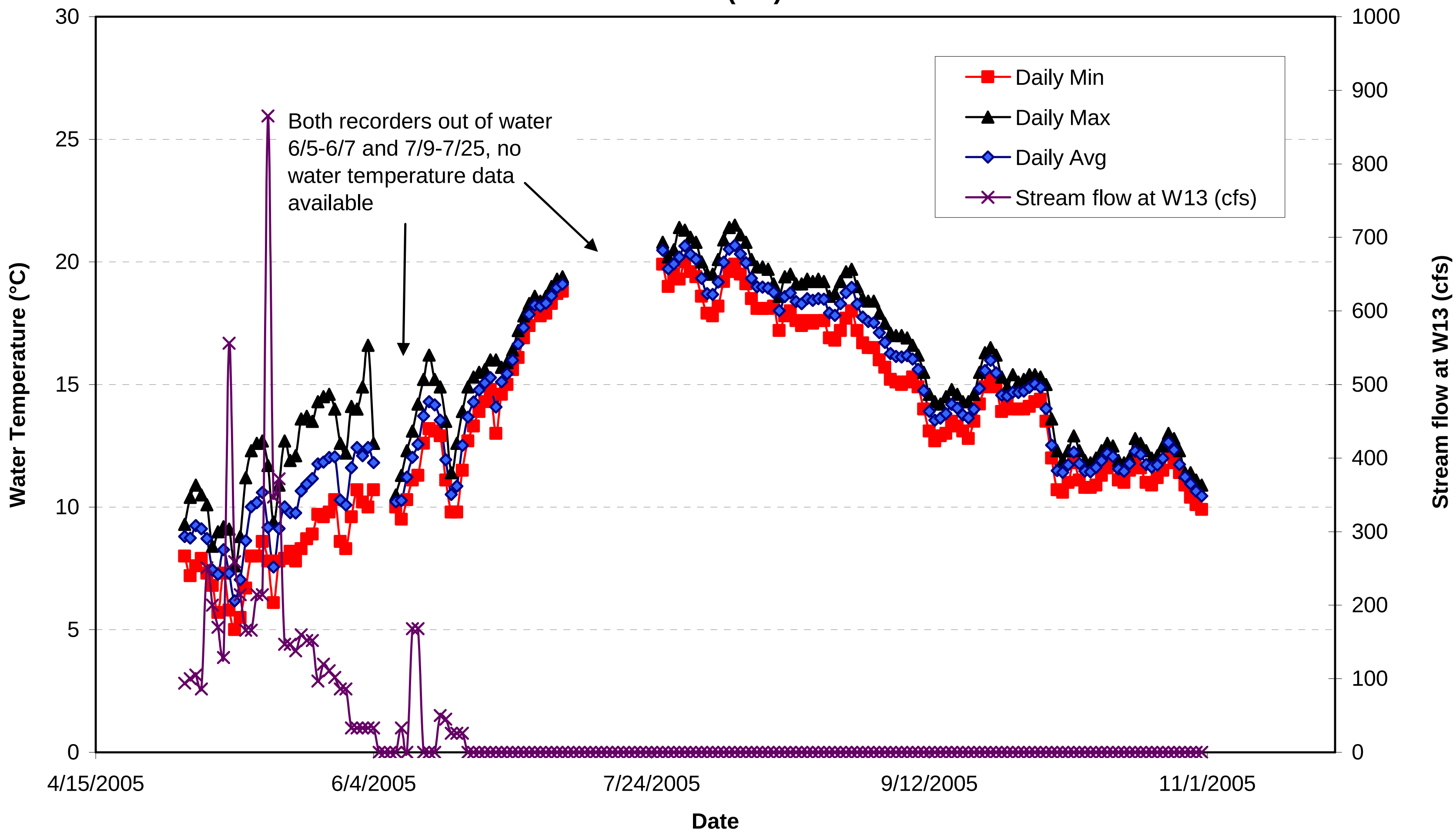


**Figure 3.2-11**
**Station T10, Willow Creek River Mile 4.3 (at Gage W-26)**
**Daily Average, Minimum, and Maximum Water Temperatures (°C) and stream flow at gage W26 (cfs)**

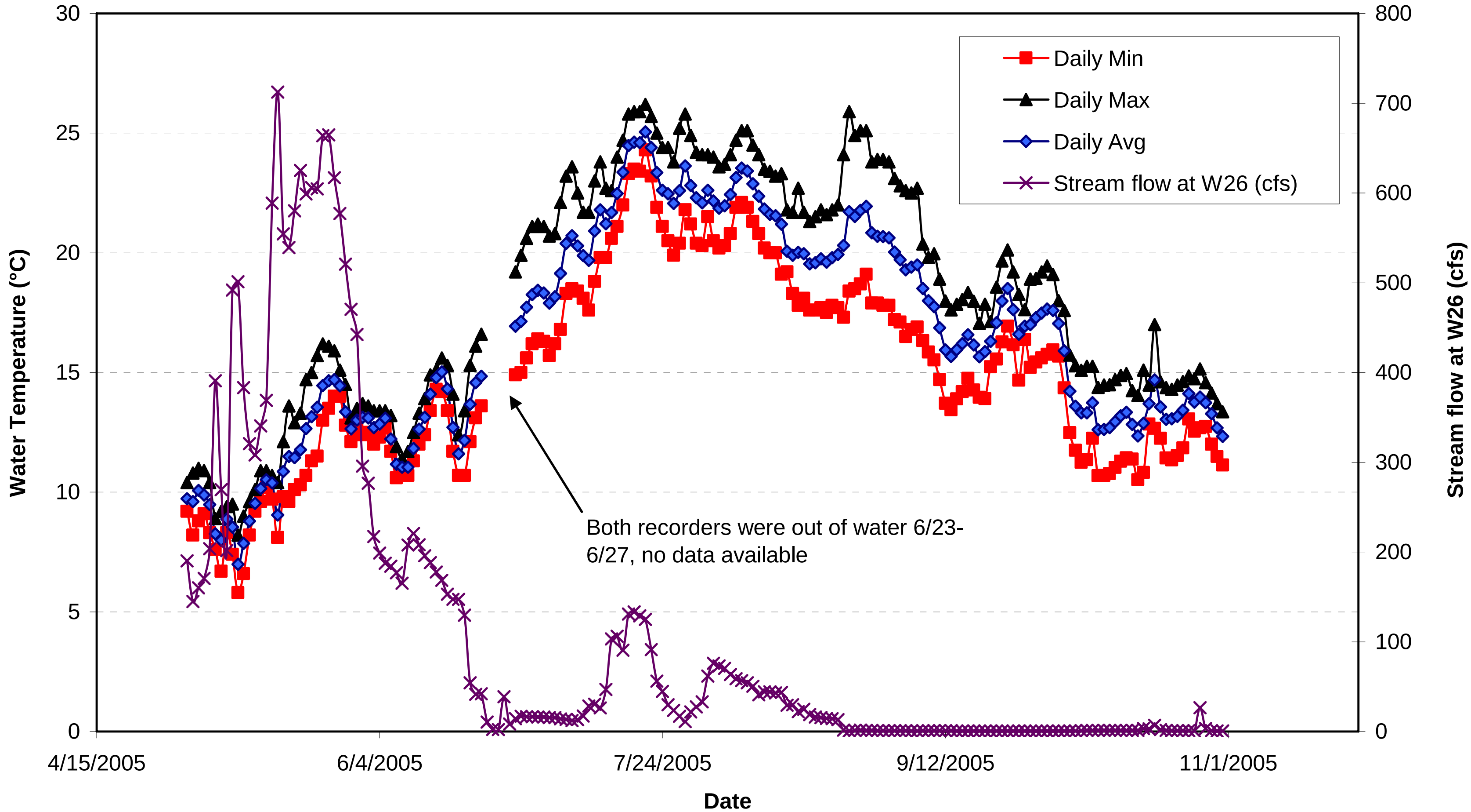


**Figure 3.2-12**
**Station T11, Willow Creek River Mile 1.8 at the mouth of Whisky Creek**
**Daily Average, Minimum, and Maximum Water Temperatures (°C)**

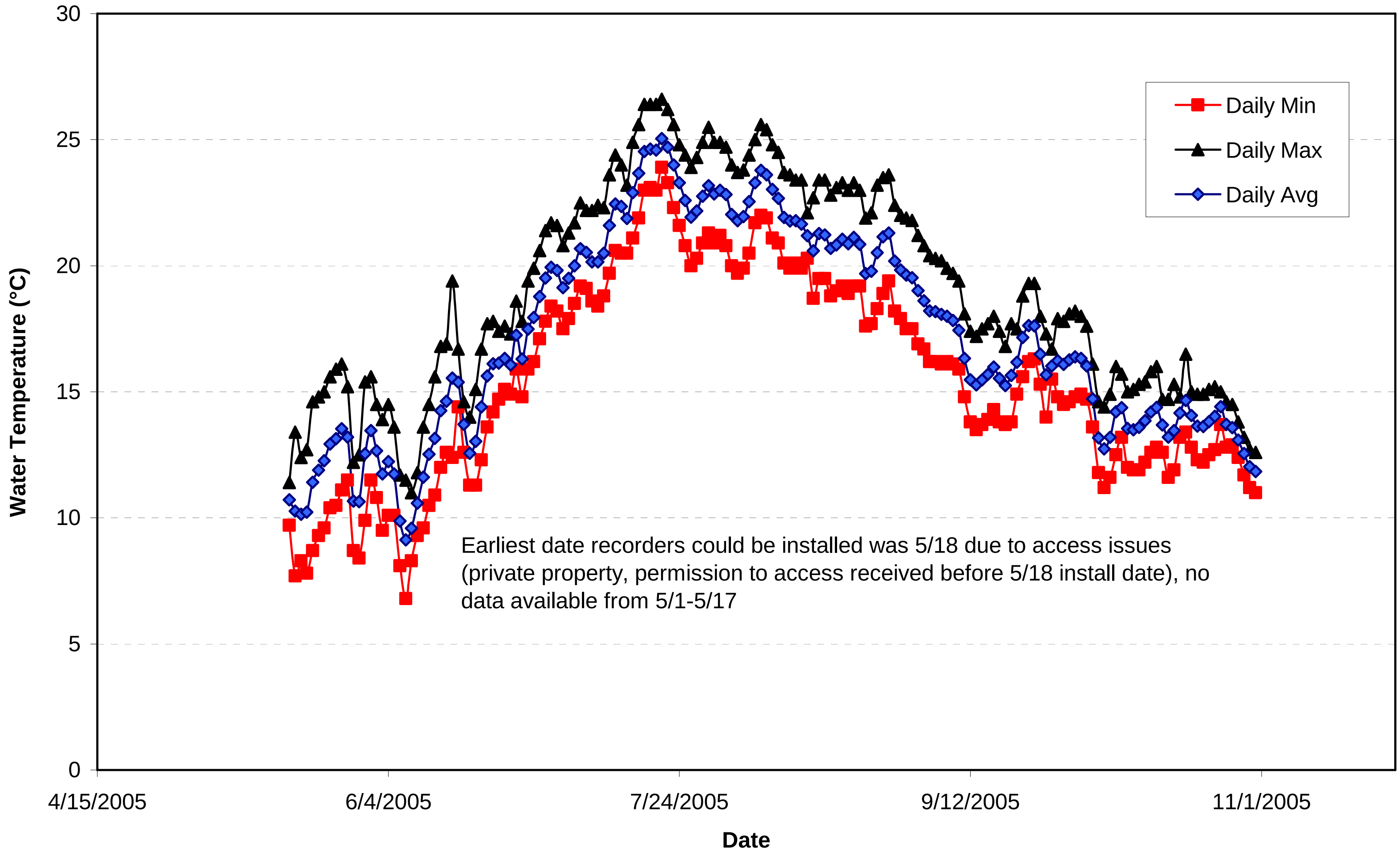


**Figure 3.2-13**
**Station T12, Willow Creek River Mile 0.37 at USGS Gage 2465**
**Daily Average, Minimum, and Maximum Water Temperatures (°C) and stream flow at USGS gage 2465 (cfs)**

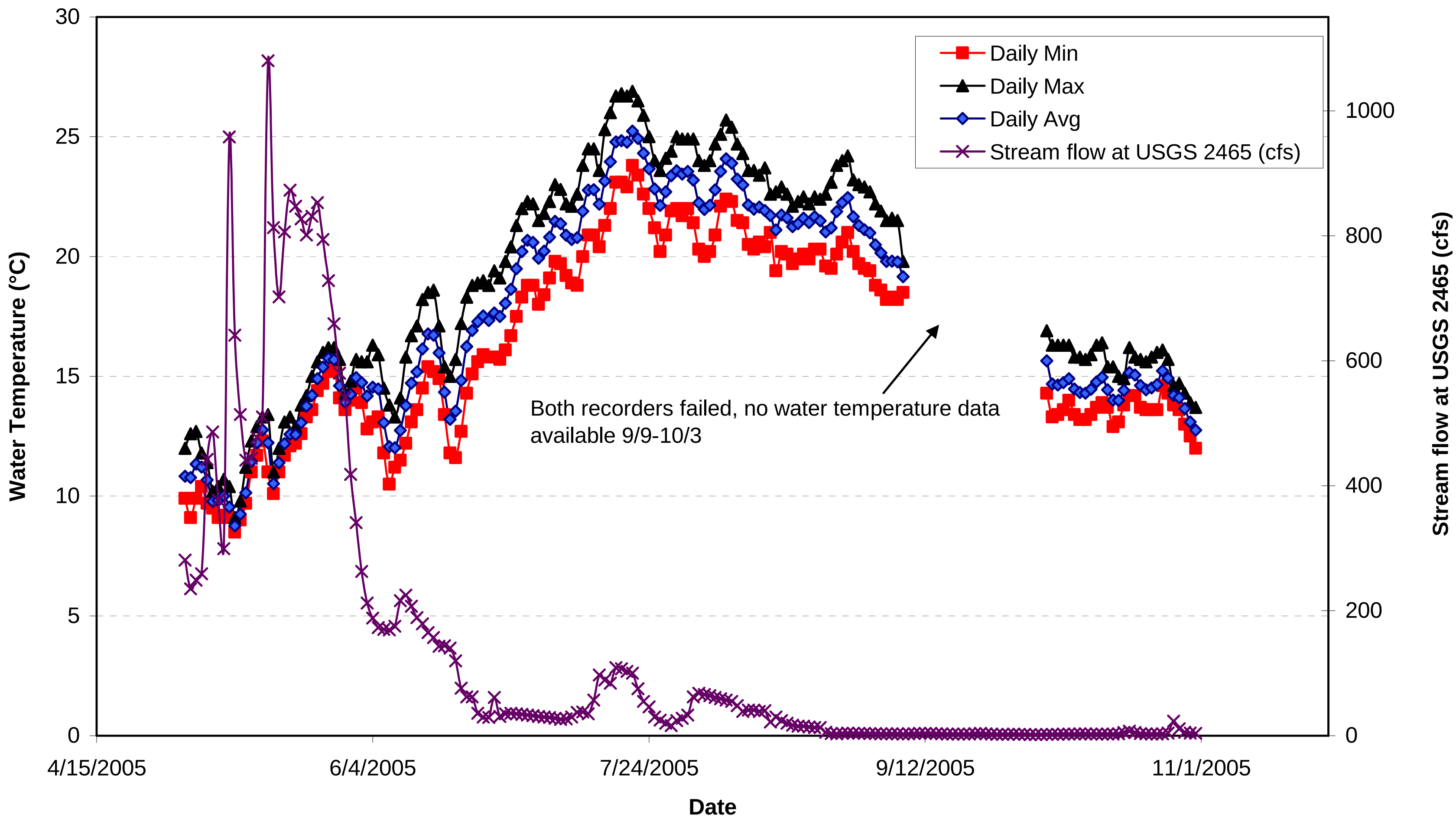


**Figure 3.2-14**
**Station T7, SFWC River Mile 6.59, upstream of the Browns Creek Diversion Dam**
**Daily Average and Maximum Water Temperatures (°C)**
**and Air Temperatures (°C)**

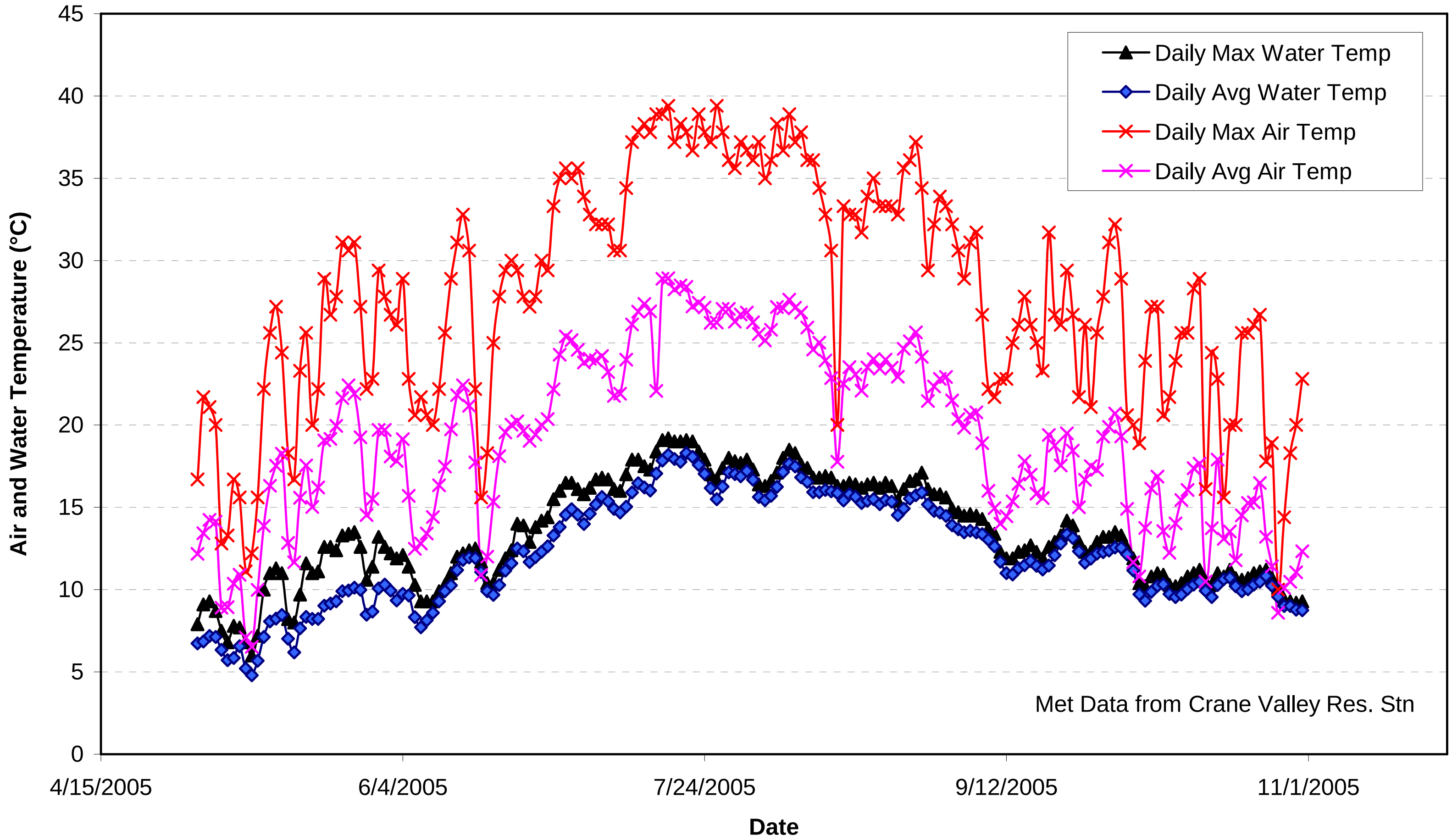


**Figure 3.2-15**
**Station T8, SFWC River Mile 6.5, downstream of the Browns Creek Diversion Dam**
**Daily Average and Maximum Water Temperatures (°C)**
**and Air Temperatures (°C)**

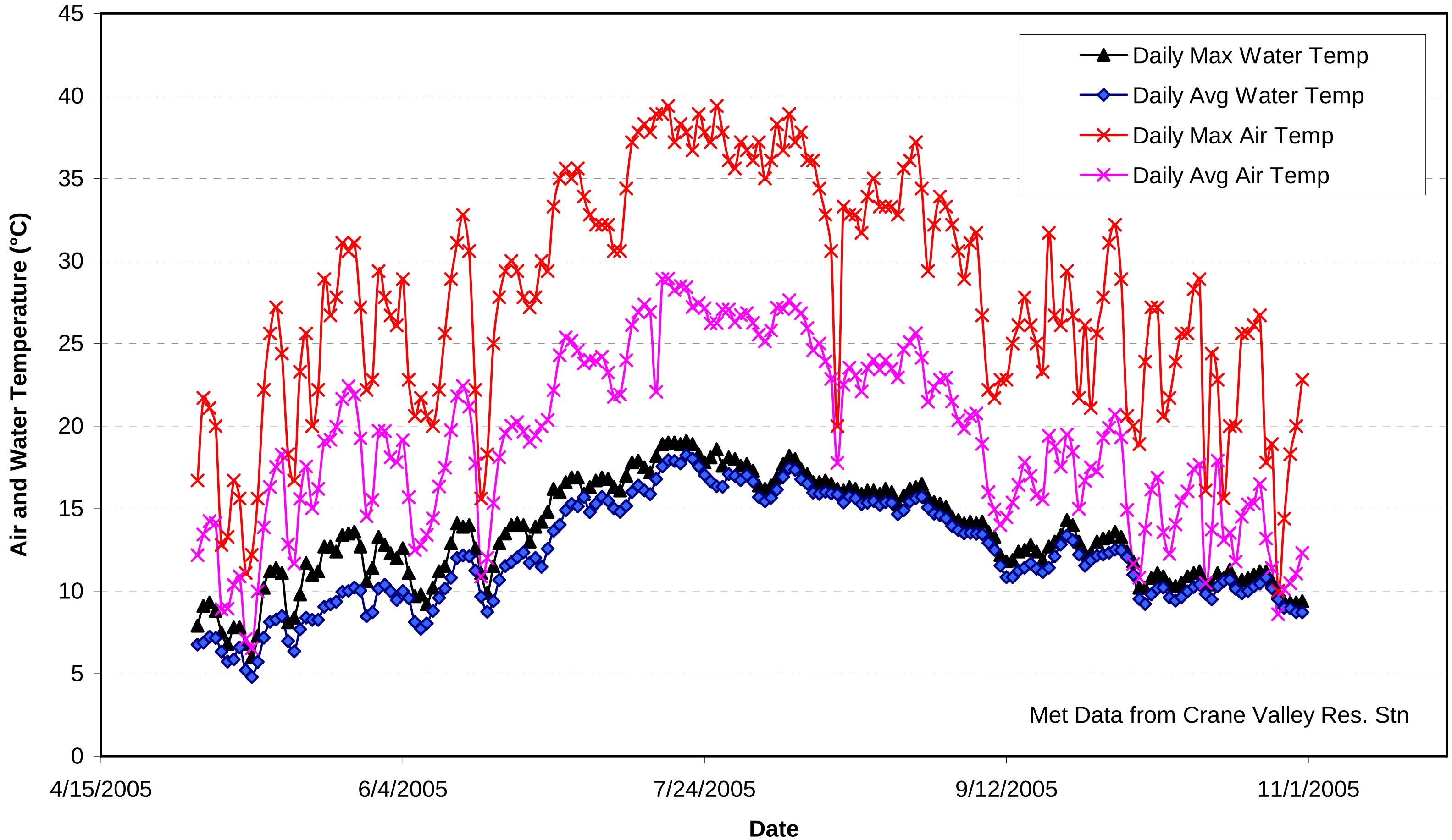


**Figure 3.2-16**
**Station T1, NFWC downstream of Bass Lake at the Crane Valley PH Tailrace**
**Daily Average and Maximum Water Temperatures (°C)**
**and Air Temperatures (°C)**

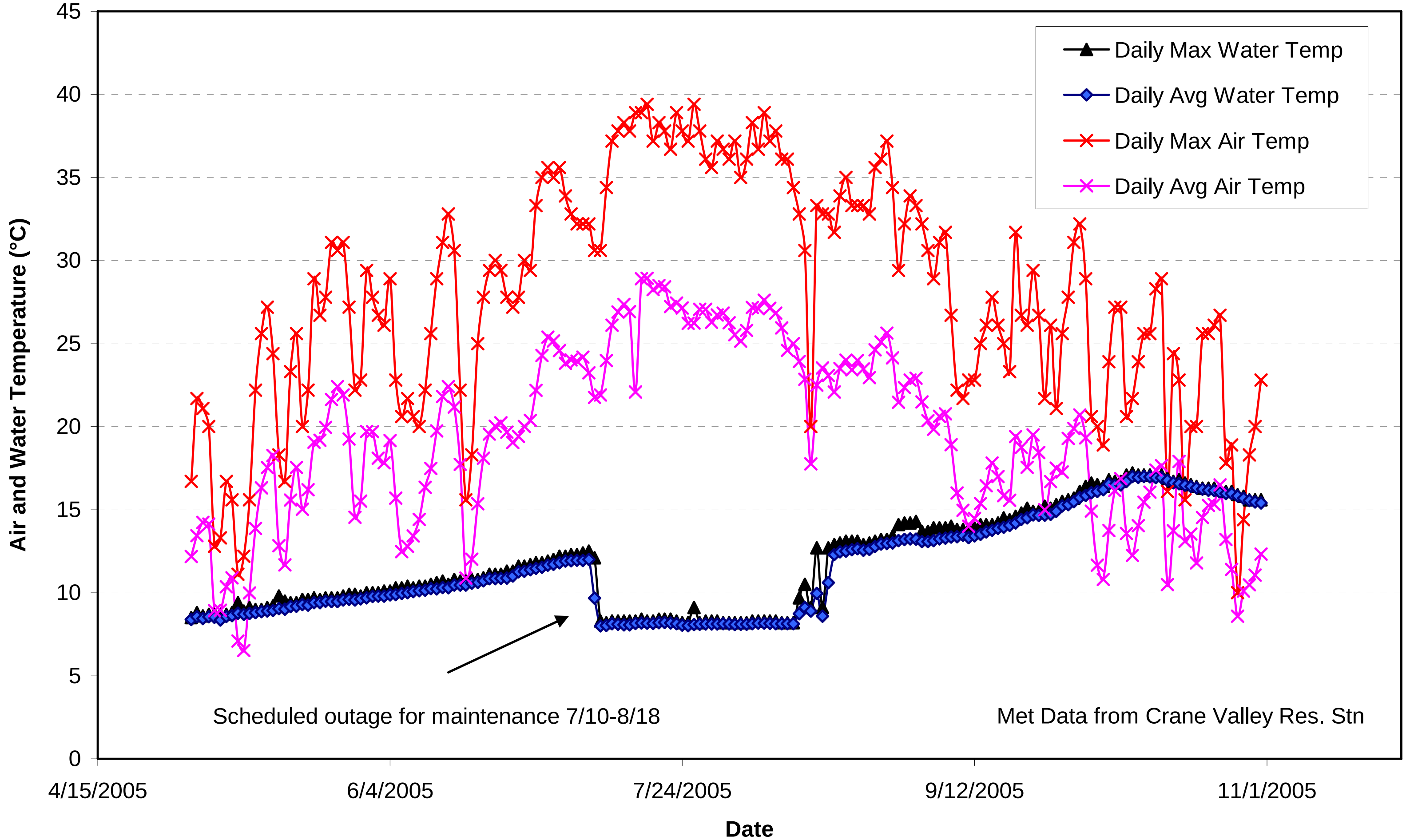


**Figure 3.2-17**
**Station T2, NFWC River Mile 7.13 below Bass Lake**
**Daily Average and Maximum Water Temperatures (°C)**
**and Air Temperatures (°C)**

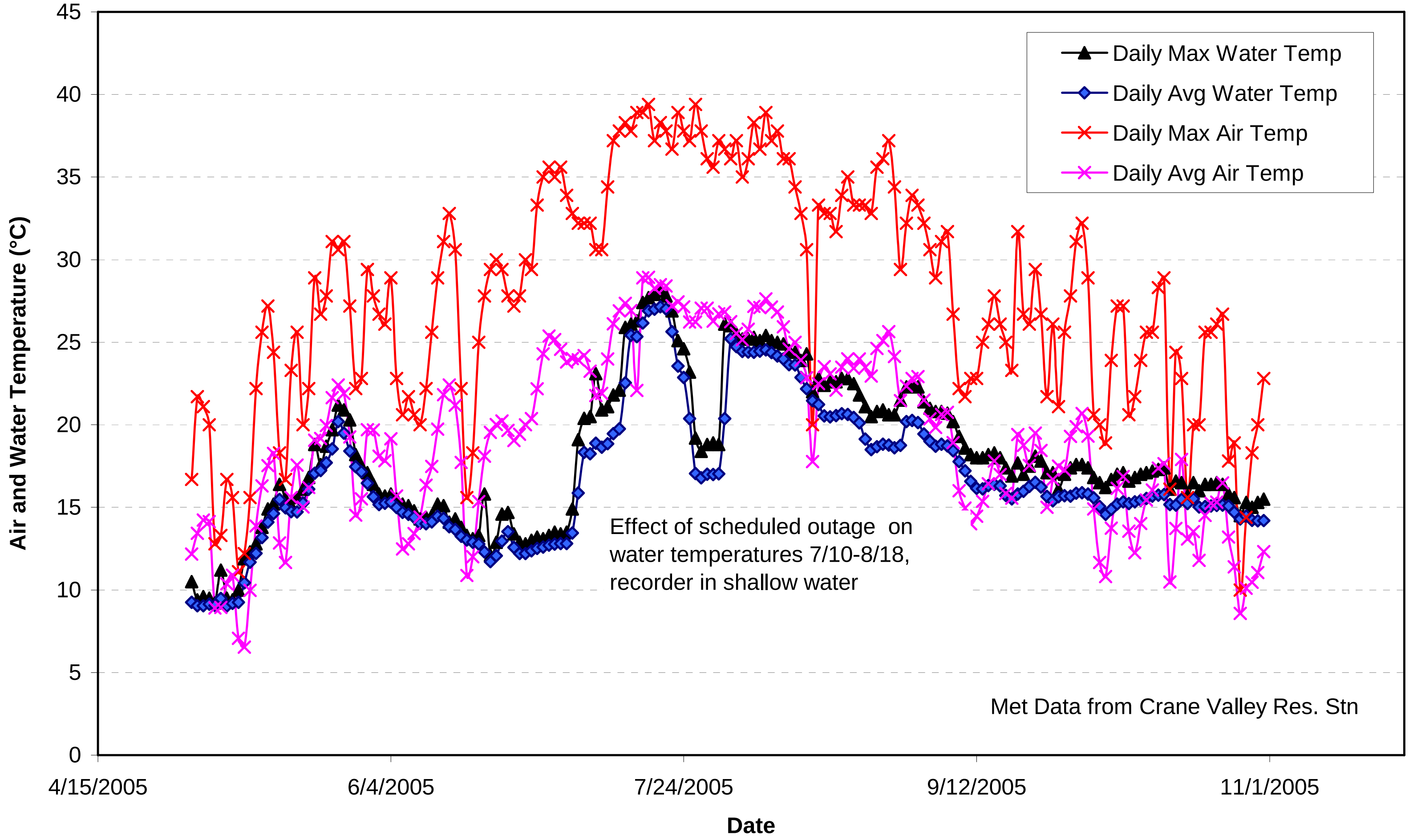


**Figure 3.2-18**
**Station T3, NFWC River Mile 4.39, upstream of Manzanita Lake**
**Daily Average and Maximum Water Temperatures (°C)**
**and Air Temperatures (°C)**

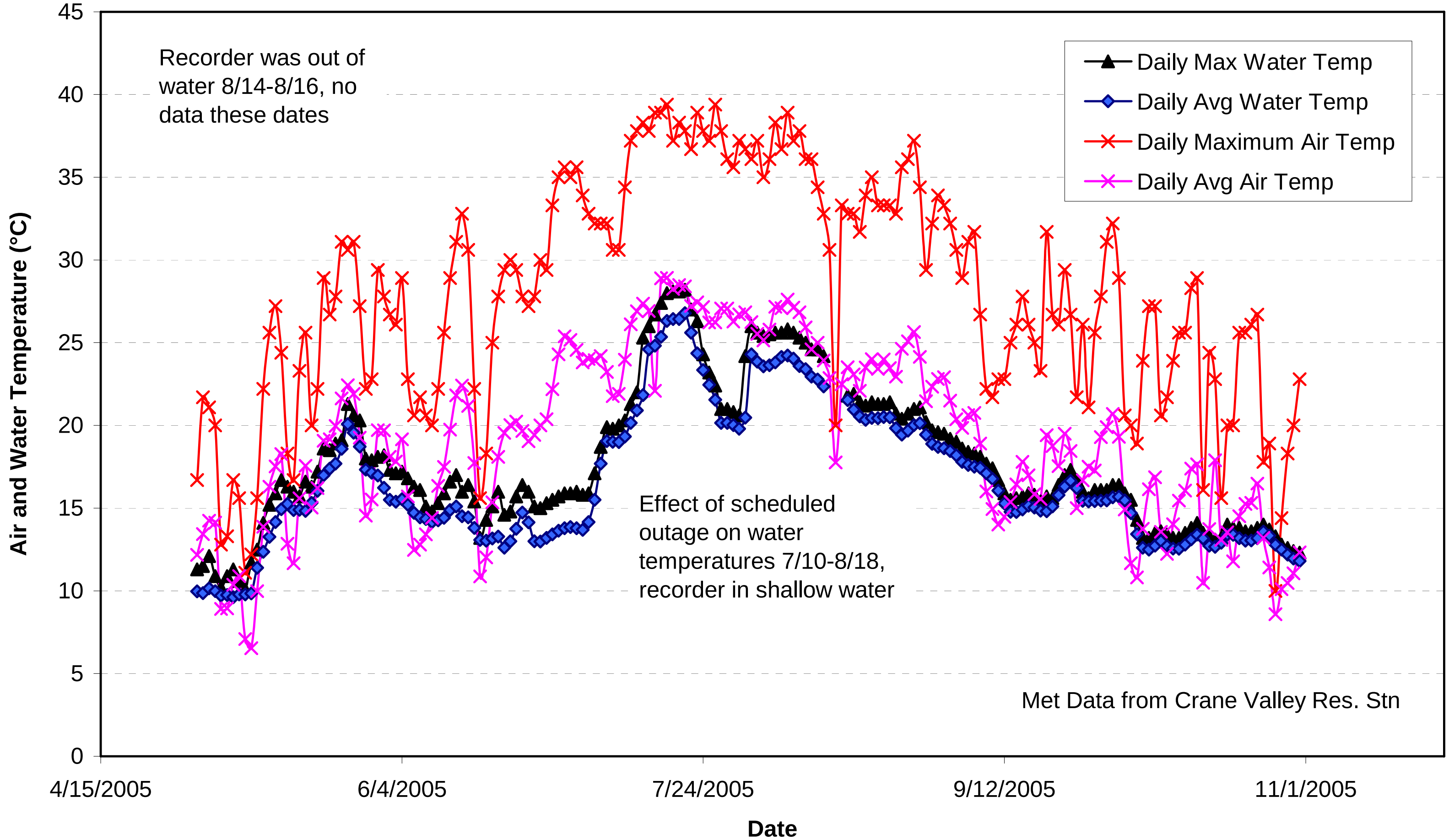


**Figure 3.2-19**
**Station T4, Manzanita Lake at the Project Diversion**
**Daily Average and Maximum Water Temperatures (°C)**
**and Air Temperatures (°C)**

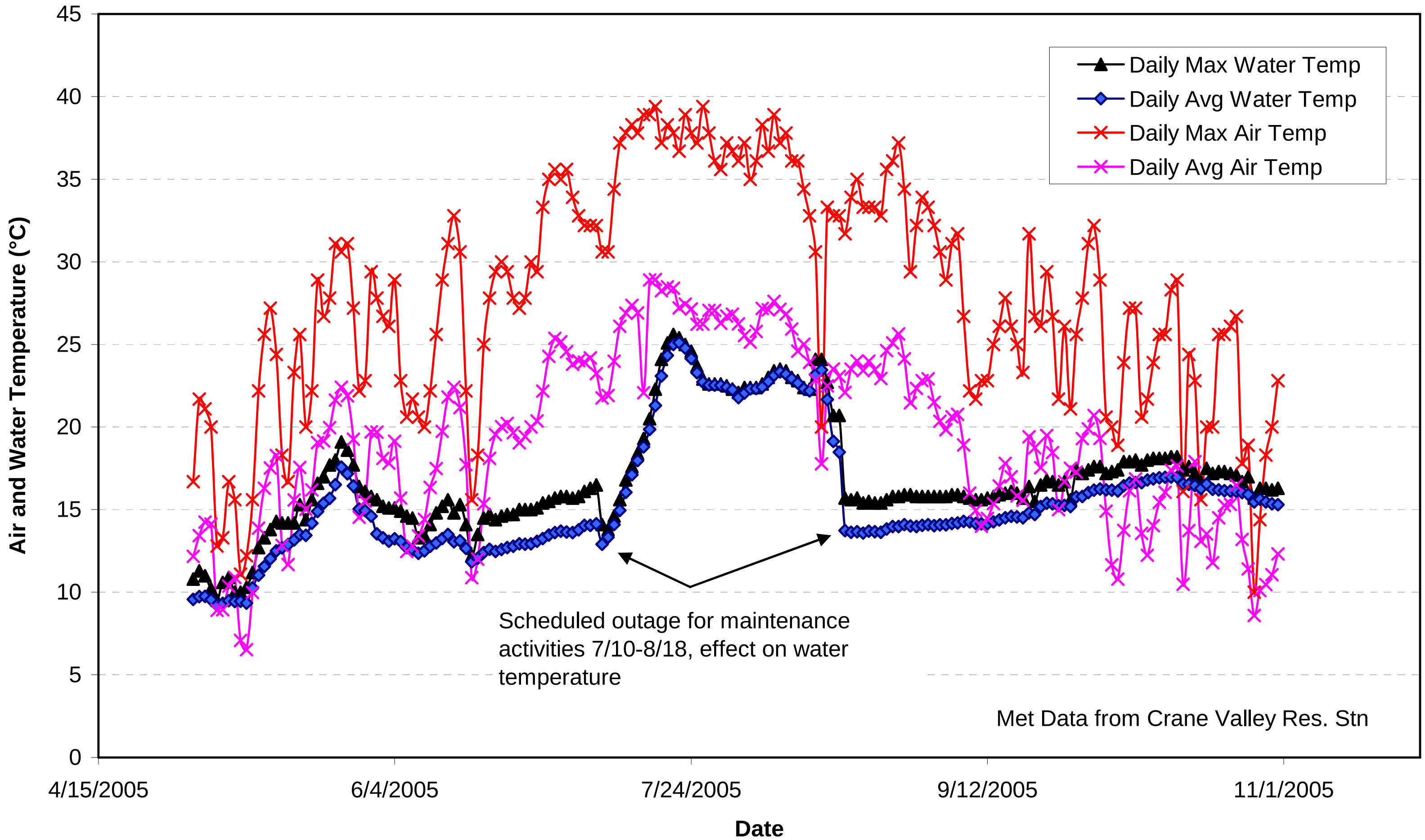


**Figure 3.2-20**
**Station T5, NFWC River Mile 3.00, downstream of Manzanita Lake**
**Daily Average and Maximum Water Temperatures (°C)**
**and Air Tempertaures (°C)**

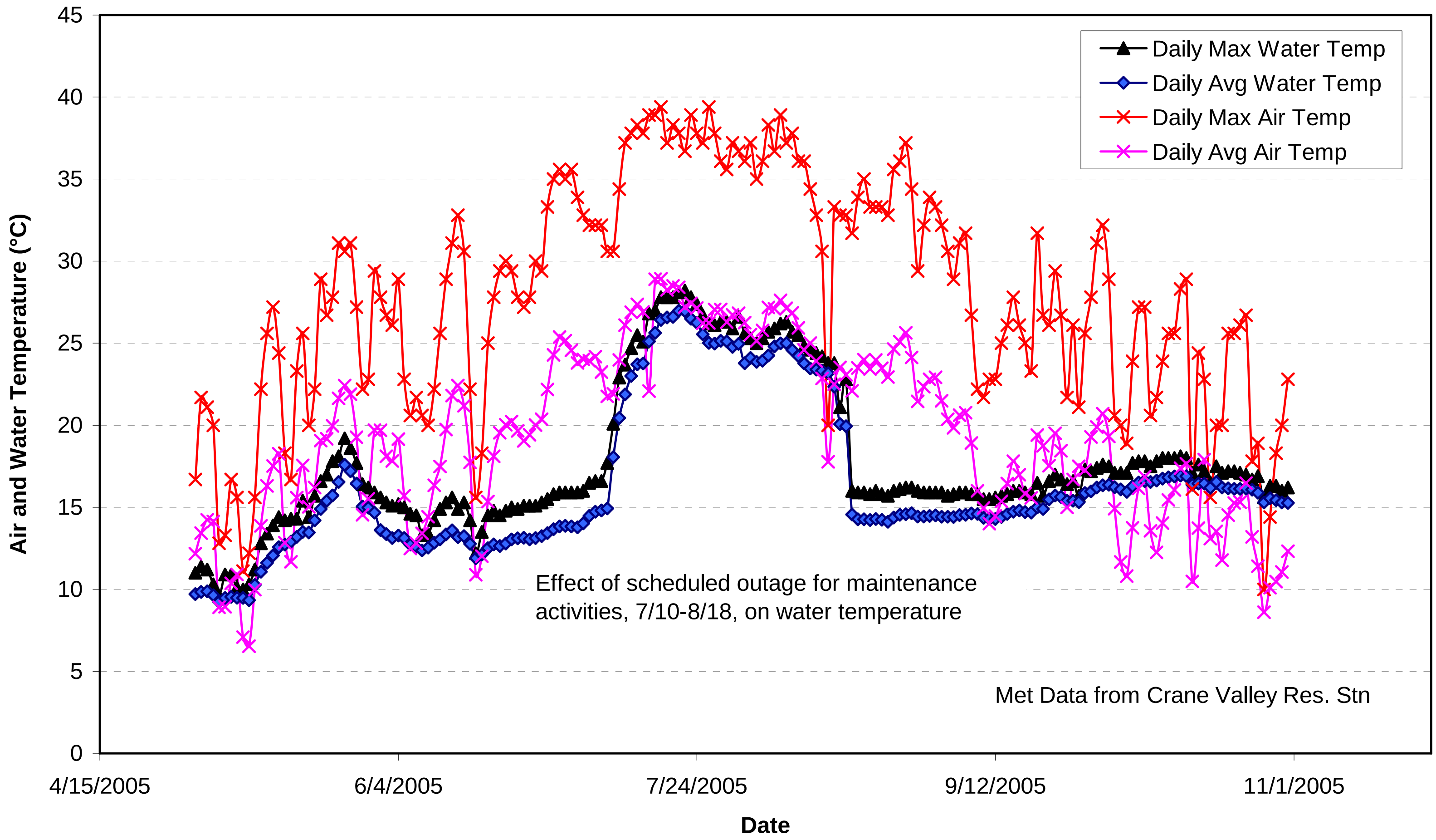


**Figure 3.2-21**
**Station T6, NFWC River Mile 0.25, upstream of the NFWC Diversion Dam**
**Daily Average and Maximum Water Temperatures (°C)**
**and Air Temperatures (°C)**

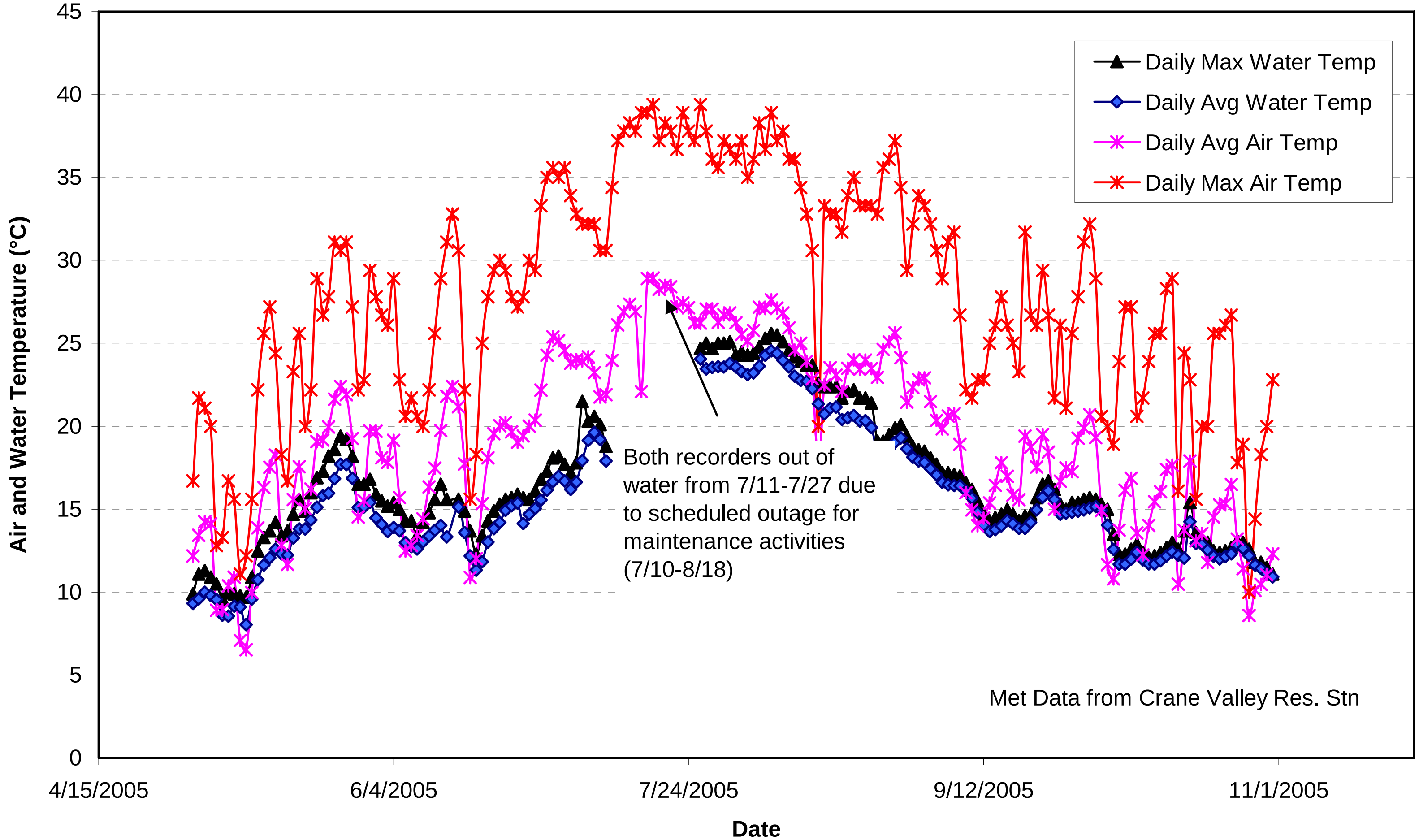


**Figure 3.2-22**
**Station T9, SFWC River Mile 0.1, upstream of the SFWC Diversion Dam**
**Daily Average and Maximum Water Temperatures (°C)**
**and Air Temperatures (°C)**

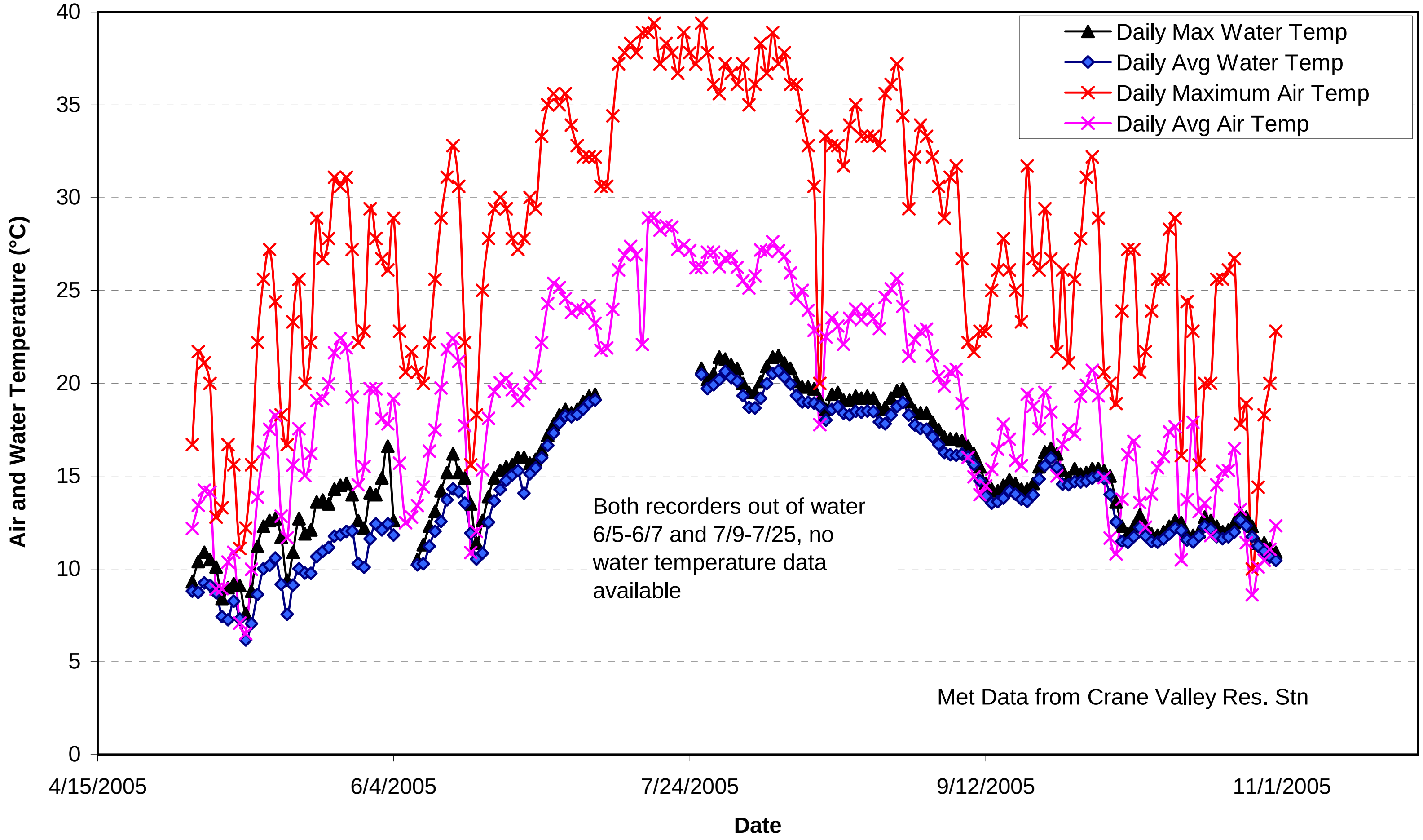


**Figure 3.2-23**
**Station T10, Willow Creek River Mile 4.3 (at Gage W-26)**
**Daily Averageand Maximum Water Temperatures (°C)**
**and Air Temperature (°C)**

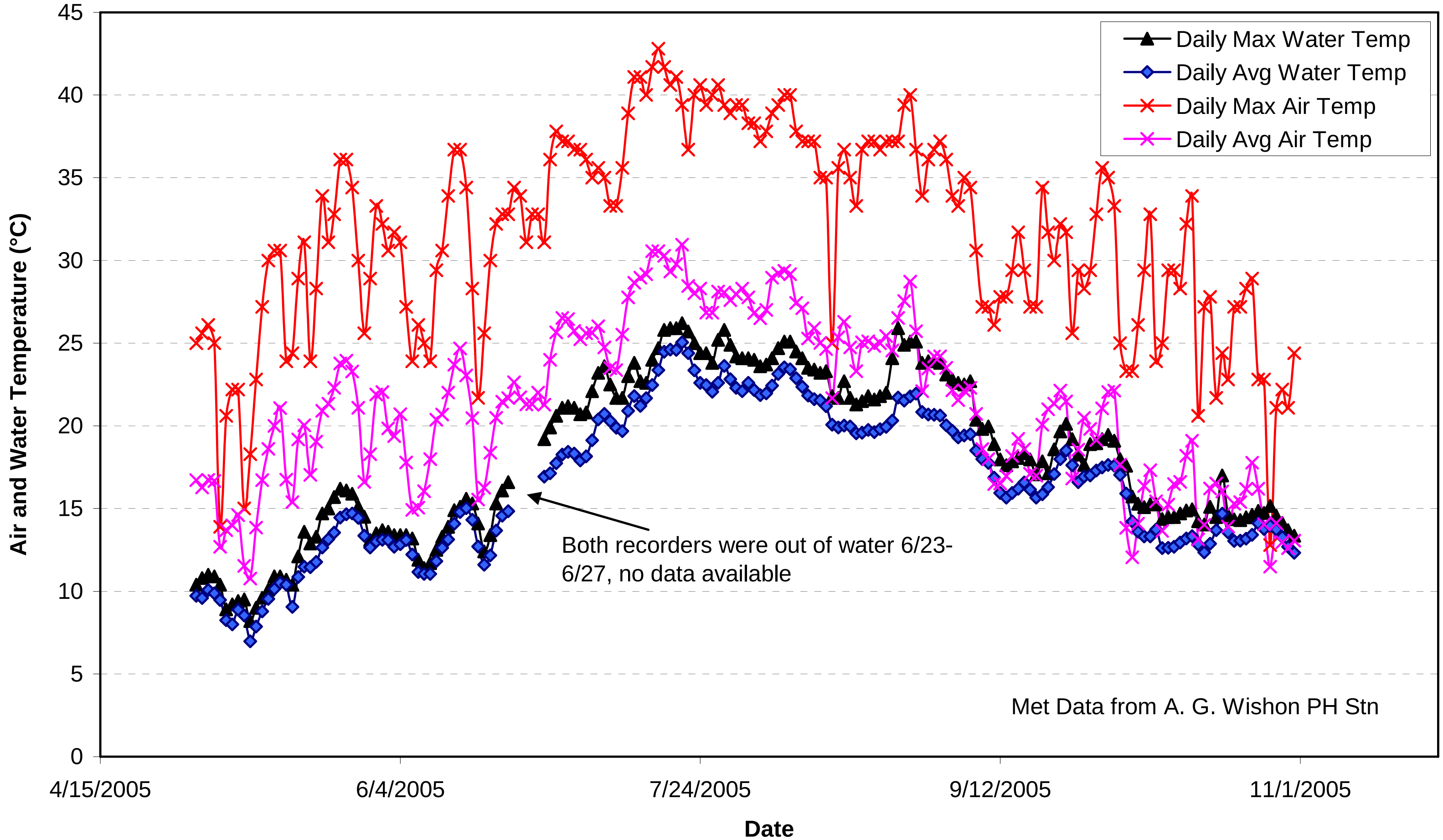


**Figure 3.2-24**
**Station T11, Willow Creek River Mile 1.8 at the mouth of Whisky Creek**
**Daily Average,and Maximum Water Temperatures (°C)**
**and Air Temperatures (°C)**

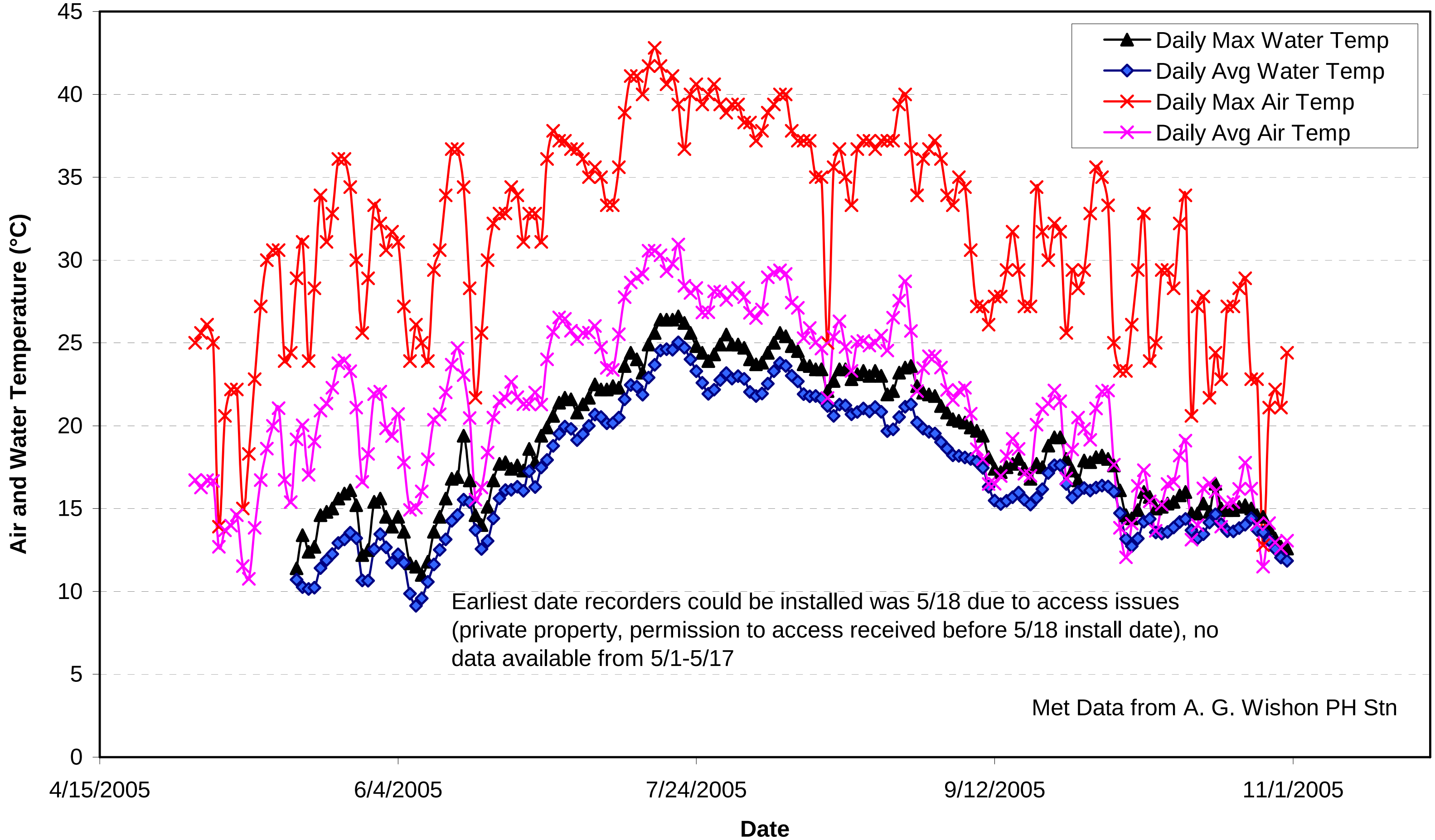
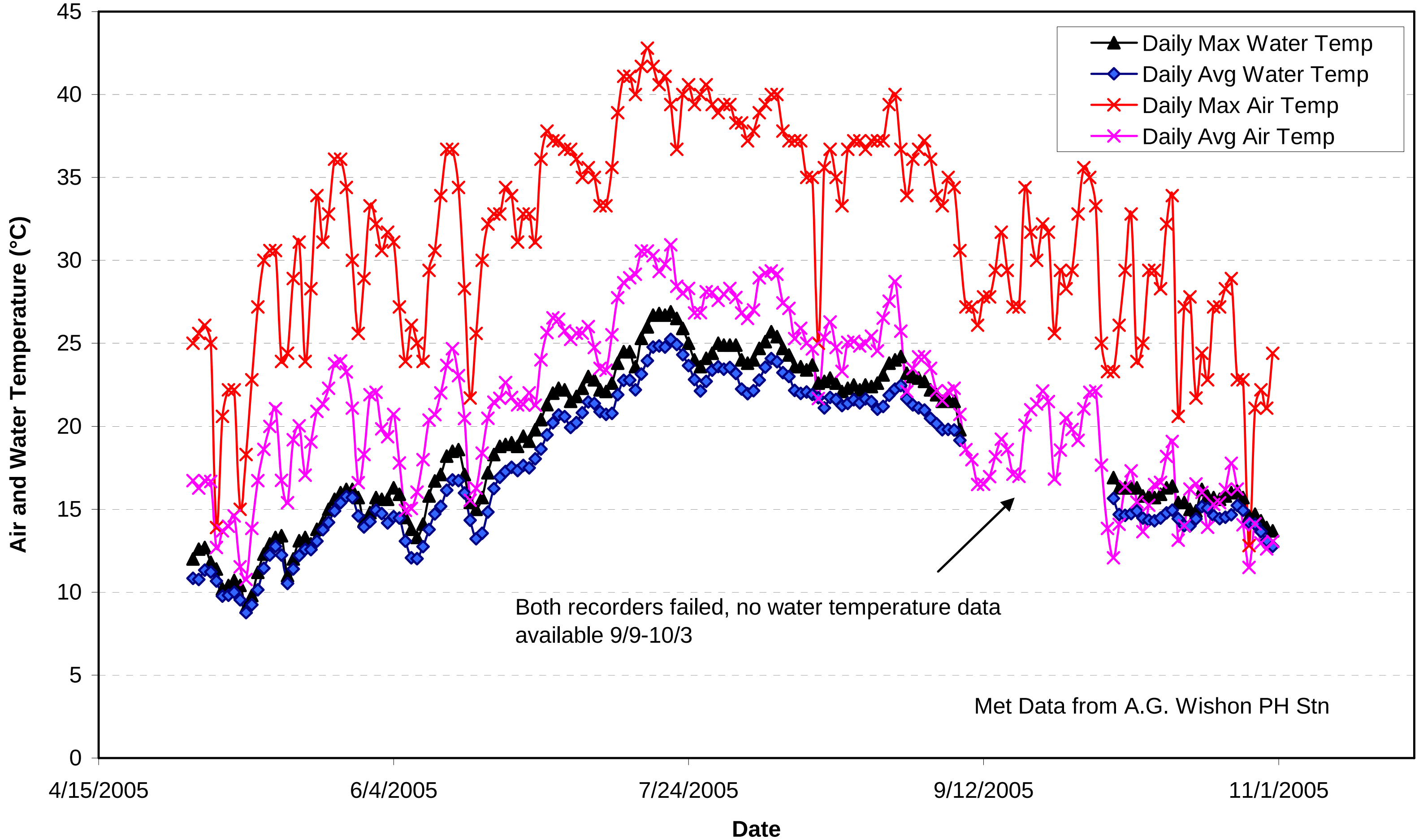


**Figure 3.2-25**
**Station T12, Willow Creek River Mile 0.37 at USGS Gage 2465**
**Daily Average and Maximum Water Temperatures (°C)**
**and Air Temperatures (°C)**



**Appendix A**

## Temperature Data (CD)

## Appendix B

## Stream Flow and Storage Data

## Appendix B1

# Stream Flow Discussion

Stream flow data are presented here as part of the Crane Valley Federal Energy Regulatory Commission (FERC) Project No. 1354 (Project) Annual Water Temperature Monitoring Program Report for the 2005 water year. Stream flow was measured continuously at twenty-one (21) existing Pacific Gas and Electric Company (PG&E) maintained and two U.S. Geological (USGS) maintained gaging stations. Stream flow and storage data during May through October 2005 are presented in this appendix as supporting documentation for the water temperature monitoring program. All stream flow data are presented as cubic feet per second (cfs) and storage data are presented in units of thousand acre feet (TAF). Stream flow data will help to provide insight to understand affects of flows on stream water temperatures in the Project area.

A complete list of the stream flow monitoring stations is listed below.

- North Fork Willow Creek near Sugar Pine (W24), (USGS maintained gage station)
- Browns Creek Diversion Dam Spill (W22)
- Browns Creek Canal at Bass Lake (W1)
- Bass Lake Storage (W2)
- Crane Valley Powerhouse (W19)
- North Fork Willow Creek near Bass Lake (W3)
- Conduit #3 Near Bass Lake (W4)
- San Joaquin #3 Powerhouse (W6)
- Manzanita Lake Spill (W8)
- #2 Conduit (W9)
- North Fork Willow Creek near Bass Lake – Total Flow (WC3)
- San Joaquin Powerhouse #2 (W11)
- South Fork Willow Creek Canal above North Fork Willow Creek (W12)
- Spill over North Fork Diversion Dam (W15)
- Spill over South Fork Diversion Dam (W13)
- Willow Creek Diversion to #1 Conduit (W14)
- #1 Conduit Spillway at San Joaquin #2 Powerhouse (W27)
- Willow Creek below Confluence of North and South Forks (W26)
- Willow Creek at Mouth (USGS-Southern California Edison maintained gage 2465)
- #1 Conduit below Bass Lake (W25)
- San Joaquin #1A Powerhouse (W16) [flow here was zero cfs during entire monitoring program]
- Corrine Lake Storage (W17)
- A. G. Wishon Powerhouse (W18)

A scheduled outage from July 10 through August 18 affected the stream flows measured at a number of stations during the 2005 water temperature monitoring program. Stream flows were zero cfs during the outage at the powerhouse and conduit stream flow stations (W11, W18, W19, W25, W4, W6, and W9). Figures of daily average stream flow and daily average storage are included in Appendix B2.

Stream flow was zero cfs at times in the Browns Creek Canal at Bass Lake (W1), which is a seasonal ditch that is dependent on natural flows. There typically is not a lot of flow in the canal in September and October (per communication with PG&E employee, Paul Linderman). The South Fork Willow Creek (SFWC) Canal above North Fork Willow Creek (NFWC) (station W12) is partially dependent on flow coming from the Browns Creek Canal (W1).

Spill flows were zero cfs on or around June 20 for spill over the South Fork Diversion Dam (W13), spill over the North Fork Diversion Dam (W15), spill over Browns Creek Diversion Dam (W22), and Manzanita Lake spill (W8). Subsequently measured flows were zero cfs at the Willow Creek Diversion to the #1 Conduit in August and September due to zero spill flow and little flow supplied from Browns Creek Canal.

Measured stream flows coming from the NFWC near Sugar Pine (W24) were highest in the spring (May and early June) and decreased steadily through the summer months. This gage station is a USGS maintained stream flow station and data were provided by the Madera Irrigation District (MID).

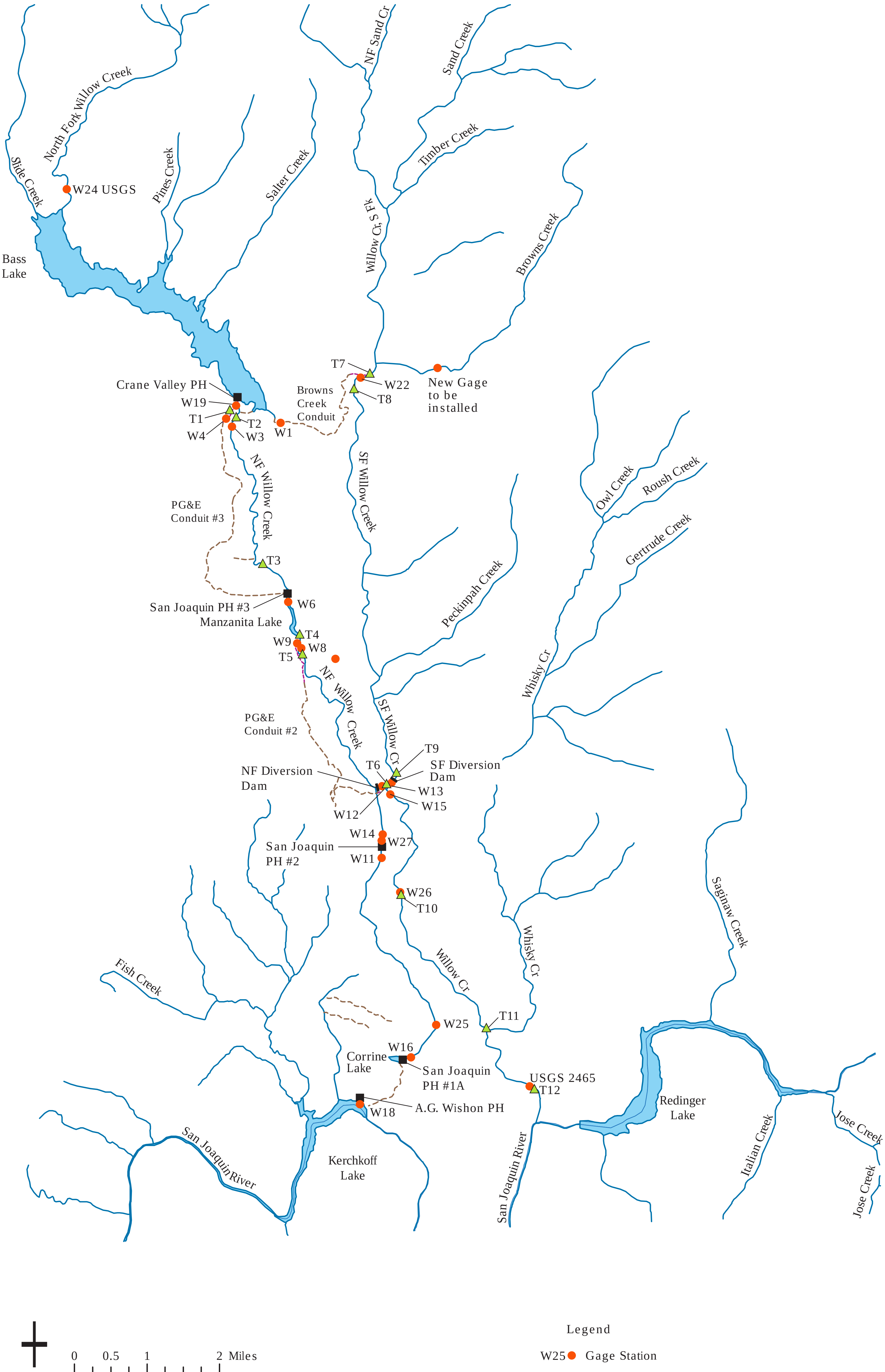
Measured stream flows in Willow Creek below the confluence of the North and South Forks at PG&E gage W26 were highest (between 600 and 700 cfs) in the spring (May) and decreased through June. The minimum stream flow release of 0.5 cfs or greater was achieved in all months of the monitoring program at gage W26. Some maintenance work was conducted during July 11 through July 27, 2005 at this gage site (new gate at ditch 1 sand trap).

Stream flows in the NFWC near Bass Lake at station W3 were highest in the spring (May) with a maximum flow of approximately 425 cfs. Stream flows ranged from approximately 4 cfs on August 16 down to 2 cfs during October.

Storage in Corrine Lake (W17) was around 0.04 TAF during May through June. A drawdown from July 10 to August 9 may be related to the scheduled outage. Storage in Corrine Lake averaged around 0.05 TAF for the remainder of the monitoring program. Storage in Bass Lake (W2) was around 45 TAF in June, July, and early August. Drawdown of the lake started in mid-August and storage levels were around 28 TAF by the end of October.

## Appendix B2

## Crane Valley Project Water Temperature and Stream Flow Gage Station Locations



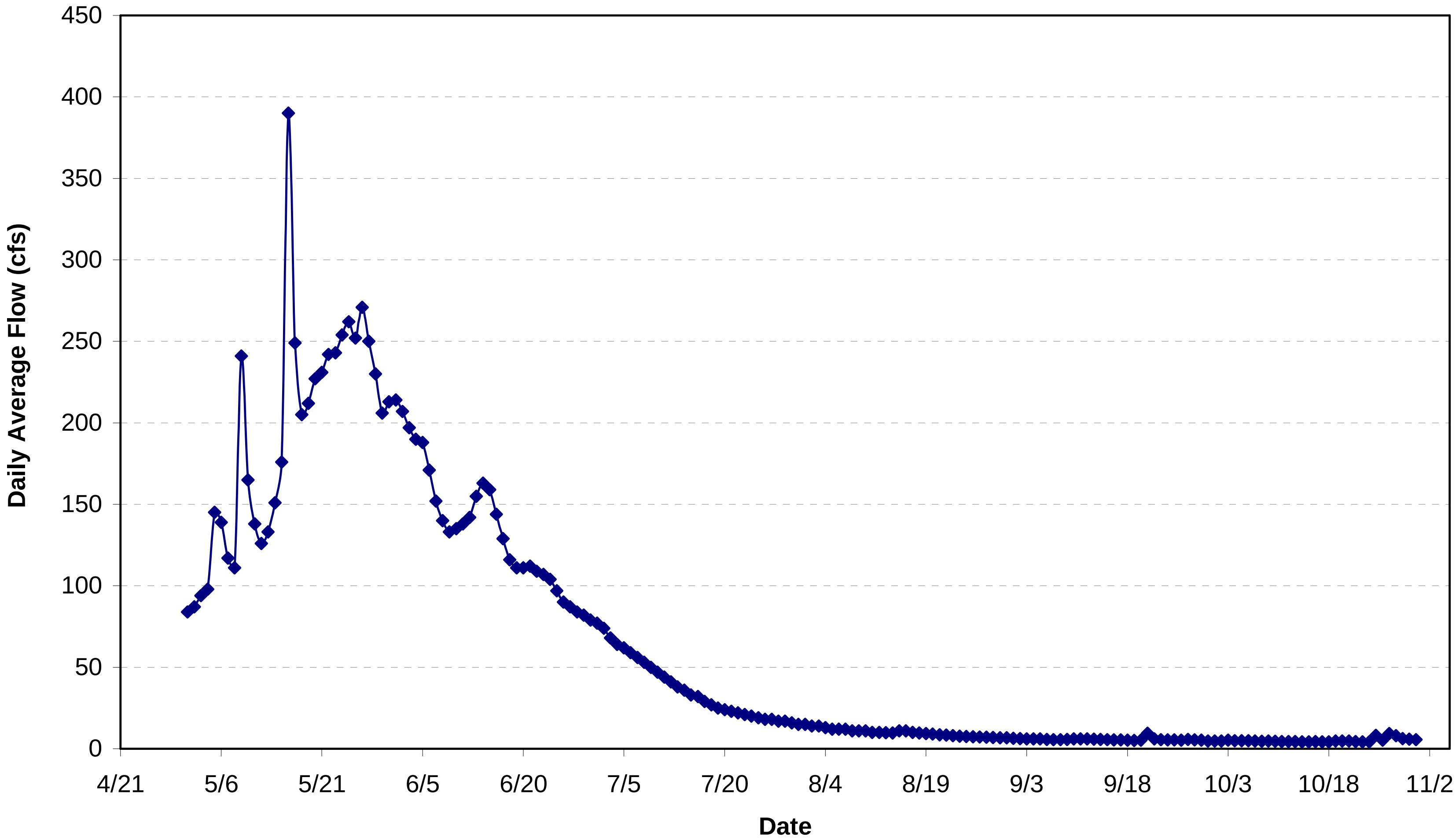

Crane Valley Project Water Temperature and Stream Flow Gage Station Locations

031236/will creek project stations 2

**Appendix B3**

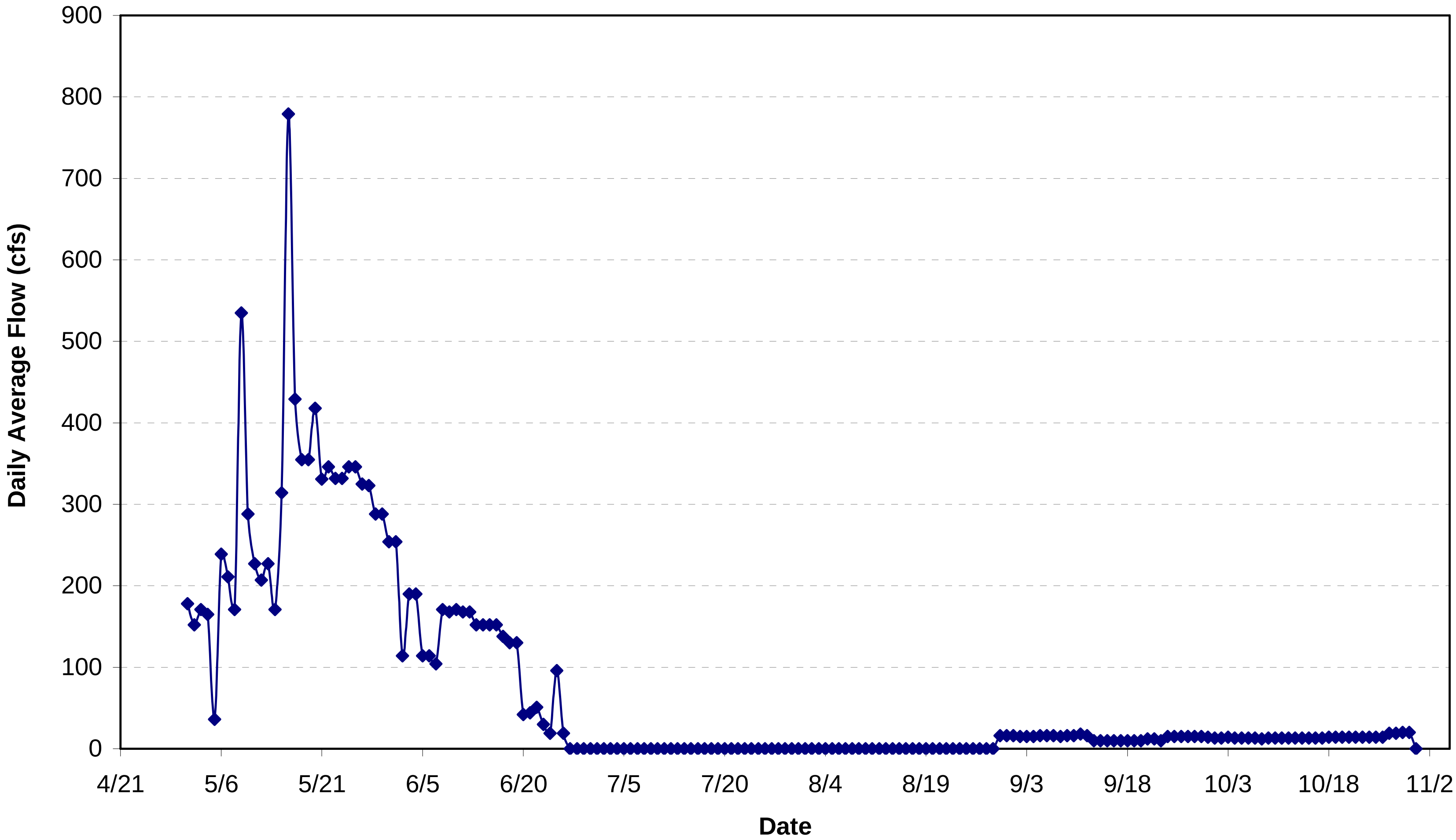
## Stream Flow Data Plots

# W24
## North Fork Willow Creek near Sugar Pine

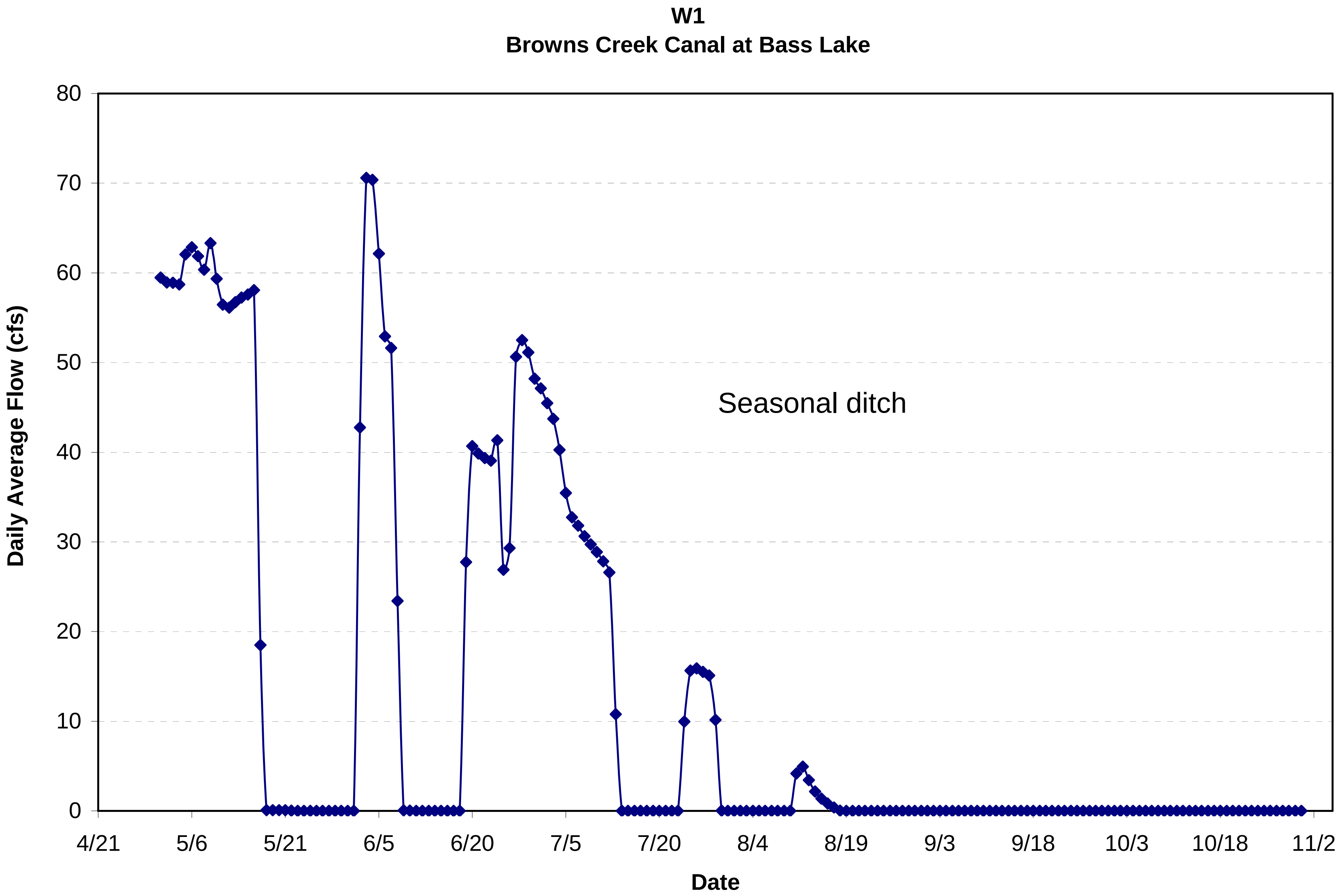



026.11.05.24

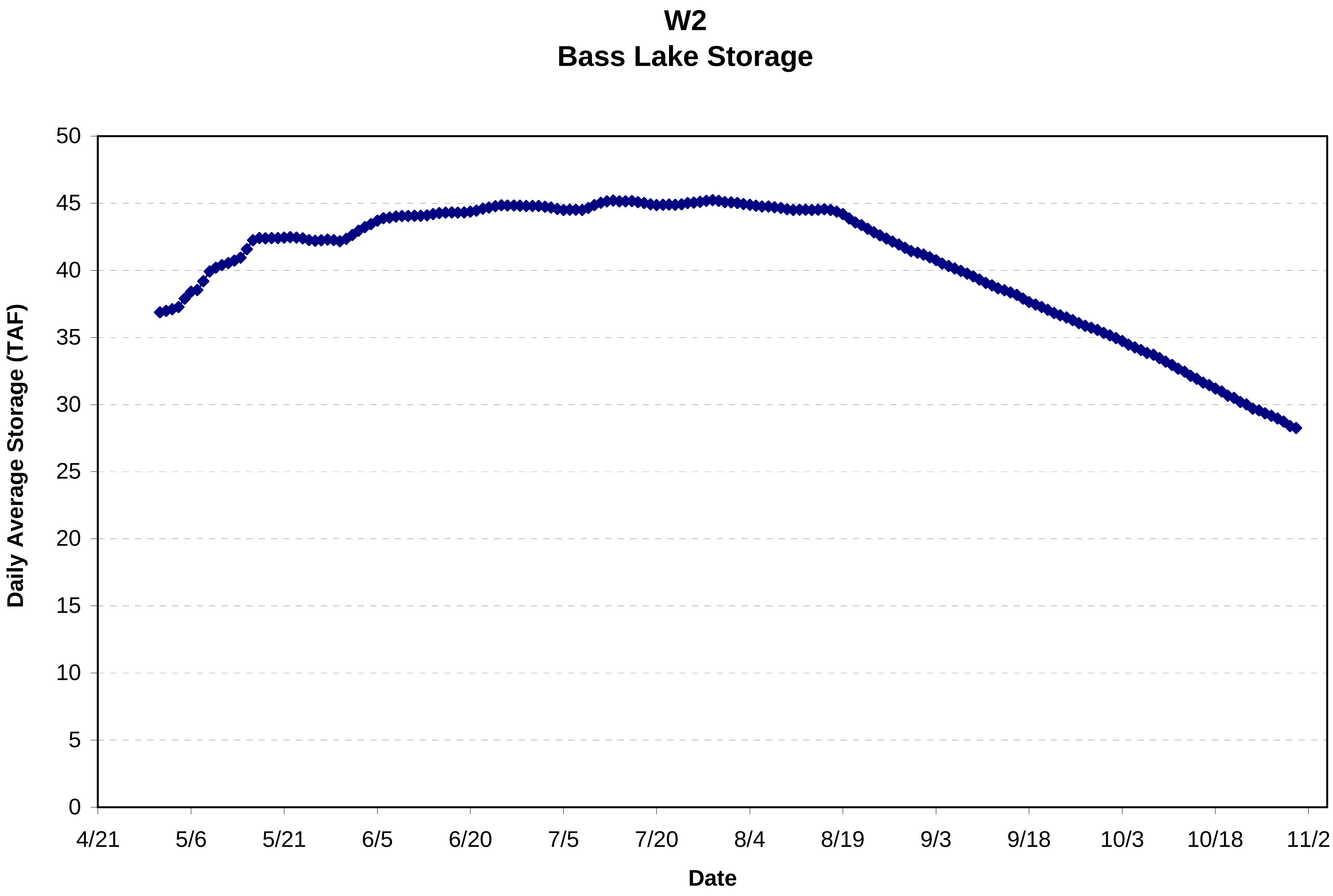
# W22
## Browns Creek Diversion Dam Spill




026.11.05.24

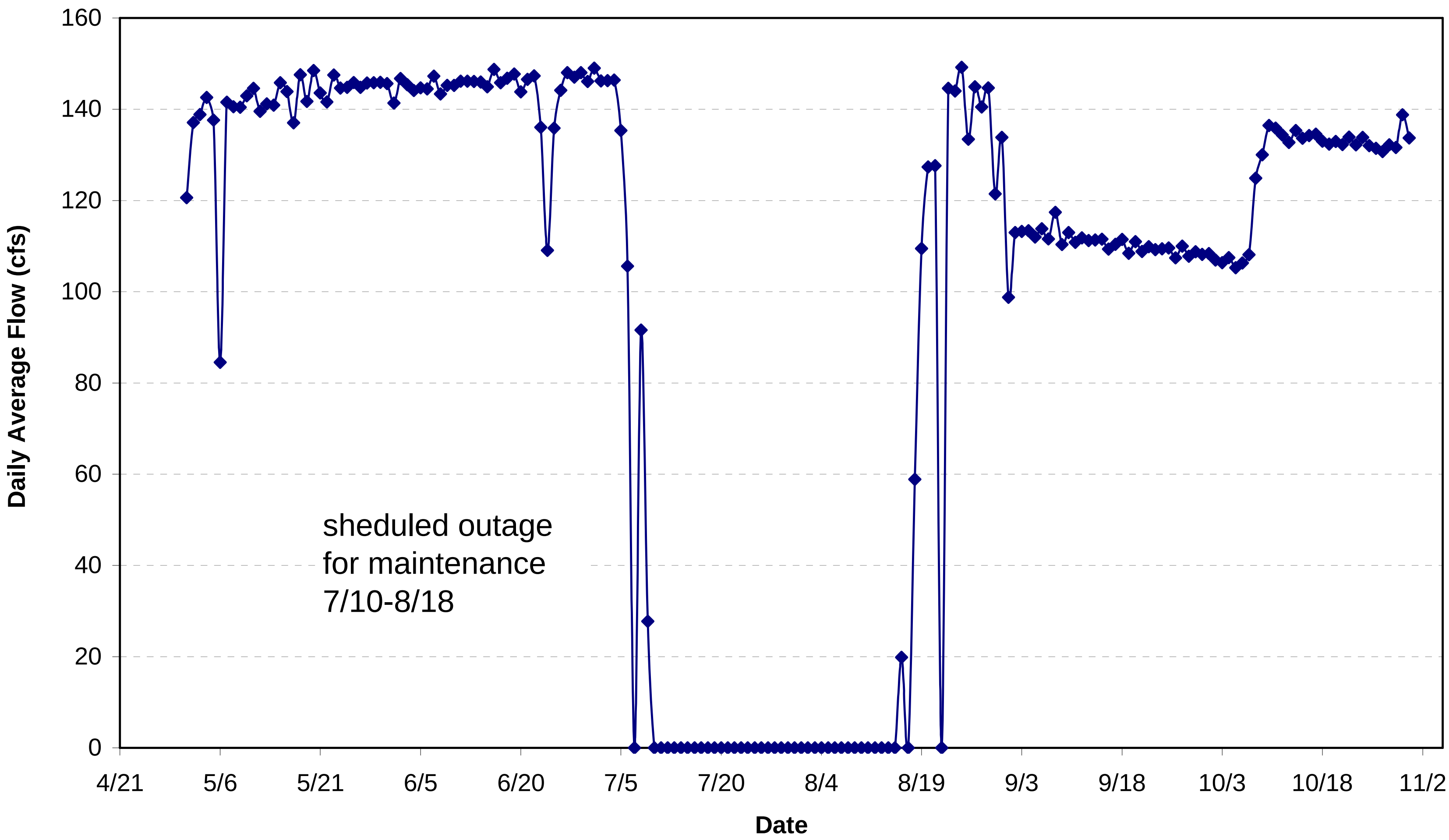

W1
Browns Creek Canal at Bass Lake
Daily Average Flow (cfs)
0
10
20
30
40
50
60
70
80
Seasonal ditch
4/21
5/6
5/21
6/5
6/20
7/5
7/20
8/4
8/19
9/3
9/18
10/3
10/18
11/2
Date

026.11.05.24

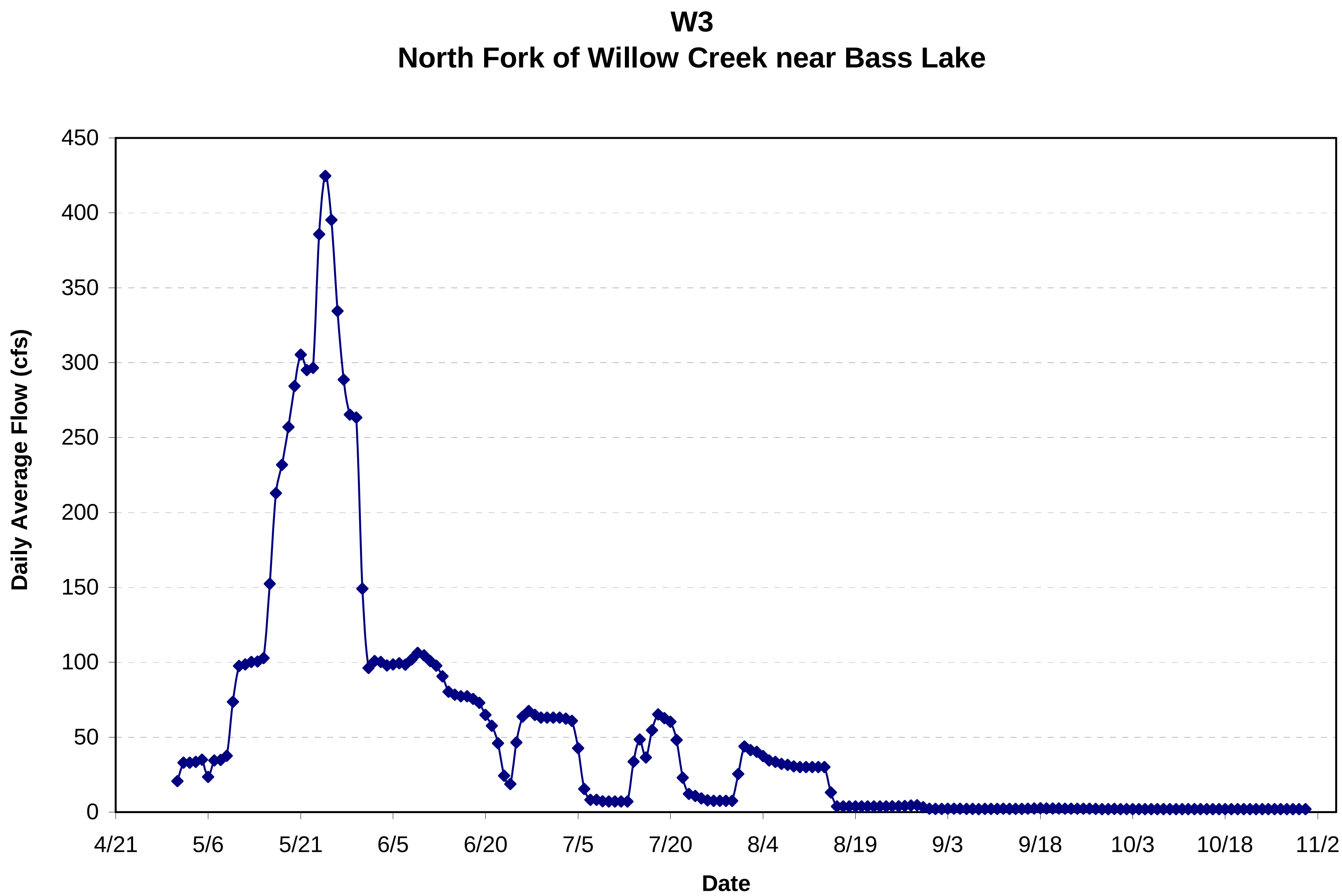

W2
Bass Lake Storage
Daily Average Storage (TAF)
50
45
40
35
30
25
20
15
10
5
0
4/21
5/6
5/21
6/5
6/20
7/5
7/20
8/4
8/19
9/3
9/18
10/3
10/18
11/2
Date

026.11.05.24

## W19
## Crane Valley Powerhouse

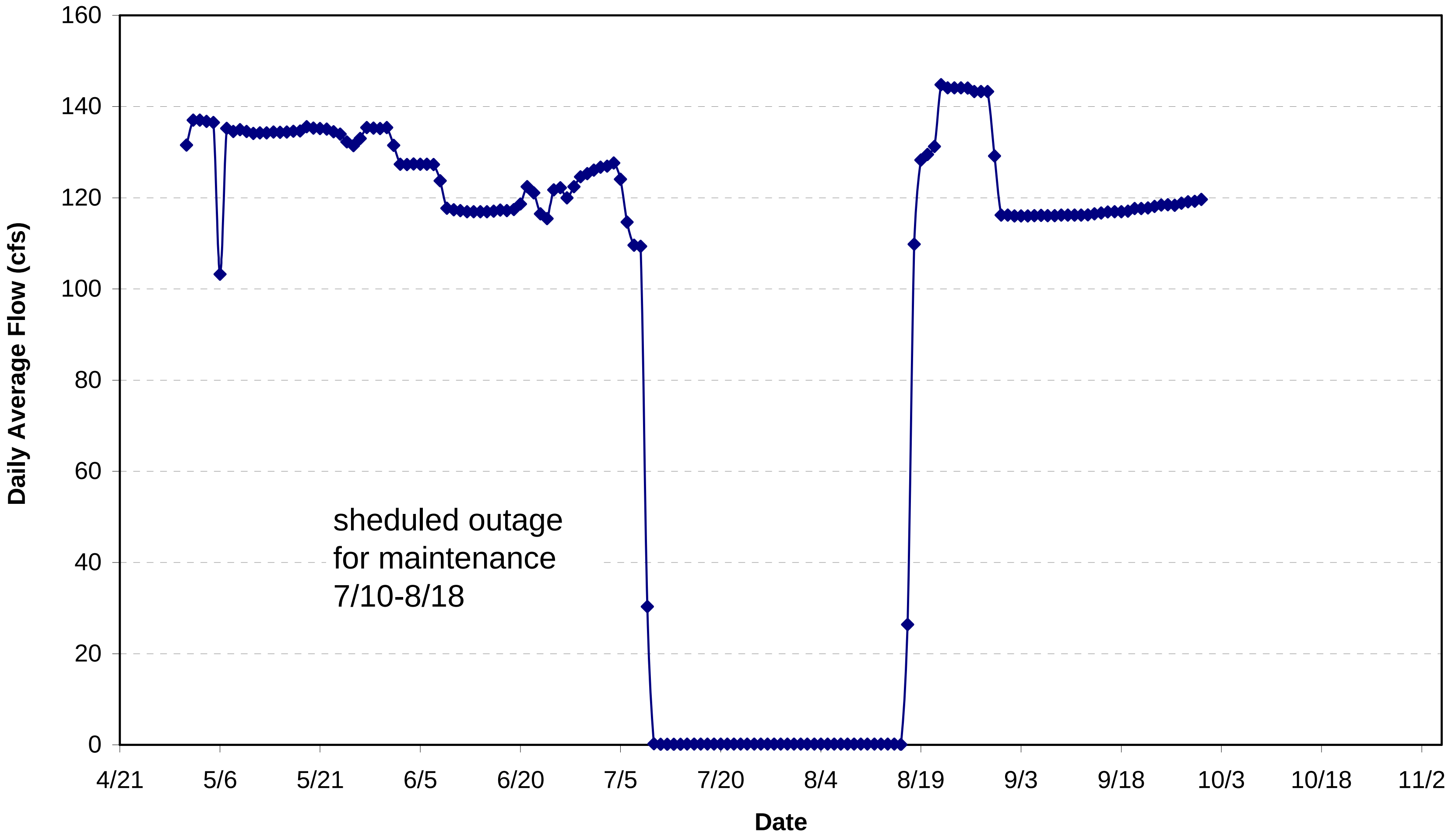



026.11.05.24


W3
North Fork of Willow Creek near Bass Lake
Daily Average Flow (cfs)
450
400
350
300
250
200
150
100
50
0
4/21
5/6
5/21
6/5
6/20
7/5
7/20
8/4
8/19
9/3
9/18
10/3
10/18
11/2
Date

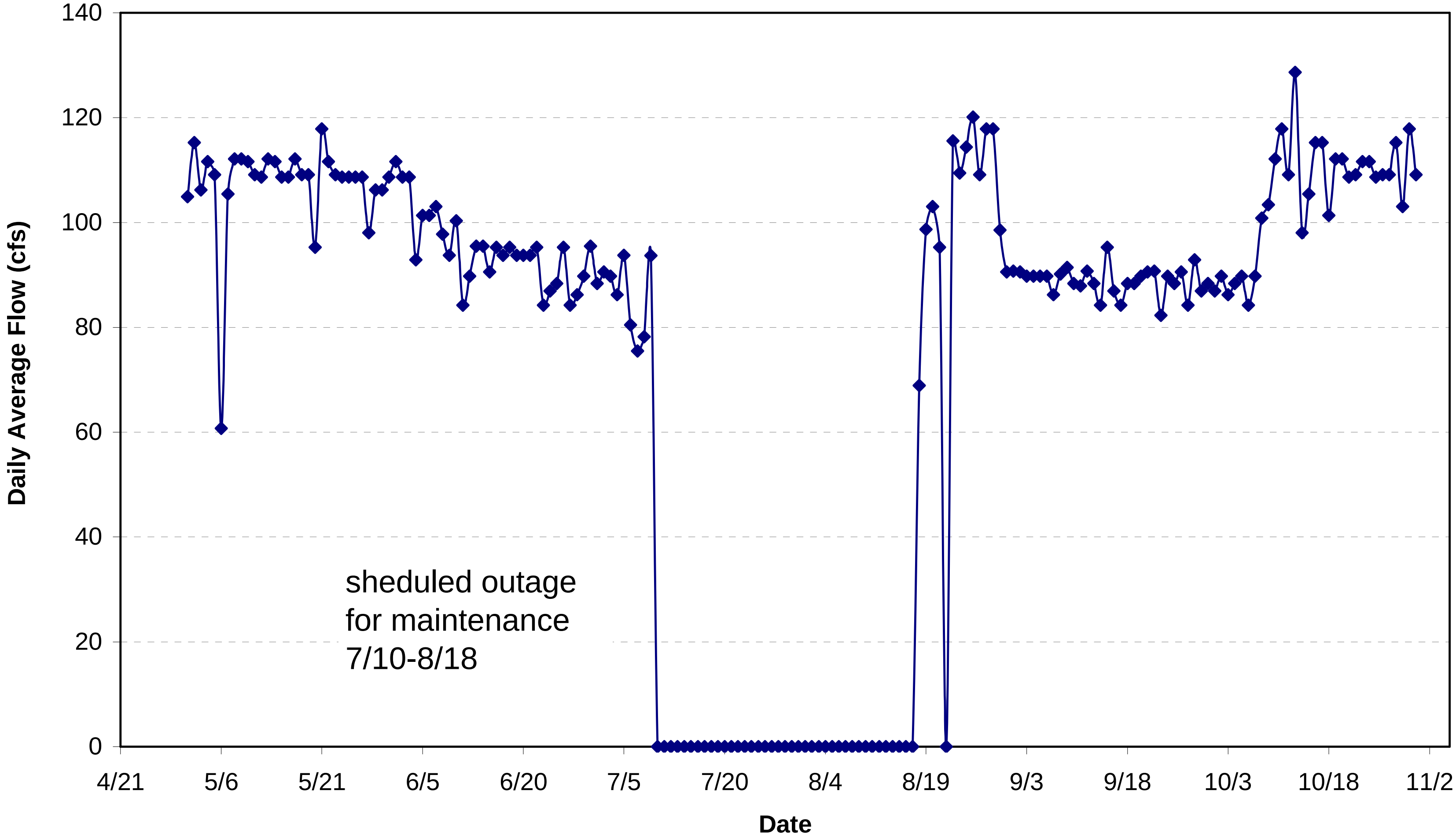
026.11.05.24

# W4
# Conduit #3 Near Bass Lake

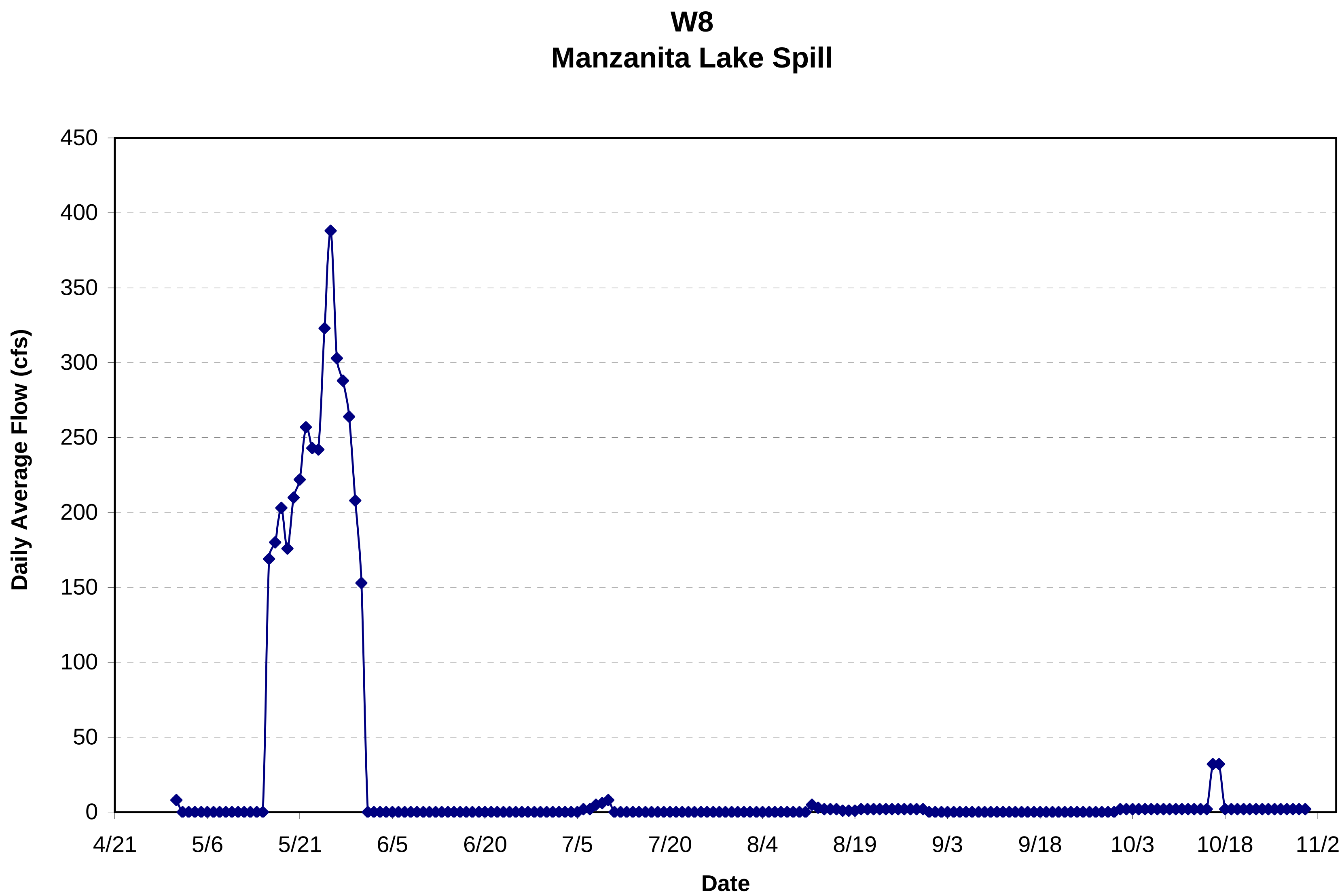



026.11.05.24

# W6
## San Joaquin #3 Powerhouse



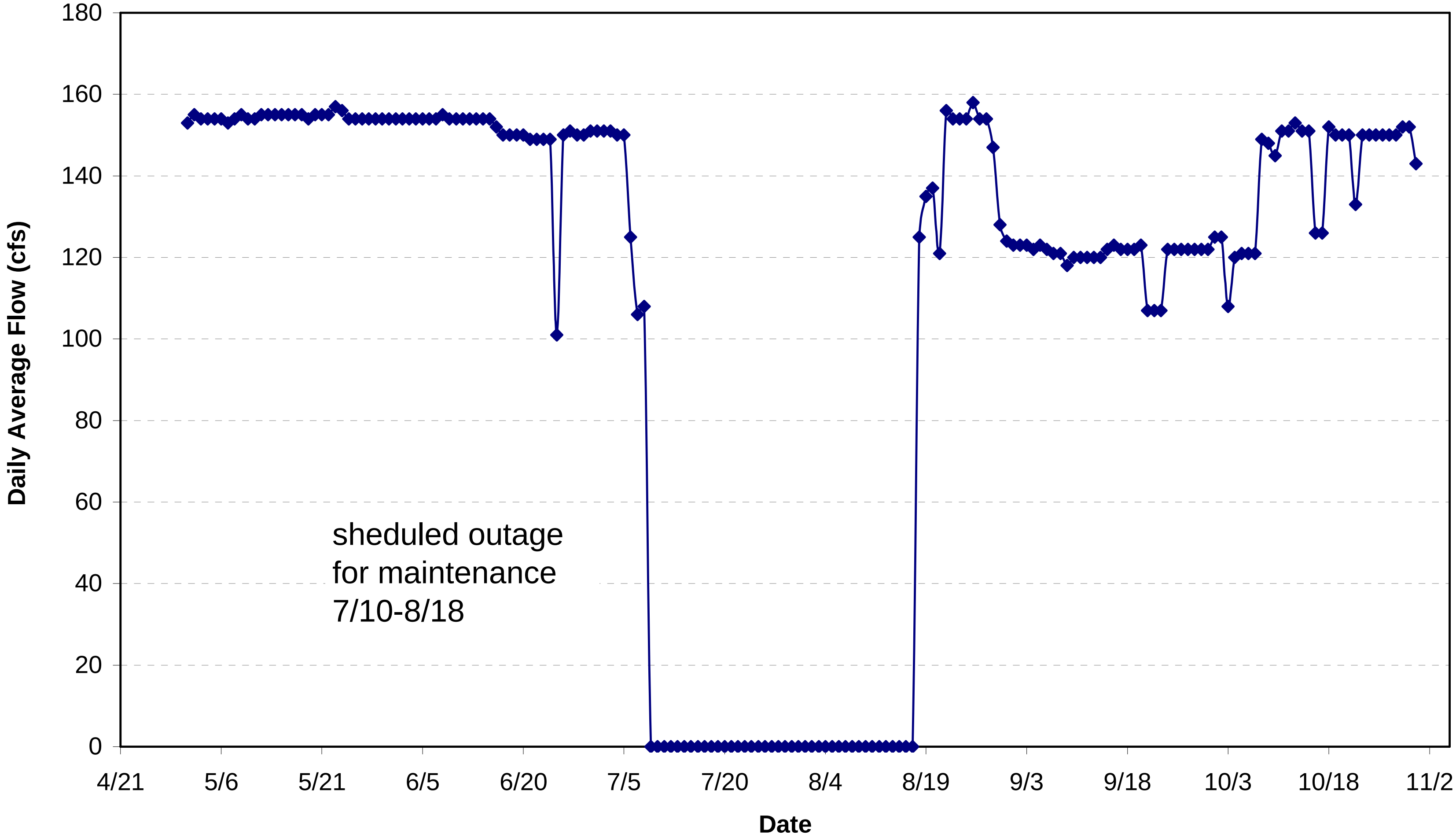

026.11.05.24



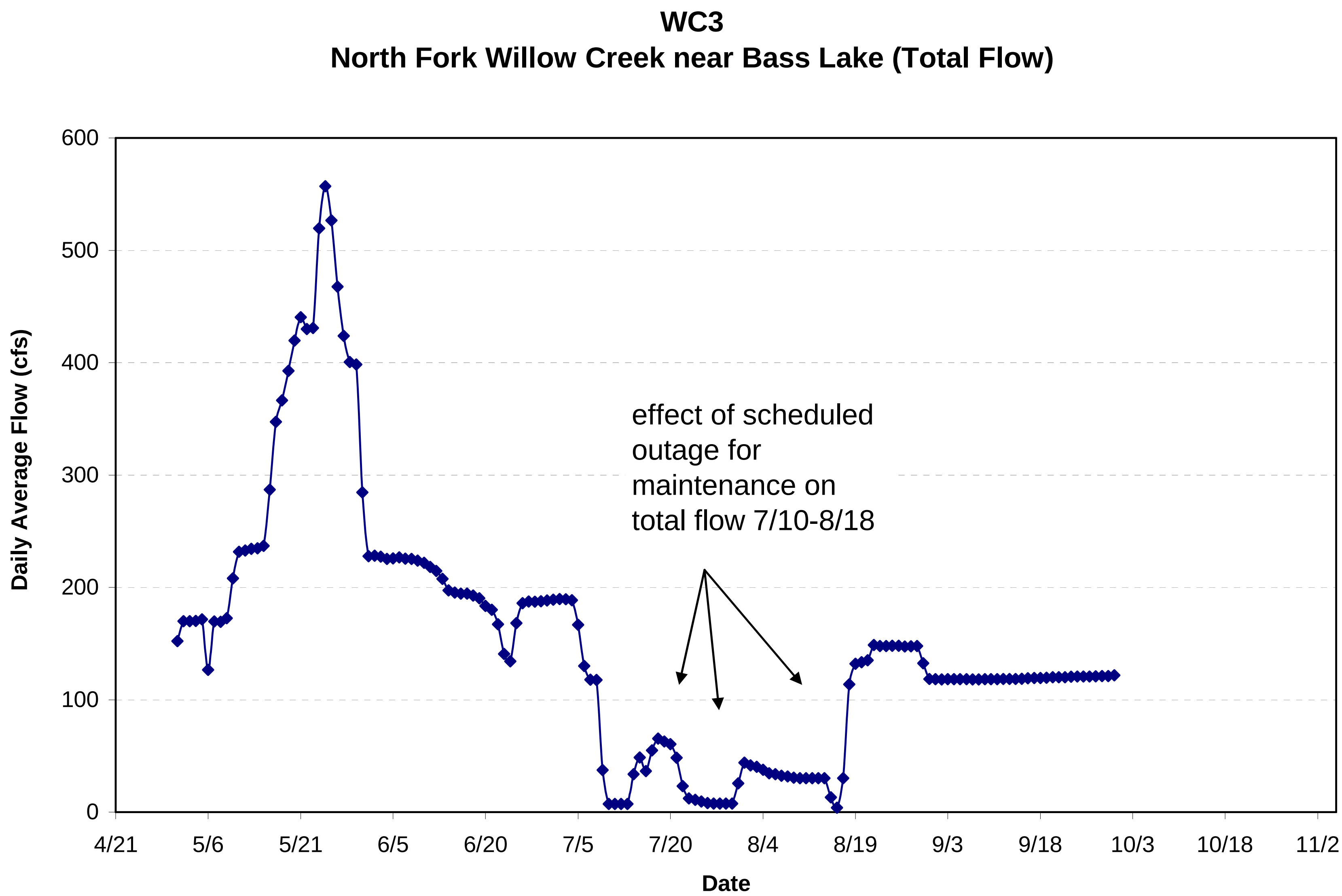
W8
Manzanita Lake Spill
Daily Average Flow (cfs)
450
400
350
300
250
200
150
100
50
0
4/21
5/6
5/21
6/5
6/20
7/5
7/20
8/4
8/19
9/3
9/18
10/3
10/18
11/2
Date


026.11.05.24

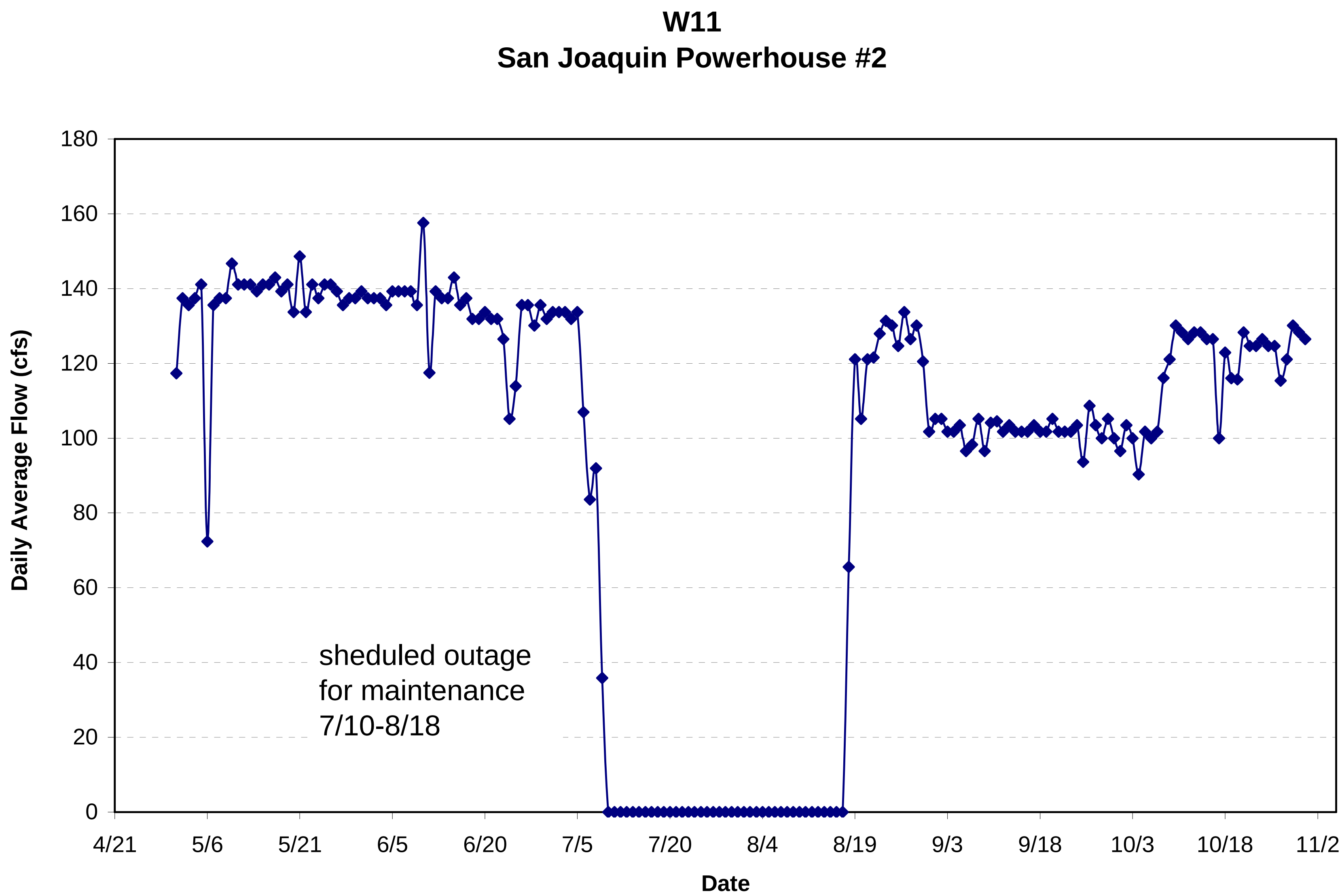
# W9
# #2 Conduit



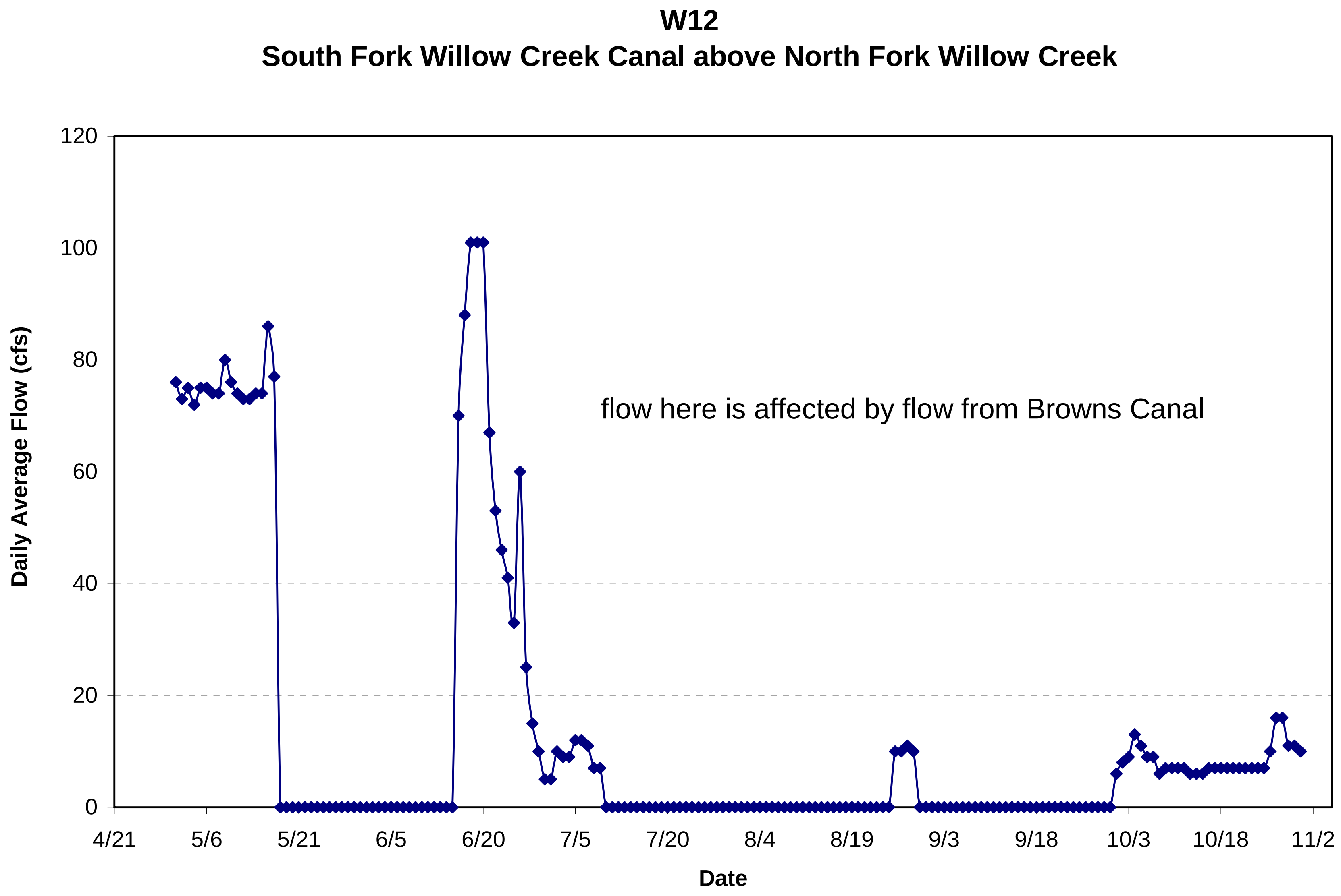
180
160
140
120
100
80
60
40
20
0
Daily Average Flow (cfs)
4/21
5/6
5/21
6/5
6/20
7/5
7/20
8/4
8/19
9/3
9/18
10/3
10/18
11/2
Date
sheduled outage
for maintenance
7/10-8/18


WC3
North Fork Willow Creek near Bass Lake (Total Flow)
Daily Average Flow (cfs)
600
500
400
300
200
100
0
4/21
5/6
5/21
6/5
6/20
7/5
7/20
8/4
8/19
9/3
9/18
10/3
10/18
11/2
Date
effect of scheduled outage for maintenance on total flow 7/10-8/18

026.11.05.24

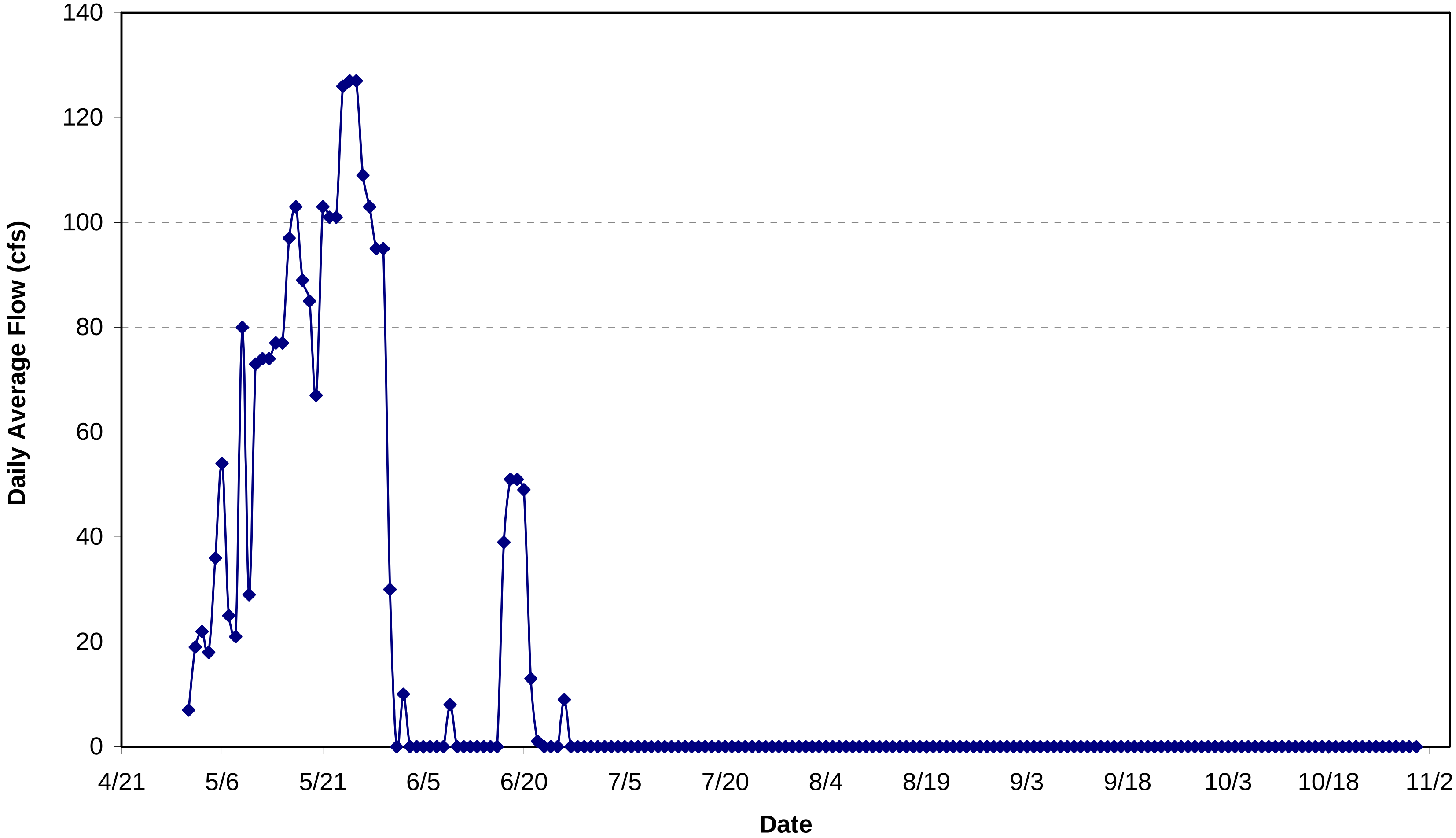

W11
San Joaquin Powerhouse #2
Daily Average Flow (cfs)
180
160
140
120
100
80
60
40
20
0
sheduled outage
for maintenance
7/10-8/18
4/21
5/6
5/21
6/5
6/20
7/5
7/20
8/4
8/19
9/3
9/18
10/3
10/18
11/2
Date

026.11.05.24


W12
South Fork Willow Creek Canal above North Fork Willow Creek
Daily Average Flow (cfs)
0
20
40
60
80
100
120
4/21
5/6
5/21
6/5
6/20
7/5
7/20
8/4
8/19
9/3
9/18
10/3
10/18
11/2
Date
flow here is affected by flow from Browns Canal

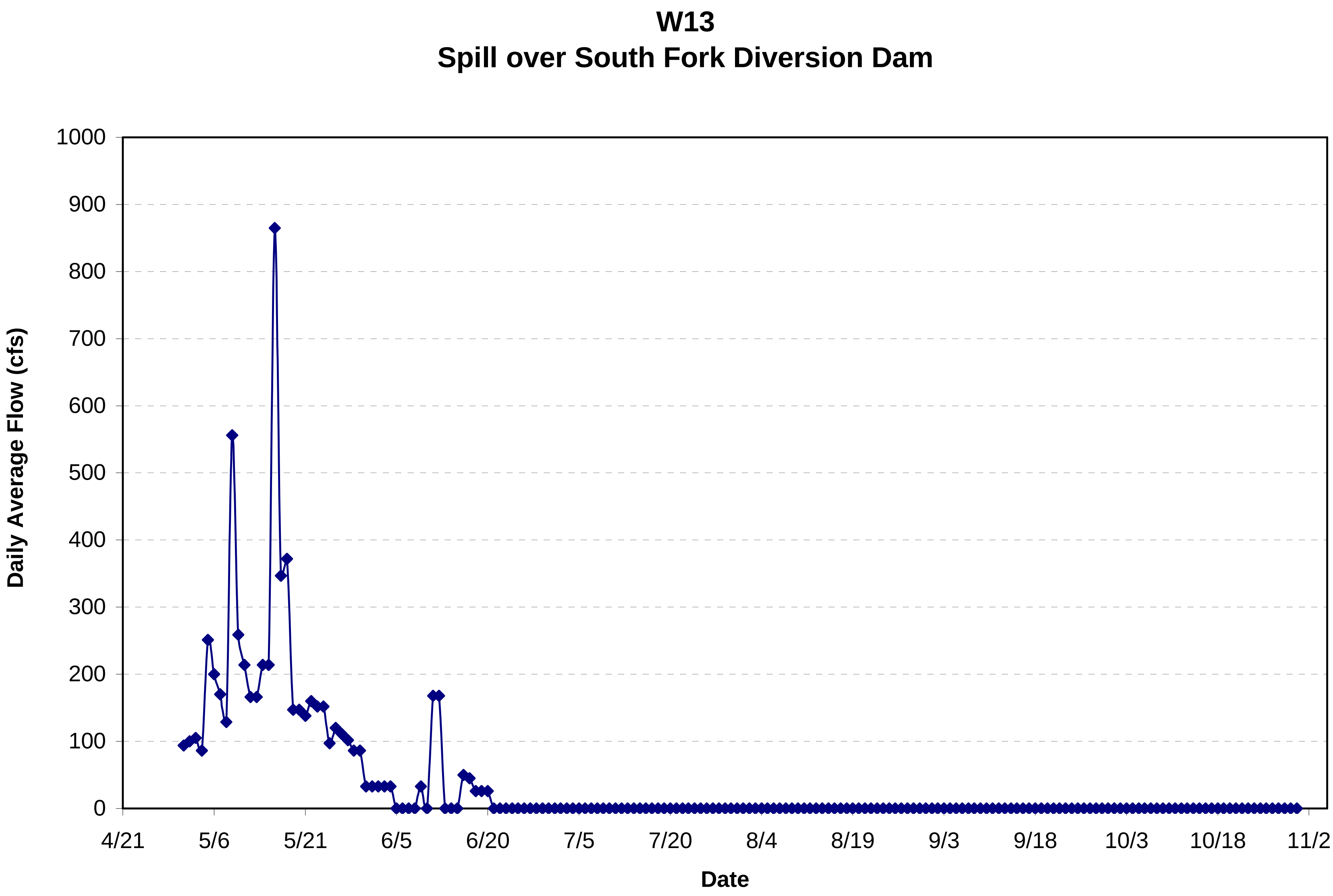
026.11.05.24

# W15
# Spill over North Fork Diversion Dam



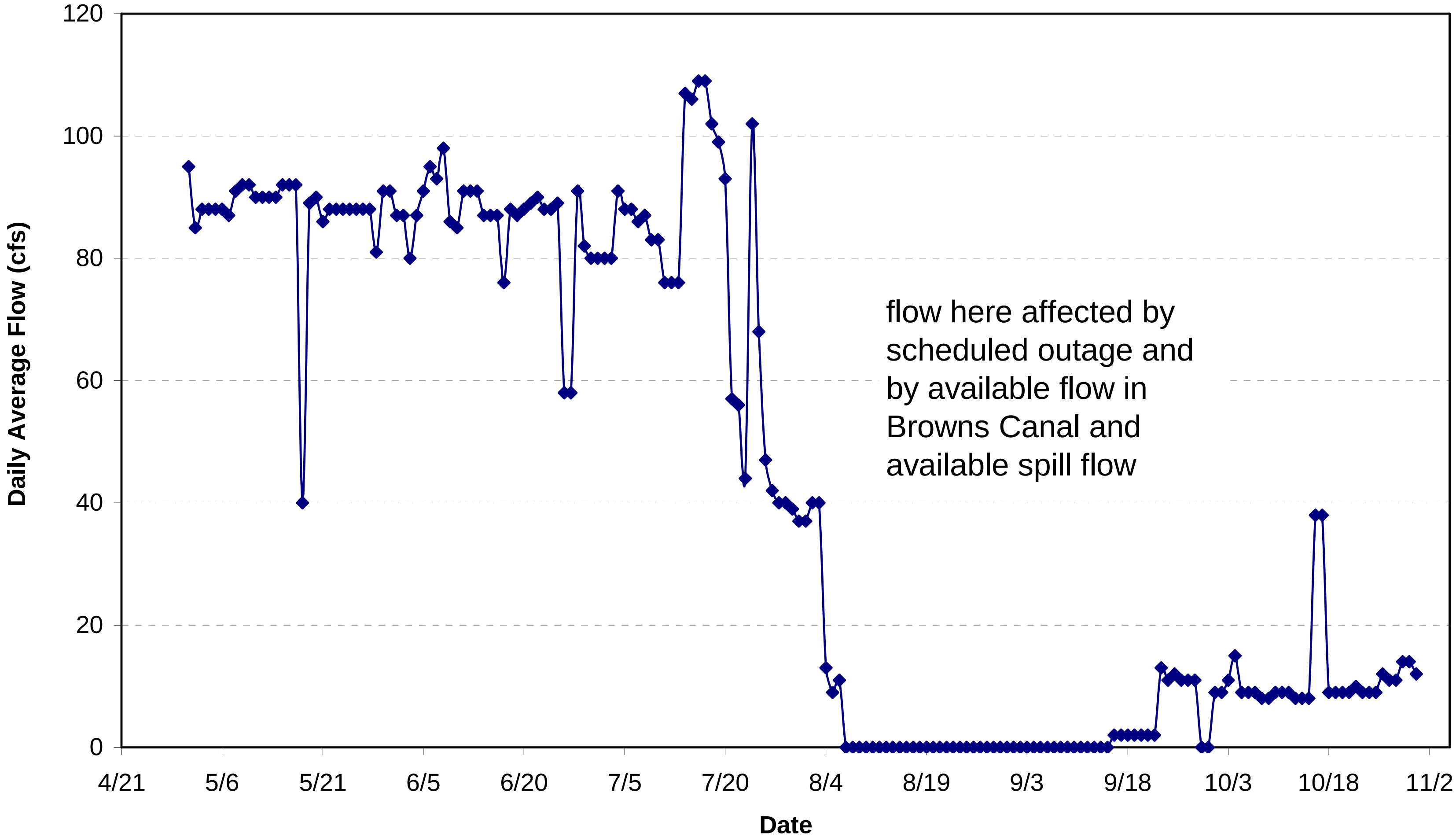

TES

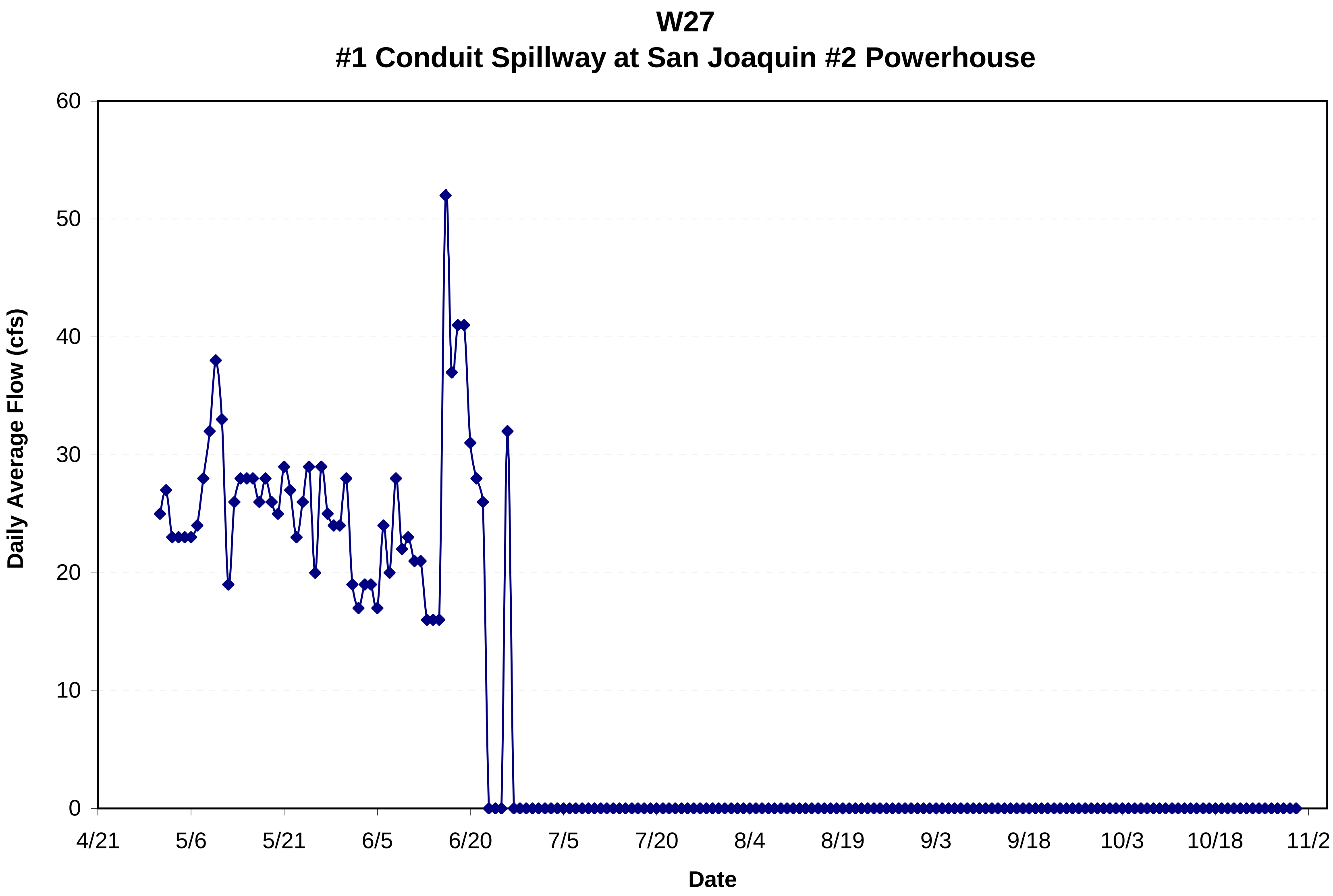
026.11.05.24


W13
Spill over South Fork Diversion Dam
Daily Average Flow (cfs)
1000
900
800
700
600
500
400
300
200
100
0
4/21
5/6
5/21
6/5
6/20
7/5
7/20
8/4
8/19
9/3
9/18
10/3
10/18
11/2
Date

026.11.05.24

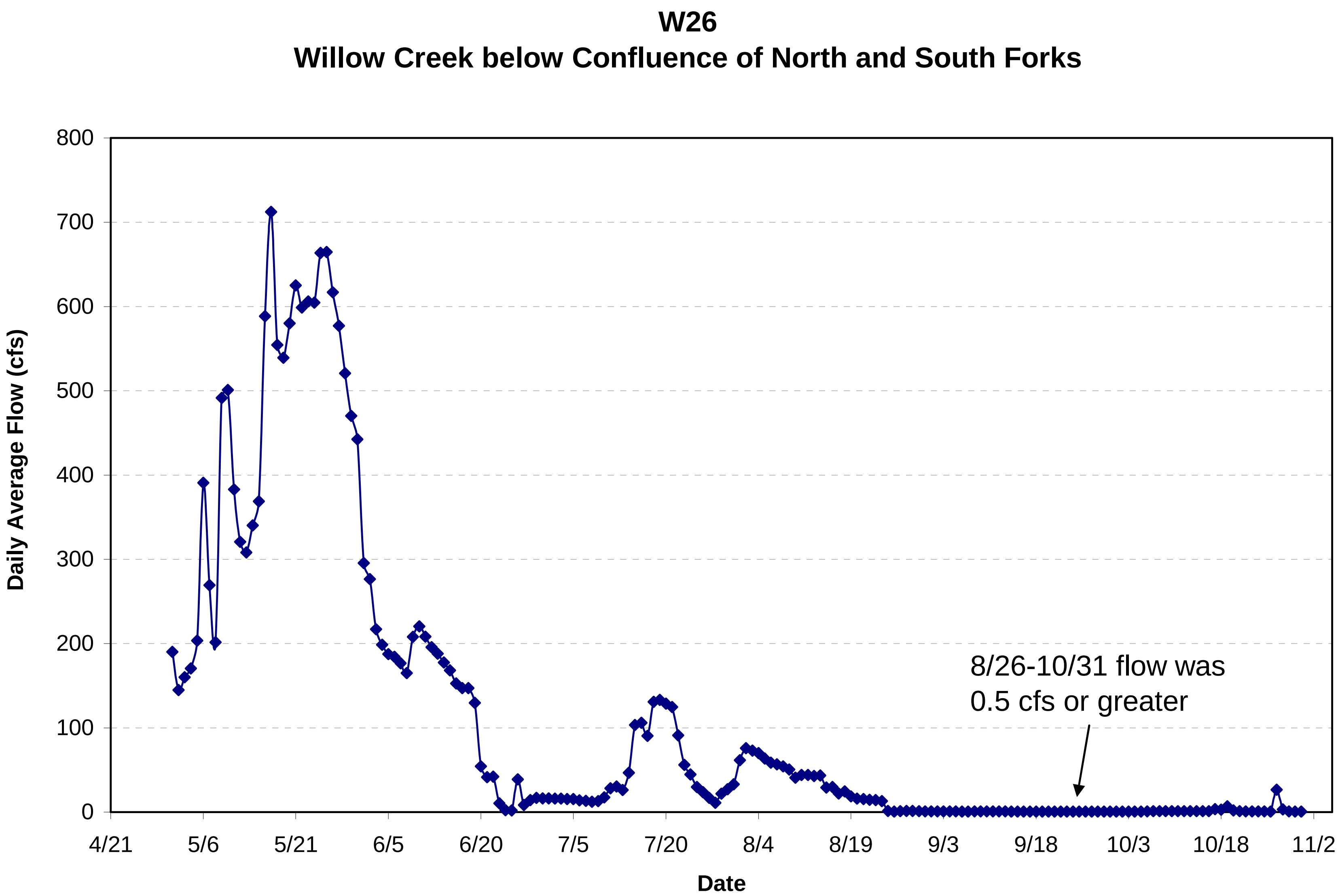
**W14**
**Willow Creek Diversion to #1 Conduit**



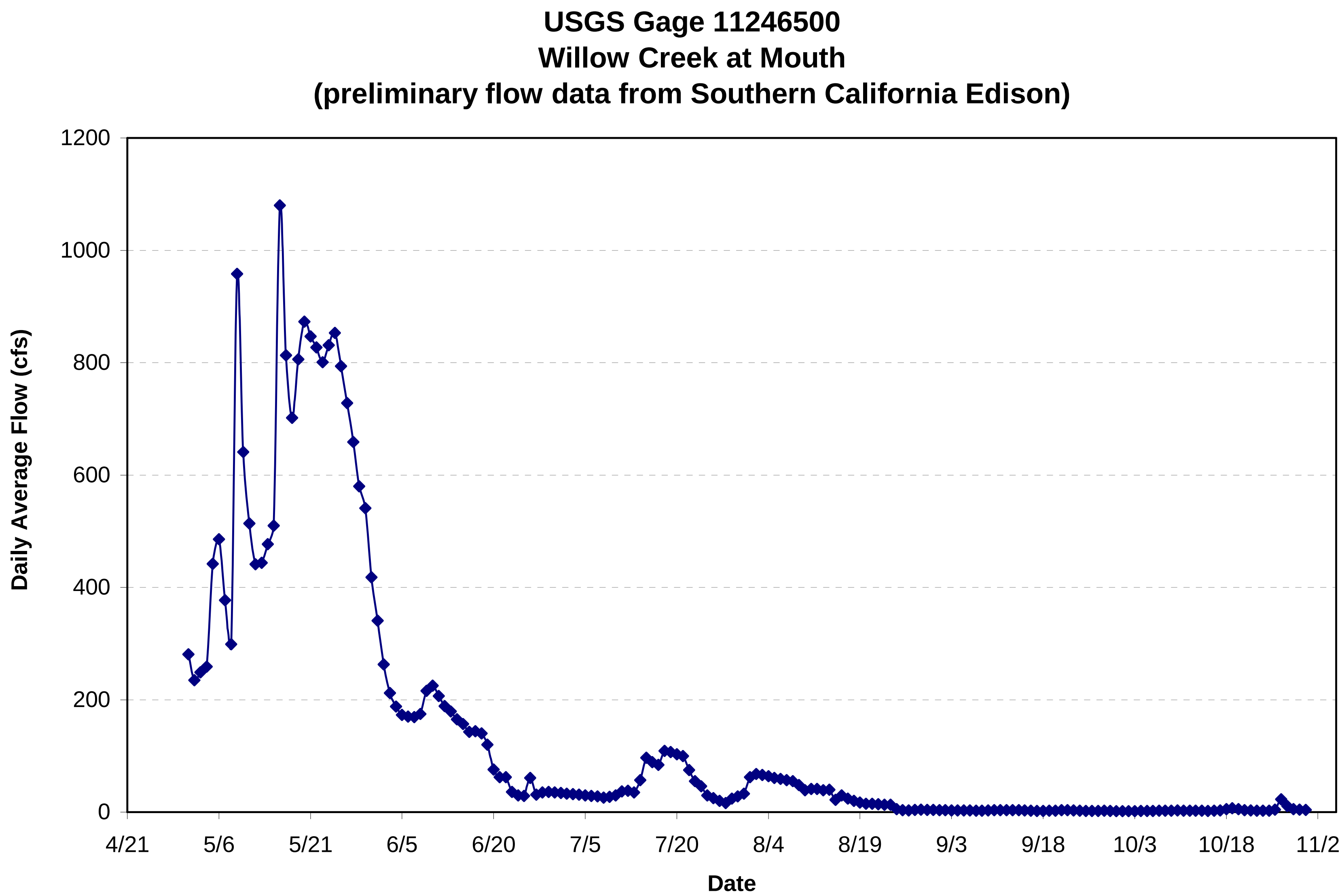


W27
#1 Conduit Spillway at San Joaquin #2 Powerhouse
Daily Average Flow (cfs)
60
50
40
30
20
10
0
4/21
5/6
5/21
6/5
6/20
7/5
7/20
8/4
8/19
9/3
9/18
10/3
10/18
11/2
Date


026.11.05.24

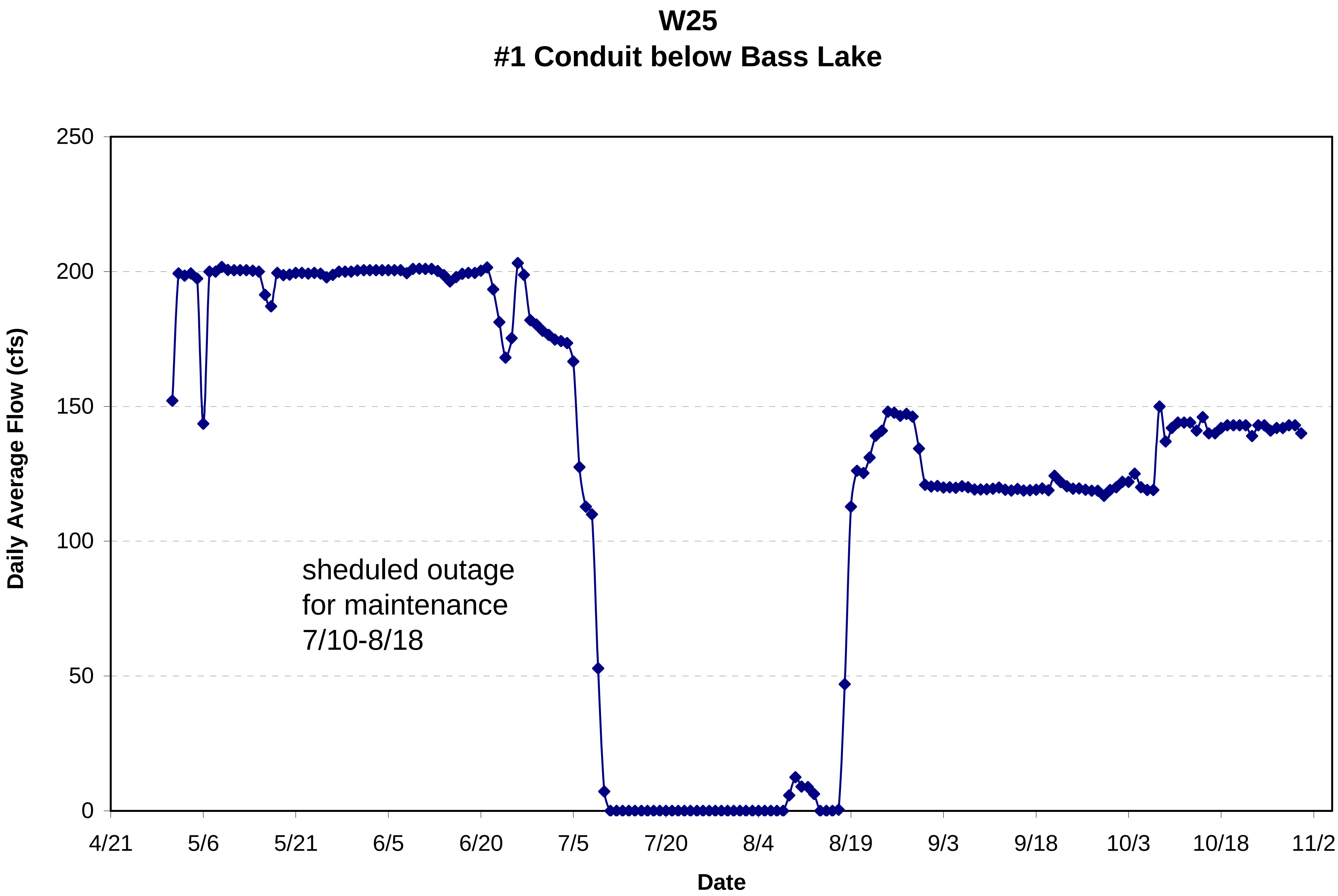

W26
Willow Creek below Confluence of North and South Forks
Daily Average Flow (cfs)
800
700
600
500
400
300
200
100
0
4/21
5/6
5/21
6/5
6/20
7/5
7/20
8/4
8/19
9/3
9/18
10/3
10/18
11/2
Date
8/26-10/31 flow was
0.5 cfs or greater

026.11.05.24



USGS Gage 11246500
Willow Creek at Mouth
(preliminary flow data from Southern California Edison)
Daily Average Flow (cfs)
0
200
400
600
800
1000
1200
4/21
5/6
5/21
6/5
6/20
7/5
7/20
8/4
8/19
9/3
9/18
10/3
10/18
11/2
Date

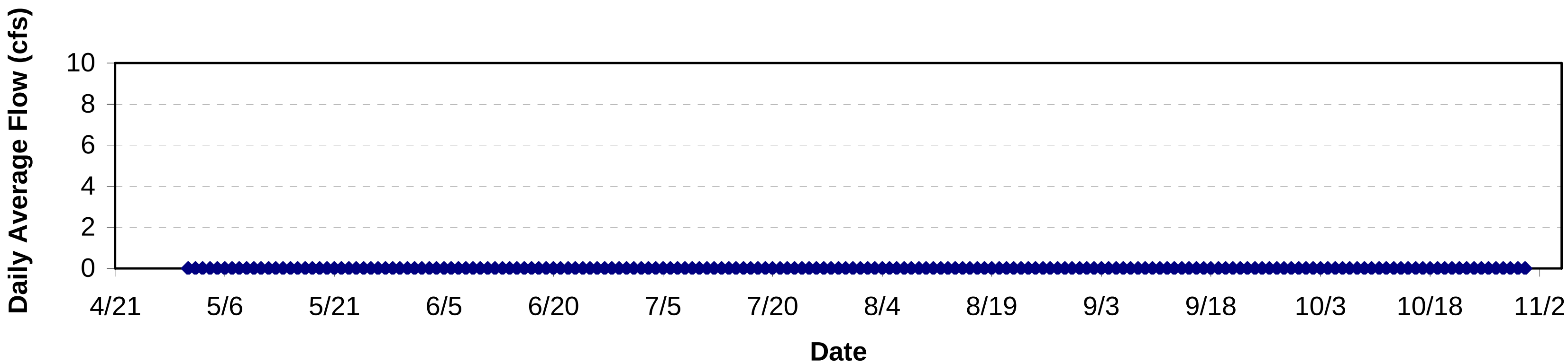

026.11.05.24


W25
#1 Conduit below Bass Lake
250
200
150
100
50
0
Daily Average Flow (cfs)
sheduled outage
for maintenance
7/10-8/18
4/21
5/6
5/21
6/5
6/20
7/5
7/20
8/4
8/19
9/3
9/18
10/3
10/18
11/2
Date

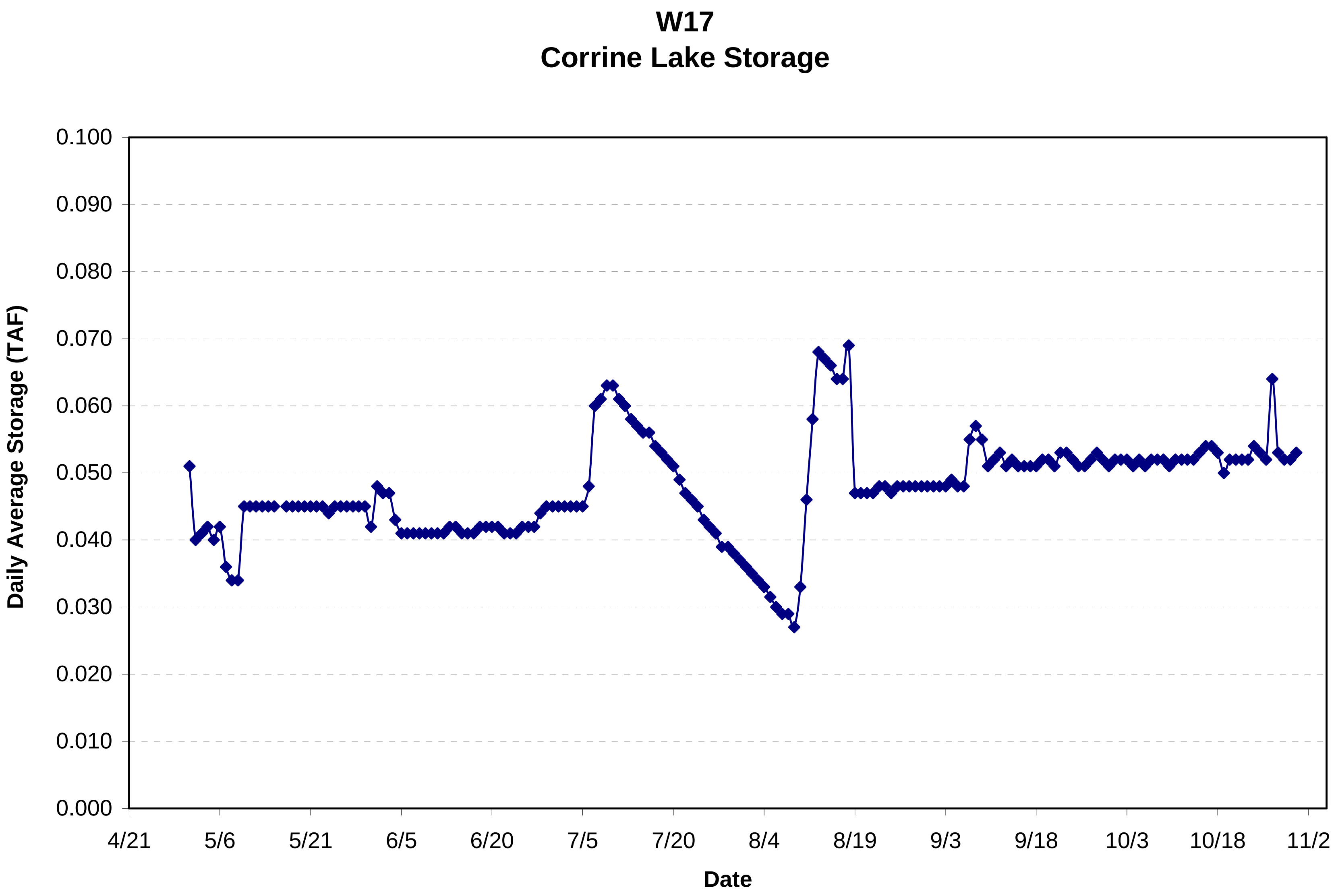
026.11.05.24

**W16**
**San Joaquin #1A Powerhouse**

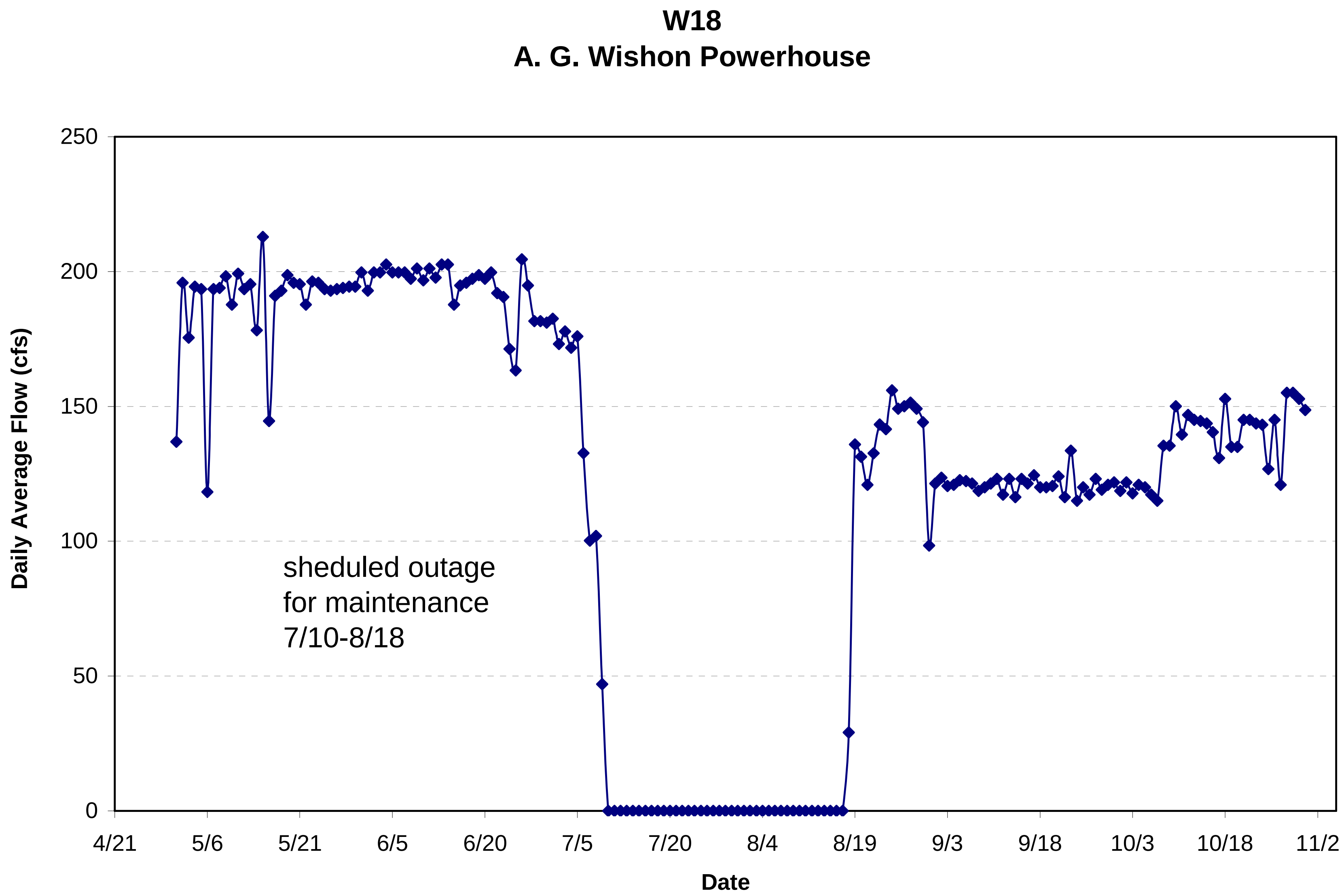
Flow was zero cfs during entire monitoring program




026.11.05.24


W17
Corrine Lake Storage
Daily Average Storage (TAF)
0.100
0.090
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
4/21
5/6
5/21
6/5
6/20
7/5
7/20
8/4
8/19
9/3
9/18
10/3
10/18
11/2
Date

026.11.05.24


W18
A. G. Wishon Powerhouse
Daily Average Flow (cfs)
250
200
150
100
50
0
4/21
5/6
5/21
6/5
6/20
7/5
7/20
8/4
8/19
9/3
9/18
10/3
10/18
11/2
Date
sheduled outage
for maintenance
7/10-8/18

026.11.05.24

## Appendix C

# Meteorological Data

| Daily average and daily maximum air temperatures from A.G. Wishon and Crane Valley powerhouses | | | | | |
|---|---|---|---|---|---|
| AG Wishon PH Daily Air Tempertaures (°C) | | | Crane Valley Daily Air Temperatures (°C) | | |
| Date | Daily Average | Daily Maximum | Date | Daily Average | Daily Maximum |
| 5/1/2005 | 16.7 | 25.0 | 5/1/2005 | 12.2 | 16.7 |
| 5/2/2005 | 16.3 | 25.6 | 5/2/2005 | 13.4 | 21.7 |
| 5/3/2005 | 16.7 | 26.1 | 5/3/2005 | 14.2 | 21.1 |
| 5/4/2005 | 16.7 | 25.0 | 5/4/2005 | 14.1 | 20.0 |
| 5/5/2005 | 12.7 | 13.9 | 5/5/2005 | 8.9 | 12.8 |
| 5/6/2005 | 13.7 | 20.6 | 5/6/2005 | 8.9 | 13.3 |
| 5/7/2005 | 14.0 | 22.2 | 5/7/2005 | 10.4 | 16.7 |
| 5/8/2005 | 14.6 | 22.2 | 5/8/2005 | 10.9 | 15.6 |
| 5/9/2005 | 11.5 | 15.0 | 5/9/2005 | 7.1 | 11.1 |
| 5/10/2005 | 10.8 | 18.3 | 5/10/2005 | 6.5 | 12.2 |
| 5/11/2005 | 13.8 | 22.8 | 5/11/2005 | 10.0 | 15.6 |
| 5/12/2005 | 16.7 | 27.2 | 5/12/2005 | 13.9 | 22.2 |
| 5/13/2005 | 18.6 | 30.0 | 5/13/2005 | 16.3 | 25.6 |
| 5/14/2005 | 20.0 | 30.6 | 5/14/2005 | 17.5 | 27.2 |
| 5/15/2005 | 21.1 | 30.6 | 5/15/2005 | 18.3 | 24.4 |
| 5/16/2005 | 16.7 | 23.9 | 5/16/2005 | 12.8 | 18.3 |
| 5/17/2005 | 15.4 | 24.4 | 5/17/2005 | 11.7 | 16.7 |
| 5/18/2005 | 19.2 | 28.9 | 5/18/2005 | 15.6 | 23.3 |
| 5/19/2005 | 20.0 | 31.1 | 5/19/2005 | 17.6 | 25.6 |
| 5/20/2005 | 17.0 | 23.9 | 5/20/2005 | 15.0 | 20.0 |
| 5/21/2005 | 19.1 | 28.3 | 5/21/2005 | 16.2 | 22.2 |
| 5/22/2005 | 20.9 | 33.9 | 5/22/2005 | 19.1 | 28.9 |
| 5/23/2005 | 21.3 | 31.1 | 5/23/2005 | 19.2 | 26.7 |
| 5/24/2005 | 22.3 | 32.8 | 5/24/2005 | 20.0 | 27.8 |
| 5/25/2005 | 23.8 | 36.1 | 5/25/2005 | 21.6 | 31.1 |
| 5/26/2005 | 23.9 | 36.1 | 5/26/2005 | 22.4 | 30.6 |
| 5/27/2005 | 23.3 | 34.4 | 5/27/2005 | 21.9 | 31.1 |
| 5/28/2005 | 21.1 | 30.0 | 5/28/2005 | 19.3 | 27.2 |
| 5/29/2005 | 16.6 | 25.6 | 5/29/2005 | 14.5 | 22.2 |
| 5/30/2005 | 18.3 | 28.9 | 5/30/2005 | 15.5 | 22.8 |
| 5/31/2005 | 21.9 | 33.3 | 5/31/2005 | 19.7 | 29.4 |
| 6/1/2005 | 22.1 | 32.2 | 6/1/2005 | 19.7 | 27.8 |
| 6/2/2005 | 19.9 | 30.6 | 6/2/2005 | 18.1 | 26.7 |
| 6/3/2005 | 19.4 | 31.7 | 6/3/2005 | 17.8 | 26.1 |
| 6/4/2005 | 20.7 | 31.1 | 6/4/2005 | 19.2 | 28.9 |
| 6/5/2005 | 17.8 | 27.2 | 6/5/2005 | 15.7 | 22.8 |
| 6/6/2005 | 14.9 | 23.9 | 6/6/2005 | 12.5 | 20.6 |
| 6/7/2005 | 15.1 | 26.1 | 6/7/2005 | 12.8 | 21.7 |
| 6/8/2005 | 16.0 | 25.0 | 6/8/2005 | 13.4 | 20.6 |
| 6/9/2005 | 18.0 | 23.9 | 6/9/2005 | 14.4 | 20.0 |
| 6/10/2005 | 20.4 | 29.4 | 6/10/2005 | 16.3 | 22.2 |
| 6/11/2005 | 20.7 | 30.6 | 6/11/2005 | 17.5 | 25.6 |
| 6/12/2005 | 22.0 | 33.9 | 6/12/2005 | 19.7 | 28.9 |
| 6/13/2005 | 23.7 | 36.7 | 6/13/2005 | 21.8 | 31.1 |
| 6/14/2005 | 24.7 | 36.7 | 6/14/2005 | 22.4 | 32.8 |
| 6/15/2005 | 23.1 | 34.4 | 6/15/2005 | 21.2 | 30.6 |

Daily average and daily maximum air temperatures from A.G. Wishon and Crane Valley powerhouses

| AG Wishon PH Daily Air Tempertaures (°C) | | | Crane Valley Daily Air Temperatures (°C) | | |
|---|---|---|---|---|---|
| Date | Daily Average | Daily Maximum | Date | Daily Average | Daily Maximum |
| 6/16/2005 | 20.5 | 28.3 | 6/16/2005 | 17.7 | 22.2 |
| 6/17/2005 | 15.5 | 21.7 | 6/17/2005 | 10.9 | 15.6 |
| 6/18/2005 | 16.3 | 25.6 | 6/18/2005 | 12.0 | 18.3 |
| 6/19/2005 | 18.4 | 30.0 | 6/19/2005 | 15.3 | 25.0 |
| 6/20/2005 | 20.5 | 32.2 | 6/20/2005 | 18.1 | 27.8 |
| 6/21/2005 | 21.5 | 32.8 | 6/21/2005 | 19.5 | 29.4 |
| 6/22/2005 | 21.7 | 32.8 | 6/22/2005 | 20.0 | 30.0 |
| 6/23/2005 | 22.6 | 34.4 | 6/23/2005 | 20.2 | 29.4 |
| 6/24/2005 | 21.7 | 33.9 | 6/24/2005 | 19.7 | 27.8 |
| 6/25/2005 | 21.3 | 31.1 | 6/25/2005 | 19.0 | 27.2 |
| 6/26/2005 | 21.3 | 32.8 | 6/26/2005 | 19.4 | 27.8 |
| 6/27/2005 | 22.0 | 32.8 | 6/27/2005 | 20.0 | 30.0 |
| 6/28/2005 | 21.3 | 31.1 | 6/28/2005 | 20.4 | 29.4 |
| 6/29/2005 | 24.0 | 36.1 | 6/29/2005 | 22.2 | 33.3 |
| 6/30/2005 | 25.7 | 37.8 | 6/30/2005 | 24.3 | 35.0 |
| 7/1/2005 | 26.5 | 37.2 | 7/1/2005 | 25.4 | 35.6 |
| 7/2/2005 | 26.5 | 37.2 | 7/2/2005 | 25.2 | 35.0 |
| 7/3/2005 | 25.7 | 36.7 | 7/3/2005 | 24.6 | 35.6 |
| 7/4/2005 | 25.2 | 36.7 | 7/4/2005 | 23.8 | 33.9 |
| 7/5/2005 | 25.6 | 36.1 | 7/5/2005 | 24.0 | 32.8 |
| 7/6/2005 | 25.6 | 35.0 | 7/6/2005 | 23.9 | 32.2 |
| 7/7/2005 | 26.0 | 35.6 | 7/7/2005 | 24.2 | 32.2 |
| 7/8/2005 | 24.7 | 35.0 | 7/8/2005 | 23.2 | 32.2 |
| 7/9/2005 | 23.5 | 33.3 | 7/9/2005 | 21.8 | 30.6 |
| 7/10/2005 | 23.4 | 33.3 | 7/10/2005 | 21.9 | 30.6 |
| 7/11/2005 | 25.5 | 35.6 | 7/11/2005 | 24.0 | 34.4 |
| 7/12/2005 | 27.8 | 38.9 | 7/12/2005 | 26.1 | 37.2 |
| 7/13/2005 | 28.7 | 41.1 | 7/13/2005 | 26.9 | 37.8 |
| 7/14/2005 | 29.0 | 41.1 | 7/14/2005 | 27.4 | 38.3 |
| 7/15/2005 | 29.2 | 40.0 | 7/15/2005 | 26.9 | 37.8 |
| 7/16/2005 | 30.6 | 41.7 | 7/16/2005 | 22.1 | 38.9 |
| 7/17/2005 | 30.6 | 42.8 | 7/17/2005 | 28.9 | 38.9 |
| 7/18/2005 | 30.3 | 41.7 | 7/18/2005 | 28.9 | 39.4 |
| 7/19/2005 | 29.3 | 40.6 | 7/19/2005 | 28.3 | 37.2 |
| 7/20/2005 | 29.8 | 41.1 | 7/20/2005 | 28.5 | 38.3 |
| 7/21/2005 | 31.0 | 39.4 | 7/21/2005 | 28.4 | 37.8 |
| 7/22/2005 | 28.5 | 36.7 | 7/22/2005 | 27.2 | 36.7 |
| 7/23/2005 | 28.0 | 40.0 | 7/23/2005 | 27.4 | 38.9 |
| 7/24/2005 | 28.3 | 40.6 | 7/24/2005 | 27.2 | 37.8 |
| 7/25/2005 | 26.8 | 39.4 | 7/25/2005 | 26.2 | 37.2 |
| 7/26/2005 | 26.9 | 40.0 | 7/26/2005 | 26.2 | 39.4 |
| 7/27/2005 | 28.1 | 40.6 | 7/27/2005 | 27.1 | 37.8 |
| 7/28/2005 | 28.1 | 39.4 | 7/28/2005 | 27.1 | 36.1 |
| 7/29/2005 | 27.6 | 38.9 | 7/29/2005 | 26.3 | 35.6 |
| 7/30/2005 | 28.0 | 39.4 | 7/30/2005 | 26.7 | 37.2 |
| 7/31/2005 | 28.3 | 39.4 | 7/31/2005 | 26.8 | 36.7 |

| Daily average and daily maximum air temperatures from A.G. Wishon and Crane Valley powerhouses | | | | | |
|---|---|---|---|---|---|
| AG Wishon PH Daily Air Tempertaures (°C) | | | Crane Valley Daily Air Temperatures (°C) | | |
| Date | Daily Average | Daily Maximum | Date | Daily Average | Daily Maximum |
| 8/1/2005 | 27.8 | 38.3 | 8/1/2005 | 26.2 | 36.1 |
| 8/2/2005 | 26.8 | 38.3 | 8/2/2005 | 25.5 | 37.2 |
| 8/3/2005 | 26.5 | 37.2 | 8/3/2005 | 25.1 | 35.0 |
| 8/4/2005 | 27.0 | 37.8 | 8/4/2005 | 25.8 | 36.1 |
| 8/5/2005 | 29.0 | 38.9 | 8/5/2005 | 27.2 | 38.3 |
| 8/6/2005 | 29.2 | 39.4 | 8/6/2005 | 27.1 | 36.7 |
| 8/7/2005 | 29.4 | 40.0 | 8/7/2005 | 27.6 | 38.9 |
| 8/8/2005 | 29.2 | 40.0 | 8/8/2005 | 27.1 | 37.2 |
| 8/9/2005 | 27.4 | 37.8 | 8/9/2005 | 26.8 | 37.8 |
| 8/10/2005 | 27.1 | 37.2 | 8/10/2005 | 25.9 | 36.1 |
| 8/11/2005 | 25.3 | 37.2 | 8/11/2005 | 24.6 | 36.1 |
| 8/12/2005 | 25.9 | 37.2 | 8/12/2005 | 25.0 | 34.4 |
| 8/13/2005 | 25.0 | 35.0 | 8/13/2005 | 23.9 | 32.8 |
| 8/14/2005 | 24.7 | 35.0 | 8/14/2005 | 22.9 | 30.6 |
| 8/15/2005 | 21.7 | 25.0 | 8/15/2005 | 17.8 | 20.0 |
| 8/16/2005 | 25.4 | 35.6 | 8/16/2005 | 22.5 | 33.3 |
| 8/17/2005 | 26.3 | 36.7 | 8/17/2005 | 23.5 | 32.8 |
| 8/18/2005 | 24.8 | 35.0 | 8/18/2005 | 23.1 | 32.8 |
| 8/19/2005 | 23.3 | 33.3 | 8/19/2005 | 22.1 | 31.7 |
| 8/20/2005 | 25.1 | 36.7 | 8/20/2005 | 23.5 | 33.9 |
| 8/21/2005 | 25.1 | 37.2 | 8/21/2005 | 24.0 | 35.0 |
| 8/22/2005 | 24.8 | 37.2 | 8/22/2005 | 23.4 | 33.3 |
| 8/23/2005 | 25.0 | 36.7 | 8/23/2005 | 24.0 | 33.3 |
| 8/24/2005 | 25.4 | 37.2 | 8/24/2005 | 23.5 | 33.3 |
| 8/25/2005 | 24.5 | 37.2 | 8/25/2005 | 22.9 | 32.8 |
| 8/26/2005 | 26.5 | 37.2 | 8/26/2005 | 24.6 | 35.6 |
| 8/27/2005 | 27.5 | 39.4 | 8/27/2005 | 25.1 | 36.1 |
| 8/28/2005 | 28.7 | 40.0 | 8/28/2005 | 25.6 | 37.2 |
| 8/29/2005 | 25.7 | 36.7 | 8/29/2005 | 24.1 | 34.4 |
| 8/30/2005 | 22.1 | 33.9 | 8/30/2005 | 21.5 | 29.4 |
| 8/31/2005 | 23.5 | 36.1 | 8/31/2005 | 22.3 | 32.2 |
| 9/1/2005 | 24.2 | 36.7 | 9/1/2005 | 22.8 | 33.9 |
| 9/2/2005 | 24.2 | 37.2 | 9/2/2005 | 22.9 | 33.3 |
| 9/3/2005 | 23.5 | 36.1 | 9/3/2005 | 21.5 | 32.2 |
| 9/4/2005 | 22.2 | 33.9 | 9/4/2005 | 20.4 | 30.6 |
| 9/5/2005 | 21.6 | 33.3 | 9/5/2005 | 19.8 | 28.9 |
| 9/6/2005 | 22.1 | 35.0 | 9/6/2005 | 20.6 | 31.1 |
| 9/7/2005 | 22.3 | 34.4 | 9/7/2005 | 20.8 | 31.7 |
| 9/8/2005 | 20.7 | 30.6 | 9/8/2005 | 18.9 | 26.7 |
| 9/9/2005 | 18.6 | 27.2 | 9/9/2005 | 16.0 | 22.2 |
| 9/10/2005 | 18.0 | 27.2 | 9/10/2005 | 15.0 | 21.7 |
| 9/11/2005 | 16.5 | 26.1 | 9/11/2005 | 14.0 | 22.8 |
| 9/12/2005 | 16.5 | 27.8 | 9/12/2005 | 14.5 | 22.8 |
| 9/13/2005 | 17.0 | 27.8 | 9/13/2005 | 15.4 | 25.0 |
| 9/14/2005 | 18.2 | 29.4 | 9/14/2005 | 16.4 | 26.1 |
| 9/15/2005 | 19.2 | 31.7 | 9/15/2005 | 17.8 | 27.8 |

**Daily average and daily maximum air temperatures from A.G. Wishon and Crane Valley powerhouses**

| AG Wishon PH Daily Air Tempertaures (°C) | | | Crane Valley Daily Air Temperatures (°C) | | |
|---|---|---|---|---|---|
| Date | Daily Average | Daily Maximum | Date | Daily Average | Daily Maximum |
| 9/16/2005 | 18.6 | 29.4 | 9/16/2005 | 17.0 | 26.1 |
| 9/17/2005 | 17.1 | 27.2 | 9/17/2005 | 15.8 | 25.0 |
| 9/18/2005 | 17.0 | 27.2 | 9/18/2005 | 15.6 | 23.3 |
| 9/19/2005 | 20.1 | 34.4 | 9/19/2005 | 19.4 | 31.7 |
| 9/20/2005 | 21.0 | 31.7 | 9/20/2005 | 18.8 | 26.7 |
| 9/21/2005 | 21.3 | 30.0 | 9/21/2005 | 17.5 | 26.1 |
| 9/22/2005 | 22.1 | 32.2 | 9/22/2005 | 19.5 | 29.4 |
| 9/23/2005 | 21.5 | 31.7 | 9/23/2005 | 18.5 | 26.7 |
| 9/24/2005 | 16.8 | 25.6 | 9/24/2005 | 15.0 | 21.7 |
| 9/25/2005 | 18.6 | 29.4 | 9/25/2005 | 16.7 | 26.1 |
| 9/26/2005 | 20.5 | 28.3 | 9/26/2005 | 17.5 | 21.1 |
| 9/27/2005 | 19.8 | 29.4 | 9/27/2005 | 17.3 | 25.6 |
| 9/28/2005 | 19.2 | 32.8 | 9/28/2005 | 19.3 | 27.8 |
| 9/29/2005 | 21.1 | 35.6 | 9/29/2005 | 19.9 | 31.1 |
| 9/30/2005 | 22.1 | 35.0 | 9/30/2005 | 20.7 | 32.2 |
| 10/1/2005 | 22.1 | 33.3 | 10/1/2005 | 19.3 | 28.9 |
| 10/2/2005 | 17.7 | 25.0 | 10/2/2005 | 14.9 | 20.6 |
| 10/3/2005 | 13.8 | 23.3 | 10/3/2005 | 11.7 | 20.0 |
| 10/4/2005 | 12.1 | 23.3 | 10/4/2005 | 10.8 | 18.9 |
| 10/5/2005 | 14.1 | 26.1 | 10/5/2005 | 13.7 | 23.9 |
| 10/6/2005 | 16.4 | 29.4 | 10/6/2005 | 16.2 | 27.2 |
| 10/7/2005 | 17.3 | 32.8 | 10/7/2005 | 16.9 | 27.2 |
| 10/8/2005 | 15.4 | 23.9 | 10/8/2005 | 13.6 | 20.6 |
| 10/9/2005 | 13.7 | 25.0 | 10/9/2005 | 12.2 | 21.7 |
| 10/10/2005 | 15.2 | 29.4 | 10/10/2005 | 14.0 | 23.9 |
| 10/11/2005 | 16.5 | 29.4 | 10/11/2005 | 15.5 | 25.6 |
| 10/12/2005 | 16.6 | 28.3 | 10/12/2005 | 16.1 | 25.6 |
| 10/13/2005 | 18.2 | 32.2 | 10/13/2005 | 17.4 | 28.3 |
| 10/14/2005 | 19.1 | 33.9 | 10/14/2005 | 17.7 | 28.9 |
| 10/15/2005 | 13.1 | 20.6 | 10/15/2005 | 10.5 | 16.1 |
| 10/16/2005 | 14.0 | 27.2 | 10/16/2005 | 13.7 | 24.4 |
| 10/17/2005 | 16.2 | 27.8 | 10/17/2005 | 17.9 | 22.8 |
| 10/18/2005 | 16.5 | 21.7 | 10/18/2005 | 13.1 | 15.6 |
| 10/19/2005 | 16.0 | 24.4 | 10/19/2005 | 13.5 | 20.0 |
| 10/20/2005 | 13.9 | 22.8 | 10/20/2005 | 11.8 | 20.0 |
| 10/21/2005 | 15.3 | 27.2 | 10/21/2005 | 14.5 | 25.6 |
| 10/22/2005 | 15.4 | 27.2 | 10/22/2005 | 15.3 | 25.6 |
| 10/23/2005 | 16.2 | 28.3 | 10/23/2005 | 15.3 | 26.1 |
| 10/24/2005 | 17.8 | 28.9 | 10/24/2005 | 16.5 | 26.7 |
| 10/25/2005 | 16.2 | 22.8 | 10/25/2005 | 13.2 | 17.8 |
| 10/26/2005 | 14.1 | 22.8 | 10/26/2005 | 11.4 | 18.9 |
| 10/27/2005 | 11.5 | 12.8 | 10/27/2005 | 8.6 | 10.0 |
| 10/28/2005 | 14.1 | 21.1 | 10/28/2005 | 10.1 | 14.4 |
| 10/29/2005 | 13.0 | 22.2 | 10/29/2005 | 10.5 | 18.3 |
| 10/30/2005 | 12.6 | 21.1 | 10/30/2005 | 11.1 | 20.0 |
| 10/31/2005 | 13.1 | 24.4 | 10/31/2005 | 12.3 | 22.8 |

## Appendix D

## Water Quality and Temperature Equipment QA/QC Documentation

# IDRONAUT Srl

Via Monte Amiata, 10 I-20047 BRUGHERIO (MI) ITALY
Tel. +39 039879656 / 039883832 Fax. +39 039883382
**E-mail:** idronaut@idronaut.it **Web**: www.idronaut.it

## CERTIFICATE OF CALIBRATION

| | | | |
|---|---|---|---|
| **Model:** | Probe 304 | **Serial No.** | 0505065 |
| **Calibration date** | 7 June 2005 | **Client : Pacific Gas & Electric USA** | |
| **Next Calibration date** | | **End User:** | |

This is to certify that the equipment has been calibrated and is within the manufacturers specified accuracy.
Calibration results where appropriate are shown on the attached sheets
The equipment used for calibration was as follows:

| Item | Model n° | Serial n° |
|---|---|---|
| Automatic thermometer bridge plus conductivity/ salinity adaptor | ATB1250<br>CSA1250 | 10072<br>10072 |
| Pt 25 Hart Scientific | 5680 | 5680 |
| Dead weight tester Budenberg | 580DX | 26947 |

All the above equipment is within the manufacturers recommended calibration period and is traceable to the national standards except where no such standards exists.

| | | | |
|---|---|---|---|
| **Calibration Engineer signature** | Lorenzini Davide<br>**Lorenzini Davide** | **Date:** | **07-06-05** |
| **Quality control Engineer signature** | **Confalonieri Fabio**<br>Confalonieri | **Date:** | **07-06-05** |

| Calibration date : 7 June 2005 | | | | |
|---|---|---|---|---|
| Model : IDRONAUT Pt 100 | | | Measurement range | -5 +35 °C |
| Data point | Temp.Observed ( deg °C ) | Temp.Observed ( counts ) | TempCalculated ( deg °C ) | Temp. Error ( deg °C ) |
| 1 | -0.1582 | 6539 | -0.1606 | -0.0024 |
| 2 | 4.1716 | 12142 | 4.1743 | +0.0027 |
| 3 | 8.2999 | 17455 | 8.3007 | +0.0008 |
| 4 | 12.3087 | 22601 | 12.3074 | -0.0013 |
| 5 | 16.2616 | 27663 | 16.2609 | -0.0007 |
| 6 | 20.1871 | 32672 | 20.1852 | -0.0019 |
| 7 | 24.1058 | 37666 | 24.1076 | +0.0018 |
| | | | | |
| **Maximum permitted Temp. Error = 0.005 deg°C** | | | a = -5.20352397 | |
| | | | b = 0.000769711666 | |
| **Calibration coefficients →** | | | c = 2.25132264e-10 | |

| Calibration date : 7 June 2005 | | | | | |
|---|---|---|---|---|---|
| Model : KELLER PA-10 *serial number* : TS 506 | | | Measurement range | | 10 bar |
| Data point | Pressure Applied ( bar ) | Press.Observed ( counts ) | Press.Calculated ( bar ) | Press.error ( bar ) | Press.error ( % FSR ) |
| 1 | 2.0000 | 12023 | 1.9966 | -0.0034 | -0.034 |
| 2 | 4.0000 | 23015 | 4.0010 | +0.001 | +0.01 |
| 3 | 6.0000 | 33969 | 6.0007 | +0.0007 | +0.007 |
| 4 | 8.0000 | 44914 | 8.0009 | +0.0009 | +0.009 |
| 5 | 10.0003 | 55837 | 9.9994 | -0.0009 | -0.009 |
| 6 | | | | | |
| 7 | | | | | |
| **Maximum permitted Depth. Error = 0.05% FSR** | | | a = -1.93263584 | | |
| | | | b = 0.00182025946 | | |
| **Calibration coefficients →** | | | c = 9.27170749e-11 | | |

# IDRONAUT Srl

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**I-20047 BRUGHERIO (MI) ITALY**
Fax. +39 039883382
**Web:** www.idronaut.it

## *CERTIFICATE OF CALIBRATION*

Model : Probe 304
Serial number : 1205072
Calibration date : 14 December 2005
Customer : Pacific & Gas Electric - USA

This is to certify that the equipment has been calibrated and is within the manufacturers specified accuracy.
Calibration results where appropriate are shown on the attached sheets
The equipment used for calibration was as follows:

| Item | Model n° | Serial n° |
|---|---|---|
| Automatic thermometer bridge plus conductivity/ salinity adaptor | ATB1250<br>CSA1250 | 10072<br>10072 |
| Pt 25 Hart Scientific | 5680 | 5680 |
| Dead weight tester Budenberg | 580DX | 26947 |
| Triple point of water maintenance bath | 7312 | A54108 |
| Water triple point cell | 5901 | 1459 |
| Gallium cell maintenance system | 9230 | A54032 |
| Fixed point cell – Melting point of Gallium | 5943 | GA-43043 |

*All the above equipment is within the manufacturers recommended calibration period and is traceable to the national standards except where no such standards exists.*

Calibration engineer signature Lorenzini Davide 14-12-2005

Quality control engineer signature Confalonieri Fabio 14-12-2005

| Calibration date : 14 December 2005 | | | | |
|---|---|---|---|---|
| Model : IDRONAUT Pt 100 | | | Measurement range | -5 +35 °C |
| Data point | Temp.Observed ( deg °C ) | Temp.Observed ( counts ) | TempCalculated ( deg °C ) | Temp. Error ( deg °C ) |
| 1 | -0.2688 | 6555 | -0.2687 | +0.0001 |
| 2 | 4.0527 | 12137 | 4.0530 | +0.0003 |
| 3 | 8.1830 | 17455 | 8.1830 | - |
| 4 | 12.1912 | 22600 | 12.1899 | -0.0013 |
| 5 | 16.1282 | 27642 | 16.1283 | +0.0001 |
| 6 | 20.0391 | 32639 | 20.0413 | +0.0022 |
| 7 | 23.9520 | 37617 | 23.9507 | -0.0013 |
| **Maximum permitted Temp. Error = 0.005 deg°C** | | | a = -5.327016 | |
| | | | b = 0.00077025338 | |
| **Calibration coefficients** → | | | c = 2.1411721e-10 | |

| Calibration date : 14 December 2005 | | | | | |
|---|---|---|---|---|---|
| Model : KELLER PA-10 *serial number* : TS 568 | | | Measurement range | | 10 bar |
| Data point | Pressure Applied ( bar ) | Press.Observed ( counts ) | Press.Calculated ( bar ) | Press.error ( bar ) | Press.error ( % FSR ) |
| 1 | 2.0000 | 12786 | 1.9951 | -0.0049 | -0.049 |
| 2 | 4.0000 | 24981 | 4.0020 | +0.002 | +0.02 |
| 3 | 6.0000 | 37092 | 6.0035 | +0.0035 | +0.035 |
| 4 | 8.0000 | 49175 | 8.0027 | +0.0027 | +0.027 |
| 5 | 10.0003 | 61216 | 9.9974 | -0.0026 | -0.026 |
| **Maximum permitted Depth. Error = 0.05% FSR** | | | a = -1.191772 | | |
| | | | b = 0.0016477358 | | |
| **Calibration coefficients** → | | | c = 7.9427197e-11 | | |

*Memorandum*

#

**Date:** January 3, 2006 **File #:** 026.11.06.2

**To:** ENVIRONMENTAL ENGINEERING GROUP

**From:** ERIC KENZLER

**Subject:** Hydrolab Instrument 2005 Calibration Report

Pacific Gas and Electric Company #

CHARLES WHITE
ELIZABETH FRANTZ

I certify that between March and December, 2005 the Hydrolab® multiparameter water quality analyzers listed below were calibrated at PG&E's Technical and Ecological Services Department (TES) or at the Hach/Hydrolab Loveland, Colorado repair department using manufacturer's calibration procedures and certified in tolerance. The water quality parameters pH, Conductivity, DO, and Turbidity adjusted and verified prior to field deployment.

These are field instruments for in-situ readings and although a log documenting monthly calibrations are kept in Room 151 at TES, most of the instruments were calibrated by qualified PG&E personnel in the field more often than that depending on deployment schedules.

**Instrument Identification:**

| | |
|---|---|
| Hydrolab Quanta®. #1 | S/N 01310/01277 |
| Hydrolab Quanta® #2 | S/N 01943/02100 |
| Hydrolab Quanta® #3 | S/N 01602/02089 |
| Hydrolab Data Sonde 4a® | S/N 37743 |
| Hydrolab Data Sonde 5® | S/N 42706 |

Eric Kenzler

ERIC KENZLER
Technologist, TES

EMKenzler(251-5806):emk

pc: Ed Cheslak
Scott Tu

**Memorandum**

#

**Date:** January 3, 2006 **File #:** 026.11.06.1

**To:** ENVIRONMENTAL ENGINEERING GROUP

**From:** ERIC KENZLER

**Subject:** Temperature Data Logger 2005 Calibration Report

#

PG&E **Pacific Gas and Electric Company** #

CHARLES WHITE
ELIZABETH FRANTZ

On December 3, 2004 through December 13, 2004 the VEMCO TR-12 temperature recorders on the attached list were calibrated at TES using manufacturer's calibration procedures and certified in tolerance against National Institute of Standards and Technology traceable instrumentation.

Traceable Instrument Identification:

| | | | |
|---|---|---|---|
| Model No. | 15-077-8 | S/N 221336702 | Fisher Scientific Digital Thermometer |
| Probe: | 15-077-7 | S/N 221336677 | |

Precision Water Bath:
Thermo Neslab RTC 17 S/N 103198062

Certificate information is located in the MS Word document S:\Vemco\2004 Calibration\Cal data sheet 2004-05.doc. Printed graphs of original calibration data are located in my files.

Eric Kenzler

ERIC KENZLER
Technologist, TES

EMKenzler(251-5806):emk

pc: Ed Cheslak
Scott Tu

Attachment

Pacific Gas & Electric Company - Technical and Ecological Services
VEMCO TR-12 Temperature recorders calibrated in December 2004

| | SN: | SN: | SN: | SN: |
|---|---|---|---|---|
| 1 | 2190 | 2910 | 7003 | 935 |
| 2 | 2192 | 2911 | 7004 | 936 |
| 3 | 2193 | 2912 | 7005 | 937 |
| 4 | 2197 | 2913 | 7006 | 939 |
| 5 | 2198 | 2914 | 7007 | 940 |
| 6 | 2199 | 2915 | 7008 | 941 |
| 7 | 2200 | 2917 | 9346 | 942 |
| 8 | 2201 | 2918 | 9348 | 944 |
| 9 | 2202 | 2919 | 9349 | 945 |
| 10 | 2203 | 2920 | 9350 | 946 |
| 11 | 2204 | 2921 | 9351 | 947 |
| 12 | 2205 | 2922 | 9352 | 948 |
| 13 | 2207 | 3040 | 9353 | 949 |
| 14 | 2208 | 3041 | 943 | 950 |
| 15 | 2209 | 3043 | | 951 |
| 16 | 2554 | 3044 | | 952 |
| 17 | 2555 | 3045 | | 953 |
| 18 | 2556 | 3048 | | 954 |
| 19 | 2557 | 3049 | | 955 |
| 20 | 2558 | 3050 | | 956 |
| 21 | 2559 | 3051 | | 9324 |
| 22 | 2560 | 3052 | | 9325 |
| 23 | 2561 | 3053 | | 9326 |
| 24 | 2562 | 3054 | | 9327 |
| 25 | 2563 | 3055 | | 9328 |
| 26 | 2564 | 3056 | | 9329 |
| 27 | 2565 | 3057 | | 9330 |
| 28 | 2566 | 3058 | | 9331 |
| 29 | 2568 | 3060 | | 9332 |
| 30 | 2569 | 3061 | | 9333 |
| 31 | 2570 | 3062 | | 9334 |
| 32 | 2571 | 3063 | | 9335 |
| 33 | 2572 | 3064 | | 9336 |
| 34 | 2573 | 3065 | | 9337 |
| 35 | 2903 | 3066 | | 9338 |
| 36 | 2904 | 6998 | | 9340 |
| 37 | 2906 | 6999 | | 9341 |
| 38 | 2907 | 7000 | | 9342 |
| 39 | 2908 | 7001 | | 9344 |
| 40 | 2909 | 7002 | | 9345 |

## Appendix E

## Photo Documentation of Water Temperature Stations during 2005 (CD)

## Appendix F

# Agency Consultation

# MEMO 2/28/06

**Re: 2005 Annual Water Temperature Monitoring Report for Crane Valley, contacted agency representatives (Russ Kanz, Julie Means, and Bill Foster) on status of report review**

<u>Russ Kanz (SWRCB)</u>

Spoke w/ Russ on 2/28 at 3:45 via phone call. Russ stated that he has not had time to review the report in detail, but that based on the amount of time he looked at it, it looked fine. He didn't think he would have any comments, but asked when the final report was going to be issued. I told him by the end of March. He stated that if he did have comments, he would get them in before that. He asked about Gage W26, he mentioned that it had been buried in the sand and must have been dug out (I didn't have specifics on this but told him that the flow record has been updated and that flow was never below 0.5 cfs based on the Hydrographer's recent review of the data). I gave my contact information to Russ in case he had questions or comments at a later date.

<u>Julie Means (CDFG)</u>

Left a voicemail message with Julie on 2/28 at 3:40 asking if she had received the report and if so, if she had any comments or questions. I left my contact information for her.

<u>Bill Foster (FWS)</u>

Spoke with Bill on 2/28 at 3:35 via phone call. He stated that he has not had a chance to look at the report in detail and has not conferred with others regarding the report. However, he appreciated the phone call.

Elizabeth Frantz (2/28/06)

# MEMO 3/9/06

**Re: 2005 Annual Water Temperature Monitoring Report for Crane Valley, contacted agency representatives (Russ Kanz, Julie Means, and Bill Foster) on status of report review**

<u>Russ Kanz (SWRCB)</u>

A voice message was left with Russ on 3/9/06 at 2:20 to confirm that he does not have any comments with regard to the water temperature report.

<u>Julie Means (CDFG)</u>

A voice message was received from Julie in response to first contact phone call that was made on 2/28/05. Her reply was on 3/3/06. She stated that she had not had time to review the report, but would try to get to it the following weekend and would submit any comments via email by 3/6/06 if she had any comments. A second voice message was left with Julie on 3/9/06 at 1:45 to see if she had any comments since no email had been received by 3/6/06. Specific items that Julie mentioned in her reply voicemail on 3/3/06 included a comment that data loss due to planned outages should be minimized (route water during outage if possible to prevent warming of stream, do not schedule outages in middle of summer when temperatures are warmest, and plan to have data recorders in a location that will not be out of water during the planned outage when the water level is expected to decrease), and avoid data loss from other effects if possible by better placement of recorders in the field.

<u>Bill Foster (FWS)</u>

A voice message was left with Bill on 3/9/06 at 2:15 to confirm that he does not have any comments with regard to the water temperature report.

Elizabeth Frantz (3/9/06)