2013 Summer Water Supply Season – Retrospective

Prepared: February 25, 2014, Portland Water Bureau

The following retrospective describes the 2013 drawdown season including the weather, demands, groundwater use, water efficiency and conservation, and fish flows.

Weather

The accumulation of snowpack during the winter of 2012-13 was generally near average. However, snow was not a significant contributor to summer supply from Bull Run in 2013 because the spring snowmelt was finished by early June, before drawdown of the reservoirs began. This is typically the case at the elevations found in the Bull Run watershed. When the snowpack is significantly greater than normal, however, it can help delay the onset of drawdown. For the winter of 2012-2013, the low elevation snow monitoring site at South Fork (2690' elevation) recorded a maximum accumulation of 16.8 inches of snow water equivalent (SWE; the depth of liquid water if the snowpack was completely melted). The mid-elevation site at North Fork (3060' elevation) recorded a maximum of 30.2 inches SWE. The highest elevation site at Blazed Alder (3650' elevation) had a maximum SWE of 36.2 inches SWE. The maximum SWE accumulation for 2013 at South Fork was 174% of the 1998-2012 average. The North Fork maximum SWE was 98% of average, and the Blazed Alder SWE was 90% of average. The timing of maximum snowpack at the Blazed Alder and North Fork sites was late March, whereas the peak snow pack at South Fork was in late January. Snow water equivalent data are presented graphically in Figure 1.

Precipitation during 2013 was, overall, below average in the Bull Run watershed. Total rainfall for the calendar year was 72.56 inches at Headworks, approximately 7 inches less than the annual average from 1899-2012. Figure 2 shows monthly precipitation at Headworks. January, April, May, and September were wetter than average, and all other months were drier than average. The driest month was July, with no precipitation recorded at Headworks during the month. January was the wettest month, with 12.67 inches of rainfall recorded at Headworks. The wettest month relative to the historical record was September, with 10.47 inches, or 328% of the historical September average.

Temperatures in Portland in 2013 were overall close to average, with cooler than normal temperatures in the early winter and fall months of the year and warmer than normal temperatures in the late winter, spring and summer months. With the exception of April, monthly average temperatures ranged from 0.3 ^{o}F to 1.7 ^{o}F above average from February through September (April was equal to the average). In January and from October through December, Portland temperatures ranged from 0.9 ^{o}F to 3.9 ^{o}F below average.

Demand

Historic winter base demand peaked between 1979 and 1991 at an average of approximately 100 million gallons per day (MGD). Since then winter base demand has declined, with demand over the past 5 years approximately 15% lower than this, with an average of about 85 MGD. In 2013, demand ran about 98% of the average for the previous five years; Figure 3 shows demand from 2013 and the preceding five-year period, based on 7-day moving averages. Monthly averages (not shown) ranged from 88% to 109% of the monthly averages for the previous five years. January through June and December demands were above their previous five years' averages. August through November demands were significantly less than their respective averages. July demands were nearly equal to the average July demand of the past five years.

Bull Run Supply

Drawdown of the Bull Run reservoirs began on July 3, about average for the timing of drawdown's onset. The reservoirs reached their minimum storage on September 22, when 4.3 billion gallons (43% of baseline storage) had been withdrawn. The reservoirs completed filling on September 30. A subsequent dry period resulted in a second drawdown with 3.1 billion gallons, or 32% of baseline storage, withdrawn by November 2. Reservoirs subsequently refilled again by November 8. Figure 4 shows the 2013 drawdown of the Bull Run reservoirs.

Groundwater Use

Ample supply conditions in the Bull Run watershed did not necessitate the use of the Columbia South Shore Well Field for seasonal supply augmentation in 2013. However, for purposes of exercising equipment and identifying needed repairs, a short groundwater maintenance operation was conducted on seven days between July 30th and August 8th. This maintenance operation allowed Portland Water Bureau operations and engineering staff to exercise all of the supply well pumps, booster pumps and water quality treatment equipment, to take semiannual water quality samples, and to monitor the performance of wells, pumps and motors. An average of approximately 4.8 million gallons (MG) of groundwater was pumped on each day of operation, with a total of 33.4 MG of groundwater delivered to the distribution system during the maintenance run. During the maintenance operation, the Sand and Gravel Aquifer (SGA) provided 53% of the total groundwater contribution to the distribution system, the Blue Lake Aquifer (BLA) provided 34%, and the Troutdale Sandstone Aquifer (TSA) provided 13%. Figure 5 shows the instantaneous and cumulative groundwater discharge by aquifer during this maintenance operation.

Groundwater Use Model

Since 2007, a probabilistic Groundwater Use Model has been incorporated into summer supply planning. The Groundwater Use Model uses current-year demand projections, historical reservoir inflows, and anticipated fish flow releases into the Lower Bull Run River to develop a series of reservoir drawdown curves—one for each weather year from 1940 to 2012. These projected drawdown curves are used to determine suggested groundwater pumping rates based on the remaining volume of Bull Run storage above baseline elevations, and the calendar date. These pump rates are set such that they would have kept the Bull Run Reservoirs above their baseline storage levels for all 72 of the historic weather years, while minimizing the volume of pumped groundwater and maintaining a relatively constant pumping rate throughout the drawdown season. The Groundwater Use model is based on the assumption that the temperatures and precipitation patterns in 2013 would be within the range of observed weather since 1940.

The Groundwater Use Model was run in the spring of 2013 before drawdown began. The model does not incorporate weather forecasts and is therefore run only once each year. Subsequent application of the Groundwater Use Model involves comparison of the actual course of drawdown to the groundwater pumping curves generated by the model. Figure 6 shows the groundwater pumping curves that were developed, along with the actual reservoir volumes that were observed during the drawdown season. For any date during drawdown, if the actual storage volume drops below one of the groundwater curves, that determines a suggested minimum pump rate.

Instream Flows and Fish Habitat Management

The minimum required flow in the lower Bull Run River was 120 cfs until June 15. From June 16 to the end of September, the flow target in the lower Bull Run River varied depending on the weather forecasts to meet a specific water temperature goal. When the air temperature increased, the city increased flows to maintain the water temperature in the lower river for juvenile salmon

and steelhead rearing conditions. The city's water temperature goal was to keep the 7-day average of the daily maximum water temperatures at the hottest point on the Bull Run River (at Larson's Bridge) below 21 °C (approximately 70 °F). In 2013, the highest 7-day average of the daily maxima was 20.7 °C, thus meeting the goal. The average maximum daily water temperature at Larson's Bridge from June 16 through September 30 was 18.1 °C.

In October and November, the city maintained minimum flows in the lower Bull Run River to provide habitat for spawning salmon. For the month of October, the flow targets were 50% of the reservoir inflow (calculated on a weekly basis) with a minimum of 70 cfs and a maximum of 400 cfs. In November, the targets changed to 40% of the reservoir inflow with a minimum of 150 cfs and a cap of 400 cfs. Starting in December, the minimum flow in the lower Bull Run River was set at 120 cfs and will remain there until spring 2014. Figures 7 and 8 show water temperature and flow, respectively, for the Lower Bull Run River throughout the drawdown season.

Cold Water Transfer Study

In preparation for the operation of multiple level intakes at Bull Run Dam 2, a cold water transfer study was conducted in July 2013. This was a test to determine if cold water from Reservoir 1 could effectively be banked in Reservoir 2 to help manage cold water releases from Dam 2 to the Bull Run River and to the distribution system. A total of 1.08 BG of cold water from the lower elevations of Reservoir 1 was released into Reservoir 2 while it was at full capacity. From July 2-9, water was released through Powerhouse 1 from an elevation of 960 feet. A portion of this water was observed in the 785 and 810 feet elevations in Reservoir 2 via temperature monitoring. From July 15-23, an additional approximately 0.5 BG was released from the needle valves on Reservoir 1 from elevations 930 and 895 feet. A portion of the needle valve water was observed in the 810 and 835 feet elevations in Reservoir 2.

Water Efficiency and Conservation

The bureau's water efficiency programs worked with commercial, industrial, government, residential and multi-family customers to help them meet their water efficiency goals in 2013. The programs help customers to determine the reasons for high consumption and find ways to reduce their water use, and also assist with green building projects.

The residential efficiency programs included home water assessments, community education at events, youth education through a school assembly program, a water-wise plant and efficient irrigation demonstration garden, and distribution of water efficiency devices. The bureau provided additional education to multi-family property managers through the Regional Water Providers Consortium, along with a media campaign that included television and radio. Rebates for toilets and water efficiency irrigation upgrades are currently available to all customer classes.

The bureau's Business, Industry and Government (BIG) water efficiency program assisted commercial customers with unintended water losses, summer cooling load reduction and irrigation advice. The BIG program provides technical assistance to the Bureau of Planning and Sustainability's "Sustainability at Work" program and supports increased demand from commercial customers seeking greater efficiency to offset large increases in a new Bureau of Environmental Services (BES) extra strength surcharge program for fats, oils and greases (FOG). Staff occasionally provide public presentations, which recently included the City's sustainability group leaders.

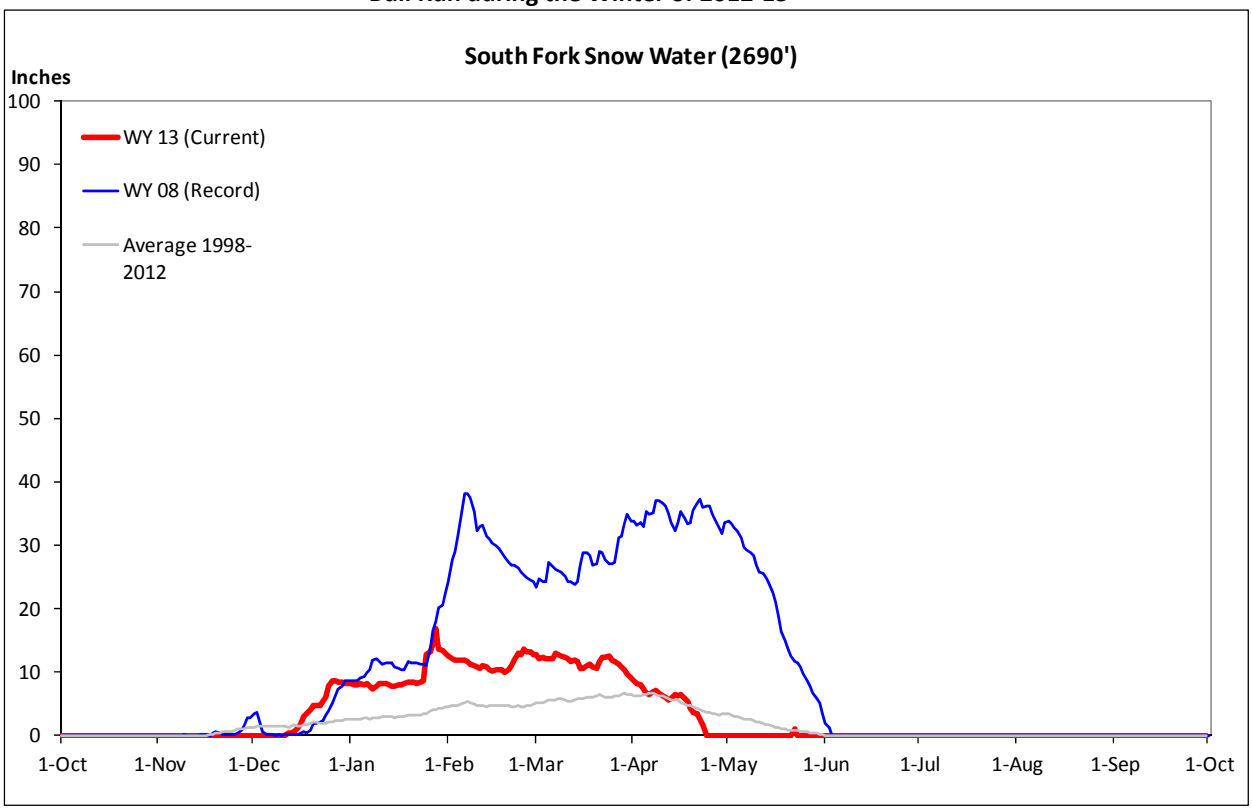
Conclusions

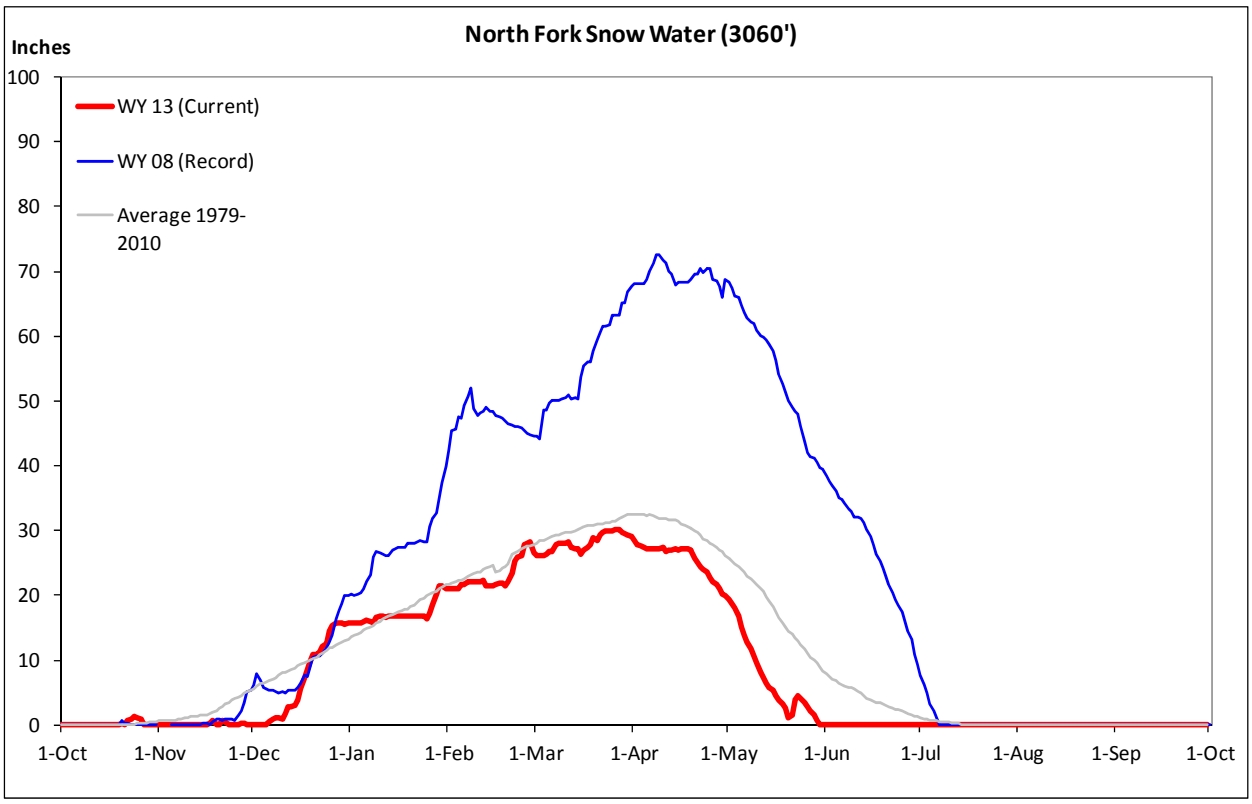
The reservoirs reached a minimum of 4.6 BG usable storage on September 22, 2013. The city was able to meet all in-town and in-stream demands using its baseline primary resources—Bull Run

reservoirs, streamflow, and conservation. Groundwater was not required for summer water supply in 2013. The Groundwater Use model was used to make conservative decisions about whether and when to operate groundwater for supply augmentation. Although groundwater was not needed for summer water supply, the groundwater maintenance operation performed in July and August of 2013 allowed the bureau to exercise equipment and identify needed repairs. In addition, operations personnel were able to cross train on the skills and knowledge needed for running the groundwater system.

Meetings of the Supply Planning Group, which occurred twice a month, were integral to the successful management of summer operations. The group balances multiple objectives in order to ensure a reliable high quality water supply for all users while effectively managing costs.

Figure 1: Snow Water Equivalent, in Inches, at Snow Monitoring Sites in Bull Run during the Winter of 2012-13





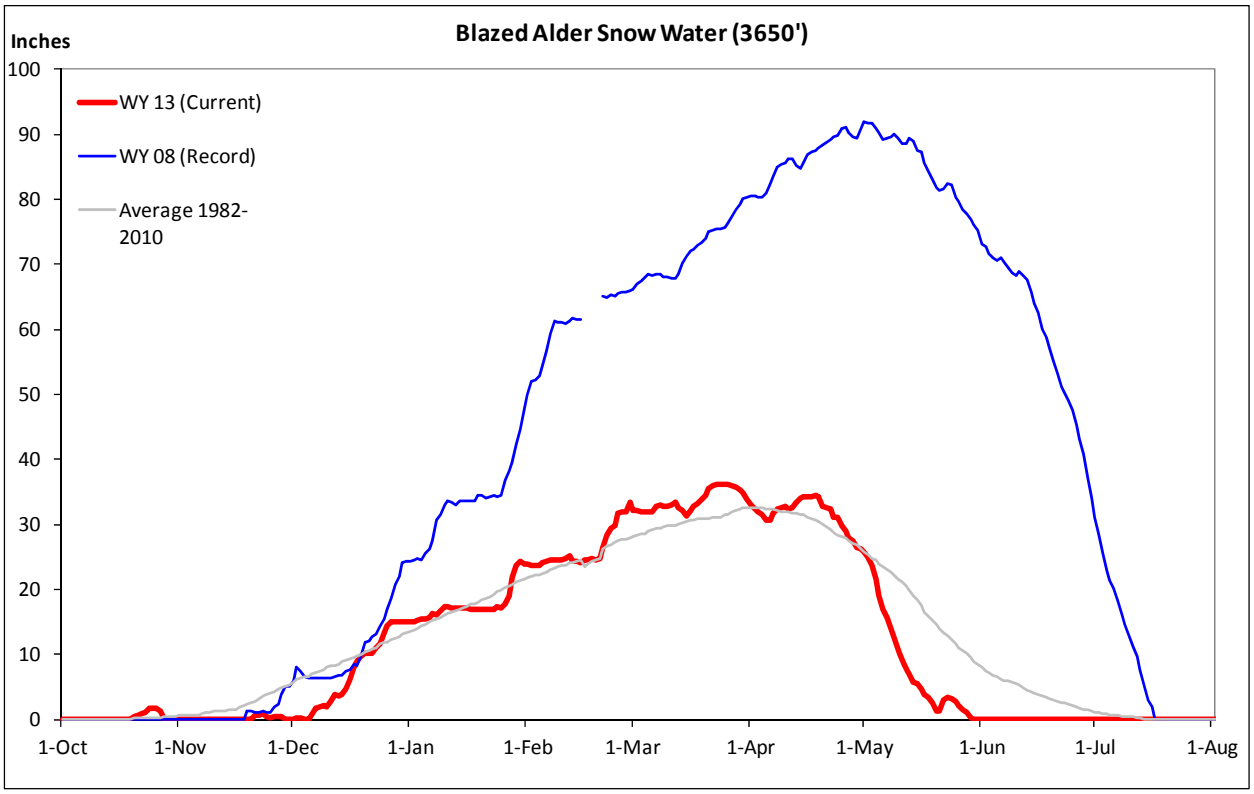

Blazed Alder Snow Water (3650')
Inches
100
90
80
70
60
50
40
30
20
10
0
WY 13 (Current)
WY 08 (Record)
Average 1982-2010
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug

Figure 2. Monthly Precipitation at Headworks, Bull Run, Oregon

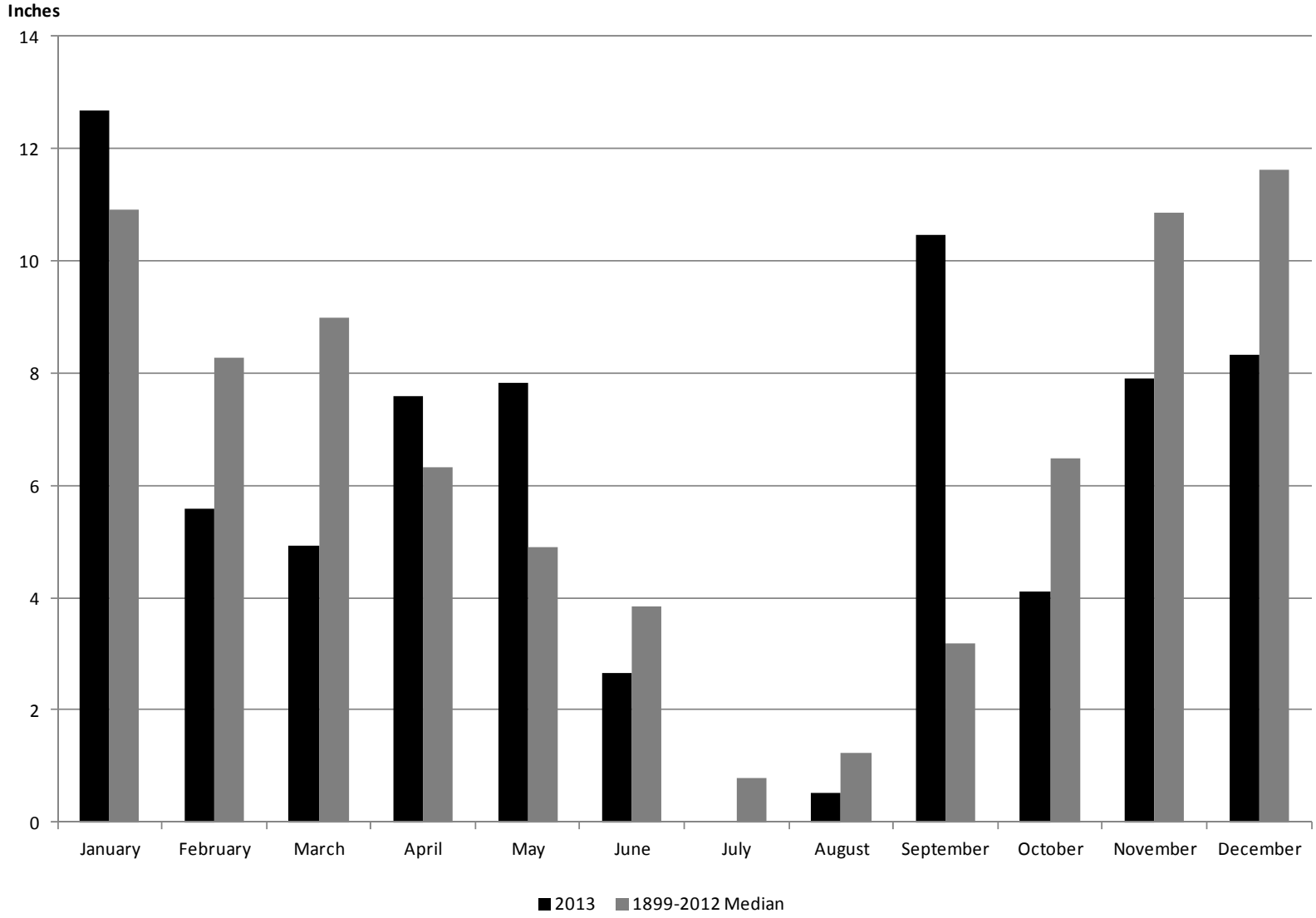


Figure 3. Current Demand Compared to Previous Five Years

7-day Moving Averages

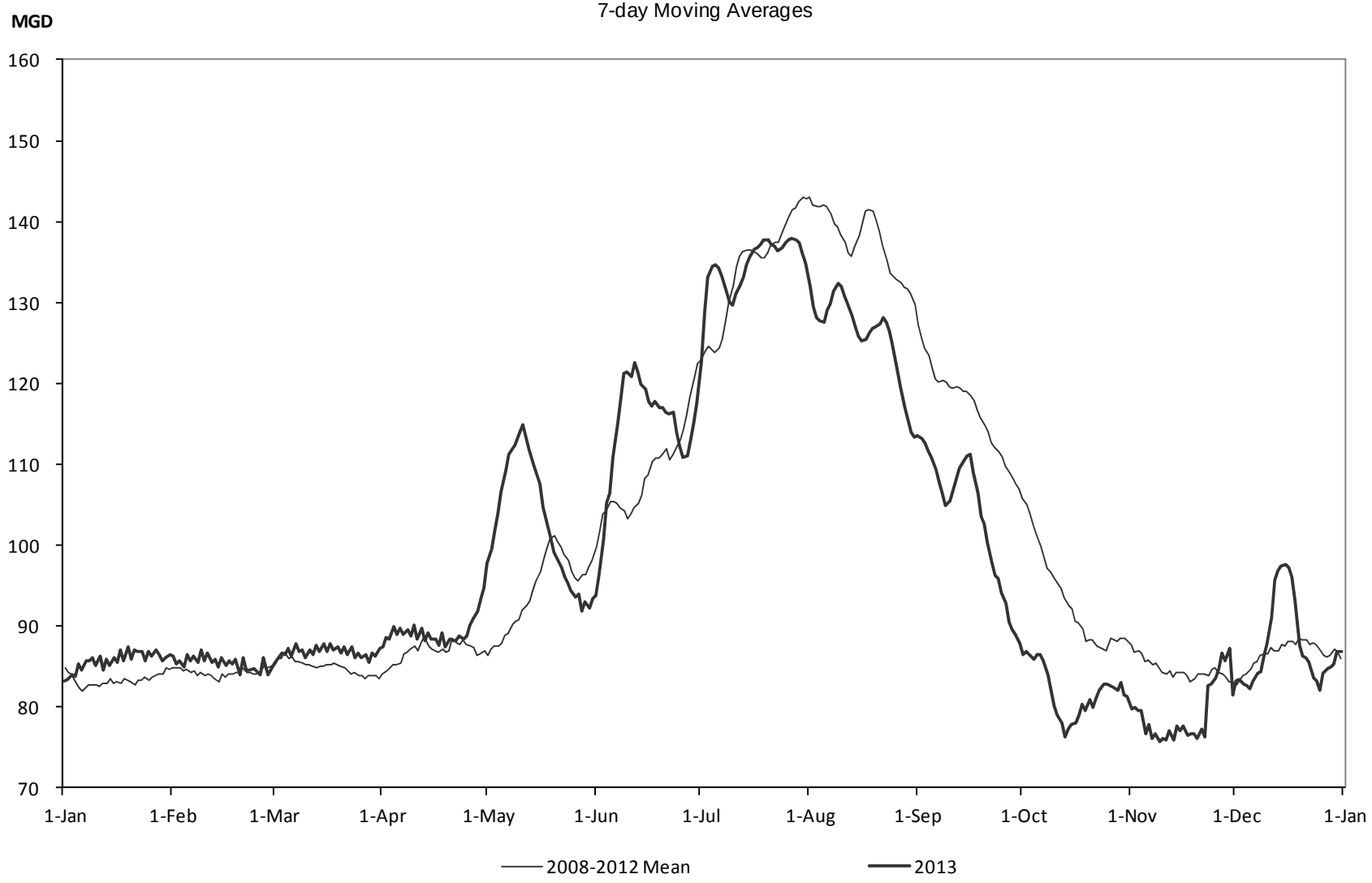


Figure 4. 2013 Bull Run Reservoir Drawdown and Refill

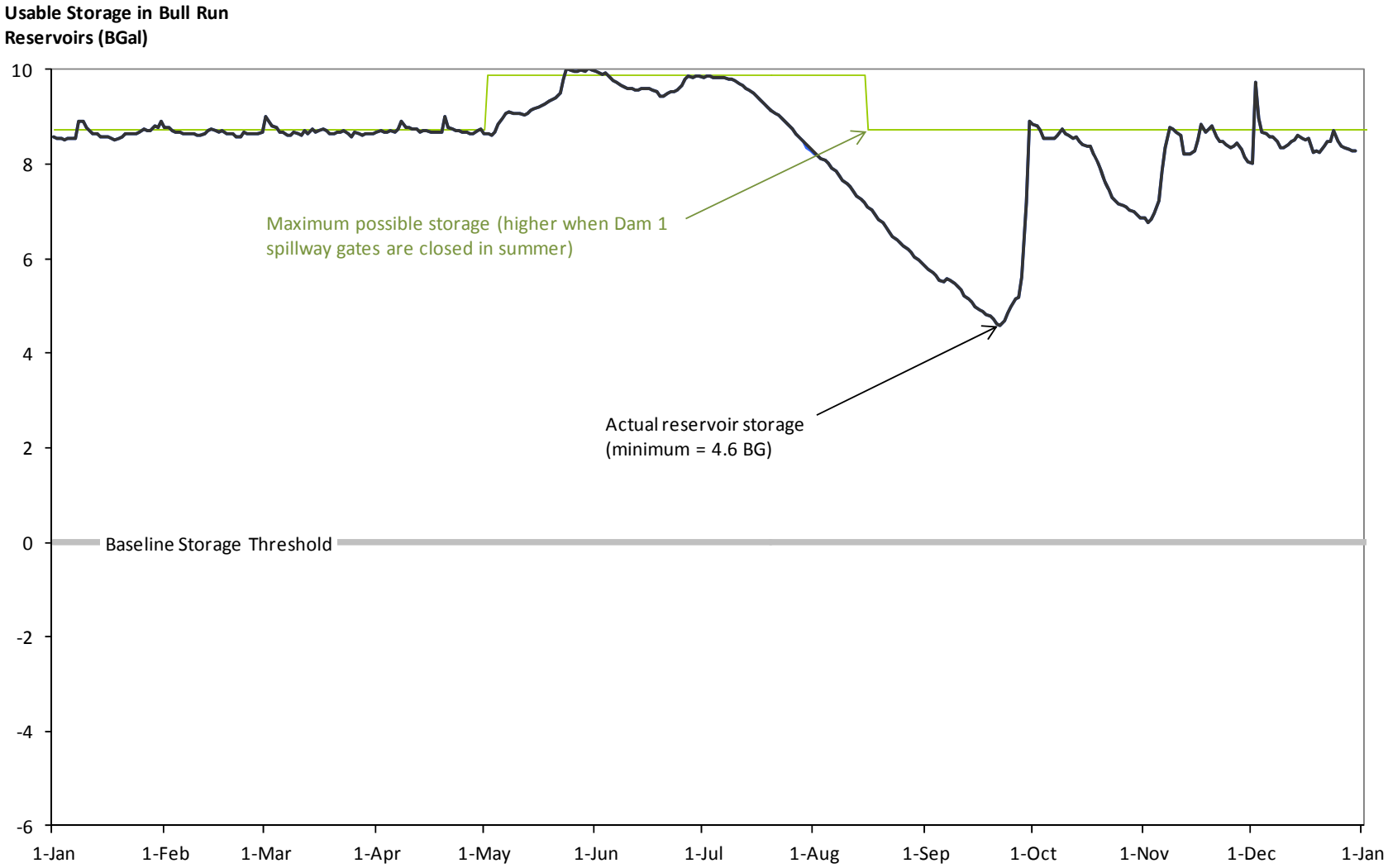


**Figure 5: Instantaneous and Cumulative Discharge to Supply,
August 2013 Groundwater Maintenance Operations**

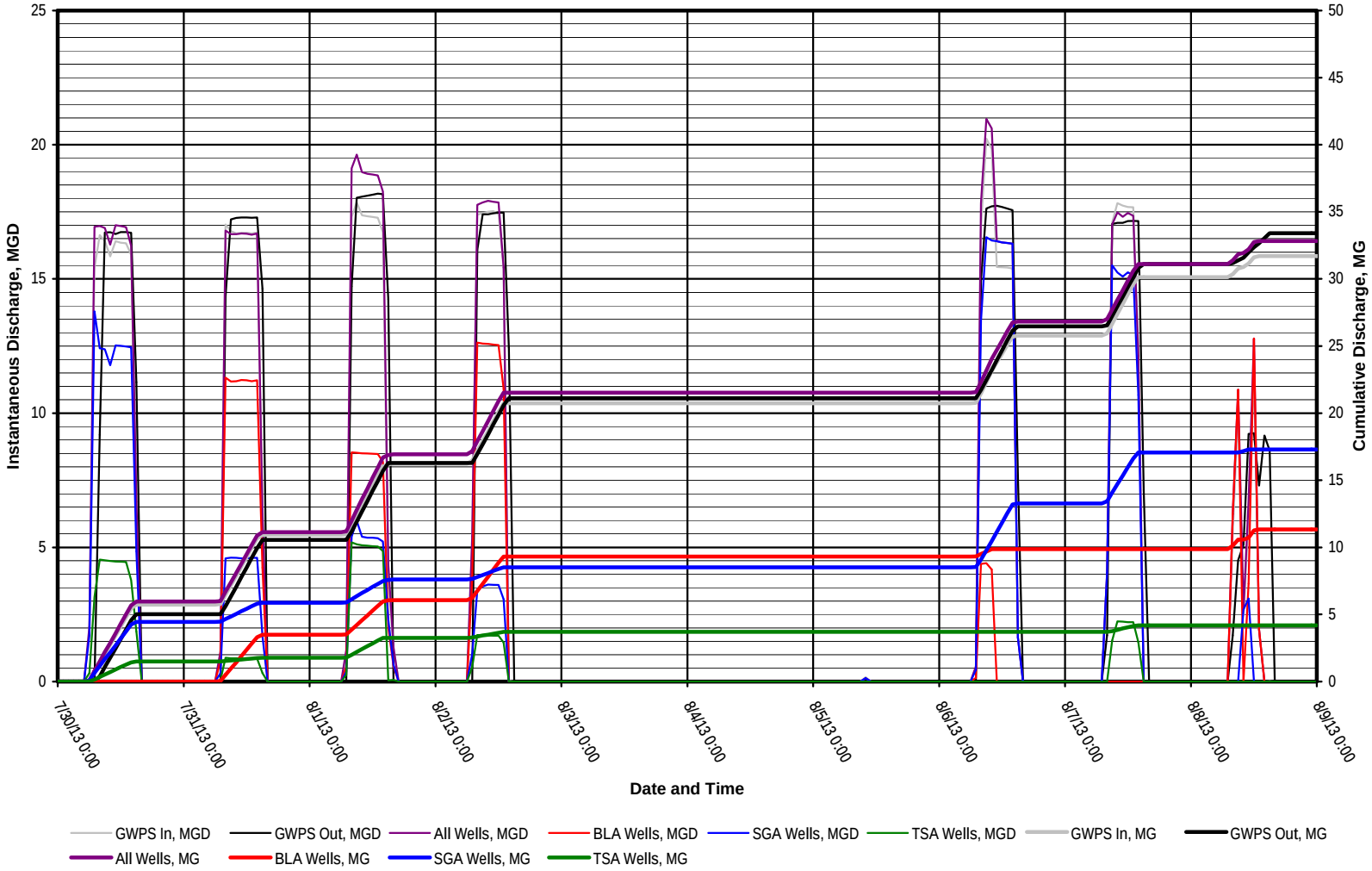


Figure 6. 2013 Observed Storage Volume and Modeled Groundwater Pump Rates

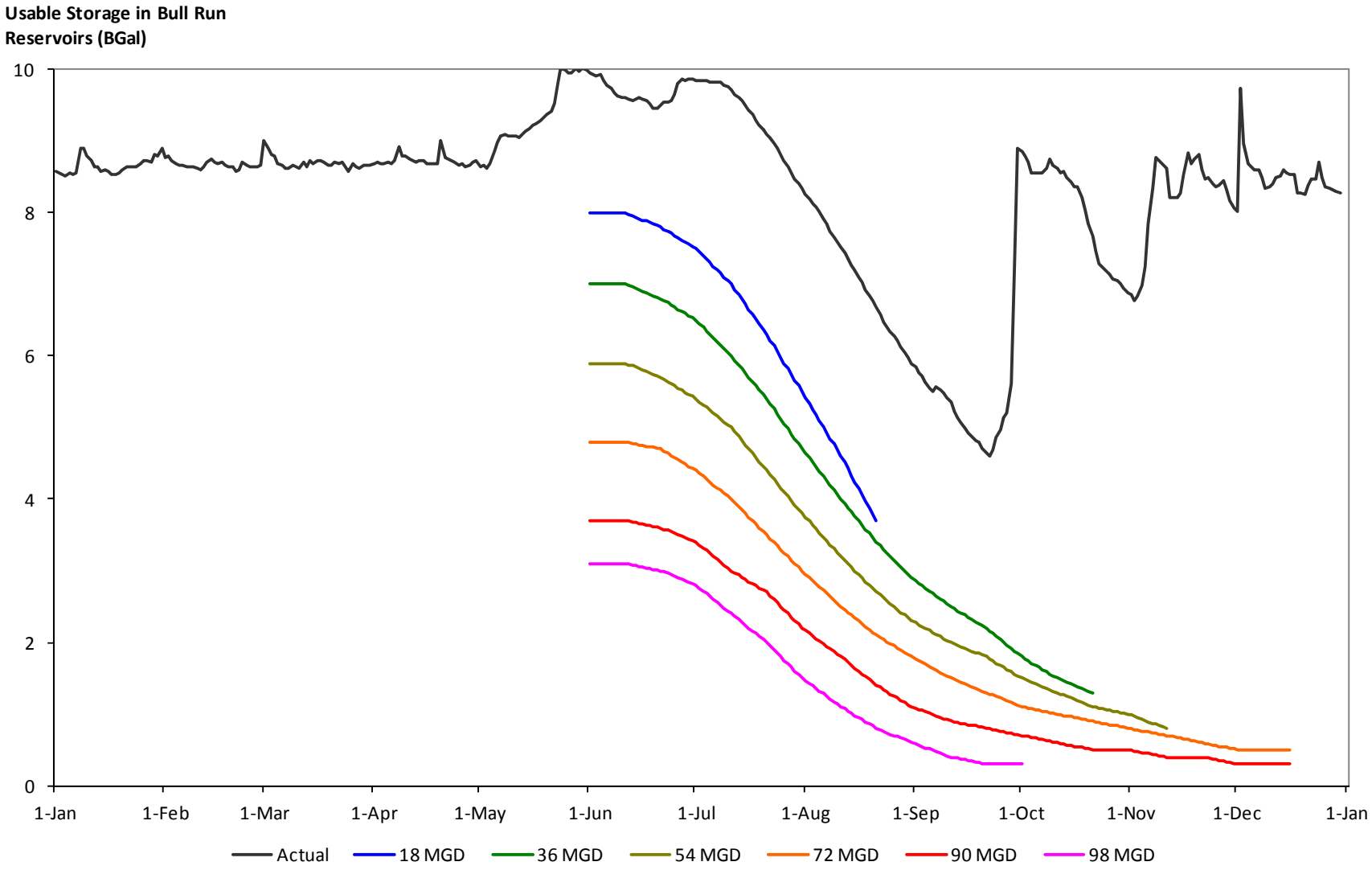


Figure 7. Water Temperature in the Lower Bull Run River, Summer 2013

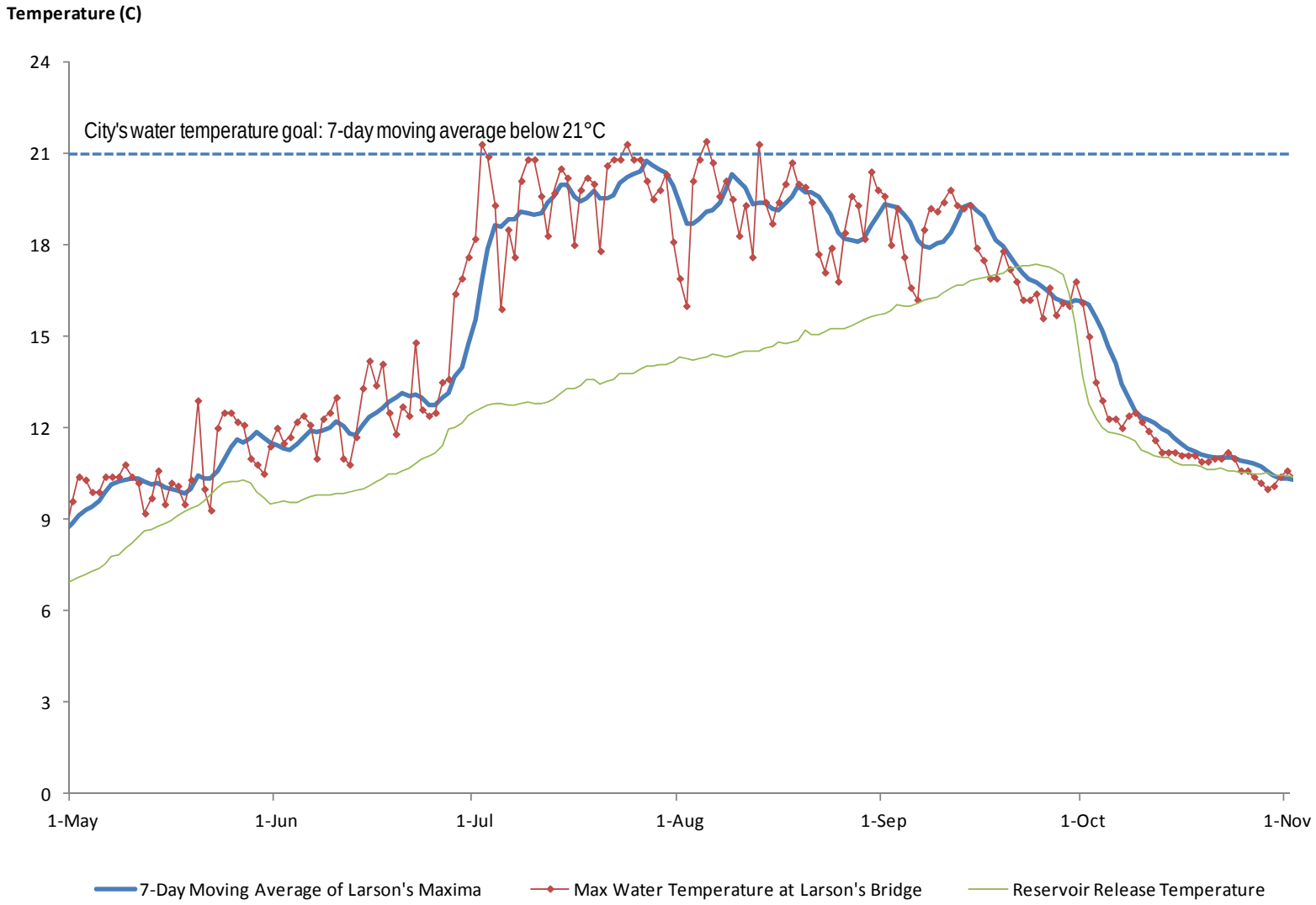


Figure 8. Mean Daily Flow at Lower Bull Run Gage, USGS 14140000