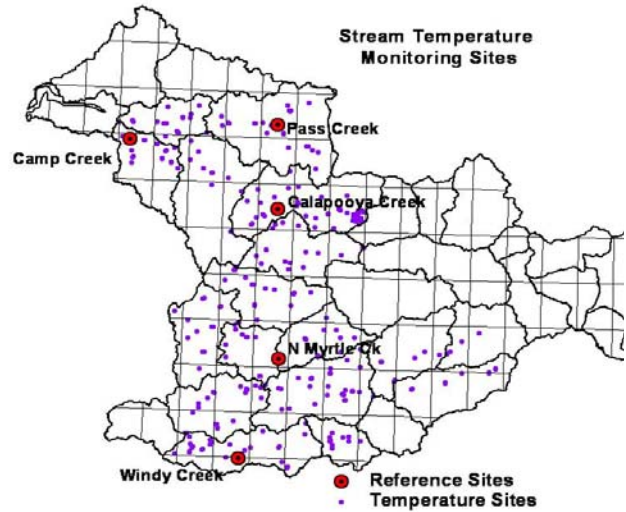


# PUR Umpqua Basin Stream Temperature Characterization Reference Site Update - 2006 Data

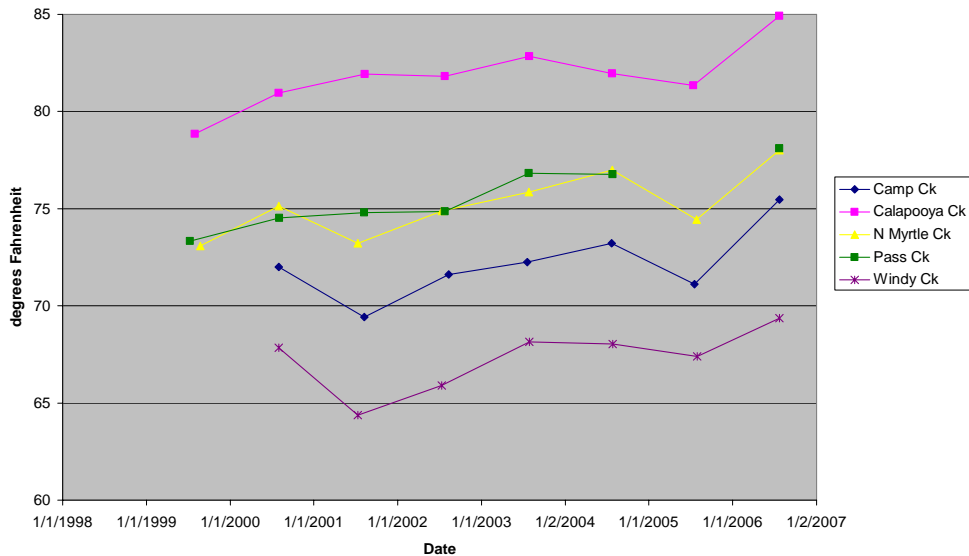
**Prepared by:  
Denise Dammann Consulting & InSight Consultants**

This report is an update of the Umpqua Basin Stream Temperature Characterization Project conducted by the Umpqua Basin Watershed Council (UBWC, now Partnership for the Umpqua Rivers (PUR)) from 1998 – 2001 (Smith, 2001). One principal objective of the study was to establish the range of variability of stream temperature in the Umpqua Basin temporally and spatially. Air and stream temperature monitoring of the five reference sites (Calapooya, Camp, North Myrtle, Pass, and Windy Creeks) has been continued to record the seasonal pattern in the Umpqua Basin and updates of the original report have been produced (Smith, 2003, 2004, & 2005). These data allow the user to make adjustments for seasonal variability when comparing stream temperature data from different years either by making an adjustment from Figure 1 or by using the SB Ratio method (available at [www.yoncalla.net](http://www.yoncalla.net)).



All temperature data and reports are located on the Umpqua Basin Stream Temperature 2006 Update CD which can be obtained from Denise Dammann, Kent Smith, or PUR.

## July 2006 Heat Wave and the Annual 7-Day Average Daily Maximum (7DADM) Temperatures



**Figure 1. Annual 7-Day Maximum Stream Temperatures for Reference Sites, 1999-2006, Umpqua Basin.**

Figure 1 shows the annual 7-day average daily maximum (7DADM) stream temperatures for the reference sites from 1999-2006. While each site varies in temperature, they show a similar pattern over the course of the study, which reflects how the climatic conditions, including air temperature and water flow, affect annual stream temperature (Beschta, *et al.*, 1987).

In 2006, stream temperatures were increased compared to other years of survey due to a record-setting heat wave affected Oregon from July 21-24, 2006. A strong ridge of high pressure, with an influx of warm, moist air from the south, caused temperature to rise rapidly on July 21 and 22, remaining high until July 24. High cloud cover resulted in Eugene, OR and Medford, OR airports recording their highest “high minimum” temperatures ever. Roseburg, OR airport, which doesn’t have a long period of record, recorded minimum temperatures of 73°F, 72°F, and 70°F for July 22-24 respectively. (Taylor and Hale, 2006)

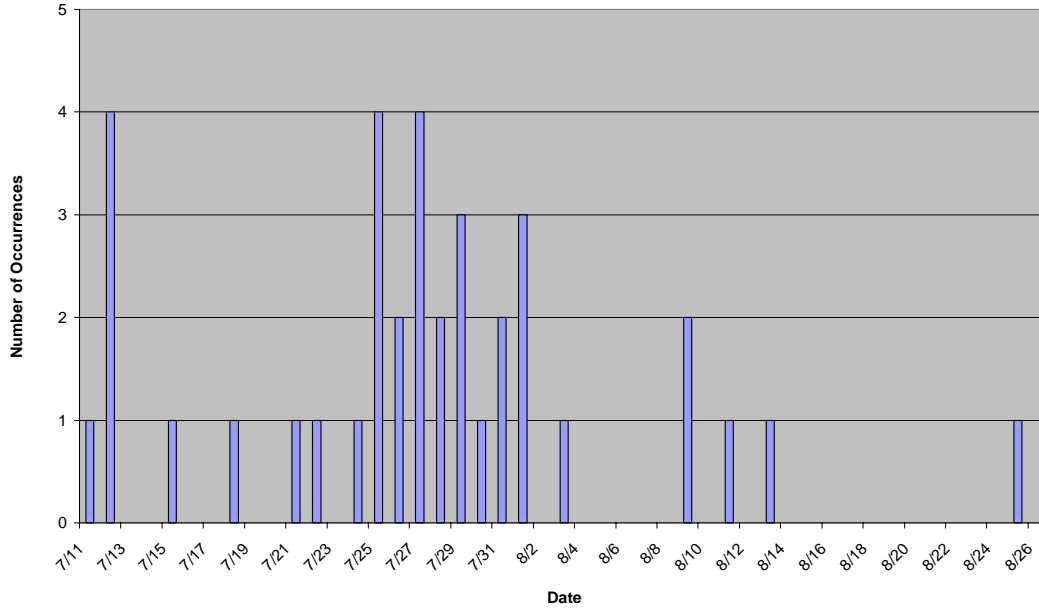
Table 1 shows the maximum, minimum, and differences in the 7DADM stream temperatures for the 7-8 years of survey. The 7DADM stream temperatures for any given site varied 4.76 to 6.06°F during this time. These results were expected, given the annual variability in air temperature given that solar radiation is an important source affecting stream temperature (Brown, 1969 and Beschta, *et al.*, 1987). The data also show the importance of long-term monitoring or using another method to reduce seasonal variability (as described above).

As a stream flows from its headwaters, its temperature will continue to change as a result of several factors including increased solar radiation (Beschta, *et al.*, 1987). The Calapooya Creek site is located the furthest from the divide (Table 1) and has the highest 7DADM stream temperature (Figure 1), while the Windy Creek site is located the closest to the divide (Table 1) and has the lowest 7DADM stream temperature (Figure 1). Smith (2003) found that the cold limit line where the water temperatures typically exceed 64°F is at 7 miles from the divide. The data at these reference sites is consistent with that finding (Table 1).

Table 1. Umpqua Basin reference site maximum, minimum, and difference in 7-day average maximum (7DADM) stream temperatures from 1998-2006 and distance from sites to ridgetop.

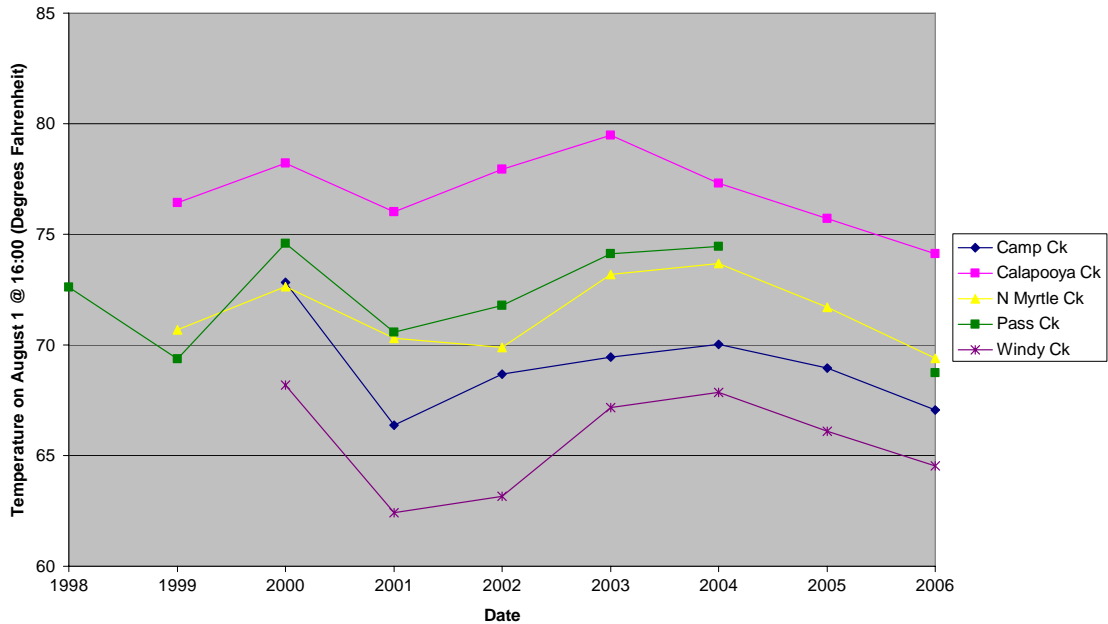
	Calapooya Ck	Camp Ck	N Myrtle Ck	Pass Ck	Windy Ck
Maximum 7DADM temperature (°F)	84.92	75.46	78.02	78.1	69.36
Minimum 7DADM temperature (°F)	78.86	69.41	73.08	73.34	64.37
Difference in 7DADM temperatures (°F) ( $\Delta T$ )	6.06	6.05	4.94	4.76	4.99
Distance from site to ridgetop divide (miles)	28.47	21.41	18.26	13.30	9.63
Years of survey	8	7	8	7	7

## Timing of 7DADM Stream Temperatures



**Figure 2.** Dates of 7-day average maximum stream temperatures for the five Umpqua Basin reference sites from 1999-2006

The date of the 7DADM stream temperatures is dependant on air temperature, volume of flow, and day length. Figure 2 indicates that though the sample size is small, the 7DADM temperatures for the five sites over the past seven years has varied from 7/11 to 8/26 and has centered around late July to early August. For this reason the temperature on August 1 at 16:00 (typically the hottest time of the day) is graphed for each year and site (Figure 3). This figure shows a similar pattern as Figure 1 (7DADM stream temperature), with Calapooya Creek being the highest and Windy Creek being the lowest.



**Figure 3.** Umpqua Basin reference site stream temperatures on August 1 at 16:00 from 1998-2006.

## **Air and Stream Temperature Patterns at Reference Sites – How the Heat Wave is Reflected**

The air temperature pattern for the reference sites was similar to that of other years (Figure 4). However, high air temperature values exceeded that of previous years for some of the sites (Figure 4 & Smith, 2003, 2004 & 2005). Until 2004, Onset Tidbit temperature recorders were used at these sites and these recorders cannot record temperatures over 100°F, therefore any temperatures over that threshold were recorded as 100°F. In 2005 and 2006, Onset Water Temp Pro temperature recorders were used and they are capable of recording temperatures in excess of 100°F. Some of the recorders may have been exposed to direct solar radiation which would result in higher temperatures than ambient air temperatures, such as the Pass Creek air temperature site (Figure 4).

Furthermore, the record-setting heat wave from July 21-24 resulted in high minimum air temperatures (see discussion above). These high minimum temperatures are reflected in the reference site data and Camp, North Myrtle and Pass Creek 7DADM air temperatures were all from July 23-25. Air temperature has a direct effect on stream temperature and this is evidenced by the reference site stream temperature patterns during the late July heat wave (Figure 5). The 7DADM stream temperatures were on July 24 or 25 for all of the sites.

Under the new temperature criteria, the 7DADM stream temperature for streams designated as core cold-water habitat may not exceed 60.8°F (16.0°C) and streams designated as salmon and trout rearing and migration areas may not exceed 64.4°F (18.0°C) (ODEQ, 2006). Calapooya, Camp, North Myrtle, and Pass Creeks are all designated as salmon and trout rearing and migration fish use (64.4°F threshold) and Windy Creek is designated as core cold-water habitat (60.8°F threshold) (ODEQ, 2003). Figure 5 shows the daily summer stream temperature fluctuation for the reference sites, with the reference value line drawn at the ODEQ threshold for each stream. All streams exceeded the criteria (Figures 1 and 5).

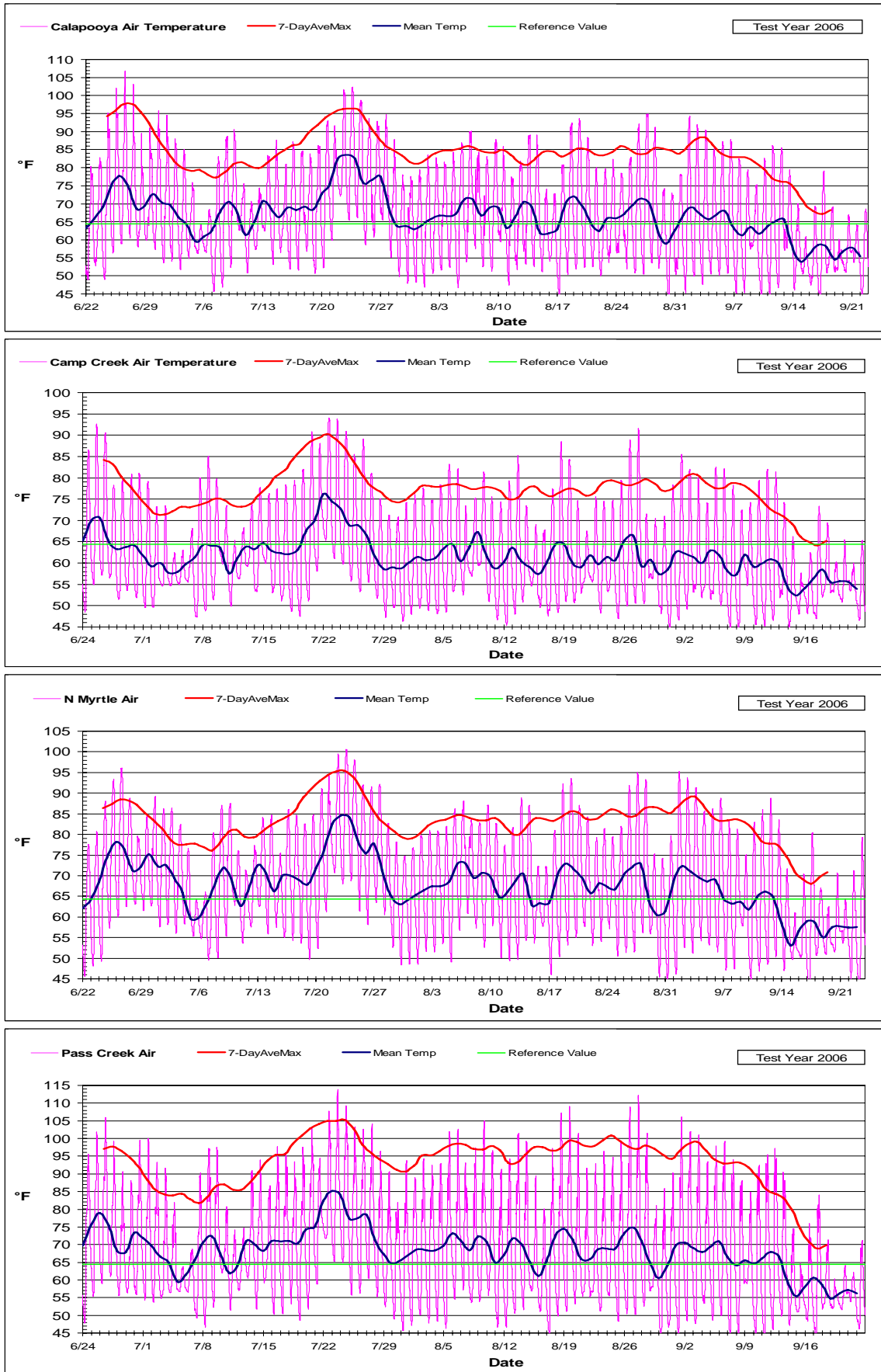


Figure 4. Umpqua Basin reference site air temperature data measured at 30-minute intervals for 2006. The reference value is 64.4°F. Windy Creek air temperature data was lost due to equipment failure.

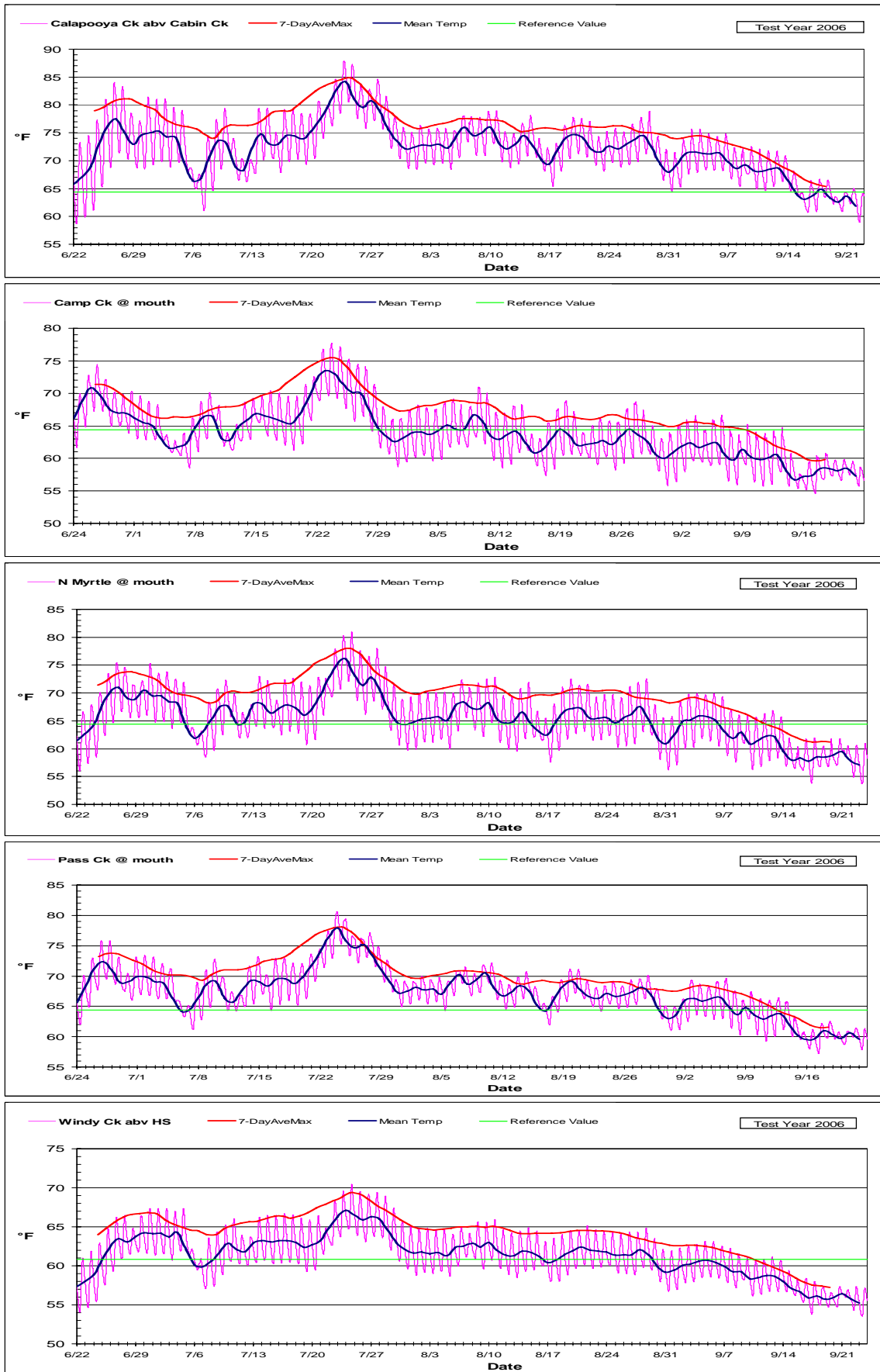


Figure 5. Umpqua Basin reference site stream temperature data measured at 30-minute intervals for 2006. The reference value is 64.4°F for all streams except Windy Creek which is 60.8°F (ODEQ 2003 & 2006).

## References:

Beschta, R.L., R.E. Bilby, G.W. Brown, L.B. Holtby, and T.D. Hofstra. 1987. Stream temperature and aquatic habitat: fisheries and forestry interactions. in: Salo, E.O. and T.W. Cundy (eds.). Streamside Management: Forestry and Fishery Interactions. College of Forest Resources, University of Washington, Seattle, WA. Pages 191-232.

Brown, G.W. 1969. Predicting temperatures of small streams. Water Resources Research. 5(1): 68-75.

ODEQ. 2003. Figure 320A: Fish Use Designations Umpqua Basin, Oregon.  
[www.deq.state.or.us/wq/standards/FishUseMapsFinal/FFigure320A\\_Umpqua.pdf](http://www.deq.state.or.us/wq/standards/FishUseMapsFinal/FFigure320A_Umpqua.pdf)

ODEQ. 2006. Assessment Methodology for Oregon's 2004/2006 Integrated Report on Water Quality Status.  
[www.deq.state.or.us/wq/303dlist/docs/intgrrptassessmentmethod0406.pdf](http://www.deq.state.or.us/wq/303dlist/docs/intgrrptassessmentmethod0406.pdf)

Smith, K. 2001. Umpqua Basin Stream Temperature Reports: 1999-2001. Umpqua Basin Watershed Council, Roseburg, OR.

Smith, K. 2003. Stream Temperature in the Umpqua Basin Characteristics and Management Implications. Umpqua Basin Watershed Council, Roseburg, OR.

Smith, K. 2004. Umpqua Basin Stream Temperature 2004 Update. Umpqua Basin Watershed Council, Roseburg, OR.

Smith, K. 2005. UBWC Stream Temperature Characterization Project Reference Site Update 2005 Data. Umpqua Basin Watershed Council, Roseburg, OR.

Taylor, G.H. and C. Hale. July 24, 2006. July Heat Wave Temperatures / Records. Oregon Climate Service. Oregon State University, Corvallis, OR.  
[www.ocs.oregonstate.edu/page\\_links/whats\\_new/daily\\_highs-lows.html](http://www.ocs.oregonstate.edu/page_links/whats_new/daily_highs-lows.html)