Portland Water Bureau
Water Quality

2018 Summer Water Supply Season – Retrospective
Prepared: February 20, 2019, Portland Water Bureau

The following retrospective describes the 2018 drawdown season including the weather, demands, groundwater use, water efficiency and conservation, and fish flows.

Weather
The accumulation of snowpack during the winter of 2017-18 was above average, in contrast to the rest of the Oregon Cascades, which experienced below average snowpack. Snow was not a large contributor to summer supply from Bull Run in 2018 because the spring snowmelt was finished by mid- to late-May, before drawdown of the reservoirs began. It is typical for snow to only be a small contributor to supply in the Bull Run watershed due to its elevation. When the snowpack is significantly greater than normal, however, it can help delay the onset of drawdown. For the winter of 2017-18, the low elevation snow monitoring site at South Fork (2690' elevation) recorded a maximum accumulation of 8.4 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 22.4 inches SWE. The highest elevation site at Blazed Alder (3650' elevation) had a maximum of 35.4 inches SWE. The maximum SWE accumulation for 2018 at South Fork was 111% of the 1999-2017 median. The North Fork maximum SWE was 109% of the median, and the Blazed Alder SWE was 112% of the median. The timing of maximum snowpack was early March at South Fork and late April at North Fork and Blazed Alder. Snow water equivalent data are presented graphically in Figure 1.

Precipitation during 2018 was, overall, well below average in the Bull Run watershed. Total rainfall for the calendar year was 62.2 inches at Headworks, approximately 17 inches less than the annual average from 1899-2017. Figure 2 shows monthly precipitation at Headworks. The driest month was July, with only 0.07 inches of observed rain recorded at Headworks during the month. April was quite a bit wetter than average, transitioning rapidly to an exceptionally dry May, with only 0.7 inches of rain in a month that typically sees about 5 inches of rain. This historically warm and dry May was caused by a very persistent and amplified ridge of high pressure. As a result, the storm track moved much farther north than normal, diverting storms away from Portland and the Bull Run watershed, keeping the region warm and dry, and causing an early drawdown of the Bull Run reservoirs. November was also much drier than average, contributing to a slow reservoir refill cycle.

Temperatures in the Bull Run watershed in 2018 were cooler than average in February, March, June, and September. They were warmer than average all other months, and more than 1°C above average in January, May, July, and August.

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 (November-March) has declined, with demand over the past 5 years approximately 15% lower at an average of about 85 MGD. In 2018, average demand was 96 MGD (about 91% of the average for the previous five years; Figure 3 shows demand from 2018 and the preceding five-year period, based on 7-day moving averages). Monthly averages (not shown) ranged from 91% to 106% of the monthly averages for the previous five years. For all months except May, demand in 2018 was less than the previous five years' average. These demand numbers reflect the total amount of water supplied to serve Portland retail and wholesale customers, and is not equivalent to the total amount of water that is metered and billed.

Bull Run Supply
Drawdown of the Bull Run Reservoirs began on May 20, about six weeks earlier than the historical onset of drawdown. The reservoirs reached their minimum storage on October 27, when 1.6 of 9.9 billion gallons (BG) of usable storage (16%) remained in the reservoirs. The reservoirs completed filling on November 30. Figure 4 shows the 2018 drawdown of the Bull Run Reservoirs.

Groundwater Use
Each year, the Portland Water Bureau (PWB) operates the Columbia South Shore Well Field to exercise equipment and identify repair needs. The 2018 groundwater maintenance operation was conducted between March 12 and March 21. A total of 166 MG of groundwater were blended with Bull Run surface water over 10 days. Groundwater was operated to supplement Bull Run supply between June 20 and October 17 due to lower than normal water levels in the Bull Run Reservoirs. The 119-day summer supply operation produced a total of 4.6 BG of groundwater which equated to between 22% and 54% of supply each day.

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 78 reservoir drawdown curves—one for each year of streamflow from 1940 to 2017. 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 78 of the historic years of streamflow, 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 2018 would be within the range of observed weather since 1940.

The Groundwater Use Model was run in the spring of 2018 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 5 shows the groundwater pumping curves that were developed, along with the actual reservoir volumes that were observed during the drawdown season. During drawdown, if the actual storage volume in the Bull Run Reservoirs drops below a groundwater pumping curve, then the pumping rate corresponding to that curve is recommended to augment supply.

Instream Flows and Fish Habitat Management
The bureau managed water releases downstream of Bull Run Reservoir 2 to meet minimum flow requirements and water temperature targets for the lower Bull Run River, which are required by the Bull Run Water Supply Habitat Conservation Plan (HCP). This was the fifth year that PWB was using the multi-levels gates on the Reservoir 2 north tower intake to meet downstream water temperature targets.

Critical spring conditions, as defined in the HCP, occurred in 2018. Spring conditions are considered critical under the HCP when drawdown starts before June 15. Minimum flow levels in 2018 were 120 cubic feet per second (cfs) until June 1, then dropped down to 30 cfs for June. In July, minimum levels decreased to summertime ranges of 20-40 cfs to manage for temperature. Each day's flow target was determined by the temperature of the water being released from Headworks and the forecast

maximum air temperature for that day. These flow variations were designed to meet the water temperature goal of keeping the 7-day average of the daily maximum water temperatures at the warmest point on the Bull Run River below the temperature target, which moves according to temperatures observed at the Little Sandy River. The year 2018 was the fifth year following these temperature targets, and conversations with regulators are ongoing.

Critical fall downstream flows were implemented in 2014 and 2015 and therefore could not be implemented in 2018, per conditions of the HCP, nor can they be declared in 2019 (declarations cannot be made for more than two consecutive years or four years after declaring). In 2018, August and September cumulative inflows to the Bull Run Reservoirs were less than the tenth percentile for all historic years (1940-2017), therefore meeting critical fall conditions. Because of the restriction in implementing critical fall flows four years after a previous critical fall implementation, normal downstream flows were implemented October and November. Minimum flow levels increased on October 1 to be 50% of the reservoir inflow (calculated on a weekly basis) with a minimum of 70 cfs and a maximum of 400 cfs. On November 1, 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 2019. Figure 6 shows mean daily flow for the Lower Bull Run River throughout the drawdown season.

The bureau met downstream water temperature targets in the HCP for 2018 with the exception of a period of time in the fall. Figure 7 shows temperature of the Lower Bull Run River. Throughout the management season, the bureau presented the 2018 water temperature information to the Oregon Department of Environmental Quality, the National Marine Fisheries Service, and the Oregon Department of Fish and Wildlife.

Cold-water Transfer

The bureau conducted a cold-water transfer in 2018 to move the bottom-most cold water from Reservoir 1 downstream into Reservoir 2, where it would be available for release to town or downstream. The transfer started on August 6 and continued through September 7, releasing a total of 3.2 BG of bottom water from Reservoir 1 via Dam 1 needle valves (using the 895’ elevation gates) into Reservoir 2. The temperature effect of these releases was most apparent in the upper and middle elevations of Reservoir 2.

Water Efficiency and Conservation

The bureau's water efficiency program worked with commercial, industrial, governmental, residential and multi-family customers to help them meet their water efficiency goals in 2018. Water efficiency education, outreach, and assistance activities were carried out throughout the summer supply season and are summarized below:

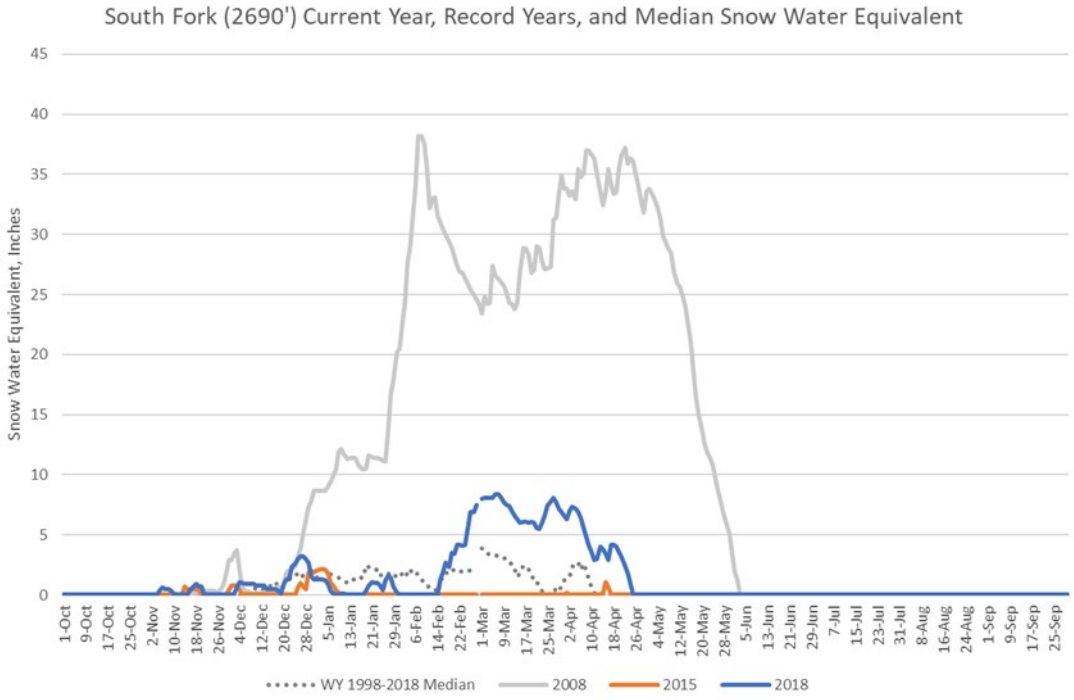
- Provided on-site water efficiency surveys, water-use analysis, irrigation system review, and high water-use investigations as requested by commercial customers. Customers served included manufacturers, offices, retail, and particularly restaurants and multifamily buildings.
- Continued testing the implementation of automatic meter reading devices as part of a pilot project that can potentially help customers observe and respond to daily water use.
- Distributed water efficiency devices and information at community events, via online order form, and at the customer service walk-in center. These kits include showerheads, aerators, and toilet leak tablets.

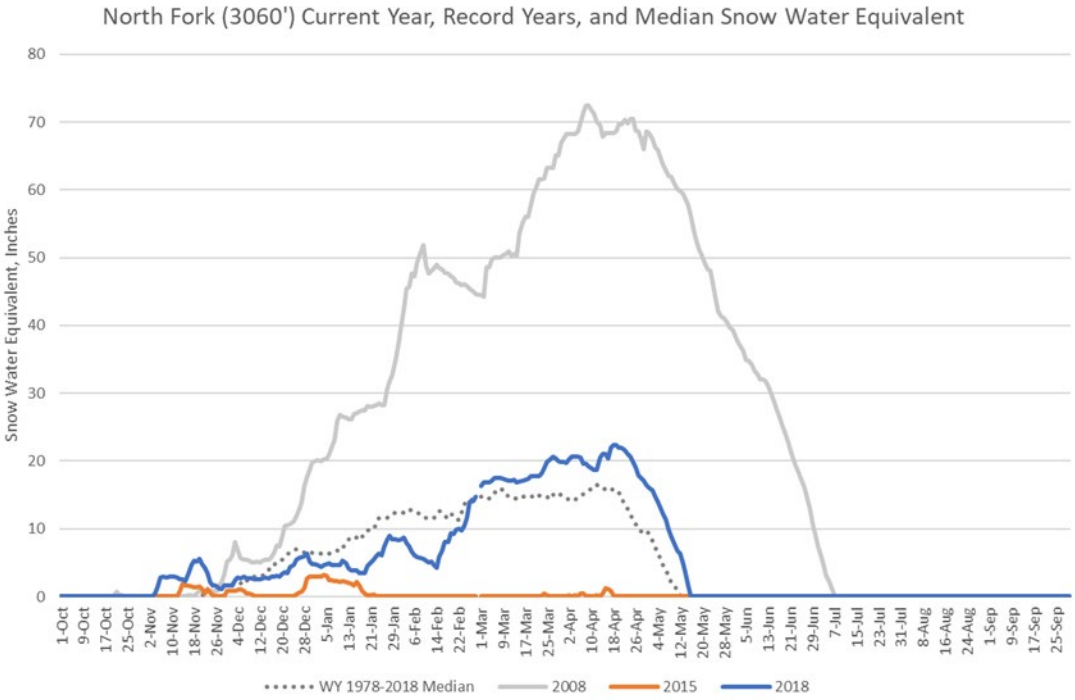
- Provided $50 rebates to replace old toilets with high-efficiency toilets for residential, commercial, and multifamily customers.
- Provided rebates for improving the water efficiency of automatic irrigation systems.
- Published a Customer Newsletter with water conservation information that was included in all bills that were sent out in the summer.
- Published blogs and social media messages regarding water conservation throughout the summer.
- Maintained the water-wise demonstration garden at the East Portland Neighborhood office in Hazelwood neighborhood to showcase water-efficient plant choices and irrigation technology.
- Partnered with the Portland Bureau of Transportation's SmartTrips program to deliver water conservation information by bicycle to new customers in the city. The Portland Water Bureau component of this program is called "Smart Drips."
- The PWB is a member of the Regional Water Providers Consortium (RWPC), and an active participant in the Conservation subcommittee. The bureau achieves public education and communication goals through the RWPC's regional conservation programming. Below is a summary of key offerings completed in the summer:
    - Placed ad spots and conducted on-air interviews during evening news programs on KATU Channel 2, Garden Time, and KUNP Univision television. Messaging was in English (KGW and Garden Time) and Spanish (KUNP). In addition to televised programs, KUNP sent a Spanish-language conservation e-newsletter which reached approximately 25,000 recipients.
    - Placed ad spots and conducted two on-air interviews on Alpha Media Radio stations (KBFF, KINK, KUFO, KUPL, KXL, KXTG, and KWEE).
    - Distributed outreach materials focused on using water efficiently outdoors to residential customers at the Portland Home & Garden Show (February) and the Hardy Plant Society of Oregon Garden Tour (July).
    - Summer outreach messaging was also distributed through the RWPC's website www.conserveh2o.org, social media (7+ messages per week on Facebook and Twitter), and through the RWPC's summer e-newsletter, which reached approximately 900 recipients.
    - Provided the Weekly Watering Number (WWN) on www.conserveh2o.org and via a weekly listserv that reached approximately 1,200 recipients from April-September. The WWN is the amount of water in inches to apply to lawns and gardens based on local weather conditions and evapotranspiration.

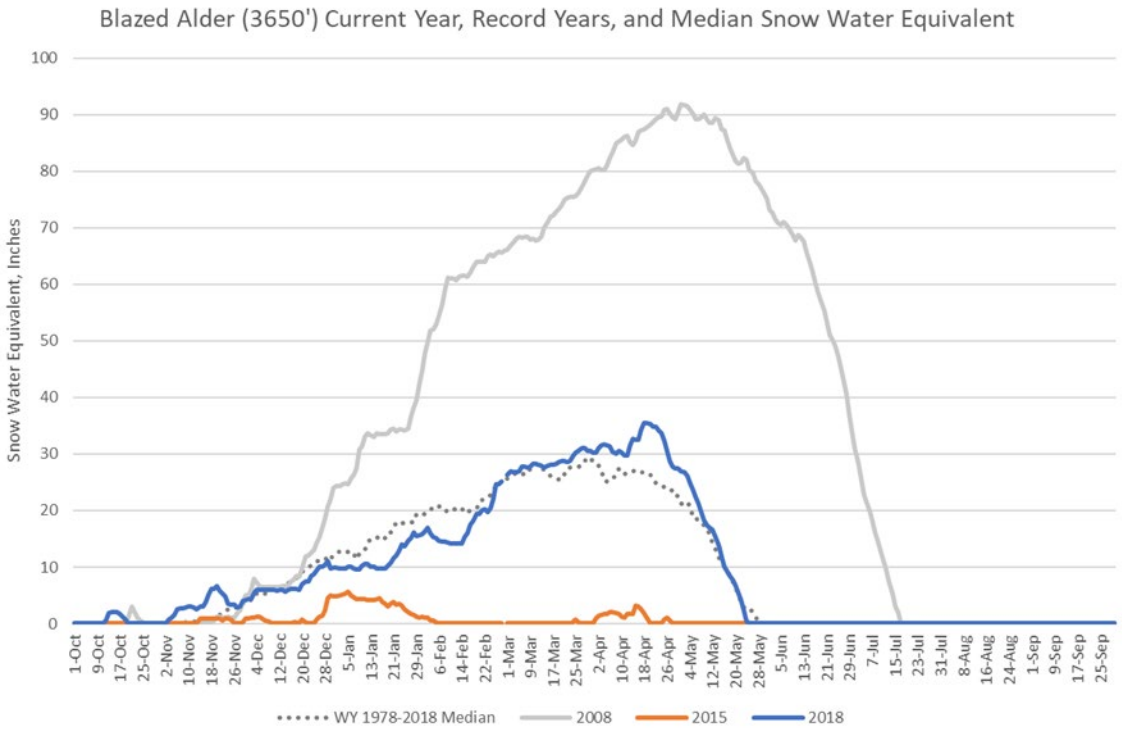
Conclusions

During the 2018 summer supply season, the PWB was able to meet all in-town and in-stream demands using its baseline resources—Bull Run Reservoirs, streamflow, conservation, and groundwater. Weekly meetings of the Supply Planning Group 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 water year (WY) 2018






Blazed Alder (3650') Current Year, Record Years, and Median Snow Water Equivalent
Snow Water Equivalent, Inches
100
90
80
70
60
50
40
30
20
10
0
1-Oct
9-Oct
17-Oct
25-Oct
2-Nov
10-Nov
18-Nov
26-Nov
4-Dec
12-Dec
20-Dec
28-Dec
5-Jan
13-Jan
21-Jan
29-Jan
6-Feb
14-Feb
22-Feb
1-Mar
9-Mar
17-Mar
25-Mar
2-Apr
10-Apr
18-Apr
26-Apr
4-May
12-May
20-May
28-May
5-Jun
13-Jun
21-Jun
29-Jun
7-Jul
15-Jul
23-Jul
31-Jul
8-Aug
16-Aug
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1-Sep
9-Sep
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WY 1978-2018 Median
2008
2015
2018

Figure 2. Monthly precipitation at Headworks

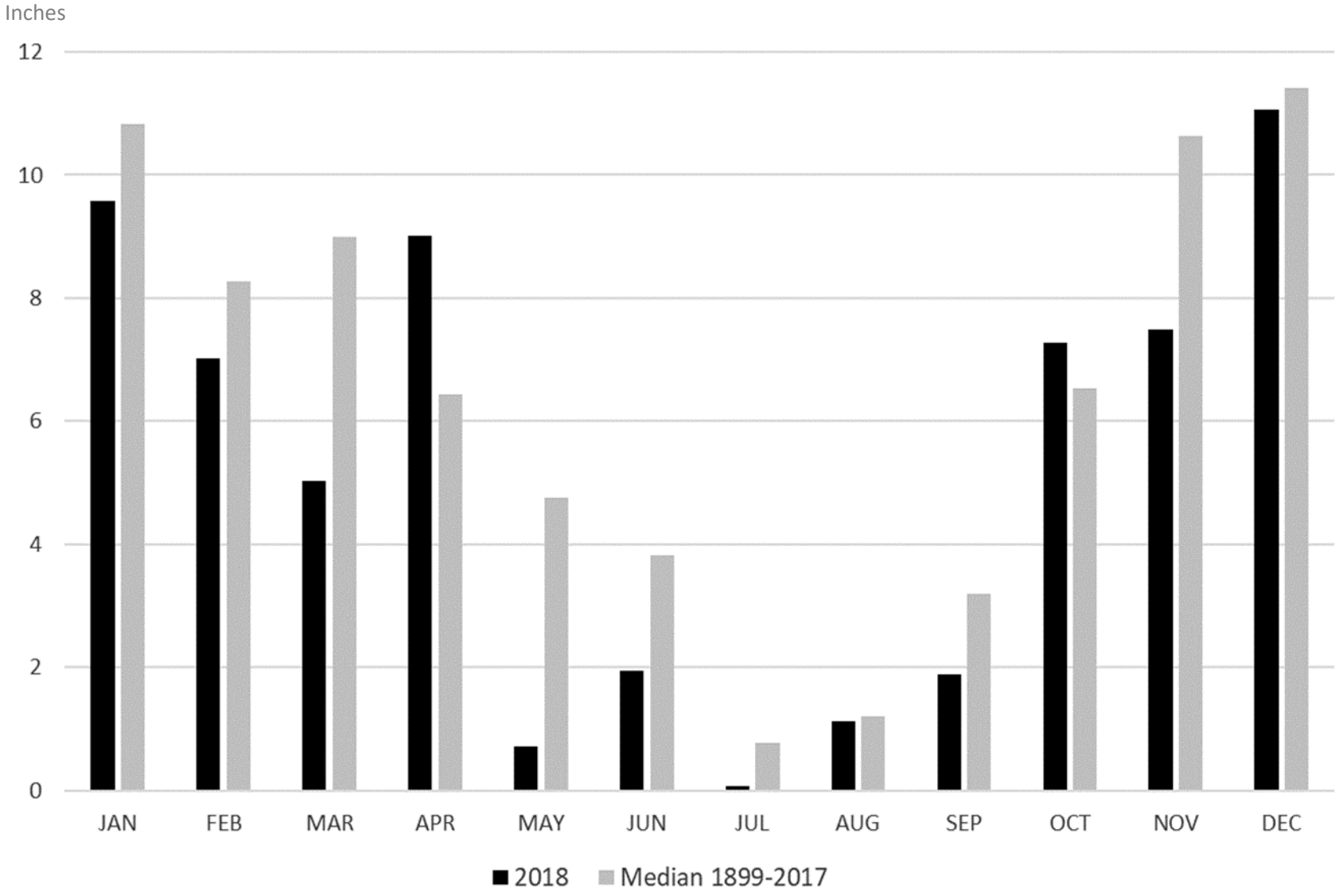

Figure 3. Current demand compared to previous five years; 7-day moving averages

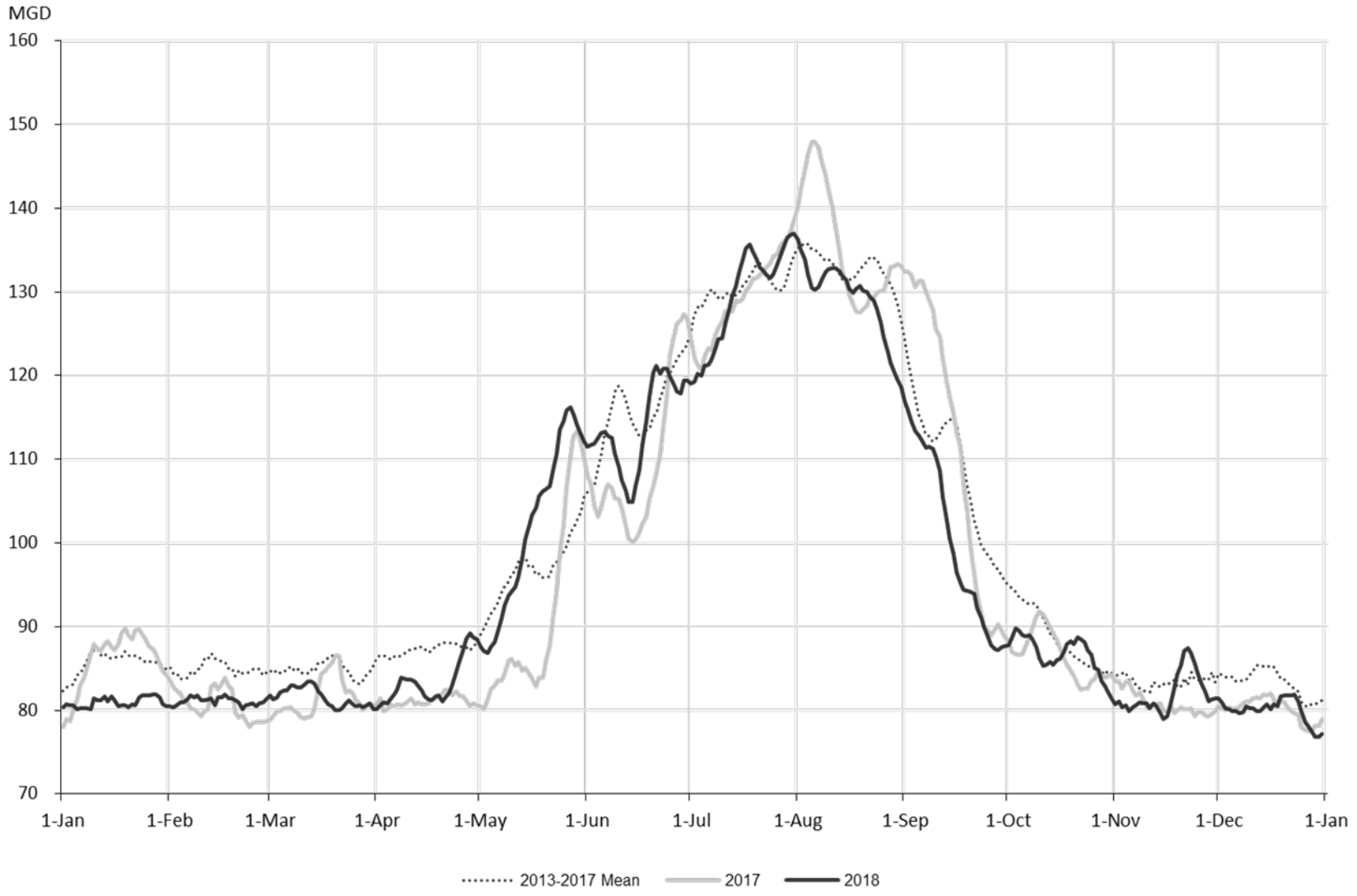

Figure 4. Bull Run Reservoirs drawdown and refill

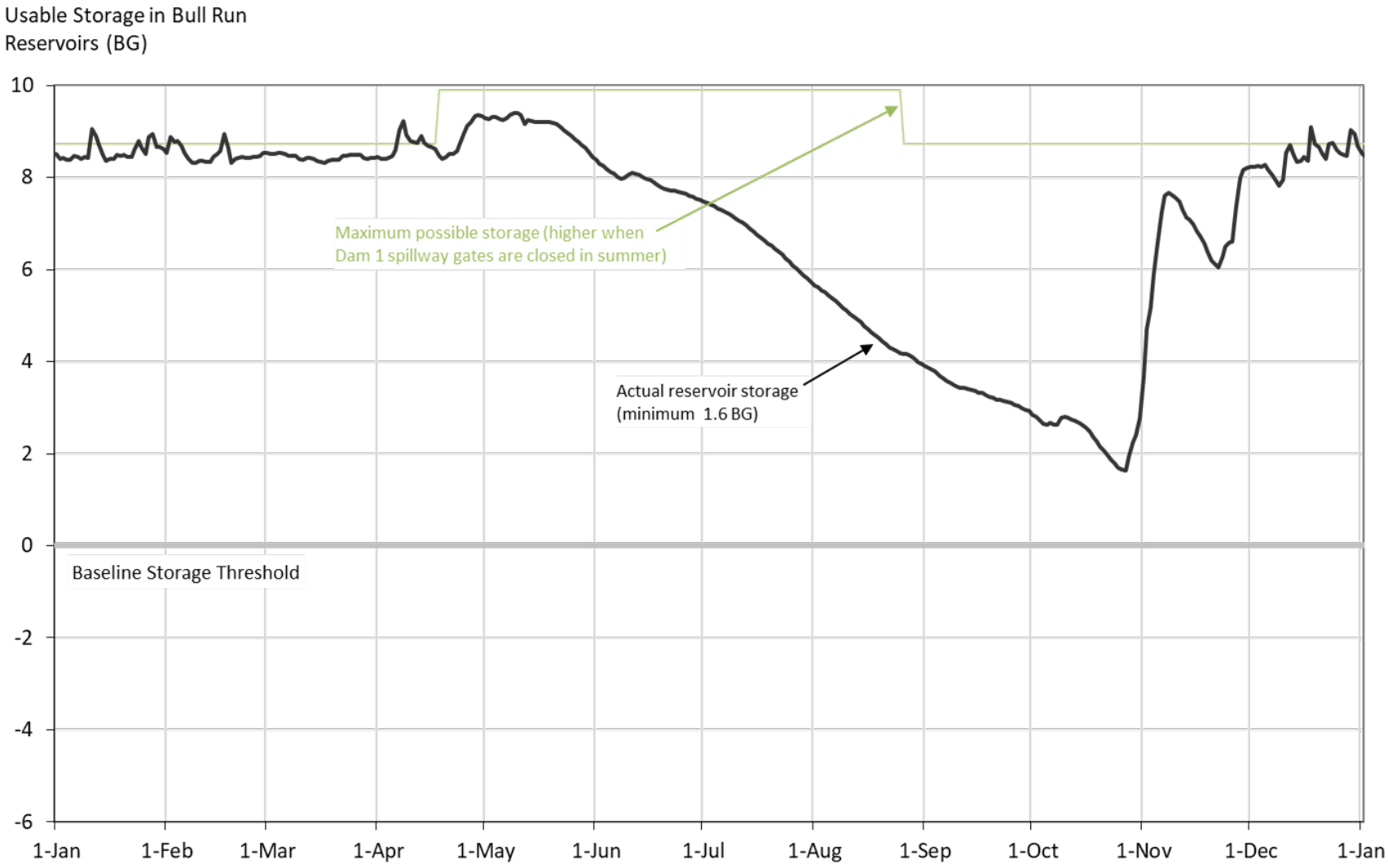

Figure 5. Observed Bull Run Reservoirs storage and modeled groundwater pump rates

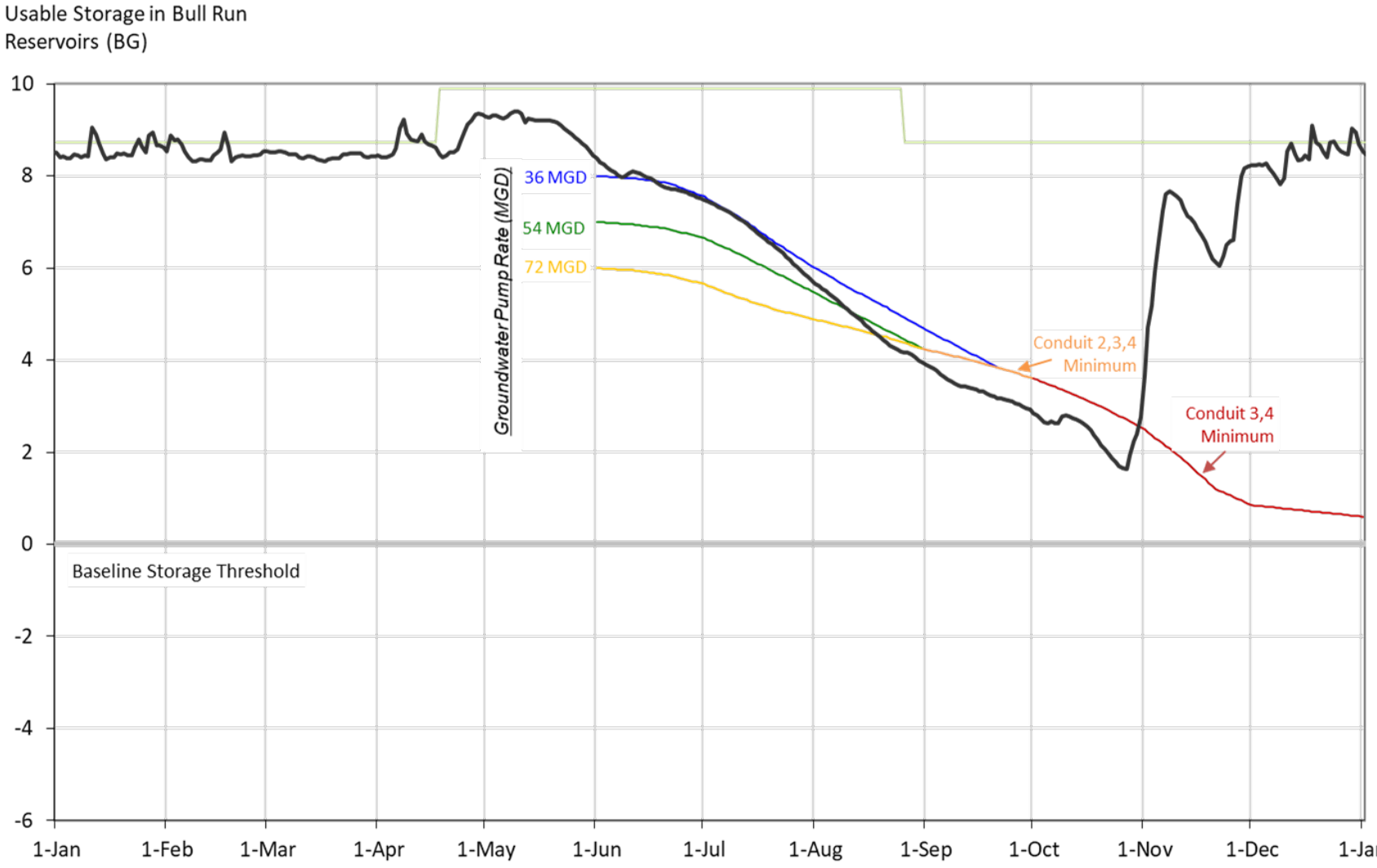

Figure 6. Mean daily flow at Lower Bull Run bridge, USGS 14140000

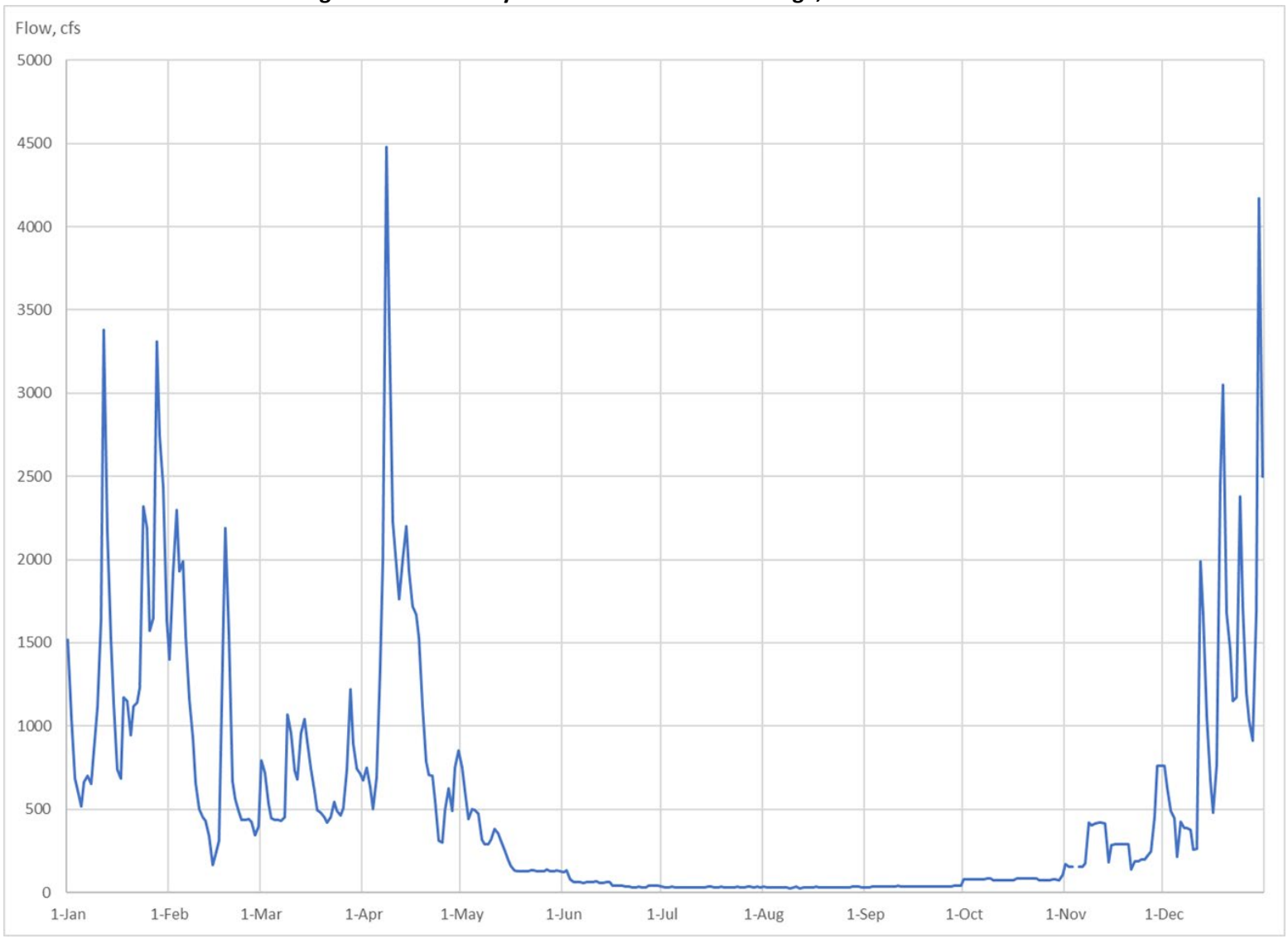

Figure 7. Water temperature of the Lower Bull Run River, summer 2018