US Army Corps
of Engineers
Kansas City District

Engineering Division
Hydrologic Engineering Branch
Water Management Section

Annual Report of Reservoir Regulation Activities

Summary for Fiscal Year 2019
(October 1, 2018 to September 30, 2019)

March 2020

1. PURPOSE AND SCOPE..... 1
2. LAKES IN THE KANSAS CITY DISTRICT..... 1
3. PROJECT FUNCTIONS AND GENERAL PLAN..... 1
4. PROJECT ACCOMPLISHMENTS. 2
5. PROJECT OPERATIONS..... 3
6. HYDROLOGIC DATA COLLECTION..... 69
7. PERSONNEL AND FUNDING..... 71

List of Plates

Plate 1: Kansas City District Map
Plate 2A: Engineering Data, Osage River Basin Projects
Plate 2B: Engineering Data, Lower Missouri River Basin Projects
Plate 2C: Engineering Data, Lower Kansas River Basin Projects
Plate 2D: Engineering Data, Republican River Basin Projects
Plate 2E: Engineering Data, Smoky Hill River Basin Projects

List of Tables

Table 4.1: Flood Reduction Benefits 2
Table 6.1: Data Collection Expenditures 71
Table 7.1 : Water Management Section Personnel 71

Appendices

Appendix A: Summary Plots of Corps of Engineers Projects
Appendix B: Summary Plots of Bureau of Reclamation Projects
Appendix C: Deviation Approvals

1. PURPOSE AND SCOPE.

This report summarizes the past year's regulation activities at storage projects within the boundaries of the Kansas City District (District) that are operated for flood control by the Water Management Section staff. It also summarizes major work items affecting the projects, and it outlines briefly the programs ongoing or proposed for the year ahead. Topics discussed in the report include recent weather patterns, project accomplishments, current project operations; major regulation problems and proposed solutions; lake regulation manuals; data collection programs and procedures; ongoing studies, and personnel of the Water Management Section. The reporting period for Water Management Section activities covers the operating year from October 1, 2018, through September 30, 2019, with operations summaries extending through December 2019 in order to document the complete evacuation of all 2019 accumulated flood storage. Preparation of this report is in conformance with paragraph 2-4c(10) of ER 1110-2-240, dated May 30, 2016.

2. LAKES IN THE KANSAS CITY DISTRICT.

The Kansas City District includes the watershed of the Missouri River from Rulo, Nebraska, (river mile 498.1 above the mouth) to the junction of the Missouri and Mississippi Rivers near St. Louis, Missouri. During the period covered by this report, 29 storage projects, at which the Corps of Engineers (Corps) has either complete or partial water control responsibilities, were in operation within the District. There are 18 Corps of Engineers lakes and 11 Bureau of Reclamation lakes. The location of each lake and reservoir in the District is shown on ***Plate 1***, and a summary of engineering data outlining the physical characteristics of each project is included as ***Plates 2A through 2E***.

3. PROJECT FUNCTIONS AND GENERAL PLAN.

Functions served by storage facilities in the Kansas City District include; flood control, irrigation, water supply, water quality, navigation supplementation, hydropower, recreation, and fish and wildlife. Most functions except flood control are normally provided through the regulation of storage contained in the multipurpose pool. Releases from multipurpose storage are controlled by the manipulation of gates or other means in accordance with plans, schedules, and ratings prepared in advance to meet various conditions of inflow and demand. The general plan for regulation of flood control storage is to evacuate all accumulations in the flood control space as rapidly as downstream channel capacities and flow conditions permit. Should the top of the flood pool be exceeded, criteria have been developed for each project that schedule releases for the purpose of safeguarding the structure. Downstream interests are warned of the possibility of flooding should a surcharge operation appear likely. Although the storage space in the flood control pool is normally evacuated as quickly as downstream conditions allow, release schedules may be modified at times to serve beneficial purposes such as fish and wildlife enhancement.

4. PROJECT ACCOMPLISHMENTS.

Operating purposes at storage projects in the Kansas City District include flood control, irrigation, water supply, navigation supplementation, water quality, hydropower, recreation, and fish and wildlife. Project accomplishments for flood control, for the period covered by this report, is described briefly in the following paragraph. Flood control was the focus of regulation because of the wet conditions in FY 2019.

4a. Flood Control.

Stream flow regulation by storage projects in the Kansas City District began with the closure of Kanopolis Lake in February 1948. By July of that year, Kanopolis also provided the first flood control storage, benefiting downstream damage centers. Since then, stream flow regulation by District projects has produced flood reduction benefits estimated in the millions of dollars annually. In addition to the Corps of Engineers lake projects, local protection projects in the form of levees, floodwalls, and channel improvements also have provided flood reduction benefits amounting to millions of dollars. Federal and private agricultural levees along with temporary storage of flood flows in the main stem reservoir system above Sioux City provide additional benefits within the District. During the reporting period, 14 of the District lakes stored water in the flood control pools. Flood reduction benefits during Fiscal Year (FY) 2019 credited to all Corps lake projects in the District were $1,762,775,496, as indicated in Table 4.1. During the same period, benefits credited to Section 7 Bureau of Reclamation projects within the District totaled $637,920,576. The accumulated total of flood control benefits for Bureau projects within the District totaled $2,600,889,714. The upstream main-stem projects are responsible for additional flood damage reductions along the Missouri River within the Kansas City District reach.

Table 4.1: Flood Reduction Benefits
(Thousand Dollars)

Project	Fiscal Year 2013	Cumulative
Clinton Lake, KS	$24,467.7	$1,732,676.0
Harlan County Lake, NE	$155,082.5	$396,279.3
Harry S Truman Resv., MO	$2,574.3	$1,887,979.6
Hillsdale Lake, KS	$192.0	$43,161.1
Kanopolis Lake, KS	624,678.8	$2,364,698.8
Little Blue River Lakes, MO	$2.4	$52,286.7
Long Branch Lake, MO	$284.3	$52,755.3
Melvern Lake, KS	$20,505.0	$256,993.3
Milford Lake, KS	$499,980.8	$2,262,340.8
Perry Lake, KS	$20,556.5	$7,054,788.8
Pomme De Terre Lake, MO	$531.2	$72,191.0
Pomona Lake, KS	$17,251.2	$245,834.1
Rathbun Lake, IA	$1,729.6	$164,459.2
Smithville Lake, MO	$18,006.5	$1,217,466.6
Stockton Lake, MO	$285.8	$209,298.9
Tuttle Creek Lake, KS	$132,743.7	$8,487,739.0
Wilson Lake, KS	$243,894	$1,848,279.9
NOTE: "Little Blue River Lakes" reports combined benefits accrued to both Longview Lake and Blue Springs Lake.		
TOTALS (Thousand Dollars)	**$1,762,775.5**	**$28,349,228.4**

5. PROJECT OPERATIONS.

Corps of Engineer Lakes – October 1, 2018 through September 30, 2019.

5a. Republican River Basin

Bonny, Swanson, Enders, and Hugh Butler Reservoirs all experienced below average inflows for the report period. Some reservoirs were able to increase conservation while making some irrigation related releases; however all these reservoirs stayed below the top of the conservation pool. Norton Reservoir experienced much above normal inflows, but stayed well below the top of conservation pool throughout the reporting period.

Harry Strunk Reservoir began the report period approximately 4 feet below the top of the conservation pool. March inflows resulted in the reservoir rising into the flood control pool where it remained until late August. Flood control releases were handled through fill and spill over the uncontrolled weir with maximum releases around 380 cfs in mid-July. At its mid-July maximum the flood control storage reached 16.6 percent full.

Harlan County Reservoir began the report period approximately 7 feet below the top of the conservation pool. Small but steady inflows allowed the pool to rise all fall and winter until an inflow event in March resulted in the pool rising into the flood control pool. Harlan County was out of tandem balance with Milford, so it continued to accumulate storage in the flood control pool; however, a small release of 100 cfs was started to wet the downstream channel and prepare it for larger releases when they were allowed.

In July a significant inflow event was experienced with daily inflows exceeding 12,000 cfs. The pool rose to a record of 1958.17 feet on July 23 which is 37.9 percent of the flood control pool occupied. No major concerns were experienced at this pool elevation. Harlan County continued to be out of tandem balance with Milford, but Milford had dropped to 80 percent of the flood control pool and was passing the remaining inflows. At this time the decision was made to increase Harlan County releases to 1100 cfs plus some irrigation releases and drop the pool below critical surveillance level.

After Harlan County dropped below critical surveillance level the release was reduced to 300 cfs to pass inflows and meet irrigation demands. The periodic inspection and stilling basin dewatering in October required all releases to be reduced to zero. After the inspection, Milford had dropped to the point that tandem balance was no longer an issue and the release was increased to 1100 cfs to empty the remaining flood control storage. Significant downstream channel constraints prevented a release greater than 1100 cfs. Project staff provided extensive coordination with downstream landowners and communities and did channel reconnaissance during the high releases. The loss of channel capacity is due to sedimentation and vegetation in the downstream channel and agricultural encroachments. The main areas of concern are from the down to just downstream of Franklin, NE.

Lovewell Reservoir experienced above normal inflows and the second highest pool elevation on record. Through much of the report period, Lovewell was out of tandem balance with Milford and releases were constrained resulting in the high pool elevation of 1592.97 feet on July 15. At the peak, 77.6 percent of the flood control pool was occupied. At this point, Lovewell was allowed to release based on the tandem balance curves with Milford, and releases were increased up to a maximum of 1250 cfs as the flood control pool was evacuated. The reservoir continued to be drawn down below the conservation pool to facilitate scheduled repairs on the tainter gates.

5b. Smoky Hill River Basin

Cedar Bluff Reservoir experienced above normal inflows during the report period. The pool rose over 12 feet from October 2018 to September of 2019, but remained below the top of conservation storage. No release was made through the report period.

Kanopolis Reservoir experienced above normal inflow during the report period. A heavy rainfall event in October lead to daily inflows in excess of 15,000 cfs and a substantial pool rise. Once the flood storage from that event was emptied, the pool was lowered below the uncontrolled weir to allow gate rehabilitation and sediment removal contracts to perform their work.

A very wet May, lead to sustained high inflows and a peak pool elevation of 1496.13 feet on June 2. At the peak 60.6 percent of the flood control pool was occupied. The reservoir was in the upper range of the Phase II flood control operating criteria. When downstream control points on the Smoky Hill River at Mentor, New Cambria, and Enterprise dropped below criteria, releases were stepped up to a maximum of 3776 cfs in mid-June with a combined gate and weir flow. The maximum allowable Phase II release is 5000 cfs; however, bank full channel capacity was reached with the maximum flow and agricultural damages and other out of bank flooding would occur with higher releases. The biggest impacts were from the dam to the downstream communities of Lindsborg and Marquette, KS.

Once the pool dropped back into Phase I, releases were reduced and at times were regulated to support Kansas River operations as the Lower Kansas reservoirs dealt with Phase II or greater releases.

Wilson Reservoir experienced above normal inflows and sustained outflows throughout the reporting period. Very wet May conditions lead to the pool rising to the annual maximum elevation of 1527.11 feet on June 11 which is the fourth highest pool elevation on record. At the peak 21.5 percent of the flood control pool was occupied. The Phase I maximum release of 1200 cfs was discharged for an extended time across the summer and fall to empty the accumulated flood storage.

Webster and Kirwin Reservoirs both spent the entire reporting period near or above the top of conservation pool. Wet May and August conditions lead to pool rises at both reservoirs. Webster peaked at 1899.55 feet on September 13 with 16.2 percent of the flood control pool occupied. Kirwin peaked at 1734.55 feet on June 23 with 13.7 percent of the flood control pool occupied. At times both reservoirs had to curtail releases for downstream control points and tandem

balance considerations with Waconda Reservoir. The maximum releases remained small with Webster releasing a maximum of 300 cfs and Kirwin releasing a maximum of 226 cfs.

Waconda Reservoir experienced wet conditions with high inflows and releases through much of the reporting period. Especially wet May and August conditions led to a peak pool elevation of 1466.07 feet on August 29 with 21.8 percent of the flood control pool occupied. This was the fifth highest pool elevation on record. The pool remained in Phase I while in flood control operations and the maximum release was set at 2500 cfs to empty the flood storage. This resulted in the Solomon River at Niles, KS being near its Phase I maximum of 3000 cfs as significant base flows contributed to the river reaches below Waconda.

5c. Kansas River Basin

1. Background

This report details the decisions made in the 2019 operation of the Lower Kansas River tributary Reservoirs of Milford, Tuttle Creek, Perry, and Clinton, to include operations through December 2019, in order to detail the complete evacuation of all accumulated 2019 flood storage. A brief overview of the hydrologic conditions are described. Major reservoir release decisions and the factors leading up to the decisions are also addressed.

2. Winter and Early Spring (January through March 2019)

Plots of the January through March reservoir elevation, inflow, and outflow are shown in Figures 1 through 4. All four reservoirs began the year above the multi-purpose pool because of wet fall conditions and fall rises from the water level management plans. Winter ice conditions allowed a winter drawdown in January and all the reservoirs were at or below the multi-purpose pool elevation by late January.

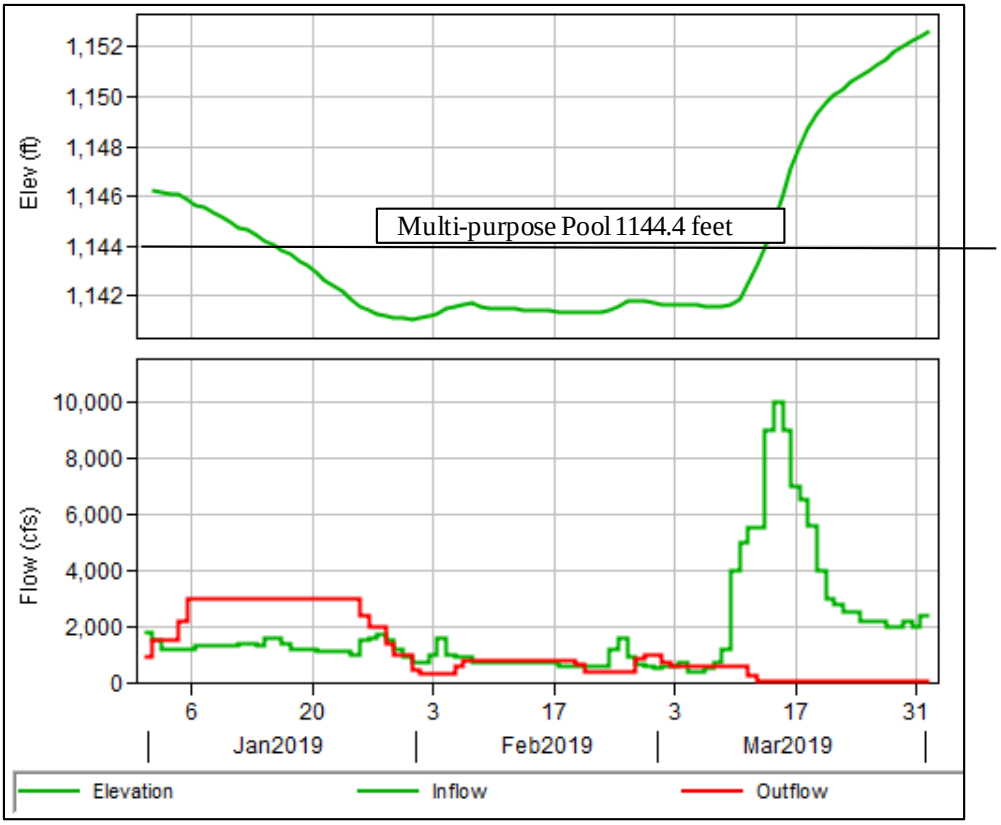


Figure 5c-1. Milford January through March 2019 reservoir elevation, inflow, and outflow.

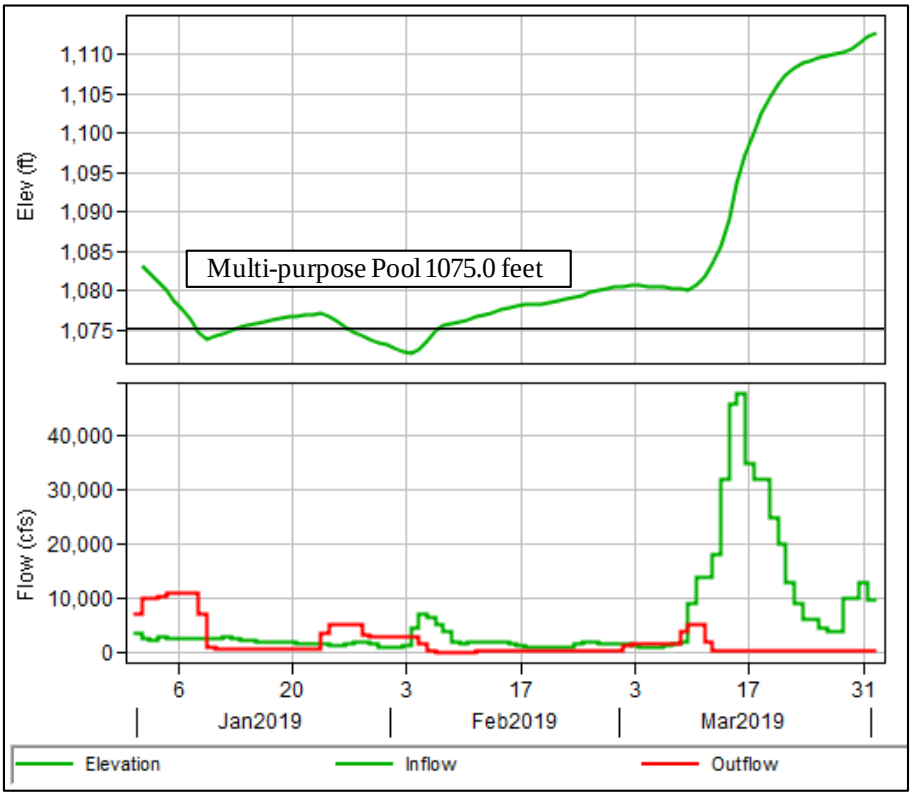


Figure 5c-2. Tuttle Creek January through March 2019 reservoir elevation, inflow, and outflow.

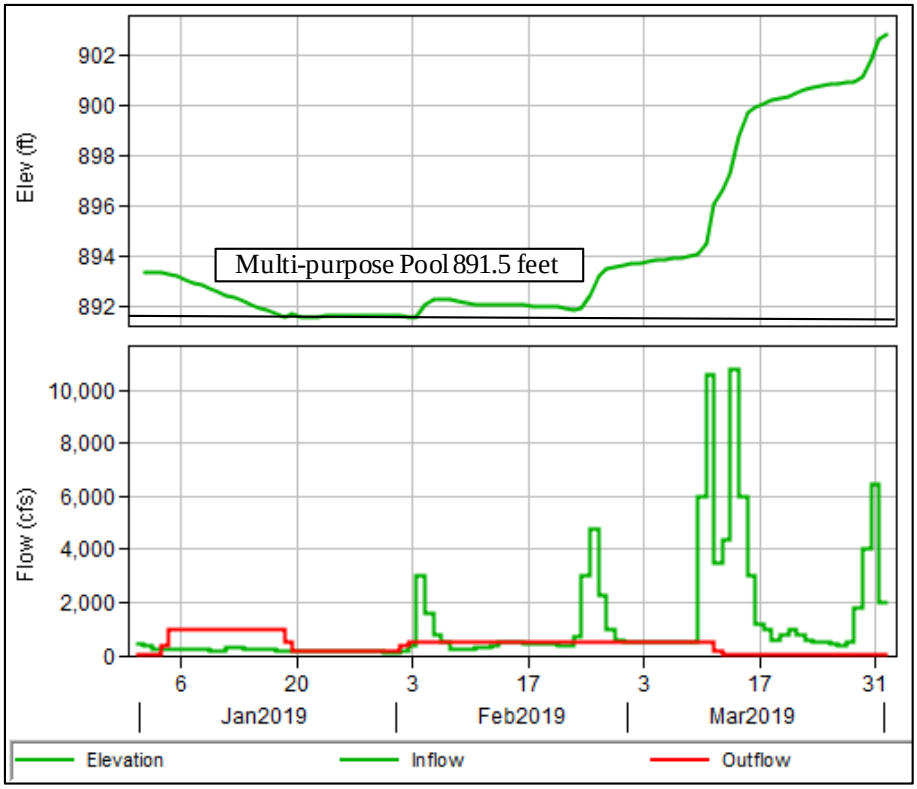


Figure 5c-3. Perry January through March 2019 reservoir elevation, inflow, and outflow.

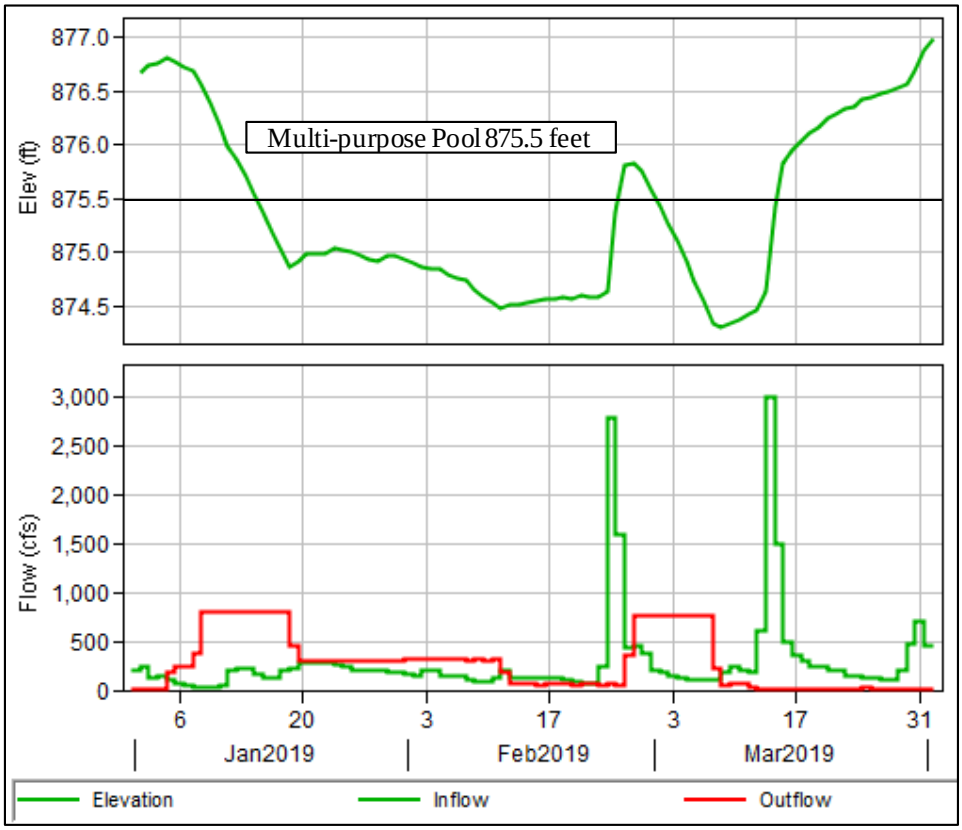


Figure 5c-4. Clinton January through March 2019 reservoir elevation, inflow, and outflow.

Tuttle Creek drew down below multi-purpose pool by January 8, but by January 9 releases were reduced to 700 cfs to facilitate work on the stilling basin. The work was completed by January 23 and releases were set to draw the reservoir down to the winter target elevation of 1072 feet. The target was nearly reached by February 3, but a small snowmelt event caused increased inflows. Releases were reduced to zero on February 5 for ongoing stilling basin construction work and they remained at or below low-flow levels until March 1 when the work was completed. Ice in the marinas prevented drawing the lake down until March 8 when releases were increased. By March 9 a significant inflow event, as discussed below, began and releases were reduced to low-flow within a few days due to downstream flooding. On March 9 when the flooding began, approximately 62,300 acre-feet of the flood control storage was occupied due to constrained releases to accommodate the stilling basin repair and construction project, and ice issues. This is just over 3% of the total 1.88 million acre feet of flood control storage at Tuttle Creek.
In mid-March, a rain on snow event led to increased inflows especially for Milford, Tuttle Creek and Perry. The March 8, National Operational Hydrologic Remote Sensing Center snow map is shown in Figure 5c-5 for the lower Republican and Blue River basins. As can be seen much of the Republican River watershed between Harlan County and Milford had 1 to 2 inches of snow water equivalent (SWE) on the ground. The Blue River basin had large areas with 1 to 2 inches of SWE with some areas of 2 to 4 inches of SWE. Much of this snow had accumulated prior to March 1. Figure 5c-6 shows the March total precipitation for this region. Figure 5c-7 shows the March percent of normal for the region.

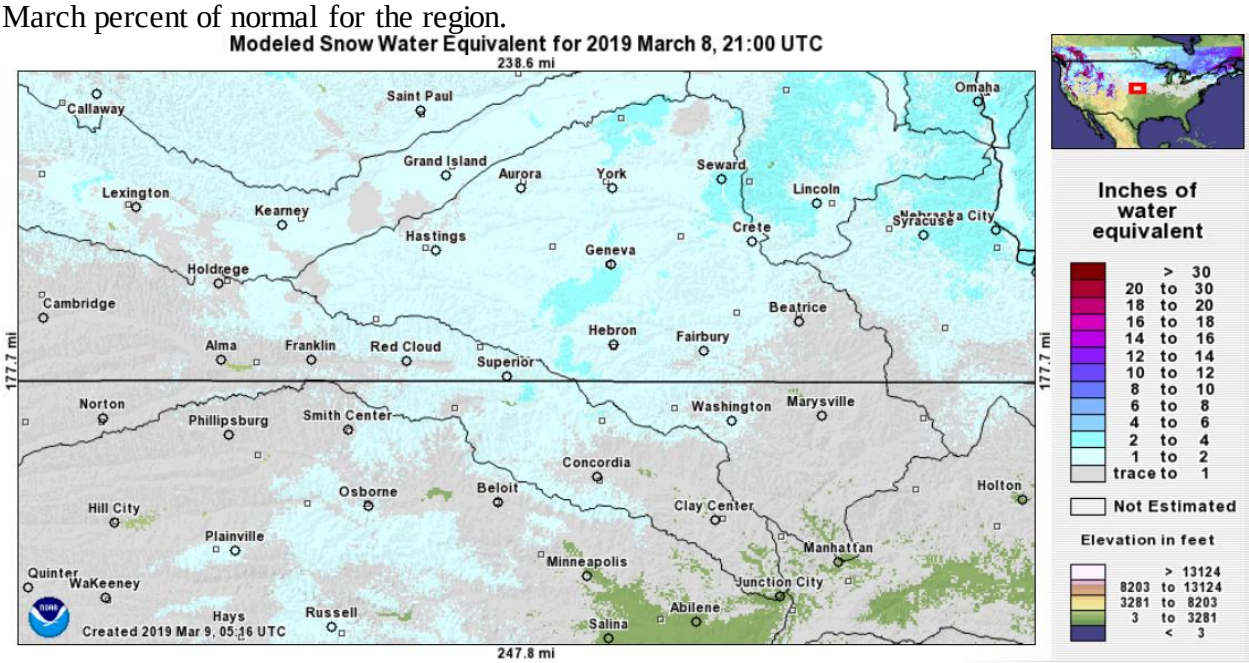


Figure 5c-5. March 8th National Operational Hydrologic Remote Sensing Center snow map.

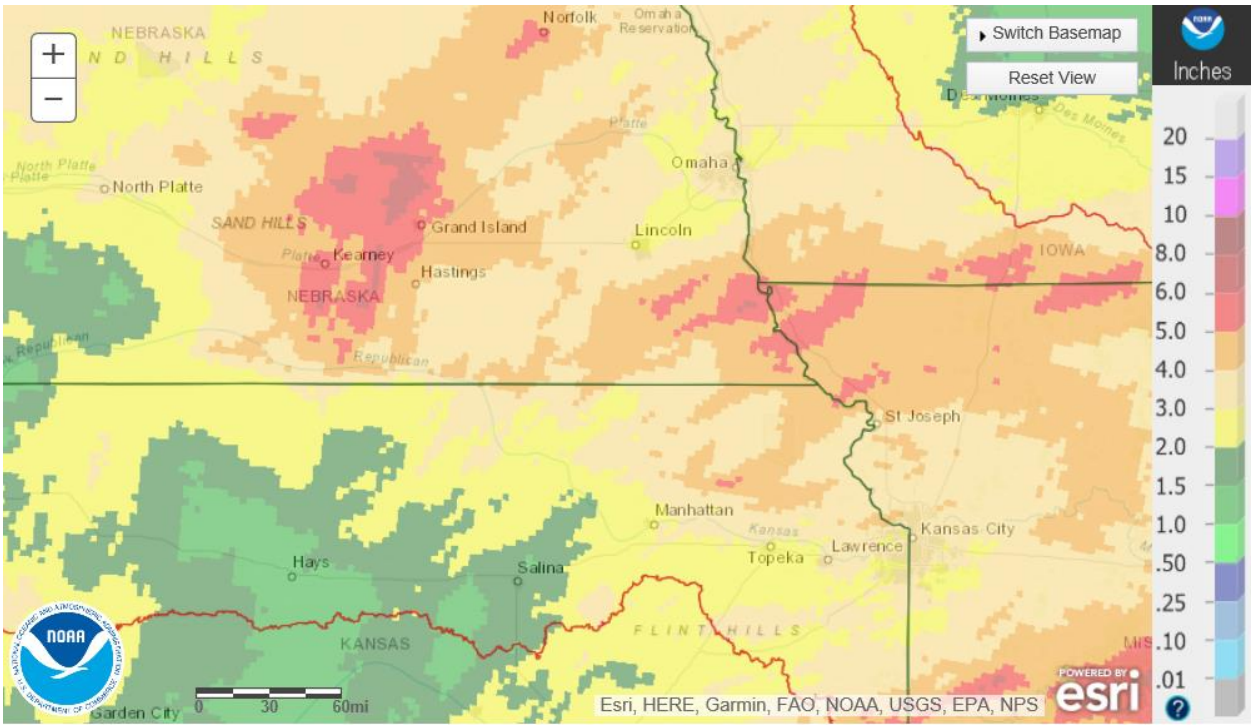


Figure 5c-6. March total precipitation across the Kansas River basin.

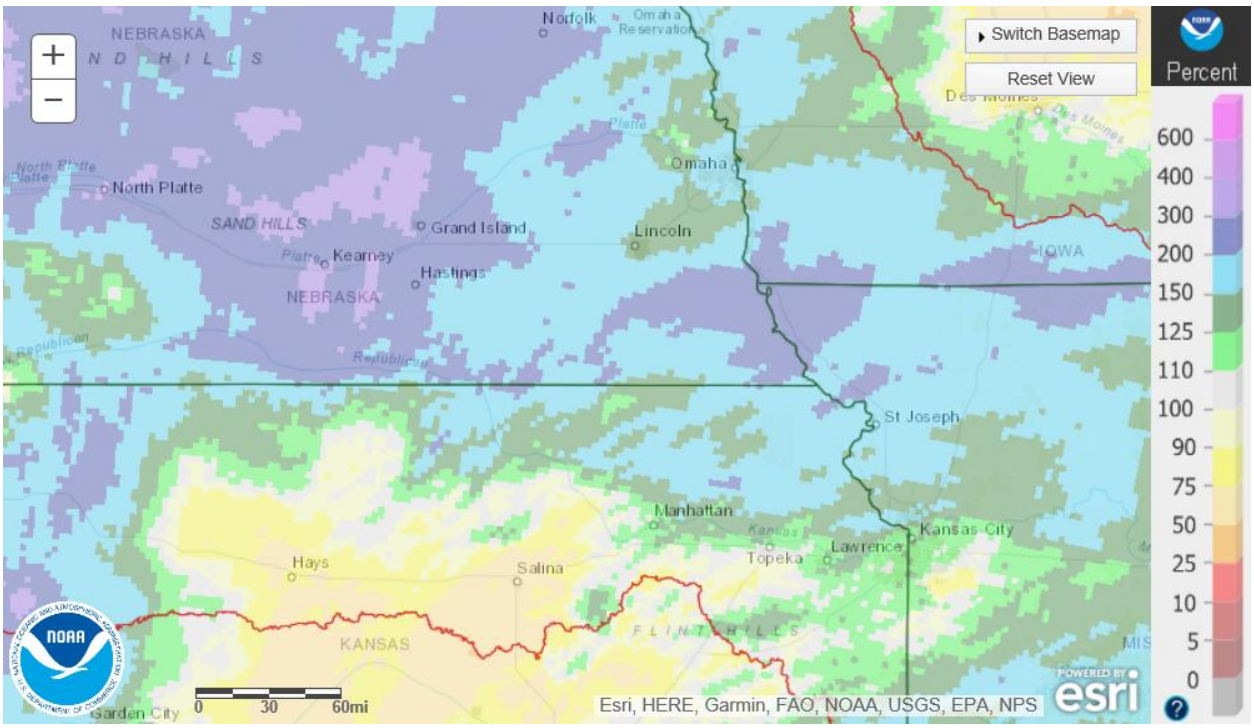


Figure 5c-7. March percent of normal precipitation.

As can be seen from Figures 5c-6 and 5c-7, above normal precipitation was observed especially on the northern side of the Kansas River basin. Some areas of the Republican River basin above Milford received 200 to 300 percent of normal. Some areas above Milford and Tuttle Creek

received 4 to 5 inches of precipitation. Combining the precipitation with the snow melt resulted in significant rises within the Phase I flood control pool especially at Milford, Tuttle Creek, and Perry.

While the reservoirs were rising, flows along the Missouri River were also increasing due specifically to historic flooding in Nebraska. A large flood hydrograph was working its way down the Missouri River to the USGS gage at Waverly, Missouri, which is the most downstream and most restrictive control point for Kansas River reservoirs flood control operations. By March 11, the Missouri River at Waverly was above the Phase I criteria of 90,000 cfs. Figure 5c-8 shows the Missouri River at Waverly flow from March through June of 2019.

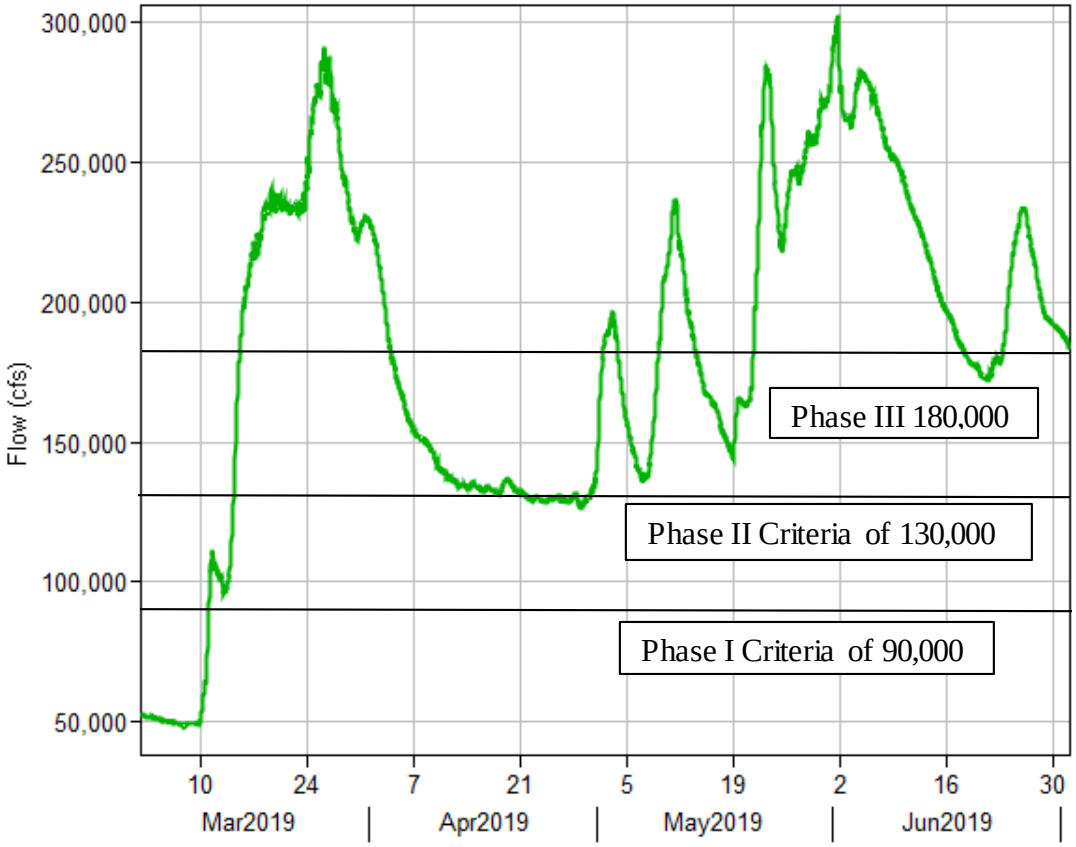


Figure 5c-8. Missouri River at Waverly flow for March through June 2019

3. Spring (April, May, and June)

See Figures 5c-9 to 5c-12 for elevation, inflow and outflow during April, May and June. After the large inflow event in March, conditions were dry in April. Most of the Kansas River basin had below normal precipitation in April, however all four reservoirs' releases were constrained by high flows on the Missouri River at Waverly, resulting in gradual pool rises. The April percent of normal precipitation is shown in Figure 5c-13.

As Tuttle Creek's elevation increased through April, the Phase I/II boundary was transitioning downward. By late April, Tuttle Creek was in Phase II and the Missouri River at Waverly had gradually and marginally dropped below the Phase II criteria of 130,000 cfs. Small releases were made in late April and early May but high base flow and rainfall minimized the opportunity for releases beneath the Waverly Phase II criteria.

The inability to release Phase II water prompted NWK to request a deviation to raise the Missouri River at Waverly Phase I target to 110,000 cfs and the Phase II target to 160,000 cfs. The deviation was approved through Missouri River Basin Water Management (MRBWM) on May 24 (**all 2019 deviation approvals can be found in Appendix C**). However, as the deviation was being approved a rainy pattern set up in mid to late May that resulted in very high flows on the Missouri River and inflows to all four reservoirs. With substantial inflows into the reservoirs and the Missouri River well above criteria for any releases, Perry and Tuttle Creek rose into surcharge and Milford and Clinton experienced substantial pool rises. According to the State of Kansas Climatologist, the month of May was the wettest month on record in the state of Kansas. Figures 5c-14 and 5c-15 show the May total precipitation and percent of normal precipitation, respectively.

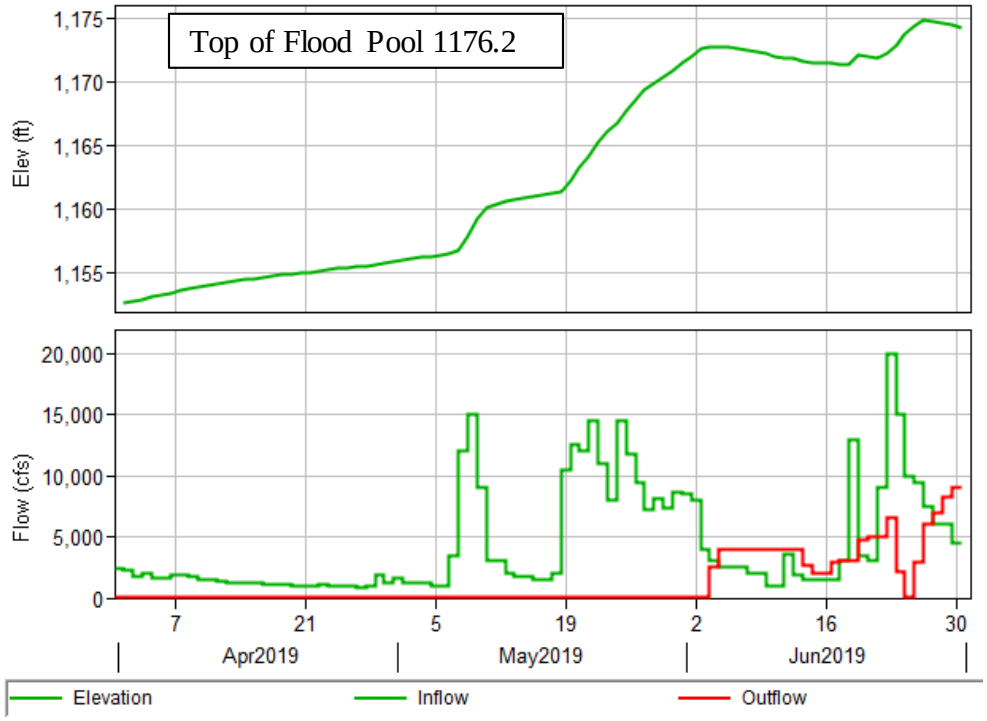


Figure 5c-9. Milford April through June 2019 reservoir elevation, inflow, and outflow.

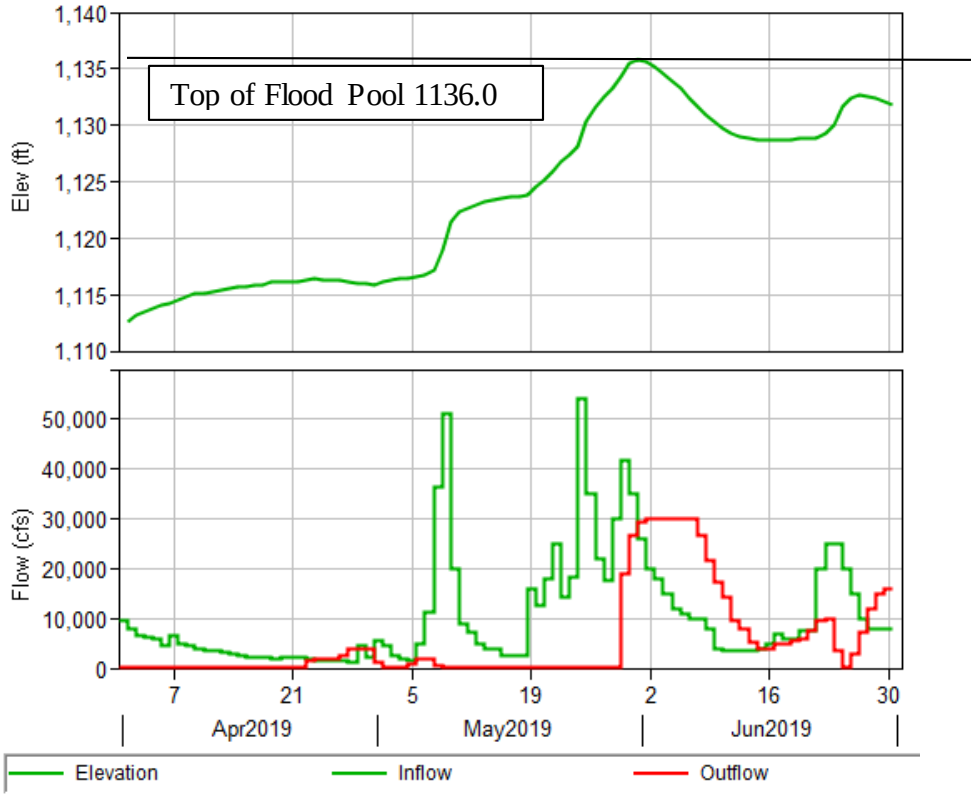


Figure 5c-10. Tuttle Creek April through June 2019 reservoir elevation, inflow, and outflow.

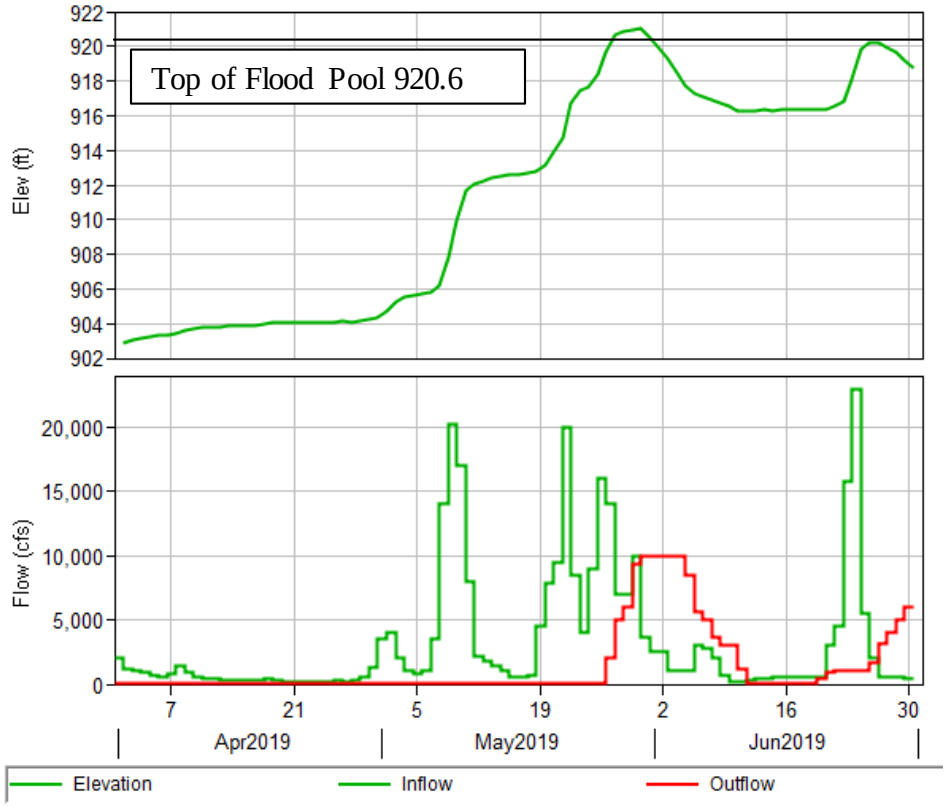


Figure 5c-11. Perry April through June 2019 reservoir elevation, inflow, and outflow.

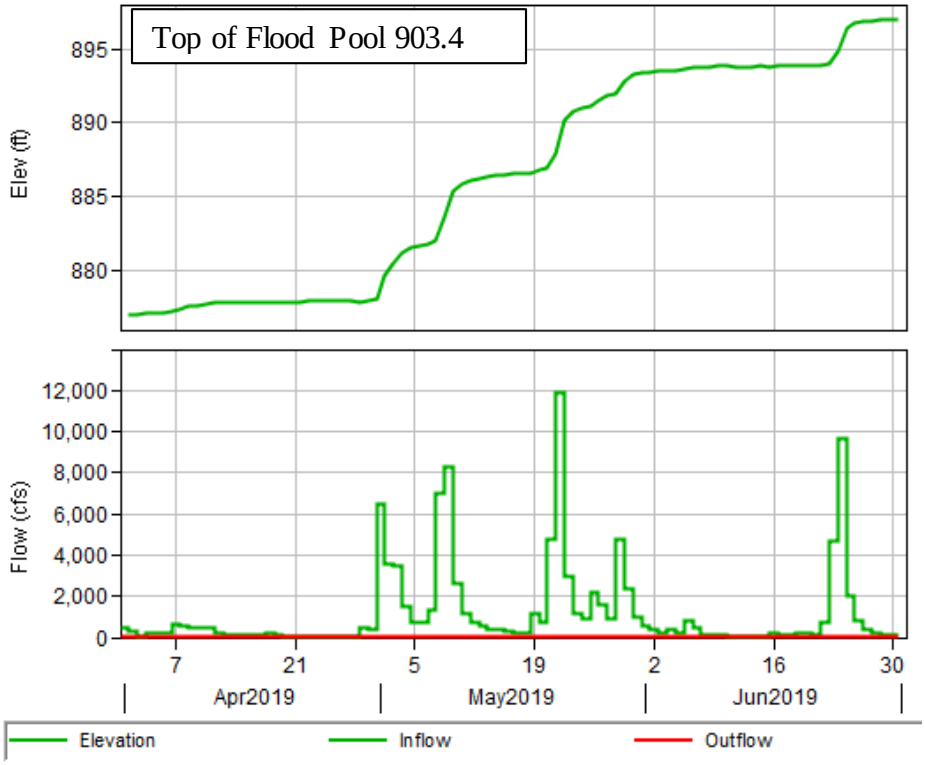


Figure 5c-12. Clinton April through June 2019 reservoir elevation, inflow, and outflow.

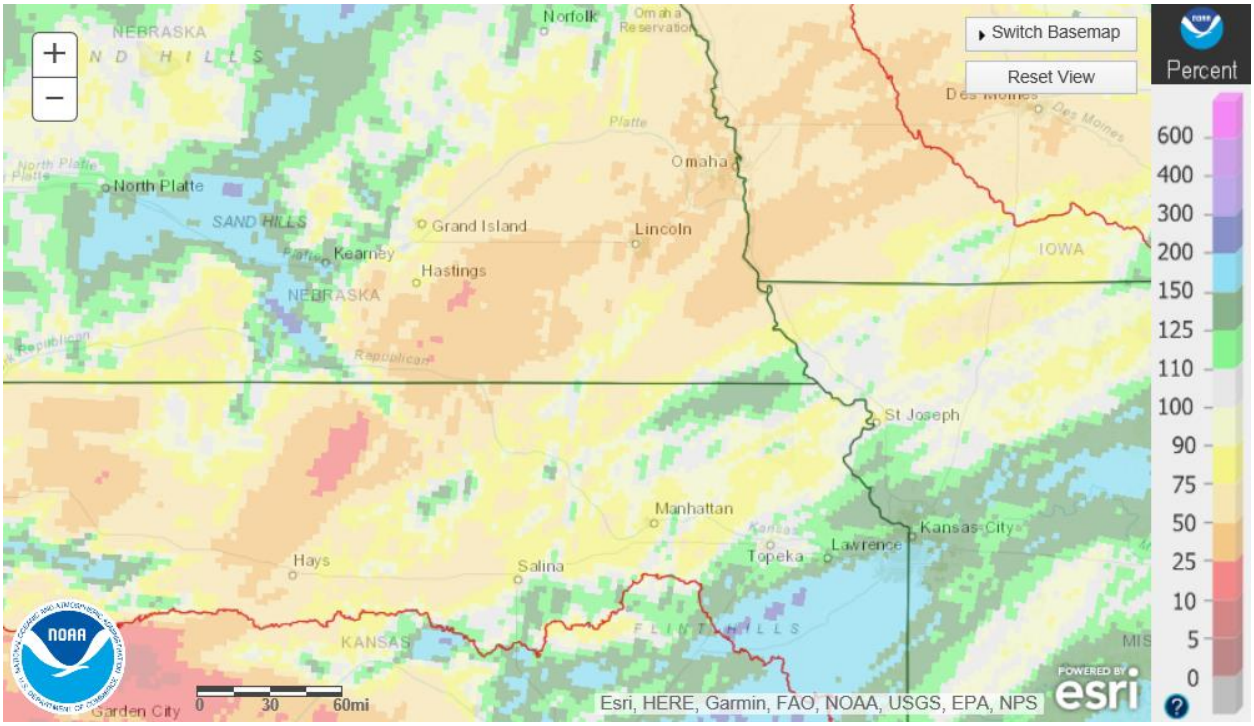


Figure 5c-13. April percent of normal precipitation.

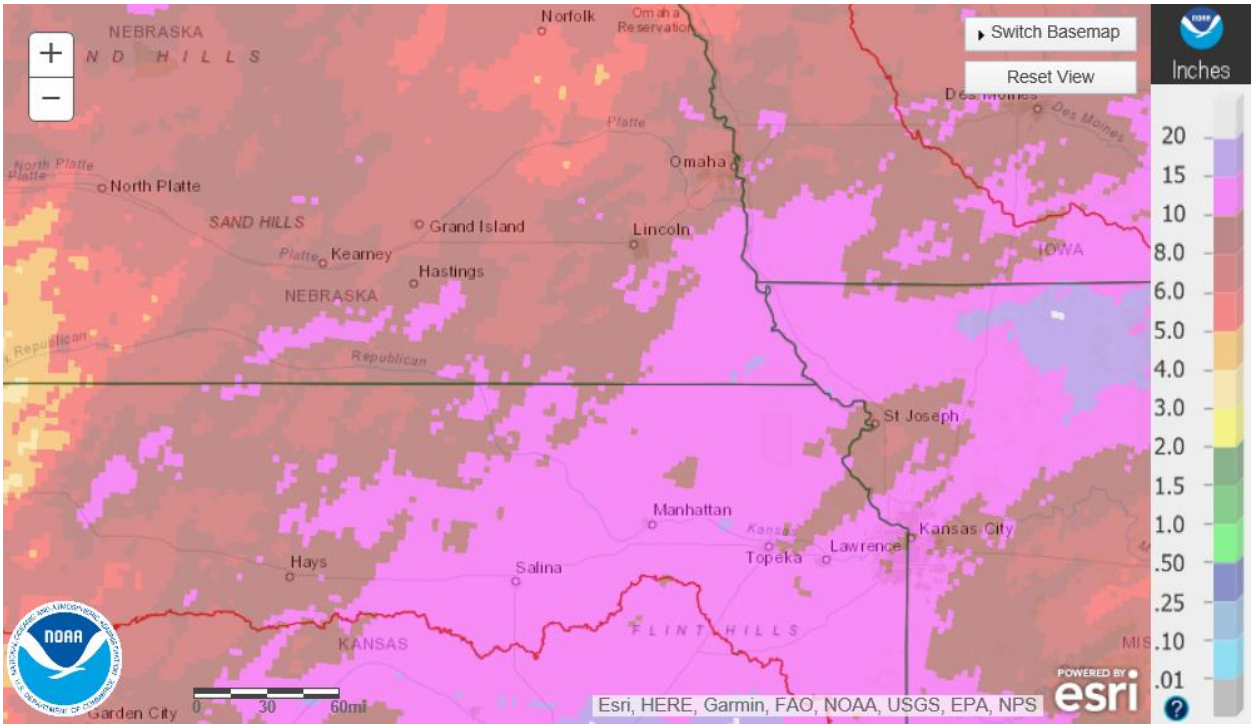


Figure 5c-14. May total precipitation across the Kansas River Basin.

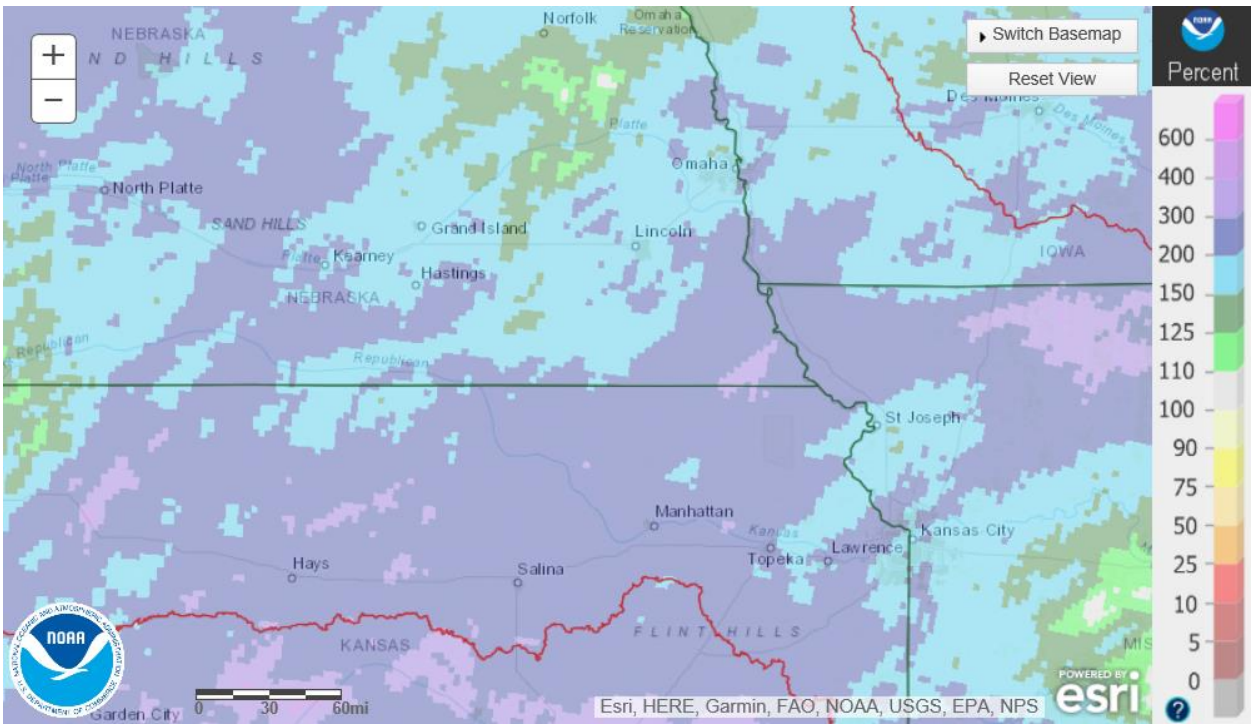


Figure 5c-15. May percent of normal precipitation.

Perry was the first project to transition from flood control operation to surcharge operations on 26 May 2019, after having been constrained to low flow since approximately 15 March 2019. The top of the flood control pool is at elevation 920.6 feet but the spillway is perched 1.4 feet

above the top of the flood control pool at elevation 922.0 feet. The water control manual guidance for surcharge operations specifies that as the reservoir exceeds 100% flood control storage occupied, inflows are to be passed through the gated outlet works, up to the capacity of the outlet works, without regard to downstream control points criteria. The uncontrolled spillway will only be used as inflows exceed the outlet works capacity.

On 25 May inflows peaked at around 16,000 cfs and were dropping as the pool approached elevation 920.6 feet. On the evening of May 26, a release of 5,000 cfs was started resulting in a gradual rise of the pool into surcharge the following day. The release was made prior to entering surcharge, based upon water on the ground, in order to allow the gate change to be made during daylight hours. This allowed conditions in the stilling basin to be monitored as the releases increased. Over the course of a few days releases were stepped up to 10,000 cfs in response to additional rainfall and hourly inflows increasing to 10,000 cfs. The reservoir crested at elevation 921.15 feet during the overnight hours of 29 -30 May 2019, exceeding the former record crest 920.85 established 25 July 1993.

The maximum surcharge release of 10,000 cfs is less than the maximum Phase I allowable release and did not cause any concern to the local communities. The release was comparatively small only because of fortuitous timing of the event which allowed storage of most of the inflow prior to reaching surcharge, allowing release to be set to match inflows while they were already beginning to drop. Negative impacts from the surcharge release were that they added to already high flows on the Missouri River.

Because Missouri River flows were well in excess of the 180,000 cfs Waverly Phase III criteria, surcharge releases from Perry would have to be throttled back to pass inflows and stabilize the pool elevation at the top of the flood control pool. Under these circumstances, the lack of any remaining available storage to provide flood protection for downstream communities was considered an unacceptable risk. A deviation was requested and approved on May 31 to address these concerns. It allowed for a surcharge release to be either maintained or reduced to the maximum Phase III release, whichever is less, until the percentage of occupied flood control storage declined to 80%. The deviation further allowed release from a reservoir with greater than 80% of the flood control pool storage occupied, provided that water contributed only to a falling hydrograph at downstream control points. These provisions provided limited flood control storage and mitigated against the threat of an immediate return to surcharge releases. This deviation allowed the Perry release of 10,000 cfs to be held for a few days while the reservoir slowly declined to 80% occupied flood control storage, after which releases were reduced to match inflows and maintain the pool at that level.

Meanwhile, Tuttle Creek continued to rise steadily throughout the month of May with consistent rainfall and elevated inflows. Releases had been constrained to low flow since 07 May 2019. The top of the flood control pool is elevation 1136 feet NGVD29 which also corresponds to the top of the tainter gates. The water control manual guidance for surcharge operations specifies that releases are to be increased as the pool approaches 100% occupied flood control storage, without regard to downstream control points criteria, in order to prevent the tainter gates from being overtopped.

By the early morning hours of 29 May 2019 there was sufficient water on the ground to exceed the remaining volume of available flood control storage and transition Tuttle Creek from flood control operations to surcharge operations. Based on trends in hourly inflows, the decision was made to initiate releases through the gated outlet works to match inflows and control the rate of rise as it approached elevation 1136.0 feet. This was a joint decision between Water

Management, Dam Safety, and Operations Division, among others, not to raise the tainter gates unnecessarily. This was a feasible option because inflows, while consistently elevated, were not beyond the release capacity of the outlet works, and upstream gages were forecast to decline within a few days.

On 29 May 2019, outlet works releases were increased from 200 to 25,000 cfs over the course of the day. At the time of the first gate change at 7 am, the pool elevation was 1134.36 feet, and at the time of the last gate change at 7 pm the pool elevation was 1135.06 feet, with the average daily inflow calculated to be 30,000 cfs. The pool continued to rise overnight and throughout the next day. Releases were increased to 27,500 cfs at 5 pm on 30 May 2019 at a pool elevation of 1135.64 feet. This was the largest release ever made through the outlet works, and there were no concerns noted other than splashing out of the stilling basin. The daily inflow was calculated to be 41,600 cfs on May 30. The pool continued to slowly rise, and there was discussion if the tainter gates should be opened to prevent overtopping. Tuttle Creek project staff surveyed the distance from the water surface to the top of the gates and found that the top of the gates were approximately 0.2 feet higher than anticipated. The difference may have been due to errors in the pool elevation gage or previous surveys of the dam, but the small amount of additional freeboard helped with the decision to continue to wait for the inflows to begin to drop rather than now opening the tainter gates.

At noon on May 31 the release was further increased to 30,000 cfs at a pool elevation of 1135.82 feet. It was decided to open the tainter gates if the reservoir was forecast to exceed 1135.95 feet by 8 am on June 1. It would be best to open the gates during day time hours to aid observing and clearing the path of the downstream channel prior to opening them. It was decided to decrease the conduit gates first before bumping the tainter gates open. It would take about one hour to make sure no one was in the channel downstream of the tainter gates and another half an hour to make all the gate changes. However, the noon increase to 30,000 cfs at the outlet works proved to be sufficient. The pool crested at elevation 1135.84 through the afternoon hours of 31 May 2019 before slowly beginning to decline through the overnight hours. The tainter gates remained closed. Through this event, Tuttle Creek crested well below the record pool elevation 1137.77 feet established during surcharge operations 22 July 1993. The release of 30,000 cfs was continued until 07 June 2019, drawing the reservoir down to 80% occupied flood control storage, at which time releases were reduced to match inflows and stabilize the pool.

Concurrently, the Missouri River at Waverly was cresting in excess of 300,000 cfs, which would become the peak-flow basis for justifying releases down to 80% occupied storage at Milford, Tuttle Creek and Perry. Flood control operations at Milford and Clinton were sufficient to manage inflows without exceeding available storage capacity, so Milford and Clinton never transitioned to surcharge operations. The deviation was leveraged at Milford, however, to permit a release of 4000 cfs beginning on 03 Jun 2019 to draw the reservoir down to 80% occupied flood storage. Meanwhile, inflows into Clinton never exceeded 80% occupied flood control storage, so its releases remained at low flow.

By mid-June Milford, Tuttle Creek and Perry were all at 80% of the flood control pool and passing inflows to stay at that level. Phase II pool elevation corresponds to approximately 80% of the flood control pool during this time of year. The Missouri River at Waverly remained elevated above the 160,000 cfs Phase II flow criteria approved by the May 24th deviation. Because of the high pool elevations and the understanding that Missouri River flows through Waverly would likely remain elevated well into the foreseeable future, minor changes were

made to the 24 May 2019 deviation to increase the Phase II flow target at the Missouri River at Waverly from 160,000 cfs to 180,000 cfs. This deviation was approved on 19 June 2019.
In late June, a large rain event occurred across the Kansas River basin and also elevated the Missouri River flows. Releases from Milford, Tuttle Creek and Perry were managed as their occupied storage increased above 80%, so long as Waverly presented a falling hydrograph. Based upon water on the ground, Perry was forecasted to re-enter surcharge. Releases were increased such that Perry crested broadly on 25 June 2019 at elevation 920.2 feet, and releases were then increased further in accordance with the terms of the 31 May deviation to re-establish available flood control storage. Milford crested broadly at elevation 1174.76 throughout the day on 26 June 2019, well below the record crest established during the 1993 Flood. Clinton rose abruptly in response to this event, cresting at elevation 897.05 feet on 29 June 2019. With approximately only 70% of its flood control storage occupied, Clinton was in a better situation than the other three reservoirs and it was not until mid-July that releases increased from Clinton and the reservoir began to decline.
The June total precipitation is shown in Figure 5c-16. The June percent of normal precipitation is shown in Figure 5c-17. As can been seen, much of the month was dry coming off of very large May rainfall. However most of the basin was still above normal pool elevation for June.

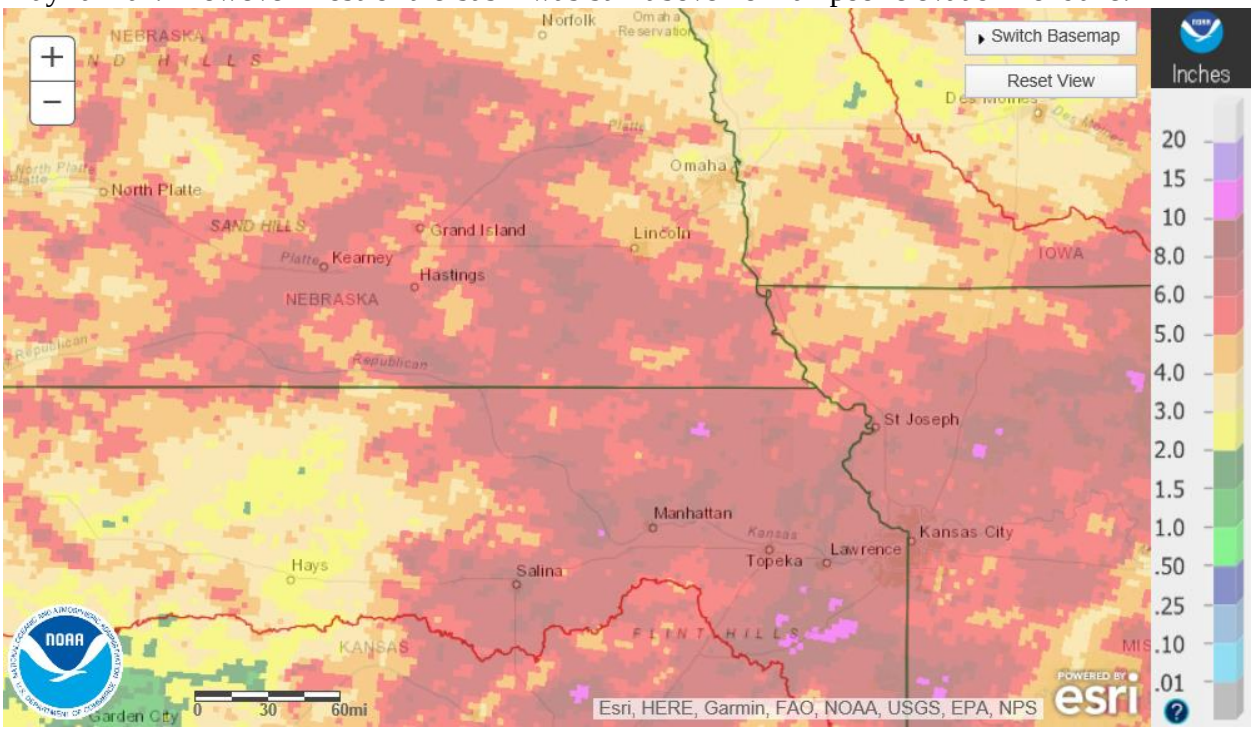


Figure 5c-16. June total precipitation across the Kansas River Basin.

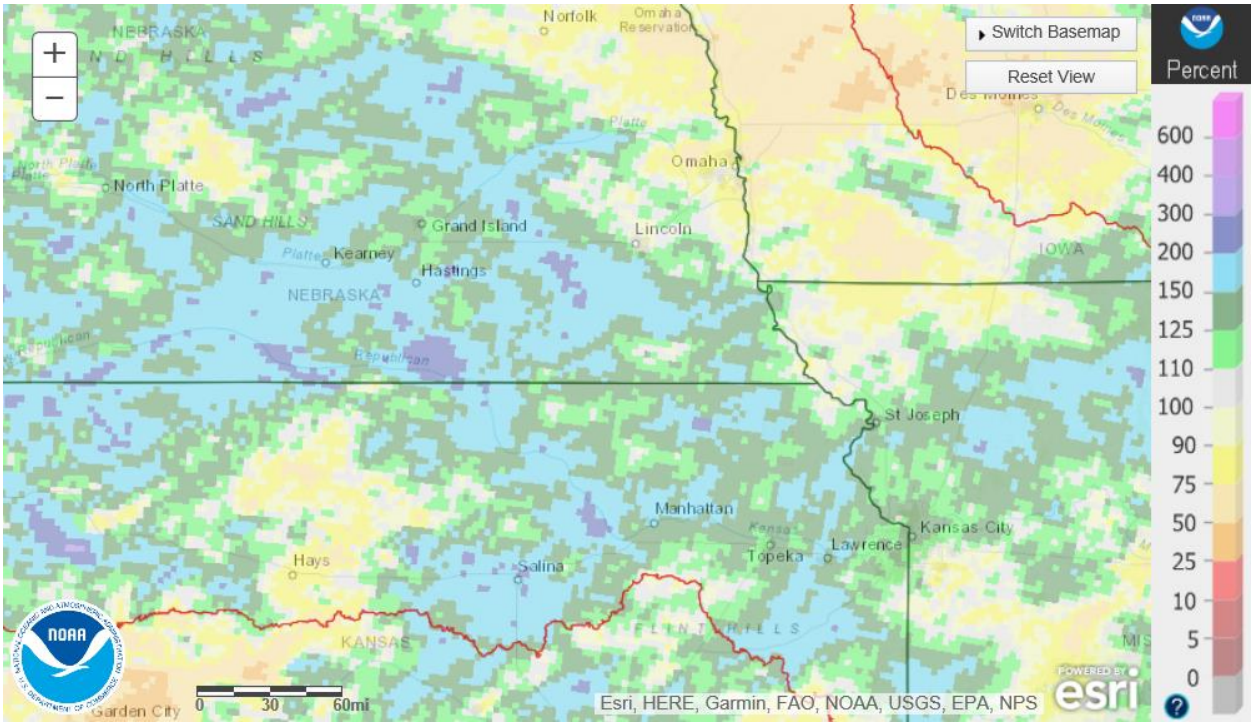


Figure 5c-17. June percent of normal precipitation across the Kansas River Basin.

4. Summer/Fall (July, August and September)

Entering July, with Milford, Tuttle Creek and Perry occupied storage in excess of 80% full, releases from these projects were managed to ensure Waverly maintained a falling hydrograph. July rainfall across much of the Kansas River Basin was approximately 75% of normal, while there were areas outside the basin that received well in excess of monthly normal rainfall. Releases were sized to attempt to bring Milford, Tuttle Creek and Perry simultaneously down to the permissible 80% target and then stabilize the pools. By 15 July, releases from these three reservoirs, plus Clinton, were being increased, based on the 19 June deviation that permitted Phase II releases through Waverly, not to exceed 180,000 cfs. All four reservoirs were now below 80% occupied storage and declining. By the end of July, releases from all four reservoirs were reduced to inflows. Each reservoir was approaching the top of their respective Phase I storage. See Figures 5c-18 to 21 for reservoir elevation, inflow and outflow.

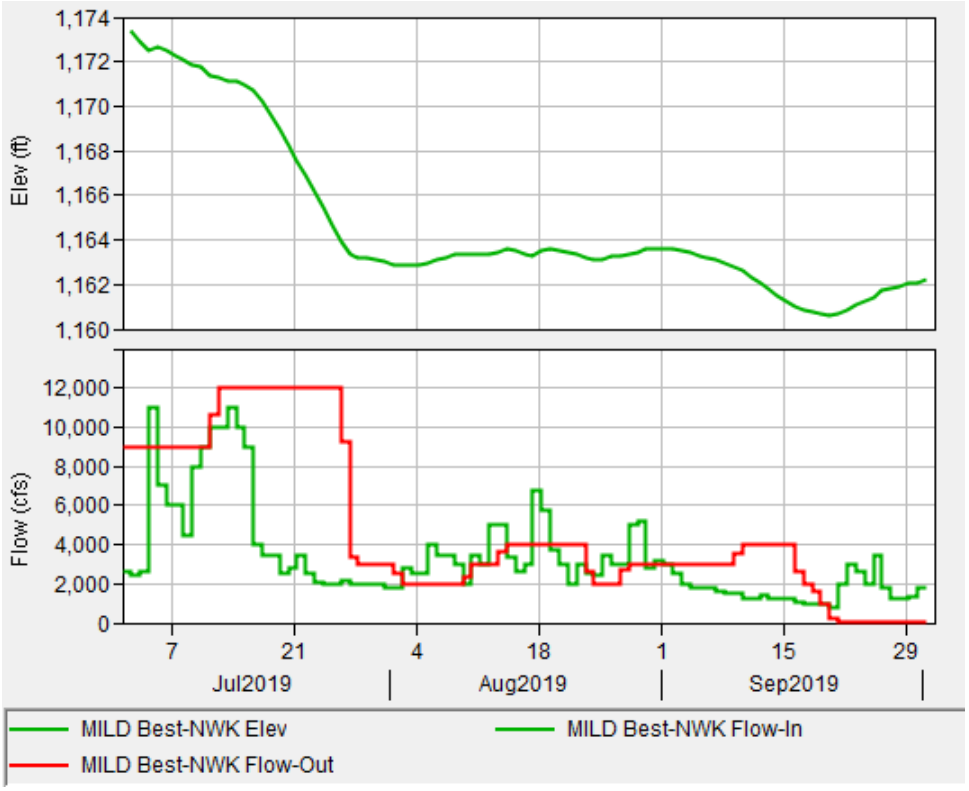


Figure 5c-18. Milford July through September 2019 reservoir elevation, inflow, and outflow.

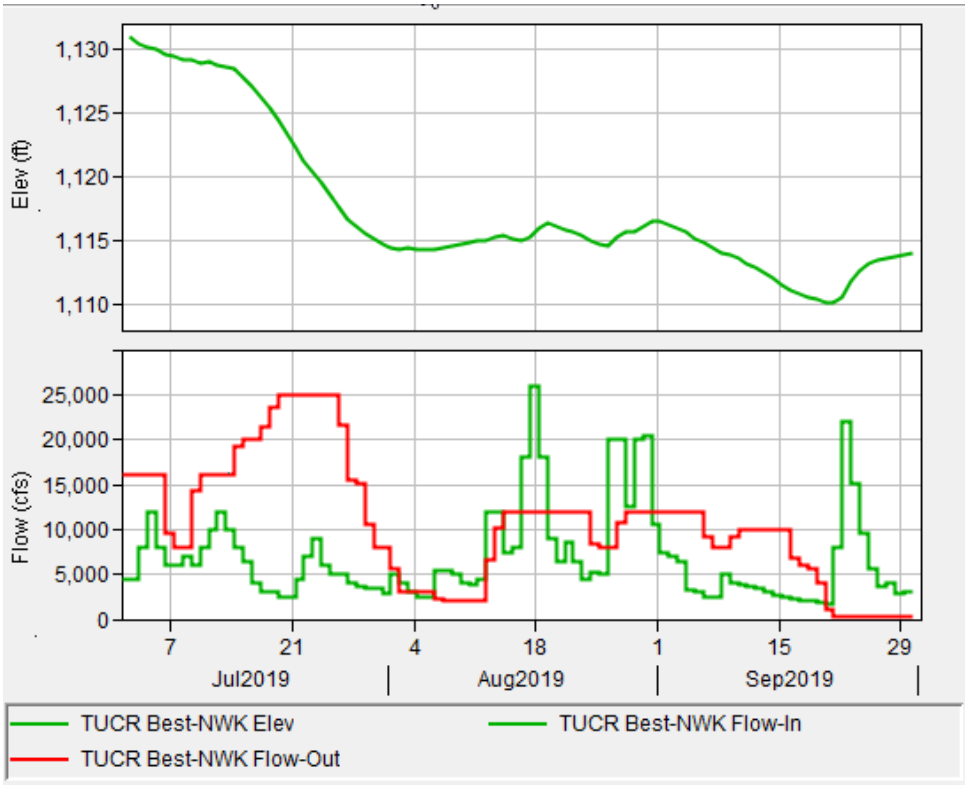


Figure 5c-19. Tuttle Creek July through September 2019 reservoir elevation, inflow, and outflow

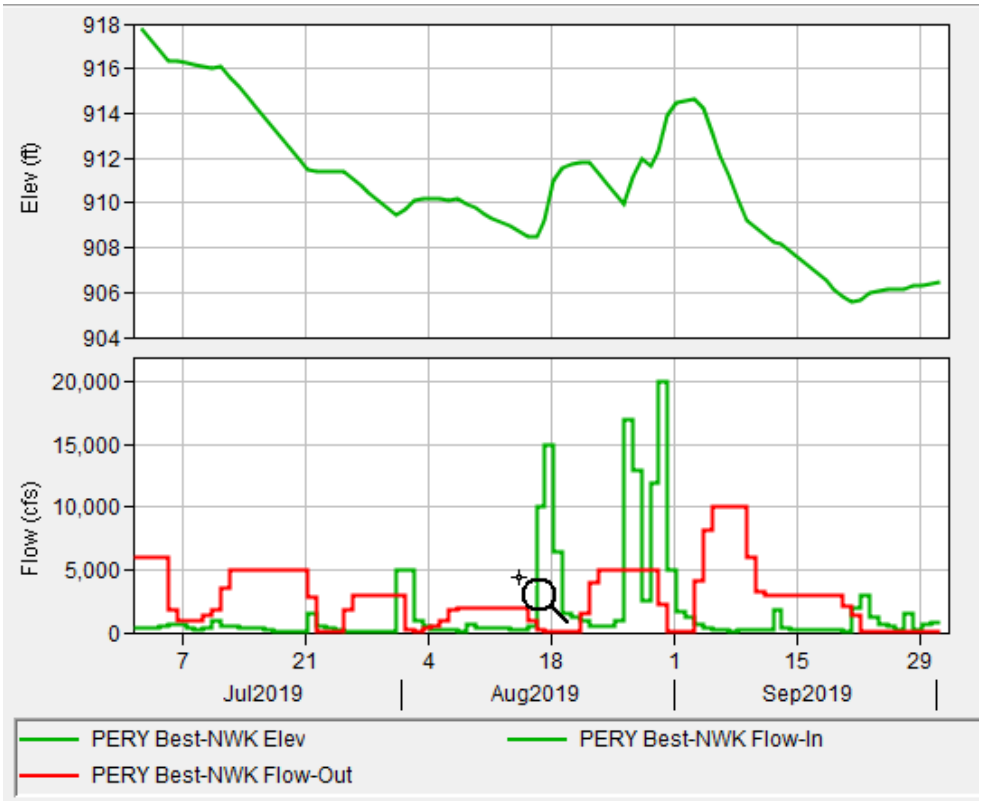


Figure 5c-20. Perry July through September 2019 reservoir elevation, inflow, and outflow

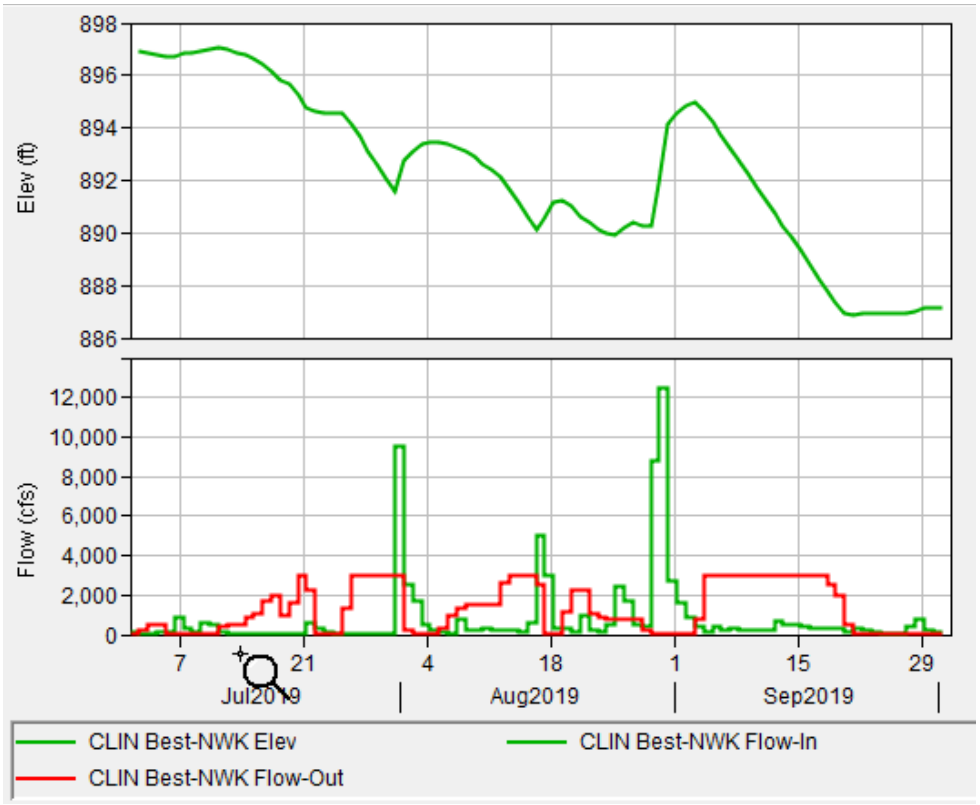


Figure 5c-21. Clinton July through September 2019 reservoir elevation, inflow, and outflow

August rainfall across the Kansas River Basin was 200% of normal in many areas, extending across areas outside the Kansas Basin. The entire month of August was spent passing and adjusting for inflows at Milford and Tuttle Creek, while Perry and Clinton were similarly adjusted. Perry and Clinton also had to be reduced to low flows, as Waverly rose in response to August rain events below Gavins Point. By 03 September, a new deviation was in effect that raised the Phase I criterion from 110,000 cfs to 140,000 cfs.
September rains across the Kansas River Basin generally averaged 50% of normal, but ranged considerably greater than that across the greater Missouri River Basin. September began with elimination of Phase II storage from Perry and Clinton, while manipulating releases from Tuttle Creek and Milford to pass inflows. The goal was to gradually synchronize and optimize Phase I releases among the four reservoir projects. However, late September rains pushed Waverly first above 170,000 cfs, then above 180,000 cfs, shutting all four projects down to low flow releases. Late September rains increased runoff and phase II storage at Milford and Tuttle Creek. It was not until October that releases from all four projects could again be implemented. See Figures 22 to 24 for monthly precipitation, represented as percent of monthly normal.

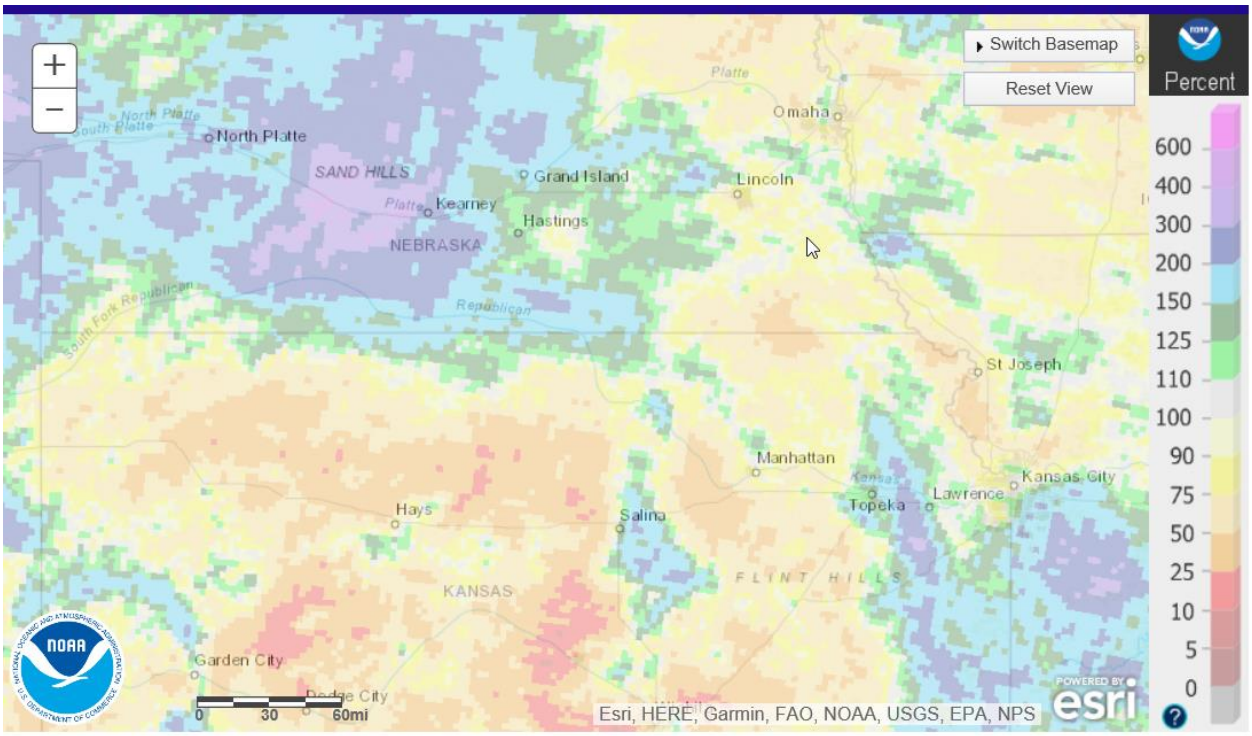


Figure 5c-22. July Precipitation 2019 across the Kansas River Basin

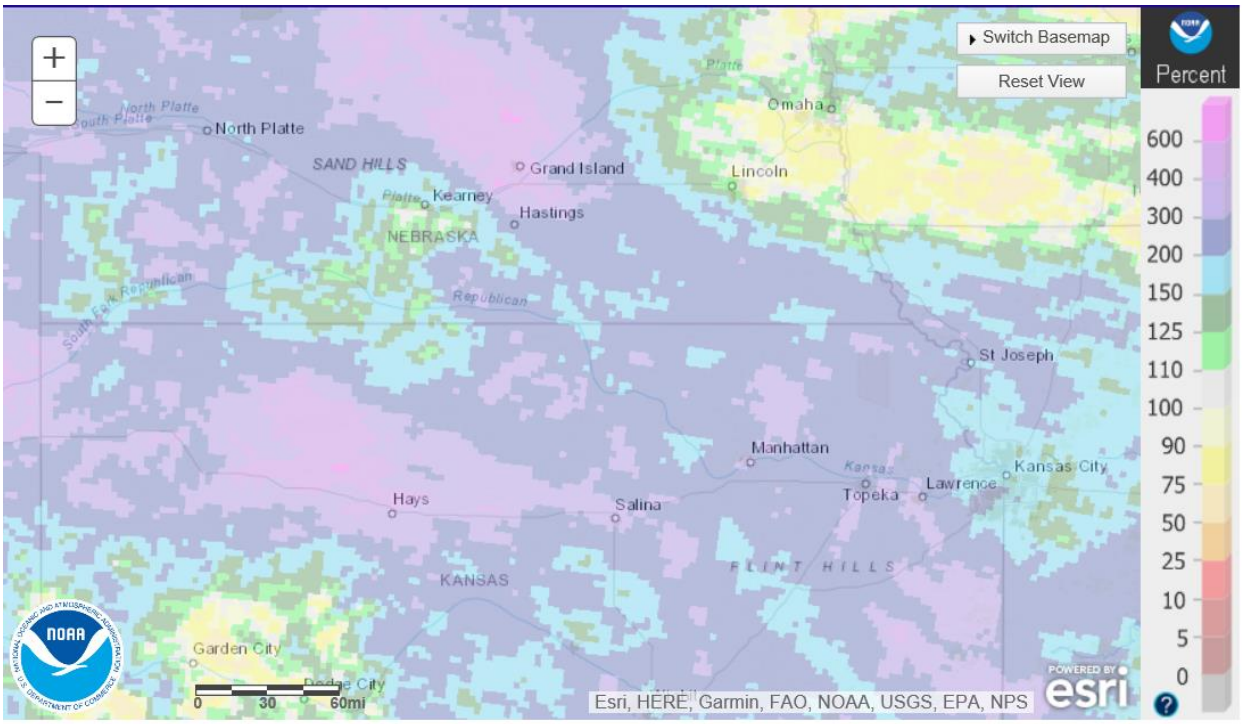


Figure 5c-23. August Precipitation 2019 across the Kansas River Basin

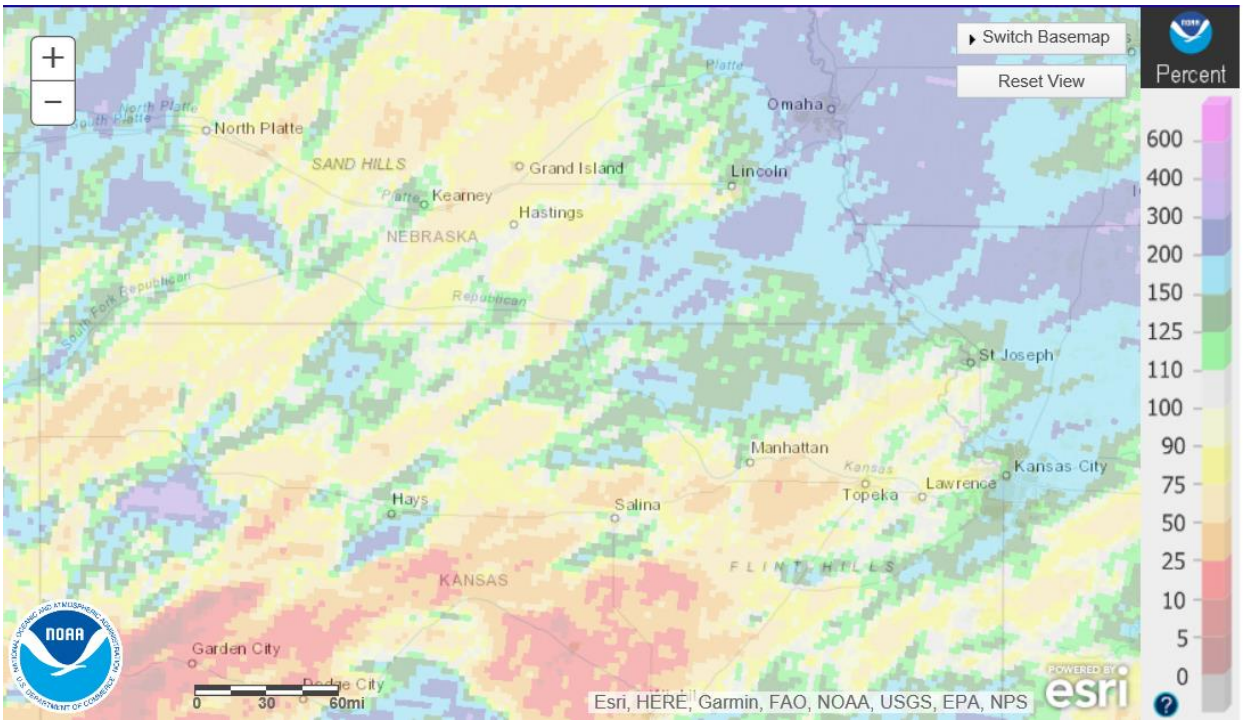


Figure 5c-24. September precipitation 2019 across the Kansas River Basin

Missouri River flows at Waverly through this period ranged from 120,000 cfs to 200,000 cfs including Gavins Point releases that ranged from 60,000 cfs to 80,000 cfs by the end of September. Throughout this time period, a considerable amount of effort was involved in

anticipating Gavins Point releases, local runoff below Gavins Point, and Kansas Basin local runoff. All of which was essential, and largely uncertain, to efforts to schedule reservoir releases across the Kansas River Basin. See Figure 5c-25 for flows on the Missouri River at Waverly and releases from Gavins Point.

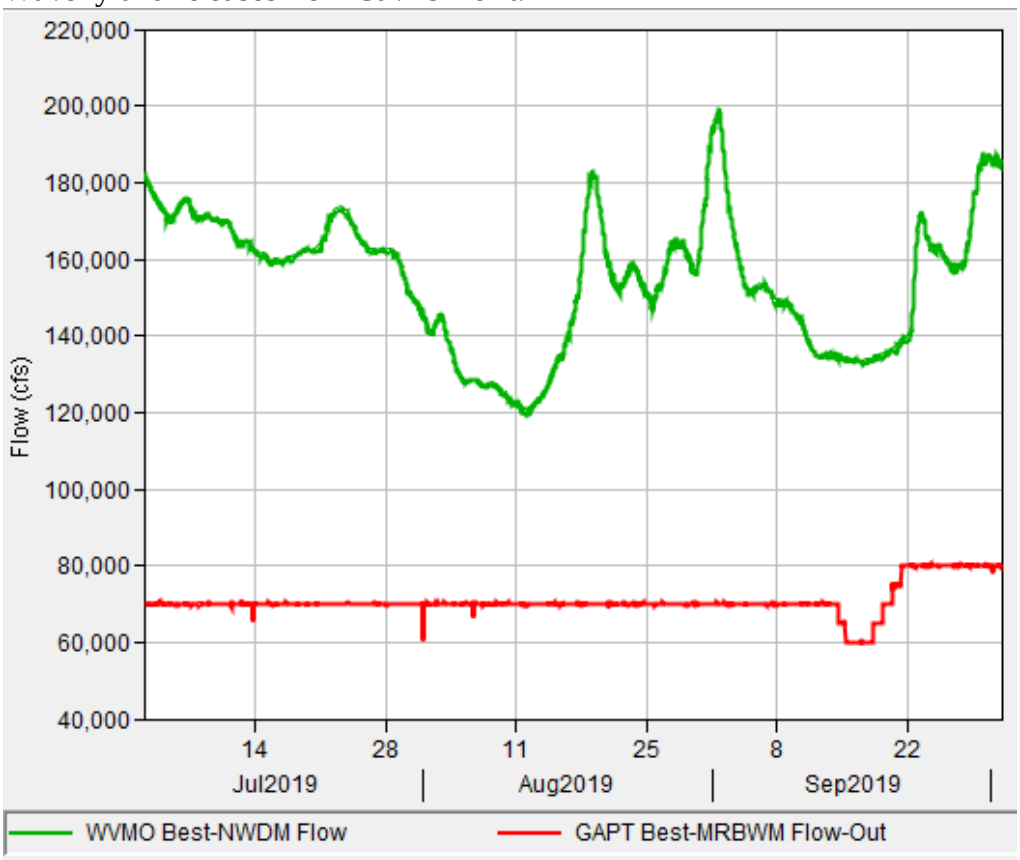


Figure 5c-25. Missouri River at Waverly flow for June through September 2019.

5. Fall/Winter (October, November and December)

October rains above Milford, Tuttle Creek and Perry, as well as other areas below Gavins Point, contributed to the further accumulation of phase II storage at these reservoirs. Otherwise, October rainfall totals across the Kansas River Basin would have been 50% to 75% of normal, except for the fringes of a swath of area extending east north east across these three reservoirs and centered over the Missouri River Basin. No later than 08 October, both Milford and Tuttle Creek were releasing Phase II water, based upon reasonable certainty of channel space below 180,000 cfs at Waverly, with Perry contributing a small Phase II release by 15 October. As October drew to a close, Milford and Tuttle Creek were reducing releases as Perry increased, in order to transition to system-wide Phase I storage evacuation. See Figures 5c-26 to 5c-29 for reservoir elevation, inflow and outflow.

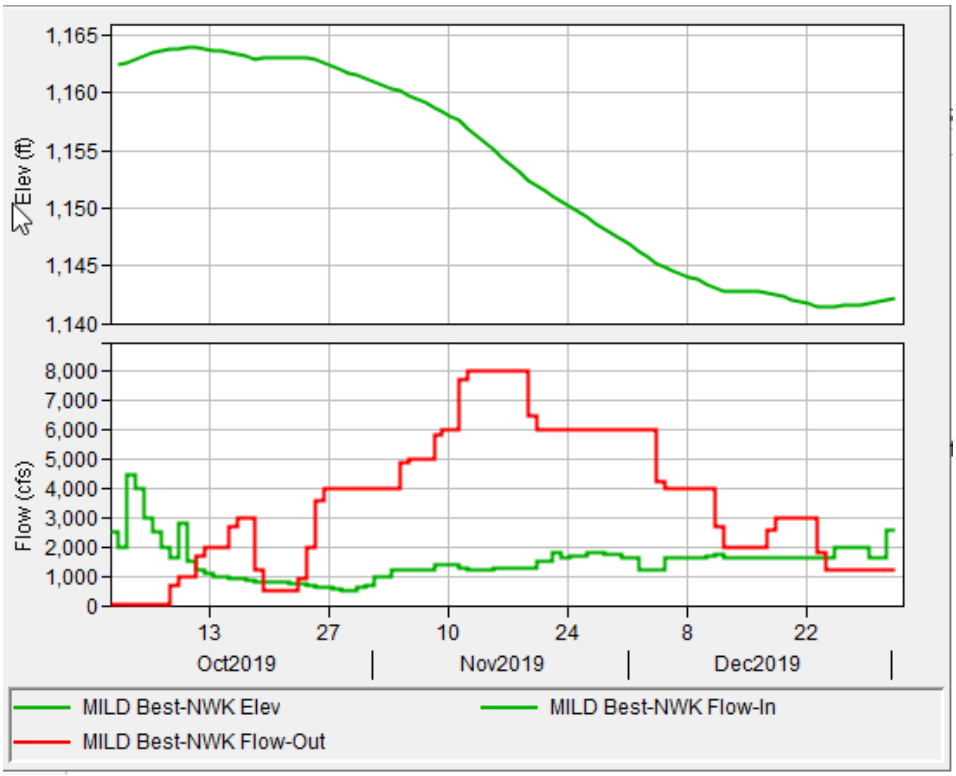


Figure 5c-26. Milford October through December 2019 reservoir elevation, inflow, and outflow

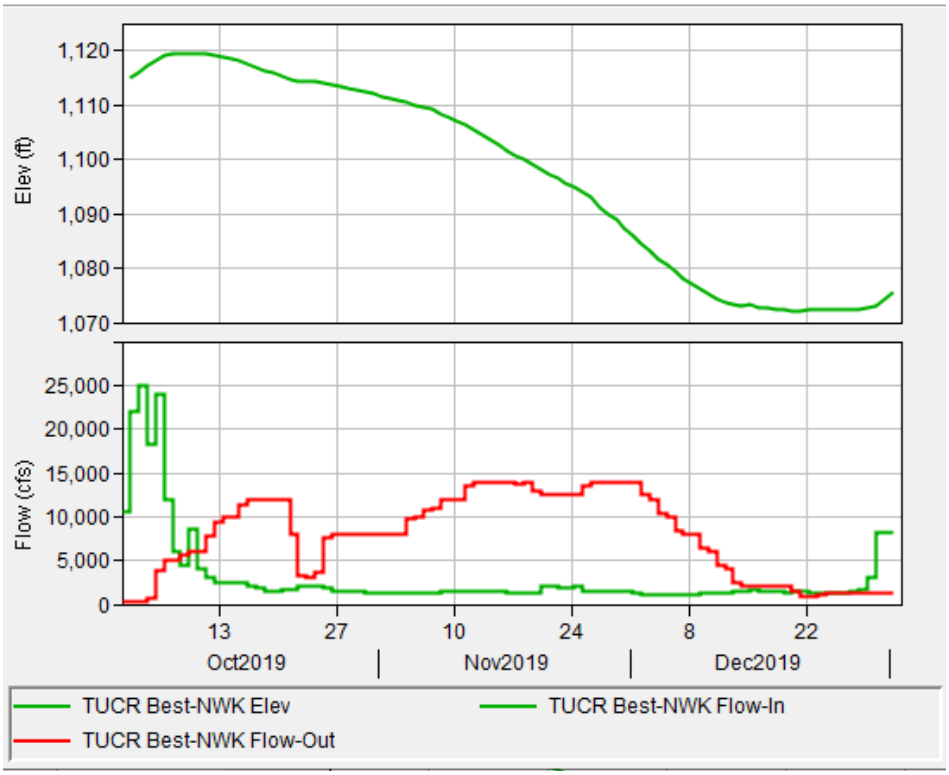


Figure 5c-27. Tuttle Creek October through December 2019 reservoir elevation, inflow, and outflow

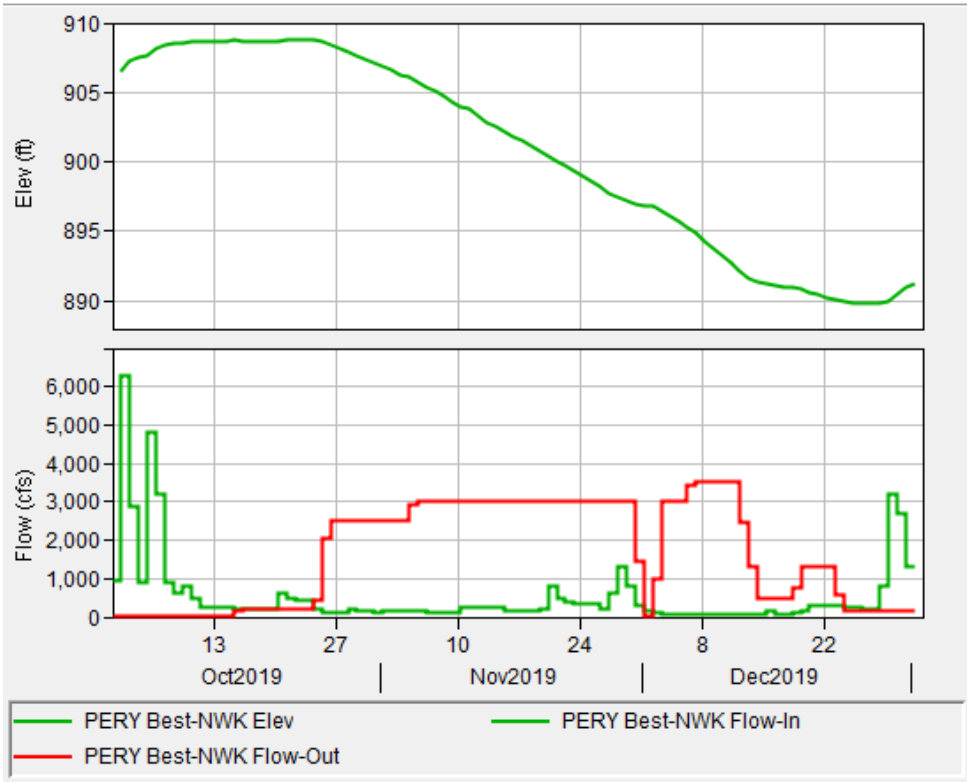


Figure 5c-28. Perry October through December 2019 reservoir elevation, inflow, and outflow

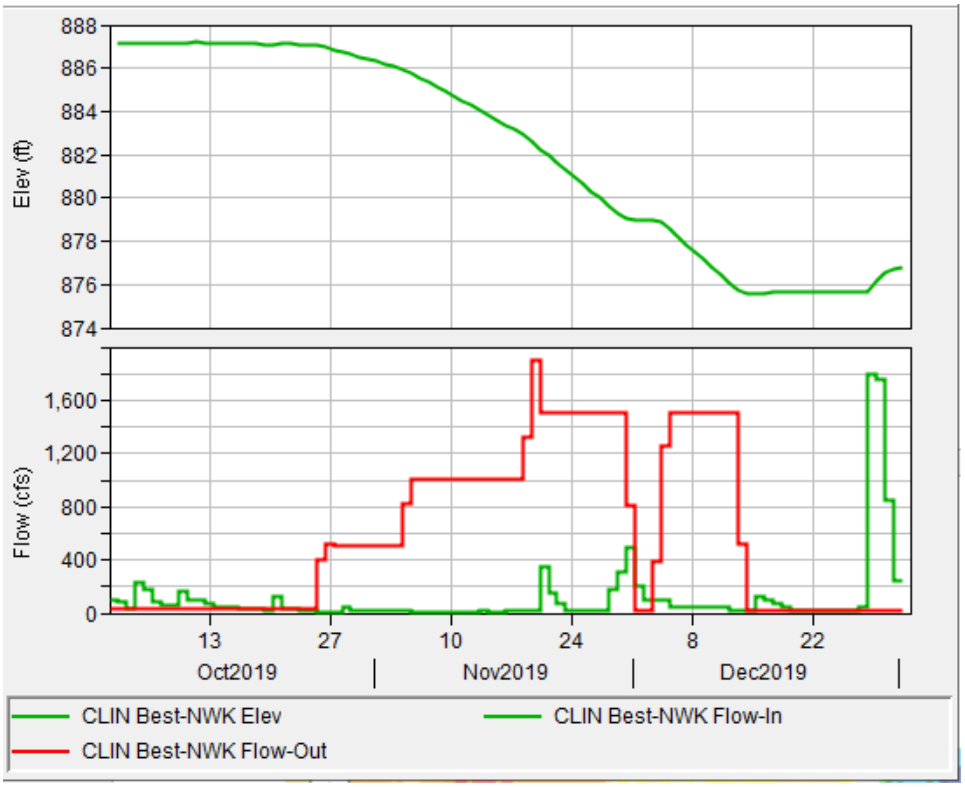


Figure 5c-29. Clinton October through December 2019 reservoir elevation, inflow, and outflow

November precipitation averaged 60% of normal across the Kansas River Basin, with no significant inflows to any of the four reservoirs, and no significant inflows below Gavins Point. However, the accumulation of flood storage at Harlan County due to tandem balance restrictions with Milford, necessitated the sustained release of approximately 1,000 cfs from Harlan County Lake as Milford was releasing. This condition persisted through December. Milford, Tuttle Creek, Perry, and Clinton all increased and sustained phase I storage releases, as diminishing local runoff below Gavins Point permitted the contribution of these Kansas releases, while not exceeding the phase I criterion of 140,000 cfs at Waverly.

December rains across the Kansas Basin were approximately normal and of no consequence. The four 2019 approved Kansas River deviations affecting Waverly control point criteria all expired 15 December. Reduced releases from Gavins Point resulted in Waverly dropping below the permanent Phase I criteria of 90,000 cfs on 16 December 2019. Favorable conditions throughout the month permitted all four reservoirs to evacuate their accumulated 2019 flood control storage by 23 December. All but Clinton continued to draw down to Winter target elevations below multipurpose. The deviations were not used to accommodate drafting below multipurpose. See Figure 5c-30 to 5c-32 for monthly precipitation, represented as percent of monthly normal. See Figure 5c-33 for flows on the Missouri River at Waverly and releases from Gavins Point.

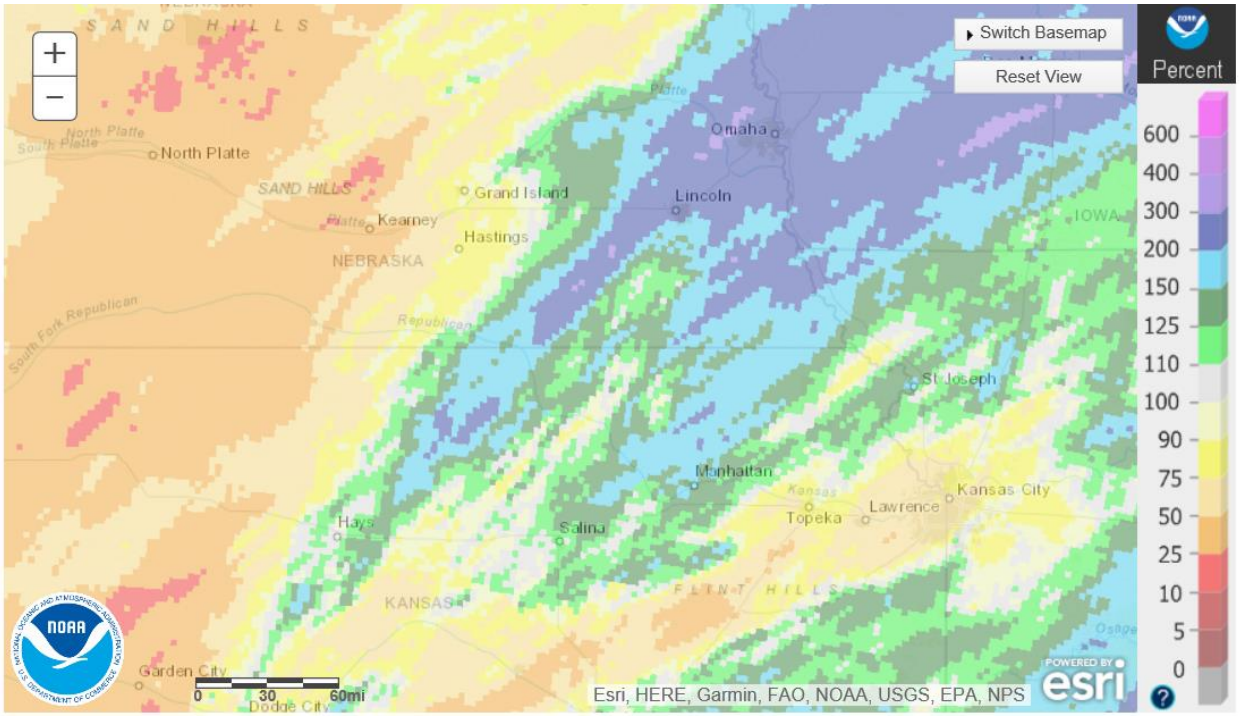


Figure 5c-30. October 2019 precipitation

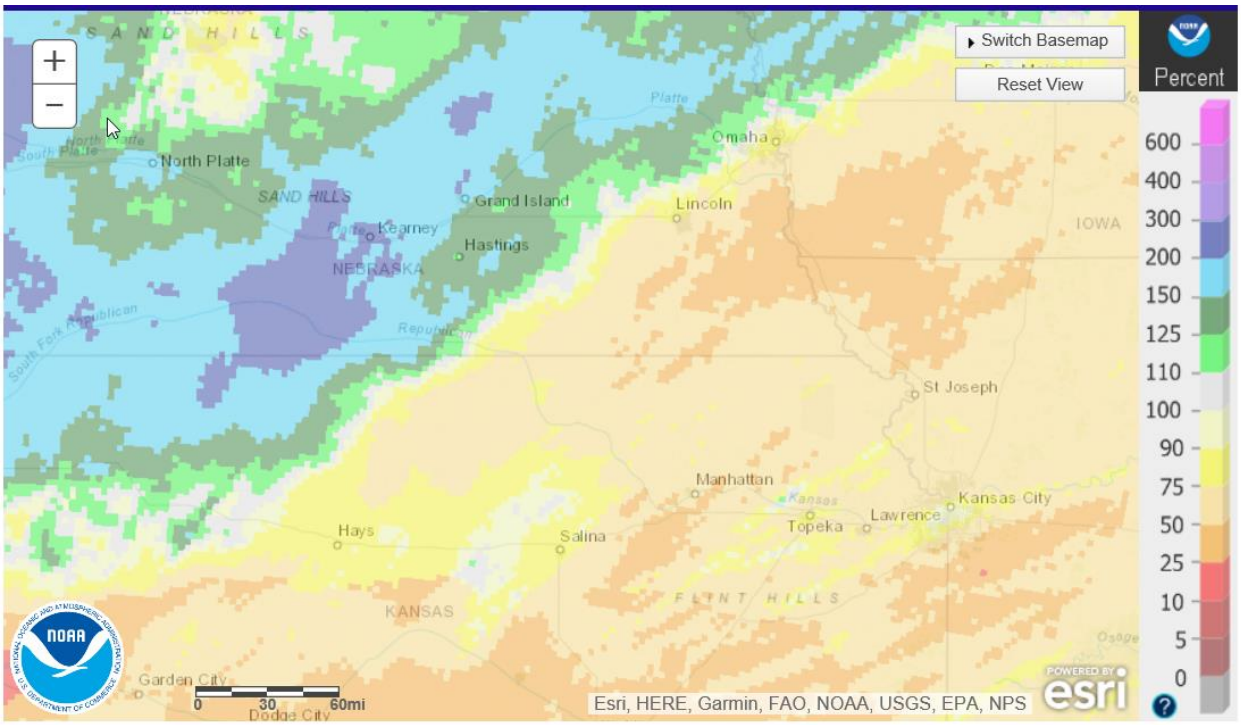


Figure 5c-31. November 2019 precipitation

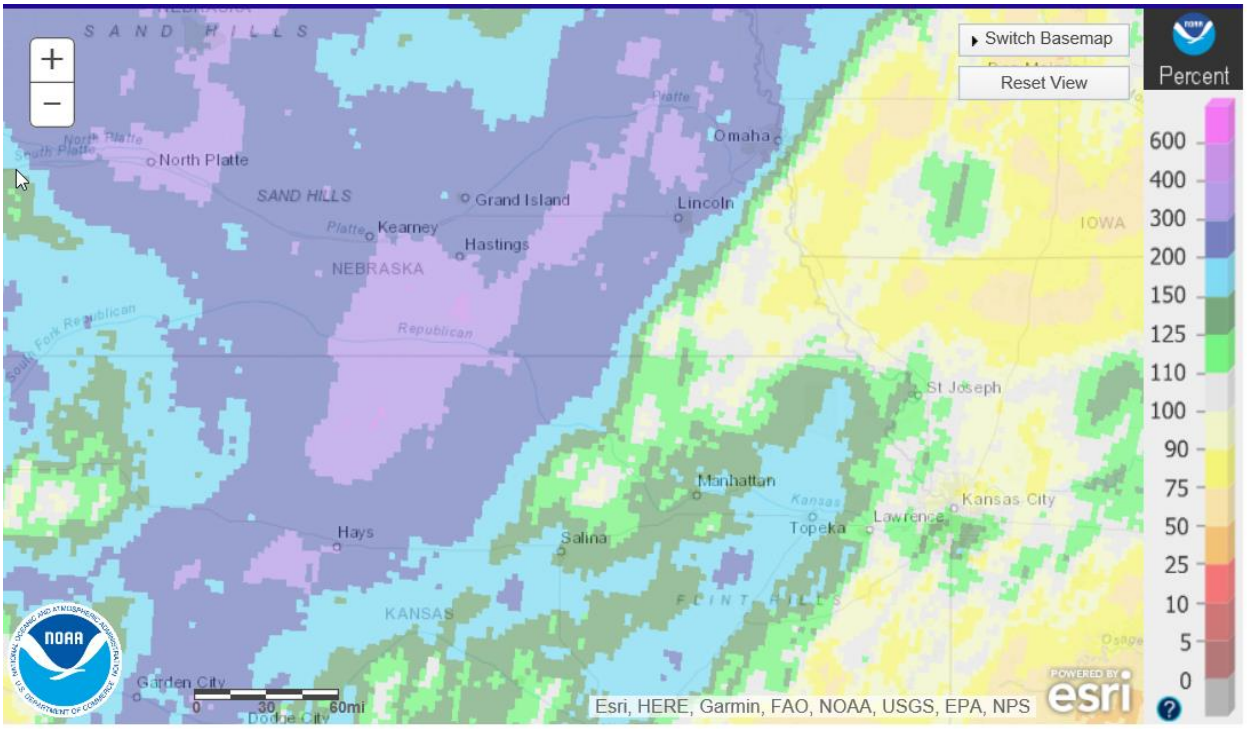


Figure 5c-32. December 2019 precipitation

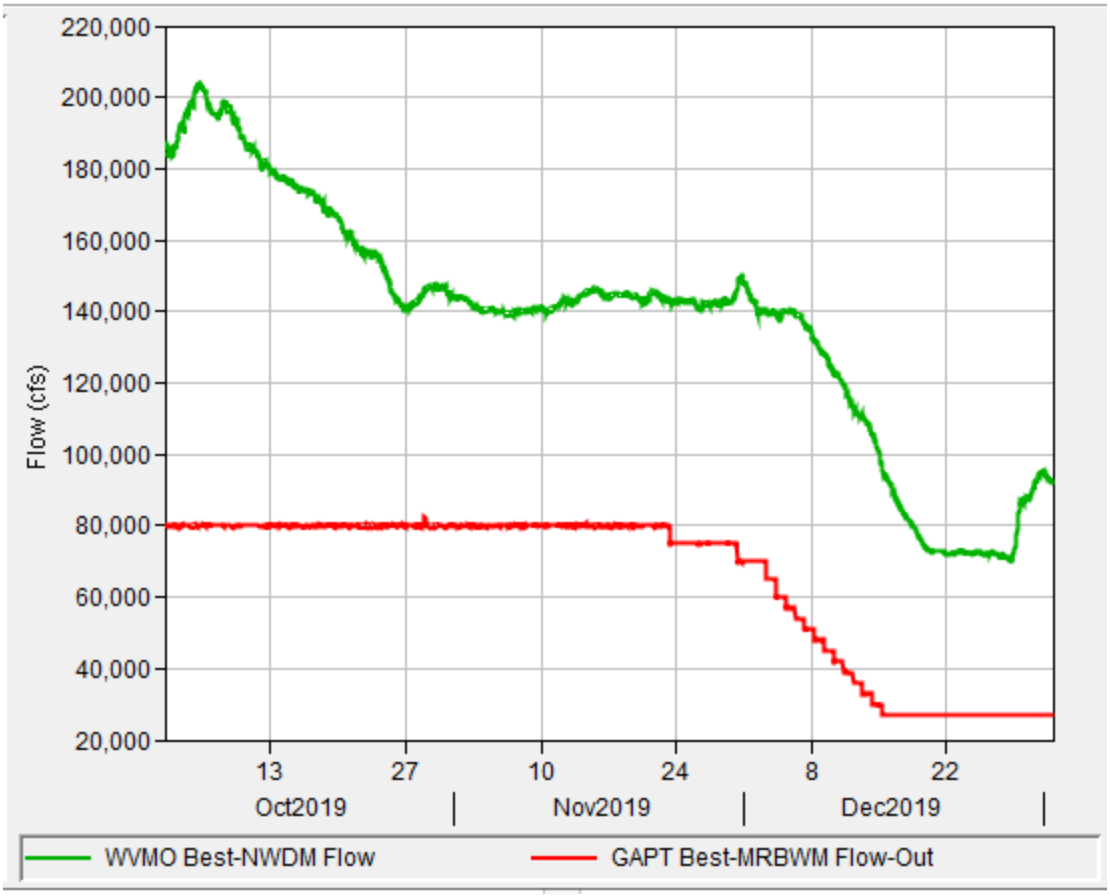


Figure 5c-33. Missouri River at Waverly flow for October through December 2019.

5d. Missouri Tributary Basin

Blue Springs Reservoir had a heavy rainfall in October 2018 that lead to the third highest pool on record. The pool elevation crested at 808.9 feet on 10 October 2018 which corresponds to 34.1 percent of the flood pool occupied. With the high pool elevation, the flow through the uncontrolled drop inlet resulted in the third highest release on record at 518 cfs. During the very wet May 2019, Blue Springs had elevated inflows but missed the heaviest rainfall. The pool elevation climbed to 806.9 feet on 22 May 2019 (23.8 percent of the flood control pool) and a maximum release of 507 cfs.

At Longview Reservoir, the October rainfall lead to the maximum pool elevation and flow for the year. The pool peaked at 897.5 feet (28.3 percent of flood pool) with a max release of 1,107 cfs. The 2019 rainy periods resulted in increased inflows in May, June, and July, but the peak pools and flows were lower than the October peak.

Smithville Reservoir experienced above average inflow over the report period. May was especially wet. High flows on the Platte and Missouri Rivers constrained releases for all of late May and early June. The peak pool elevation was 872.3 feet on 06 Jun 2019 which corresponds to 63.8 percent of the flood control pool occupied. This was the fourth highest pool elevation on record. When the downstream control points dropped below criteria, the release was increased to

2400 cfs which is the second highest release on record. No concerns were reported from the high release.

5e. Chariton River Basin

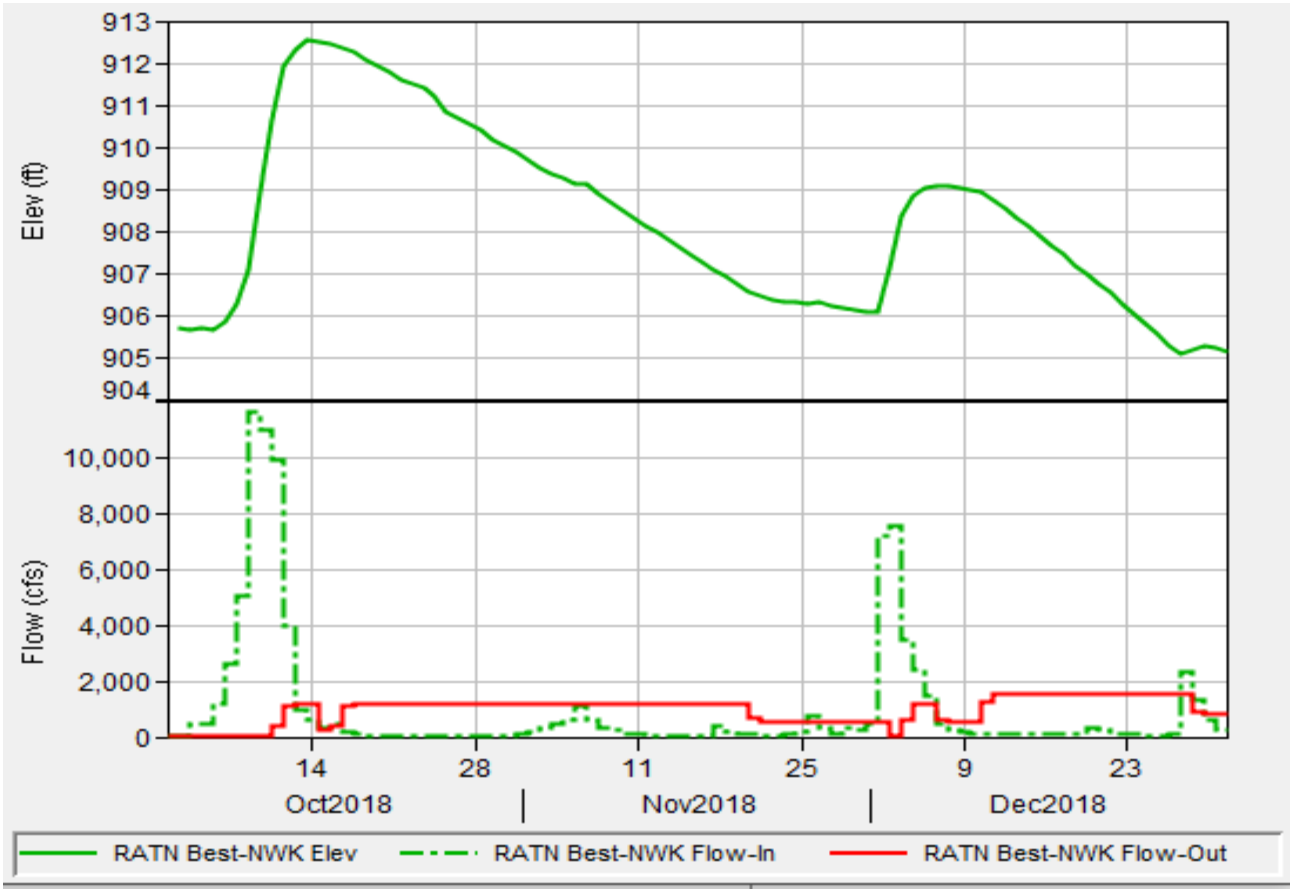


Figure 5e-1. Oct-Dec 2018 Rathbun Reservoir Annual Report

Water Year 2019 began with Rathbun Reservoir at target elevation 905.6 feet. The heavy rainfall started in the Chariton Basin on the 4th of October and continued for the next six days, with inflows as high as 11,600 cfs recorded pouring into the reservoir. The precipitation that occurred resulted in an increase of the Rathbun Reservoir pool elevation from 905.6 feet to 912.53 feet, which was approximately a seven foot increase. The pool elevation remained above target level of 905.6 feet for seven weeks with releases as high as 1,200 cfs to manage the pool elevation. The full Phase 1 release of 1,500 cfs was not implemented to reserve some channel capacity for potential runoff and prevent the downstream gages from going over the criteria. The majority of the time in November was spent focusing on continuing to evacuate the flood water to get the pool elevation down to ensure the reservoir storage can sustain another rainfall. December started off with another big rain event that lasted for two days where large inflows ranging from 7,000 cfs to 7,400 cfs were recorded. Three days after the rain event the pool elevation reached

approximately 909 feet and a release of 1,500 cfs was started. By the end of December the pool elevation was close to target hovering just over 905 feet. December target is 904 feet.

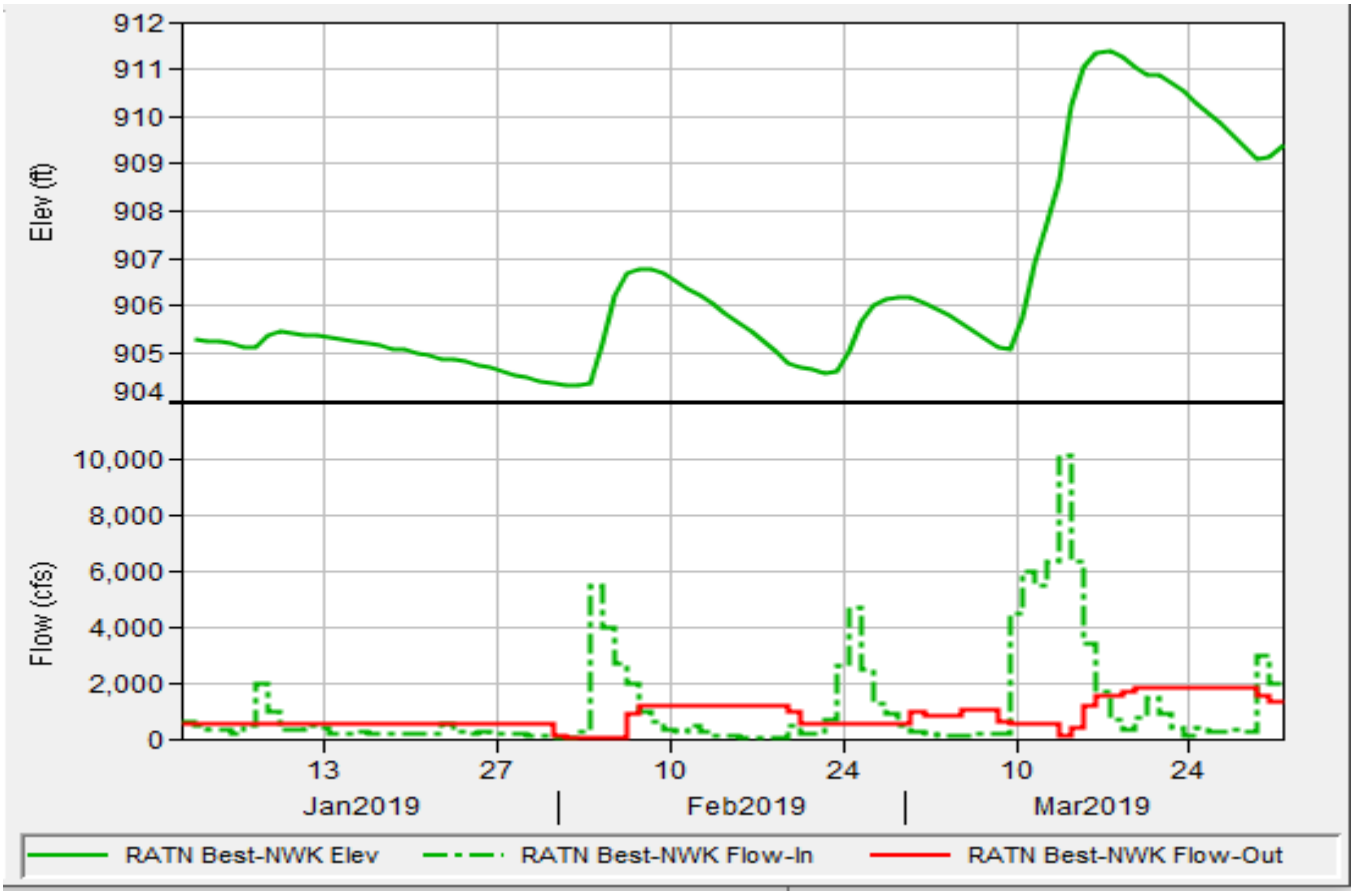


Figure 5e-2. Jan-Mar 2019 Rathbun Reservoir Annual Report

January had some minor rainfall events that were managed with a release of 500 cfs for the majority of the month, the pool elevation remained a foot above the target of 904 feet. February had two big rain events; during the first and fourth weeks of the month. Heavy rain began on the 3rd of Feb with inflows peaking as high as 5,200 cfs and later decreasing to a manageable amount after the fourth day of the event. When downstream conditions allowed, a release of 1,200 cfs was initiated. During the month of February, the pool peaked at 906.78 feet as the release was maintained the 1,200 cfs for 13 days to evacuate the water. The pool elevation was declining until the second event began on the 23rd of February. This was a slightly lighter rain event with a peak inflow of around 4,520 cfs, the event lasted for five days. A 500 cfs release was performed to prevent the pool elevation from raising, the downstream gage was not effected during this localize rainfall event. The pool was close to approaching target level 905.6 feet when a significant event occurred in the Chariton Basin on the 9th of March. This event, due to rapid snow melt, came with excessive inflows as large as 10,100 cfs that lasted for nine days and resulted in the pool elevation reaching Phase II for the first time in 2019. During this event the pool elevation peaked over 911 feet. Since spring appeared to come early an aggressive pool

evacuation of 1,800 cfs was initiated and maintained for ten days. The release was later stepped down when the pool elevation fell back down to Phase I on the 10th of April.

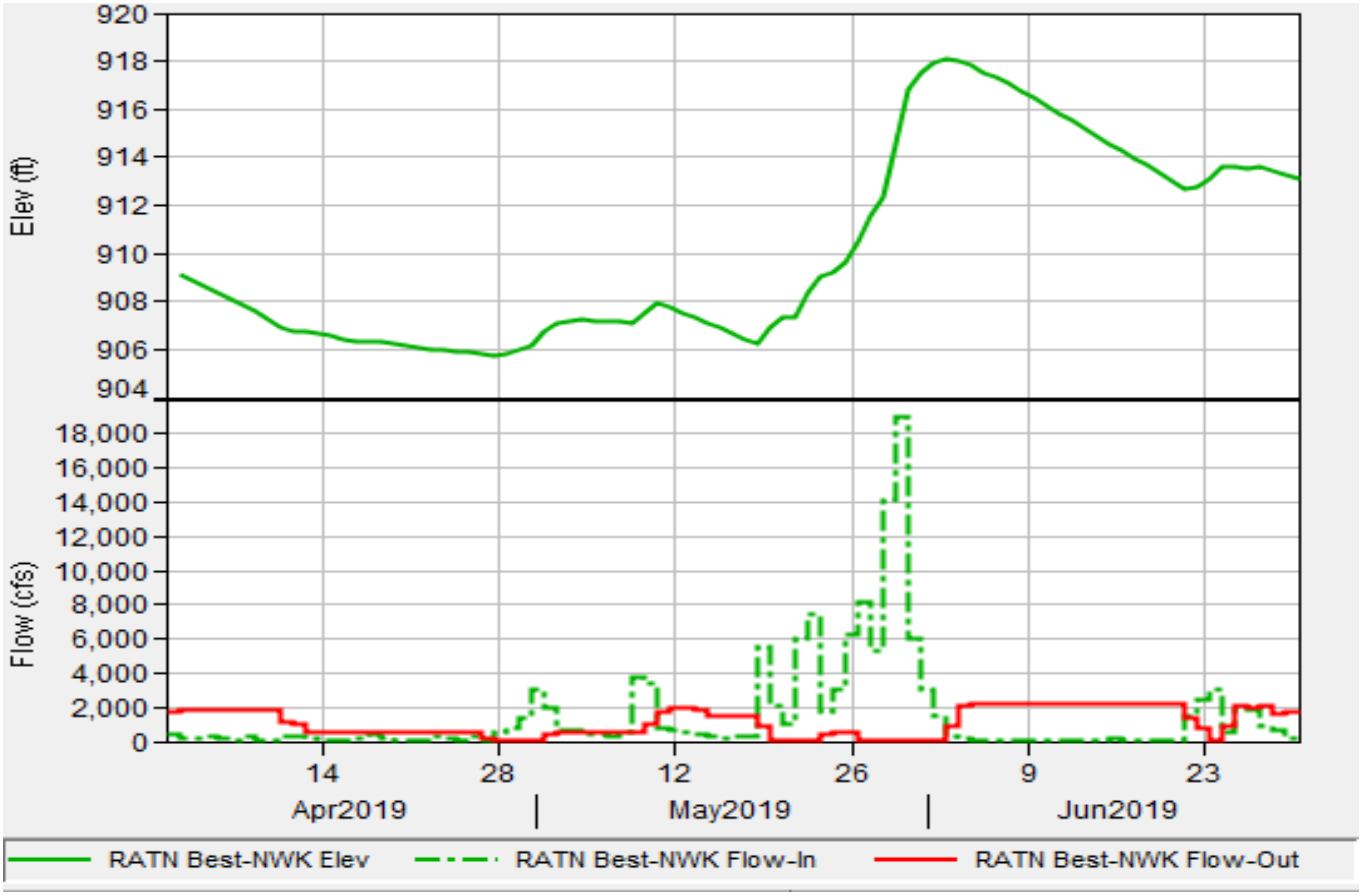


Figure 5e-3. Apr-June 2019 Rathbun Reservoir Annual Report

April did not see significant amount of precipitation in the Chariton Basin; however May was a very wet month. High inflows were recorded during the second half of the month with inflows ranging from 1,000 cfs to 19,000 cfs. With this significant amount of rain and the length of the event, the reservoir elevation climbed approximately 12 feet in a 2 week span which put the reservoir at the top of Phase II. The flood control storage was 54 percent occupied after this event. Intensive flooding also occurred downstream of Moulton and Prairie Hill; therefore releases were held back until the 2nd of June. A release of 1,200 cfs was initiated to ensure the channel capacity was available then the next day the release was increased to 2,200 cfs, which is the maximum Phase II release. The maximum Phase II release was maintained for 17 days before stepping down the release flow. Even though the rest of June did not have any additional precipitation, the release was continued for the remainder of the month and the pool elevation was reduced by 5 feet. Due to the high pool elevation Rathbun Lake had to close a couple of beach areas, boat ramps, and campsites.

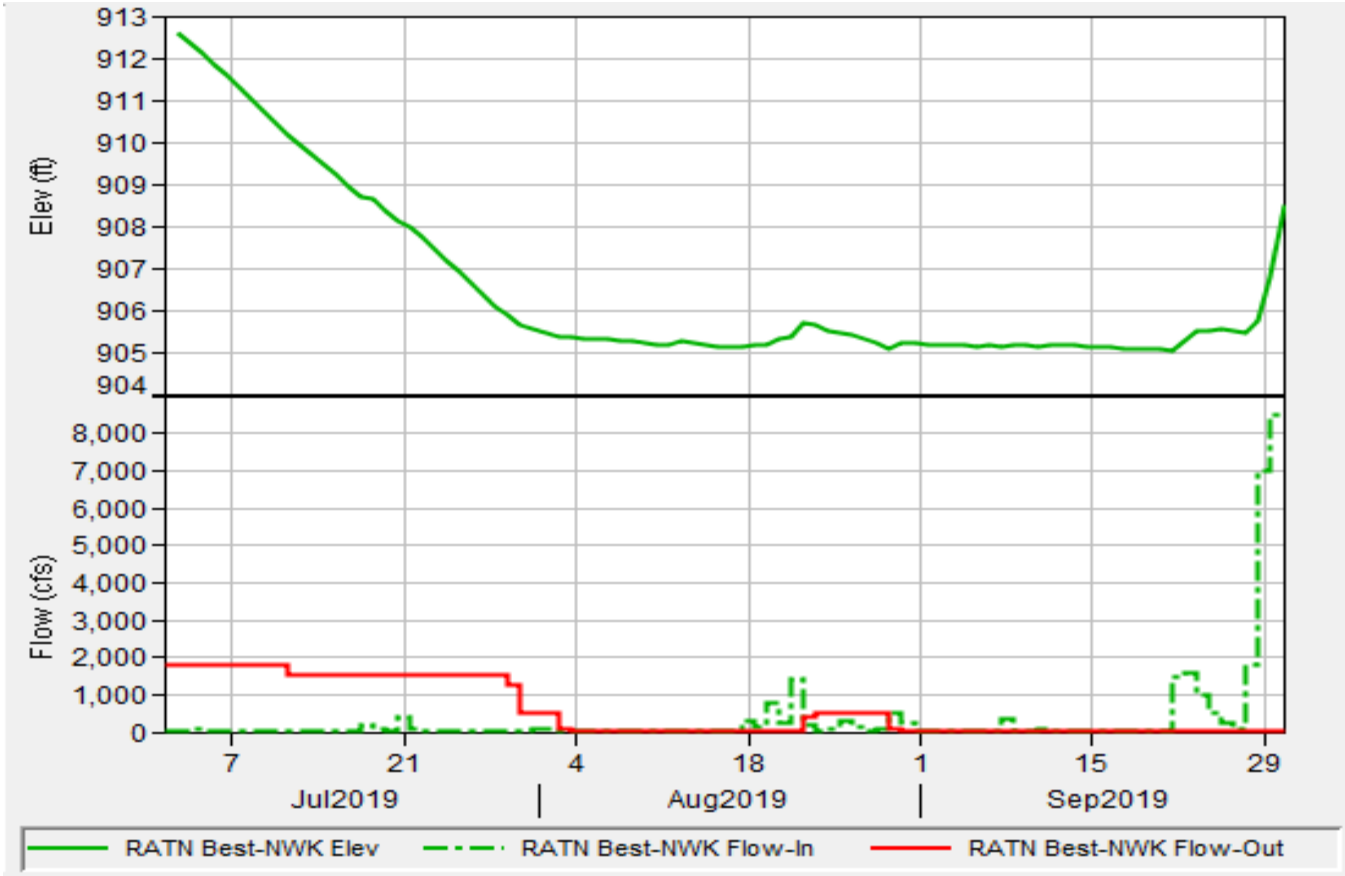


Figure 5e-4. July-Sept 2019 Rathbun Reservoir Annual Report

In July the reservoir was still in Phase II; therefore reservoir evacuation releases were continued to mid-July. During this time, water release flows as high as 1,800 cfs were implemented until the pool elevation was back down to Phase I. Then the release was stepped down to 1,500 cfs on the 12th of July. By the end of July the reservoir was just a foot from the multipurpose level of 904 feet. August was pretty calm; no heavy rainfall to report and the reservoir maintain the multipurpose level. September was also calm until the last week of the month. On the 27th of September another heavy rainfall occurred over the Chariton Basin. Before the rain event, a press release was issued informing the public of a potential fall pulse. This is in accordance with the 2016 revised Rathbun Lake Regulation Manual that states a fall pulse can be performed, during the last week of September to early October, to recharge the wetlands downstream of Rathbun Lake if requested by the state agencies when water is available. Hours after the press release the levee organizations and other state agencies expressed disagreement with the proposed fall pulse and contacted the Army Corps of Engineers. Several meetings were held to discuss and determine if the fall pulse should proceed. In the end, upper management decided that it was best to cancel the fall pulse. Ultimately, the heavy rainfall at the end of the month served to recharge the wetlands.

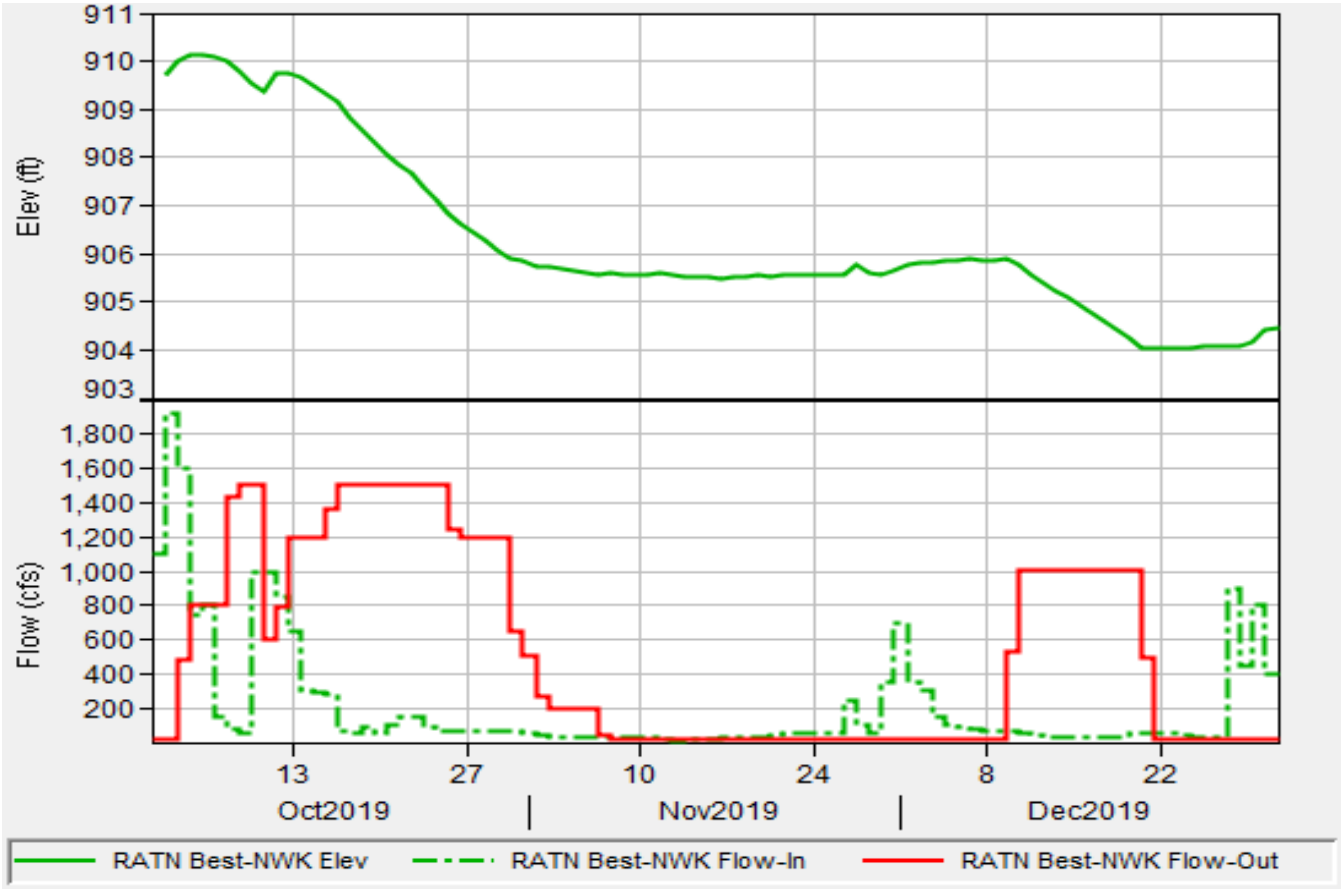


Figure 5e-5. October to December 2019 Rathbun Reservoir Annual Report

After the rain event at the end of September, reservoir inflows ranging from 200 cfs to 1,900 cfs continued for another two weeks. The pool peaked at 910.11 feet. When downstream conditions allowed, a release of 1,500 cfs was initiated to evacuate water from flood control pool storage. On the 10th of October, release was reduced to 600 cfs due to a local rain event. The following day the release was increased to 1,200 cfs and increased again to 1,500 cfs on the 15th of October. The maximum Phase 1 release of 1,500 cfs was maintained until the 23rd of October. The releases were slowly stepped down until the seasonal target pool level 905.6 ft was achieved. It took most of October and a week of November (35 days) to evacuate all the water from theflood control pool. November and December experienced a few minor precipitation events that caused no significant effects to the pool elevation. By early December a release of 1000 cfs began to drawdown the pool to the winter seasonal target level 904.0 feet.

Long Branch Report

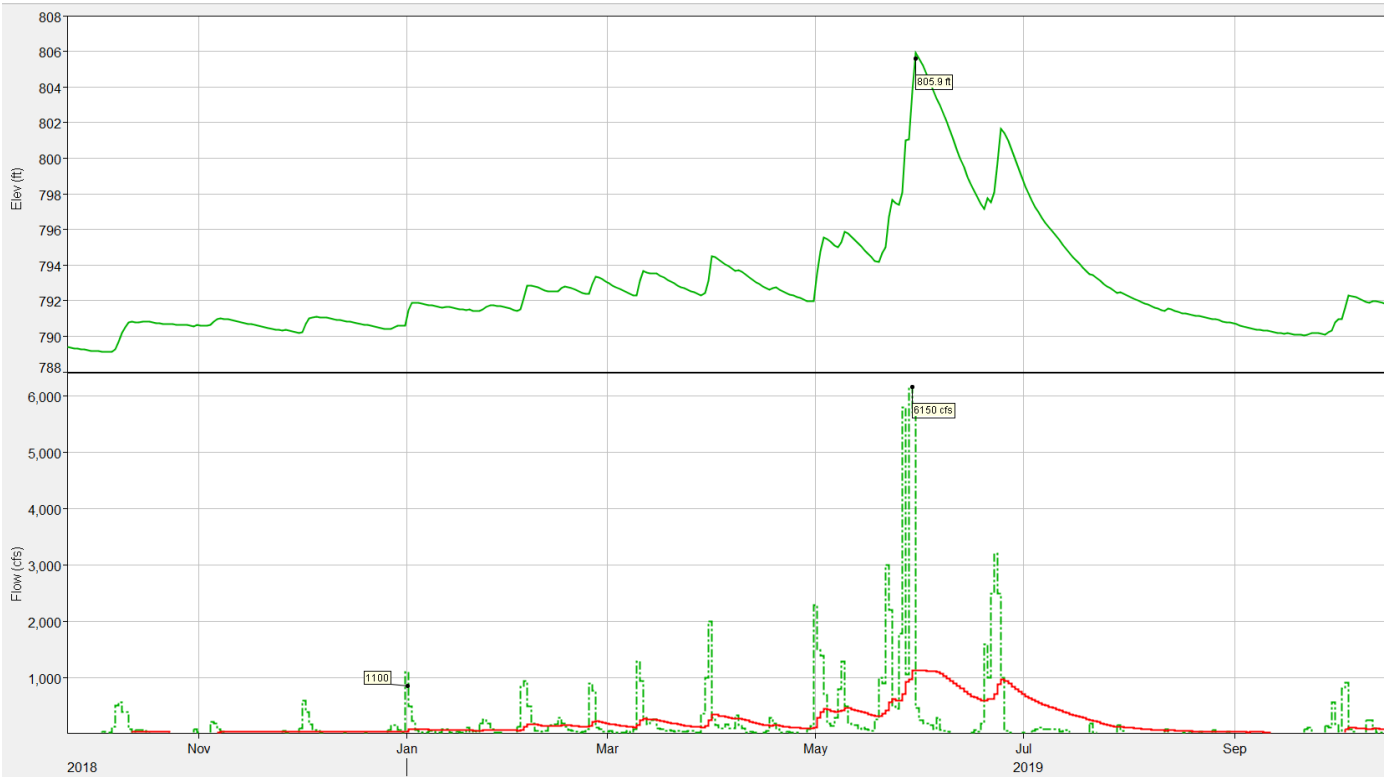


Figure 5e-6. Overview of the Long Branch Lake Water Year 2019

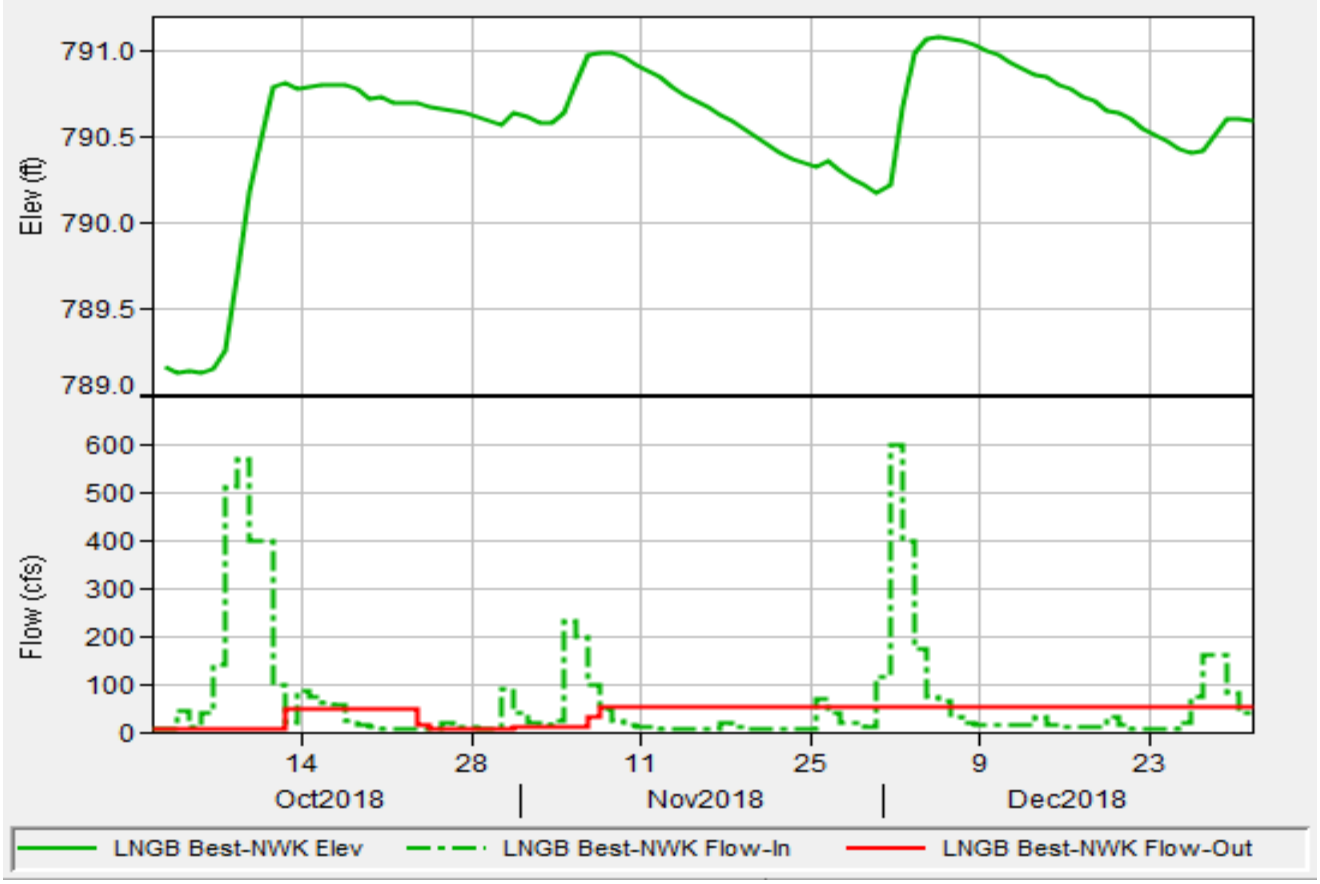


Figure 5e-7. Oct-Dec 2018 Long Branch Reservoir Annual Report

On the 1st of October Long Branch pool elevation was at 789 feet which is below the multi-purpose level of 791 feet. Long Branch Lake is a fill and spill dam, with flood control pool releases primarily through the uncontrolled weir. For the first quarter of the water year 2019, Long Branch received three minor rain events; one in each month. The highest inflows recorded within the three events was 920 cfs and the reservoir pool elevation remained at multi-purpose level of 791 feet. Most of the time the uncontrolled weir release was under 100 cfs.

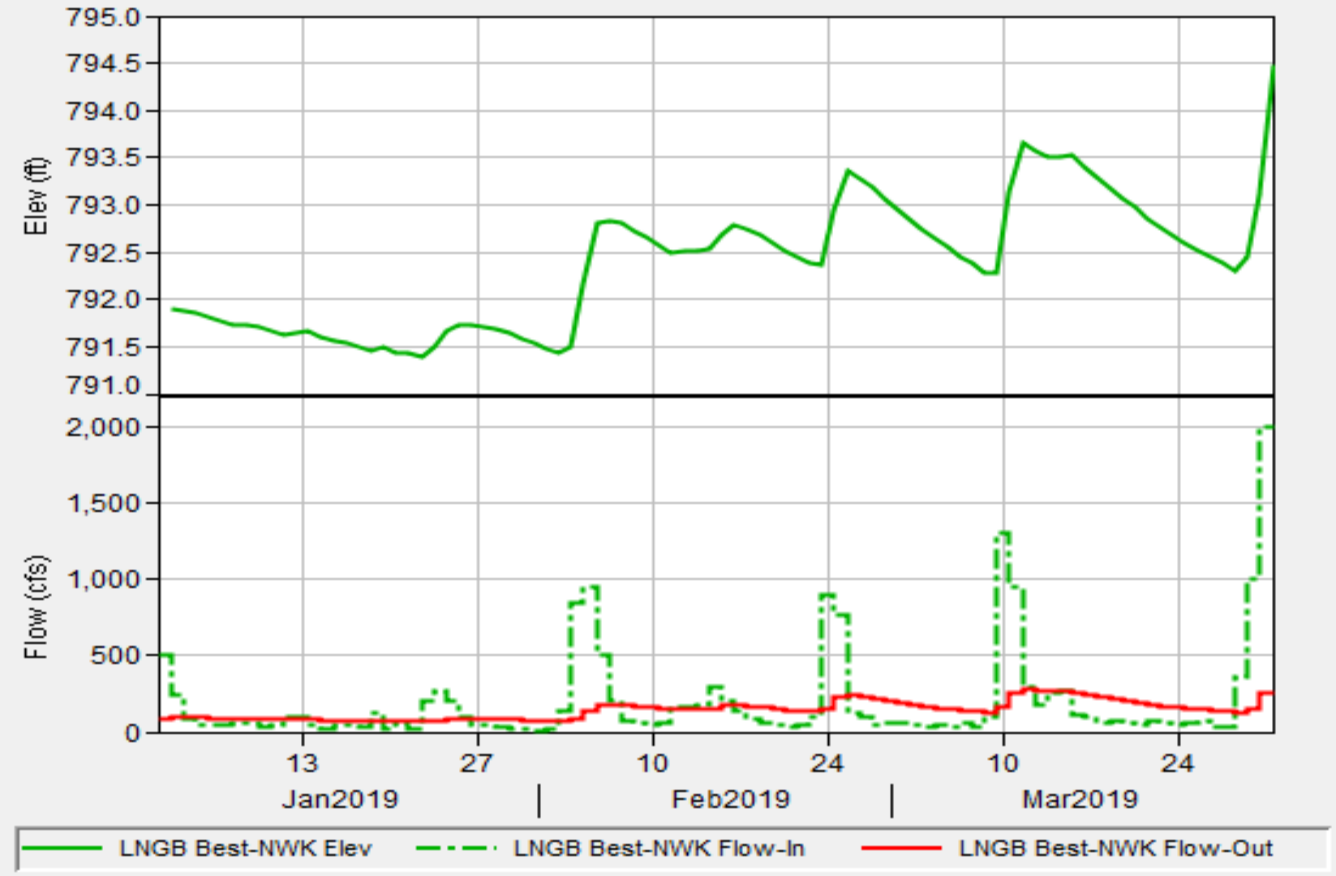


Figure 5e-8. Jan-Mar 2019 Long Branch Reservoir Annual Report

January and February also had three minor events causing the pool elevation to gain another two feet. Of the three events, the highest inflow was approximately 1,100 cfs. March had two events. The first event occurred due to the warmer temperature, inflows of 1,300 cfs from snow melt was recorded and the highest release from the weir was approximately 250 cfs. The pool elevation was 793.7 feet which is above the target elevation of 788 feet. The second rainfall event caused the pool elevation to go over 794 feet which is approximately 30 percent of the flood control storage. Runoff inflows peaked at 2,000 cfs and the weir responded with a release of approximately 350 cfs.

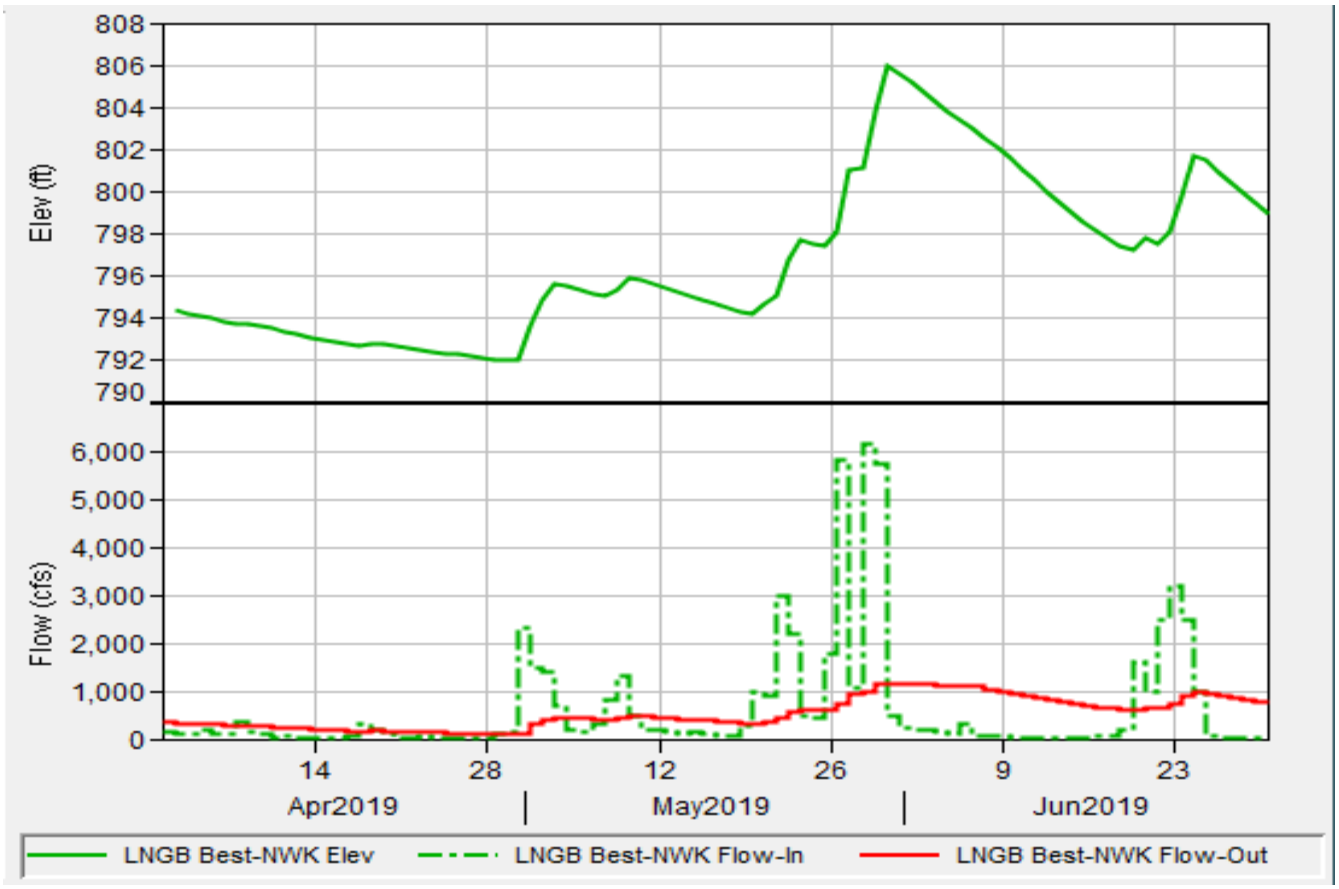


Figure 5e-9. Apr-June 2019 Long Branch Reservoir Annual Report

April had some minor sporadic rain events but the pool elevation continued to slowly decline. May experienced several rainfalls that lead to the most significant events which caused the reservoir to be in critical surveillance stage. The first event occurred on the 30th of April and saw peak inflows of approximately 2,300 cfs. During this event the pool elevation rose to 795.5 feet, which was a 4 foot jump in one day. Then just a week later on the 7th of May, another rainfall occurred over the Long Branch reservoir. This one was a smaller event and inflows were estimated at 1,400 cfs and the pool elevation remained under 796 feet which is 50 percent of the flood control pool. The third rainfall event was the most significant event for Long Branch. The rainfall started on the 19th of May and included substantial amount of inflows ranging from 500 cfs to 6,100 cfs. Excessive inflows poured into the reservoir for eleven days. Within approximately ten days the pool elevation leaped to 805.69 feet which was a 12 foot jump. The uncontrolled weir initiated a 1,200 cfs release to bring the pool elevation down. During this event, the reservoir surpassed elevation 788 feet therefore an increased in surveillance was conducted for eleven days. The top of flood pool is 801 feet. The reservoir continued to rise and went into surcharge stage and for dam safety critical surveillance were conducted for eight days and pool elevation reached a historical new high record of 805.69 feet on the 30th of May. Due to the high pool elevation most boat ramps were closed as well as campsites, and the beach. With the uncontrolled weir release the pool continued to empty the flood water storage and slowly the elevation continued to decline in June. On the 17th of June, a storm popped up and brought in inflows ranging from 1,000 to 3,200 cfs for two days and causing the pool level to hop back up 4

feet. Again the uncontrolled weir sustained the release and by the end of June the pool elevation was slightly above 798 ft, which is 70 percent of the flood control storage.

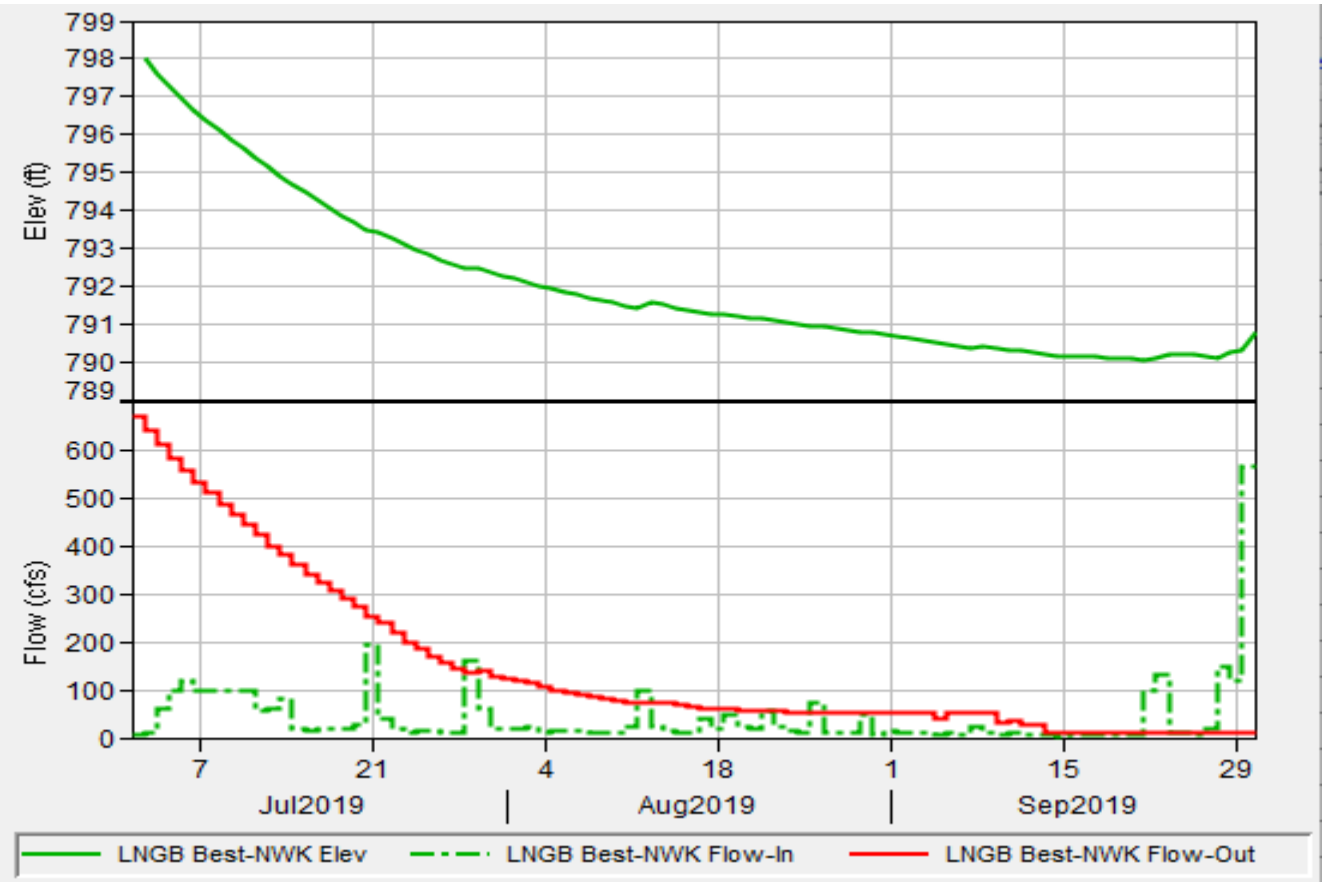


Figure 5e-10. July-Sept 2019 Long Branch Reservoir Annual Report

July, August, and September had some minor rain events but no significant amount to report except for a small event that occurred at the end of September. The pool continued to slowly drop until the 27th of September when it rained off and on for 3 days, producing only small amounts of inflow.

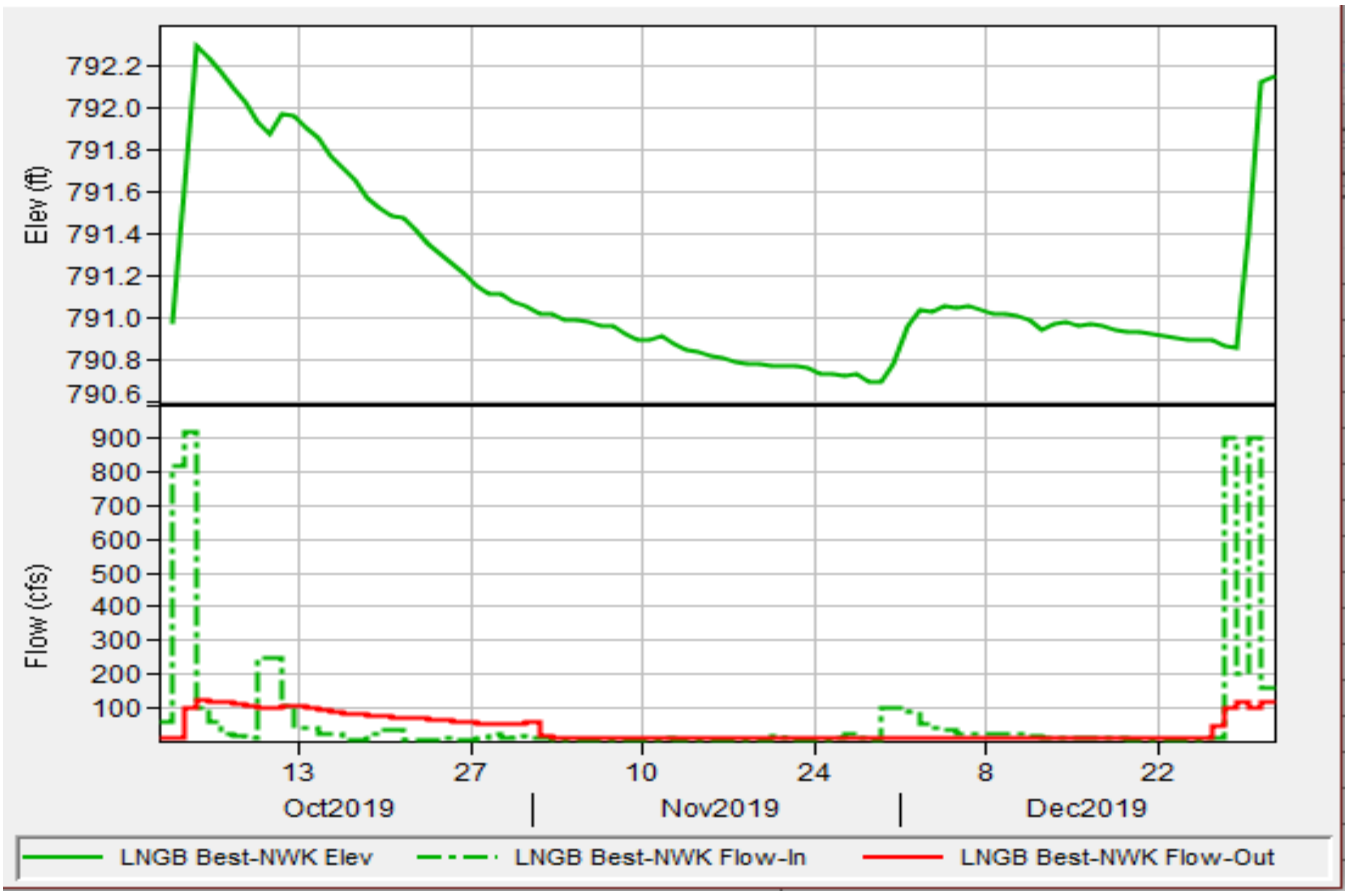


Figure 5e-11. October to December 2019 Long Branch Reservoir Annual Report

Long Branch also received rain on the 2nd of October. Inflows as high as 900 cfs were documented causing the pool elevation to peak at 792.30 feet. The reservoir release was increased from 7 cfs to 50 cfs, and the winter drawdown level of 788.0 feet was achieved. The reservoir continued to decline in elevation in November and December with a few exceptions. At the end of November a minor storm caused the pool elevation to slightly increase 0.7 inches. Then at the end of December, heavy storms hit Long Branch which caused the pool to jump to 792.16 feet.

5f. Osage River Basin

1. Background

This report details the decisions made in the 2019 operation of the Osage Reservoirs of Melvern, Pomona, Hillsdale, Stockton, Pomme de Terre, and Harry S Truman (Truman). A brief overview of the hydrologic conditions are described, major reservoir release decisions, and the factors leading up to those decisions are also addressed. Significant coordination with Ameren regarding Bagnell Dam operations and the Lake of the Ozarks below Truman is also included. Water Management routinely coordinates Truman reservoir operations with Ameren to ensure maximum utilization of channel space on the Osage River below Bagnell at St. Thomas, Missouri. The coordinated release will also be consistent with space available on the Missouri River at Hermann either not to exceed 260,000 cfs, or not to exceed 90% of the most

recent/significant crest event in excess of 260,000 cfs. When Truman is constrained to zero releases by a rising hydrograph at Hermann in excess of 260,000 cfs, Water Management will coordinate with Ameren to limit releases from Bagnell Dam to no more than inflows.

2. Winter and Early Spring (January through March 2019)

Plots of the January through March reservoir elevation, inflow, and outflow are shown in Figures 1 through 7. Several of the Osage reservoirs began the year above the multi-purpose pool because of wet fall conditions and fall rises from the water level management plans. With the exception of Pomme de Terre, all the reservoirs were at or below their multi-purpose pool elevation or below their Water Level Management Plan (WLMP) target by late January. Two rain events increased inflows into the reservoirs during this timeframe. The first in late February and the second in mid-March. The first event resulted in Melvern, Pomona, and Hillsdale reservoir elevations rising above normal pool elevation and occupying flood control storage, which was released prior to the second rain event in mid-March, as demonstrated in Figures 1 through 3. Whereas, Stockton and Pomme de Terre received continued inflows that frustrated efforts to draw the reservoir down towards multipurpose before the mid-March event occurred, as demonstrated in Figures 4 and 5. February rains proved to be a non-event for Truman and Bagnell as noted in Figures 6 and 7 with little discernible impact to pool elevations. For the period January through mid-May, there was no spill from Truman, with all releases generating hydropower. From March 13th through the 17th the USGS gage at State Line on the Marais des Cygnes River rose above phase I criteria for the fourth time this year, limiting releases to low flow for Melvern, and Pomona. Melvern, Pomona, Stockton and Truman rose steadily through the month of March. Truman reached phase II by March 27th and tandem balance kept Melvern, Pomona, and Hillsdale at low flow for the second half of March. Stockton's WLMP target elevation of 870.0 feet for the spring and summer was reached March 14th and releases were reduced to low flow by March 25th due to tandem balance restrictions with Truman. The mid-March event caused the Pomme de Terre pool elevation to rise five feet but releases were able to be made to bring the pool back down almost to the WLMP target by the end of March, before another inflow event caused the pool to rise into early April. Between March 9th and March 31st Truman rose from elevation 707.3 feet to 718.3 feet. Truman releases were made from March 11th to the 14th then reduced to zero due to the Missouri River at Hermann steadily increasing above 260,000 cfs. These circumstances at Hermann continuing from mid-March into early April, while releases from Truman throughout April effectively eliminated flood waters accumulated in March as illustrated in Figures 6, 11, and 17.

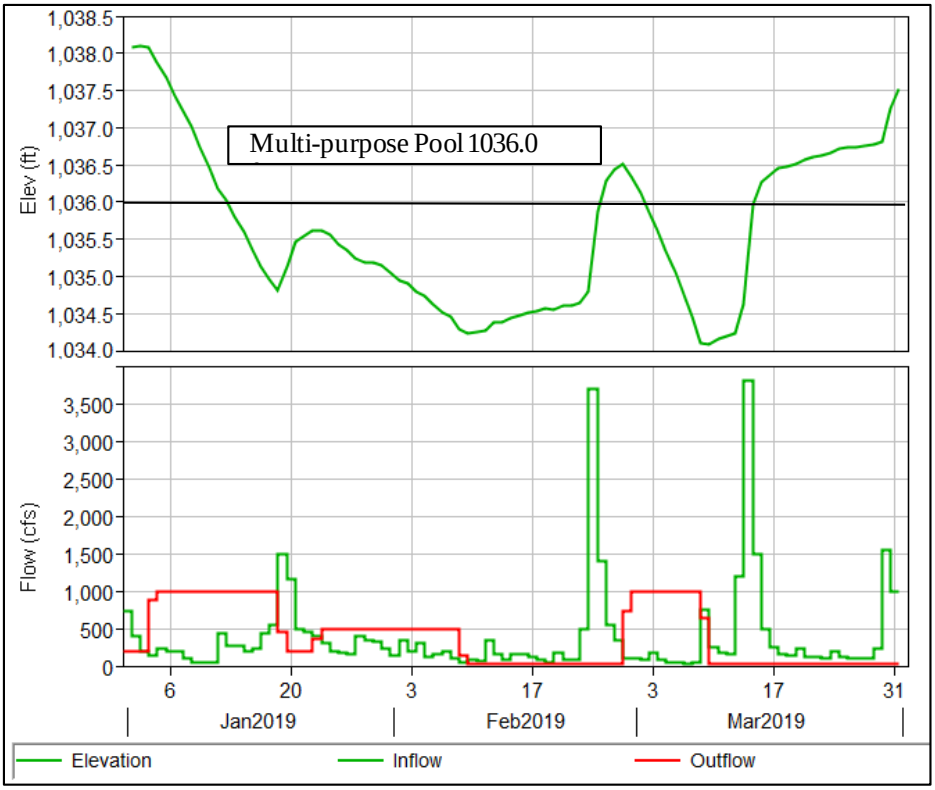


Figure 5f-1. Melvern January through March 2019 reservoir elevation, inflow, and outflow.

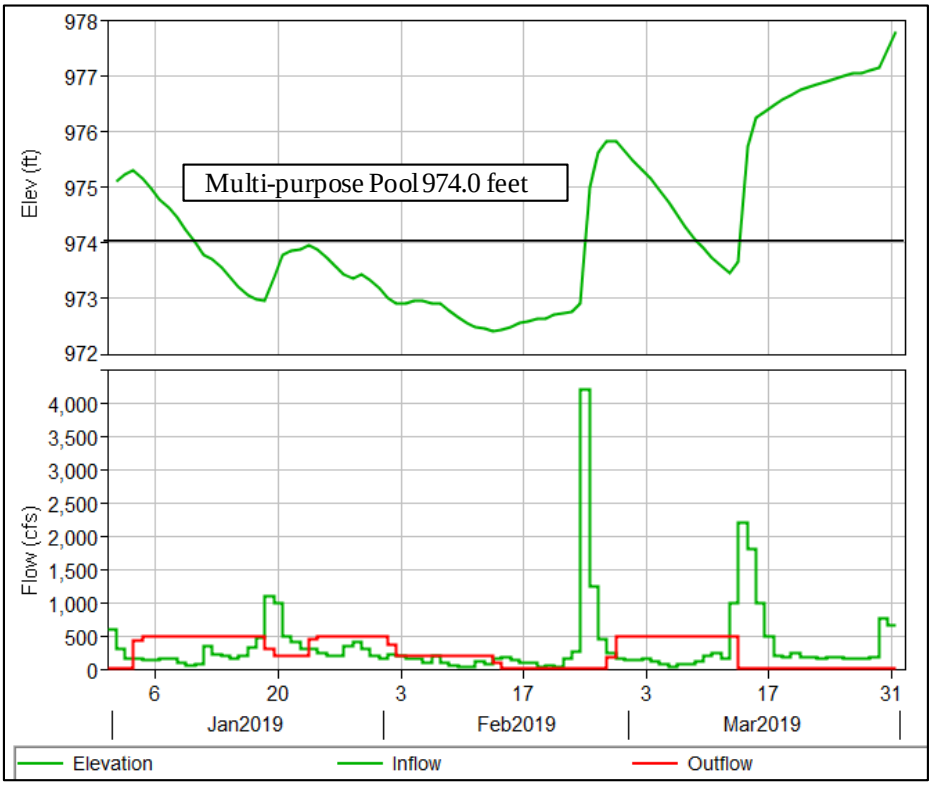


Figure 5f-2. Pomona January through March 2019 reservoir elevation, inflow, and outflow.

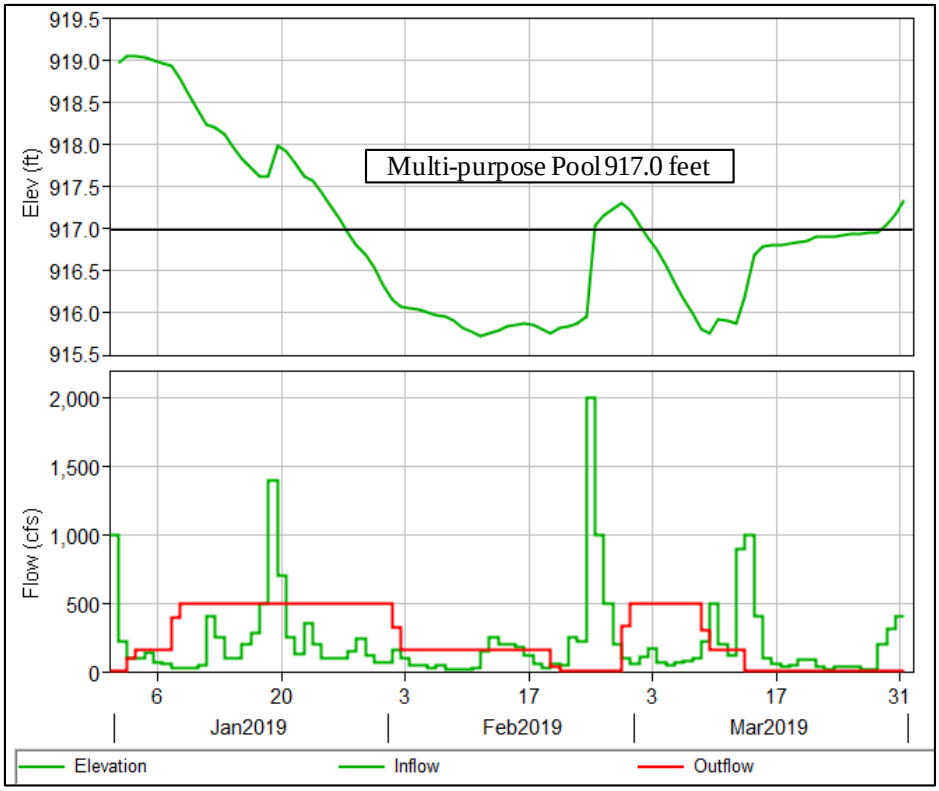


Figure 5f-3. Hillsdale January through March 2019 reservoir elevation, inflow, and outflow.

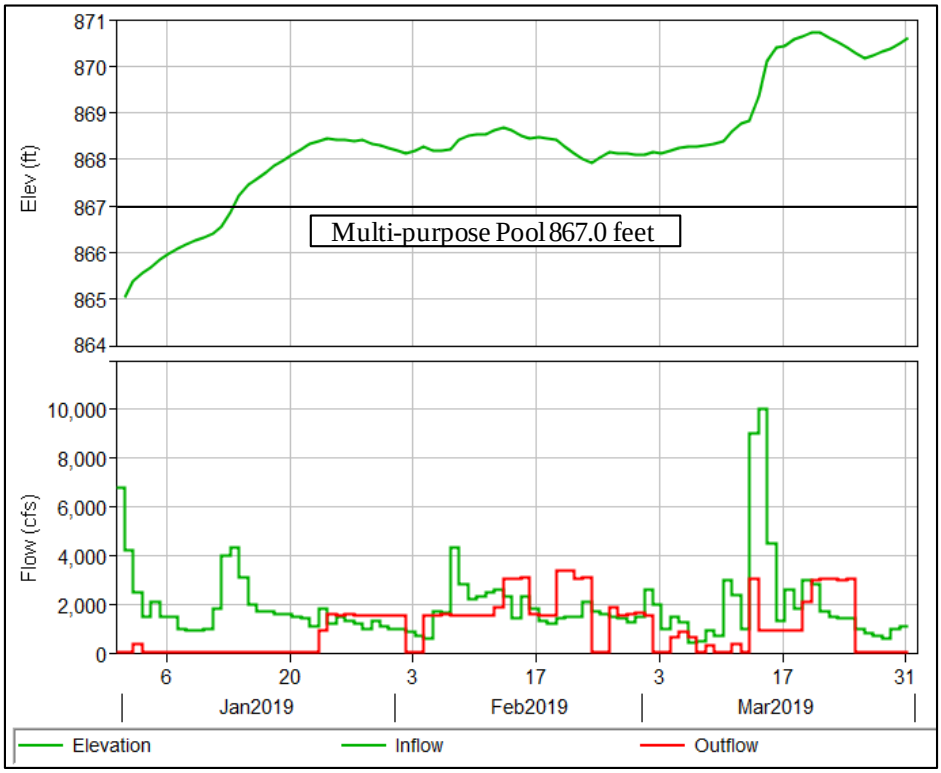


Figure 5f-4. Stockton January through March 2019 reservoir elevation, inflow, and outflow.

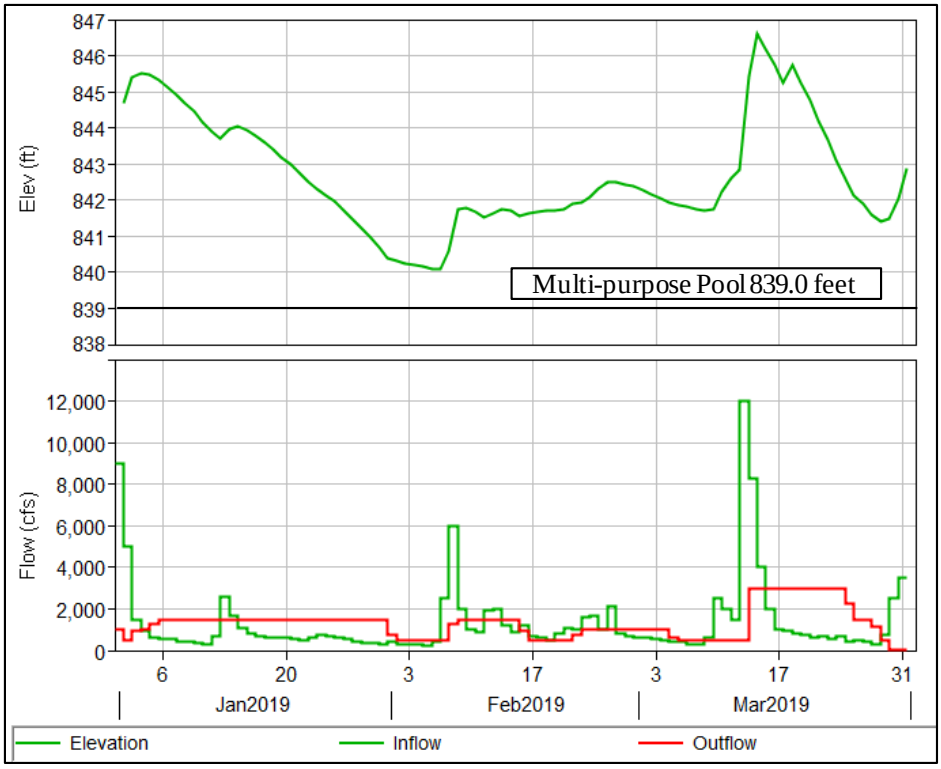


Figure 5f-5. Pomme de Terre January through March 2019 reservoir elevation, inflow, and outflow.

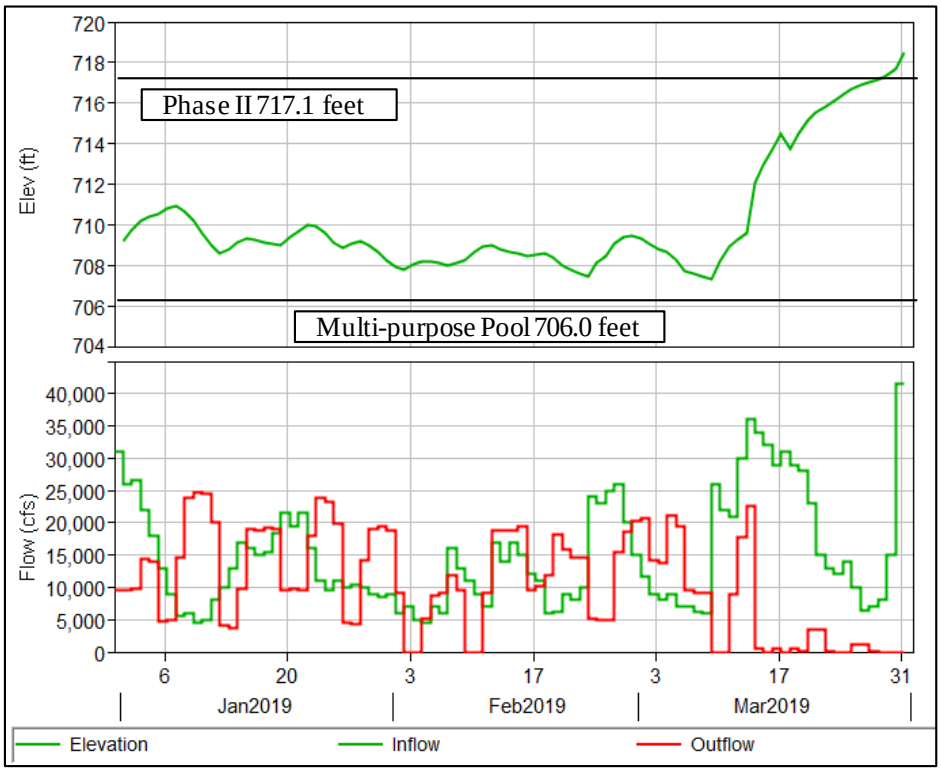


Figure 5f-6. Harry S Truman January through March 2019 reservoir elevation, inflow, and outflow.

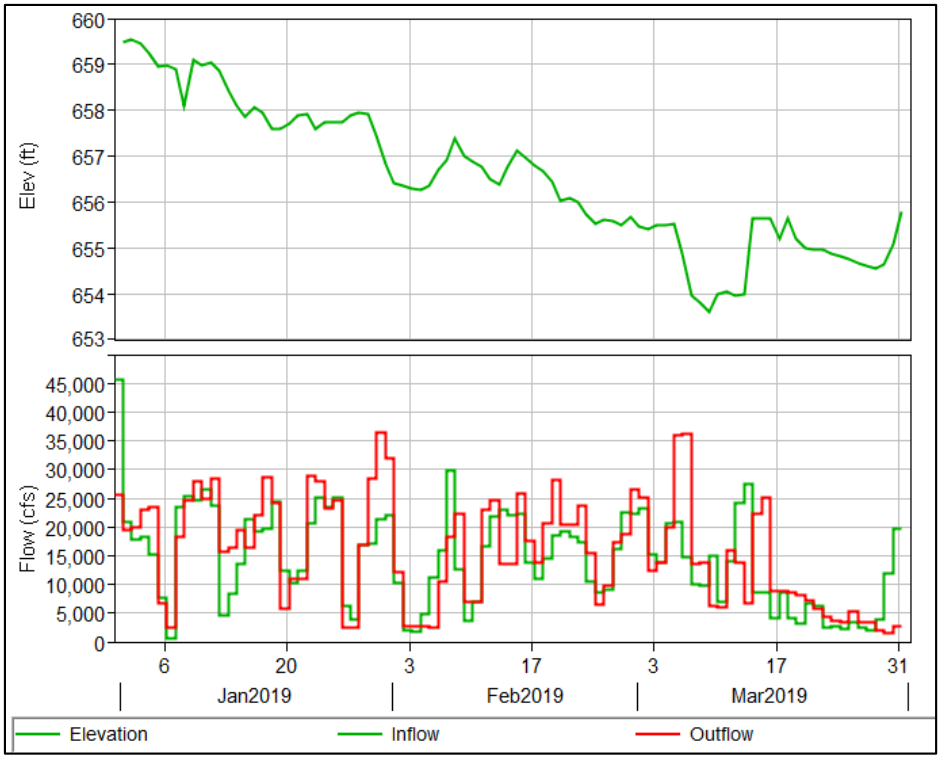


Figure 5f-7. Lake of the Ozarks (owned and operated by Ameren) January through March 2019 reservoir elevation, inflow, and outflow.

Figure 8 - 10 show the January, February, and March cumulative precipitation for this region.

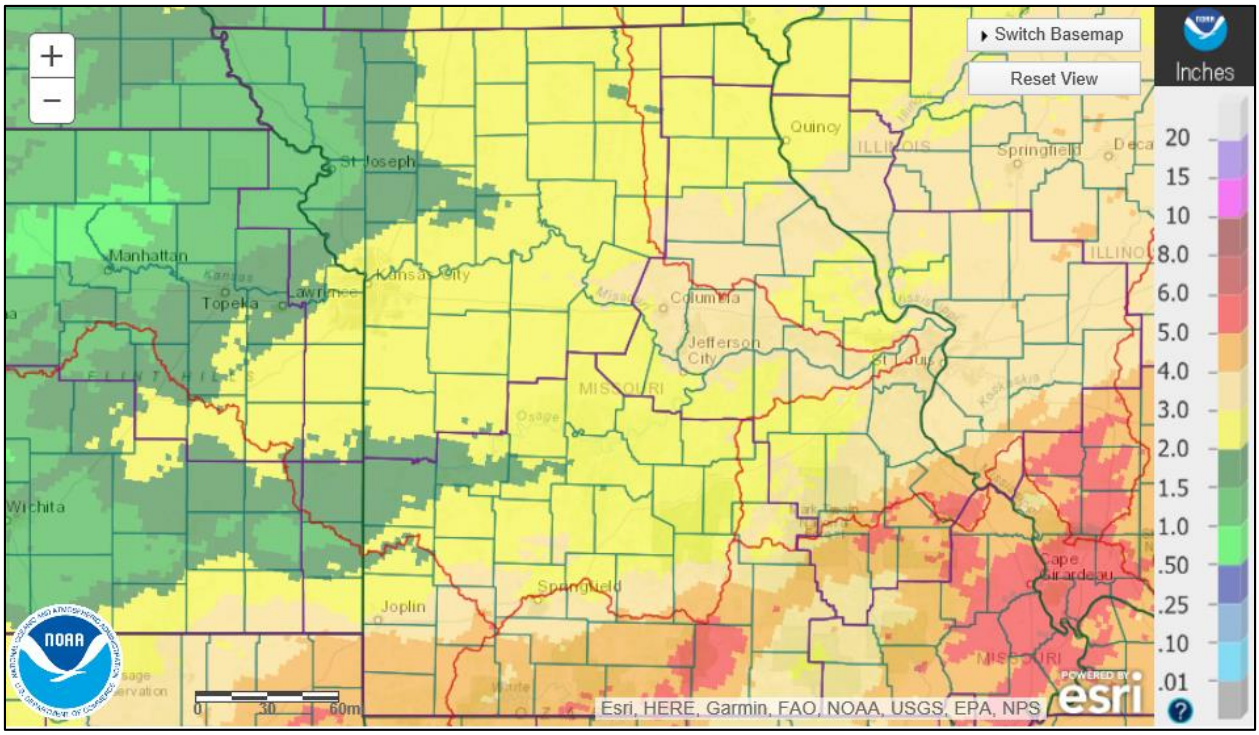


Figure 5f-8. January 2019 NOAA cumulative observed precipitation map.

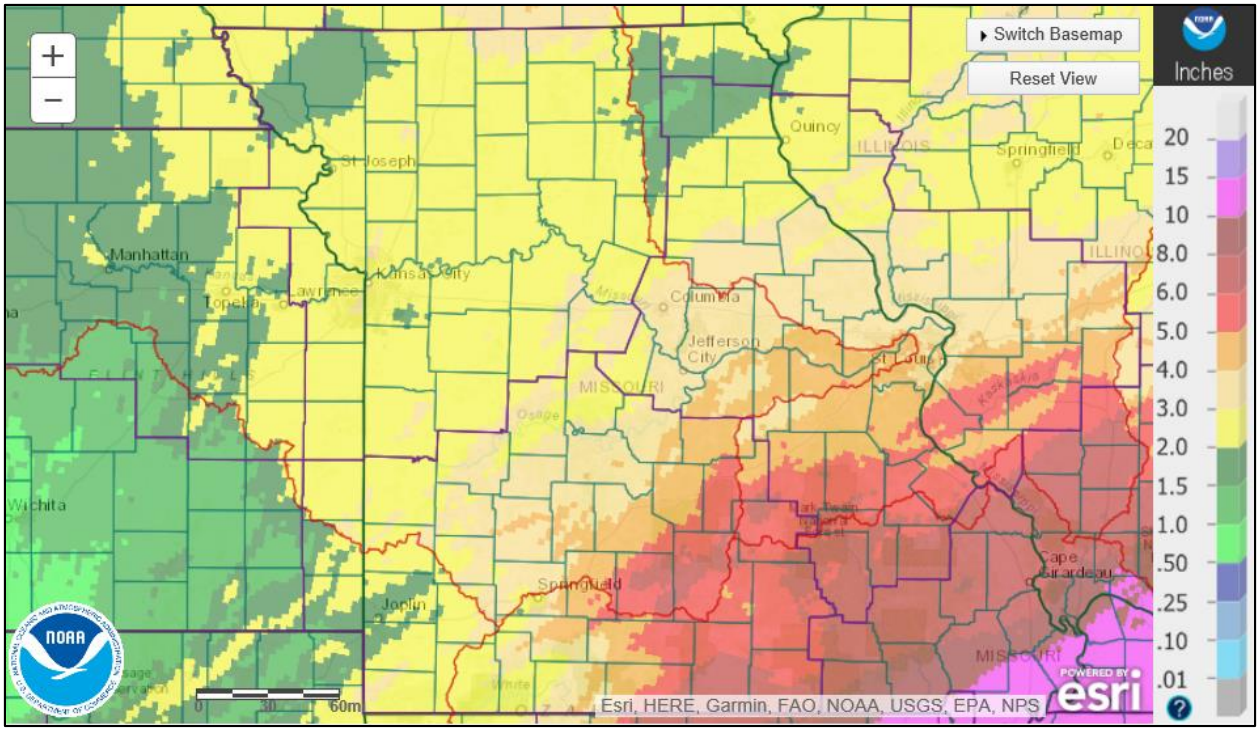


Figure 5f-9. February 2019 NOAA cumulative observed precipitation map.

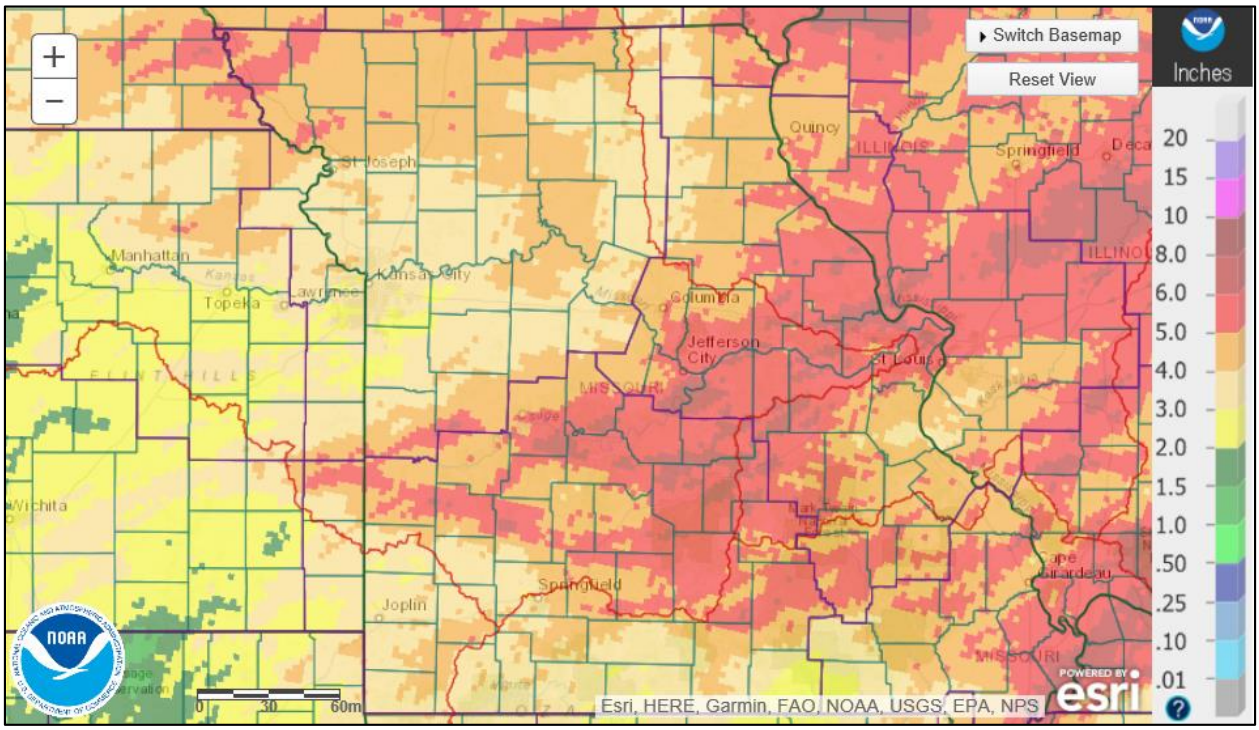


Figure 5f-10. March 2019 NOAA cumulative observed precipitation map.

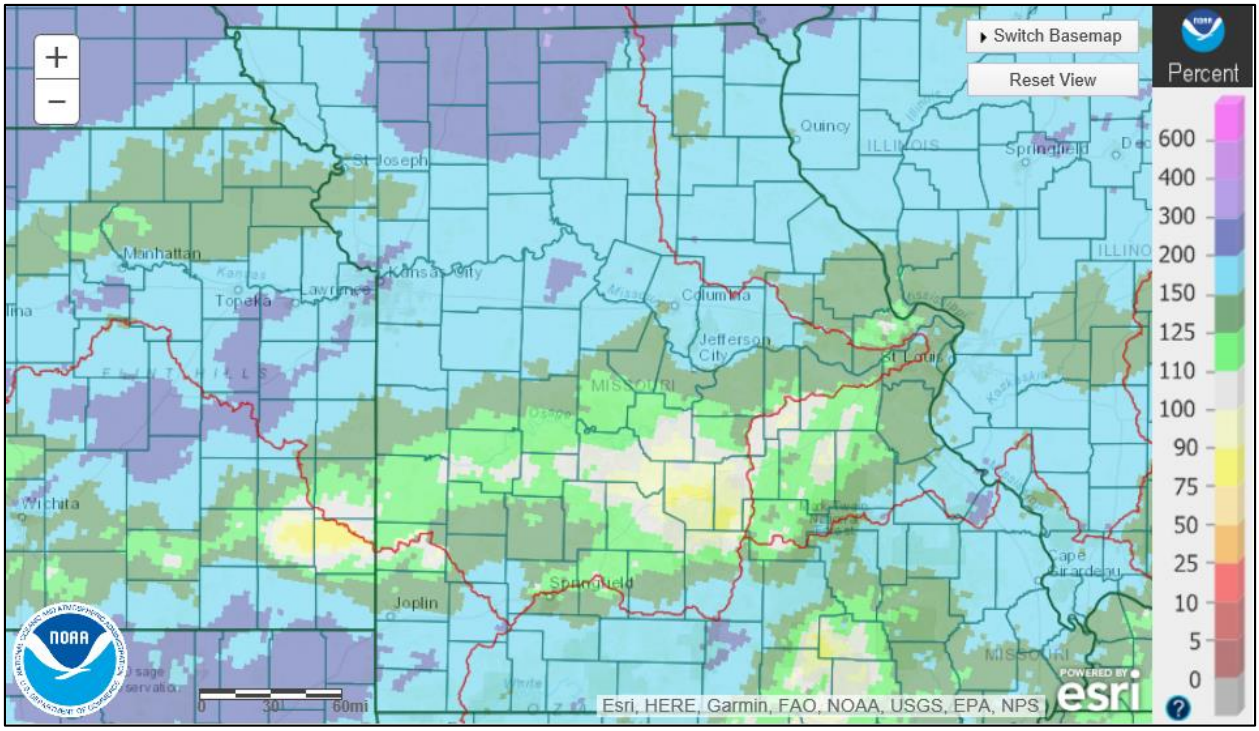


Figure 5f-11. January 2019 NOAA percent of normal precipitation map.

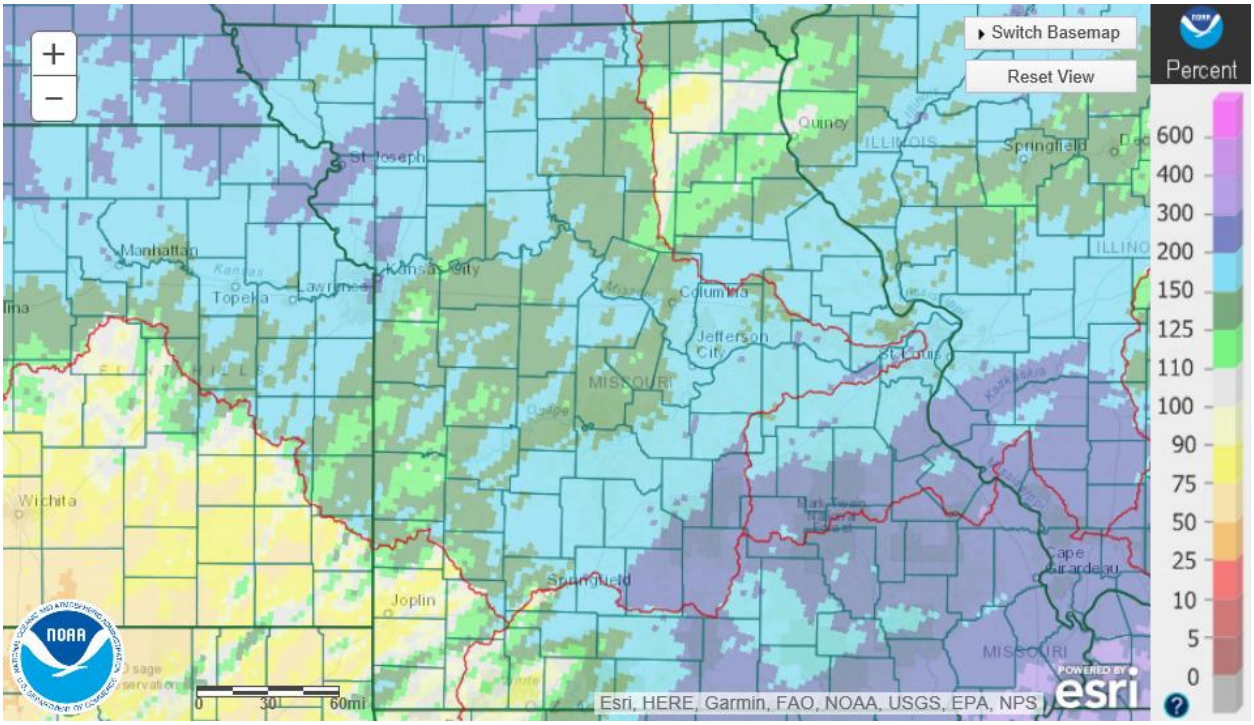


Figure 5f-12. February 2019 NOAA percent of normal precipitation map.

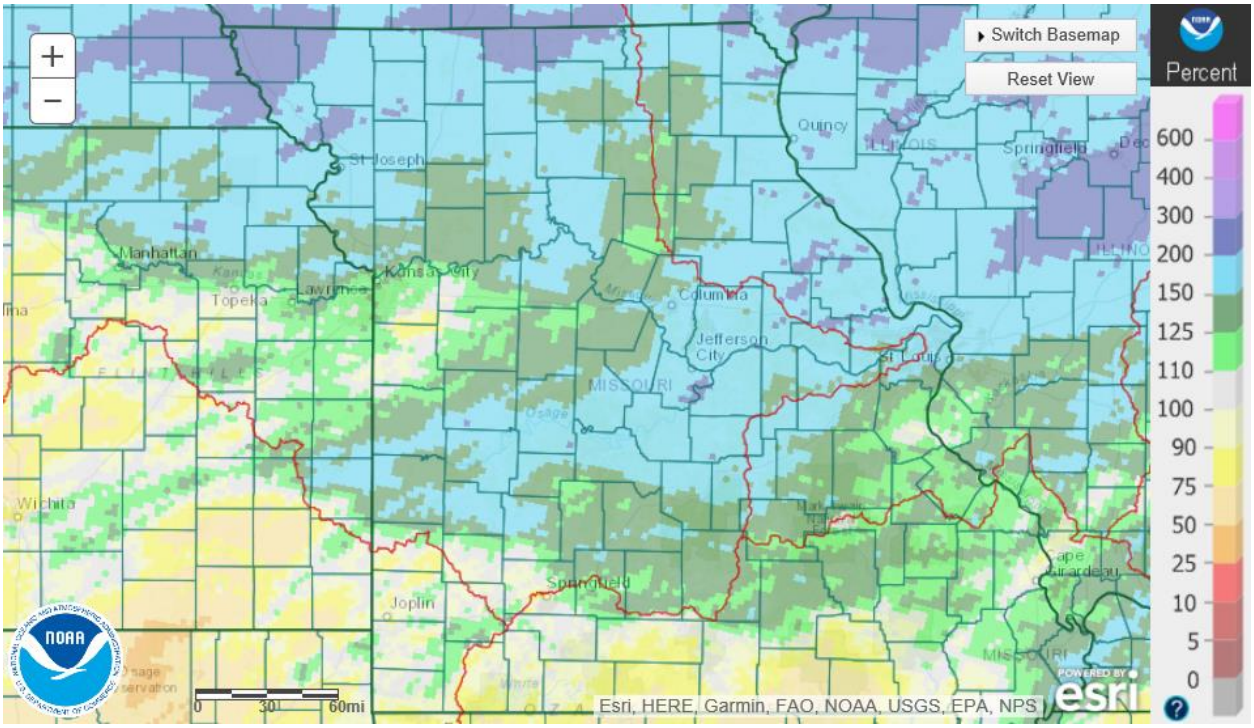


Figure 5f-13. March 2019 NOAA percent of normal precipitation map.

Above normal precipitation was observed in parts of the basin January through March. Some areas received rainfall amounts ranging from 200 to 300 percent above average in January, but larger areas received rainfall totals that ranged between 150 and 200 percent above average for all three months. The largest accumulations fell in the Gasconade basin, and near Truman and Lake of the Ozarks.

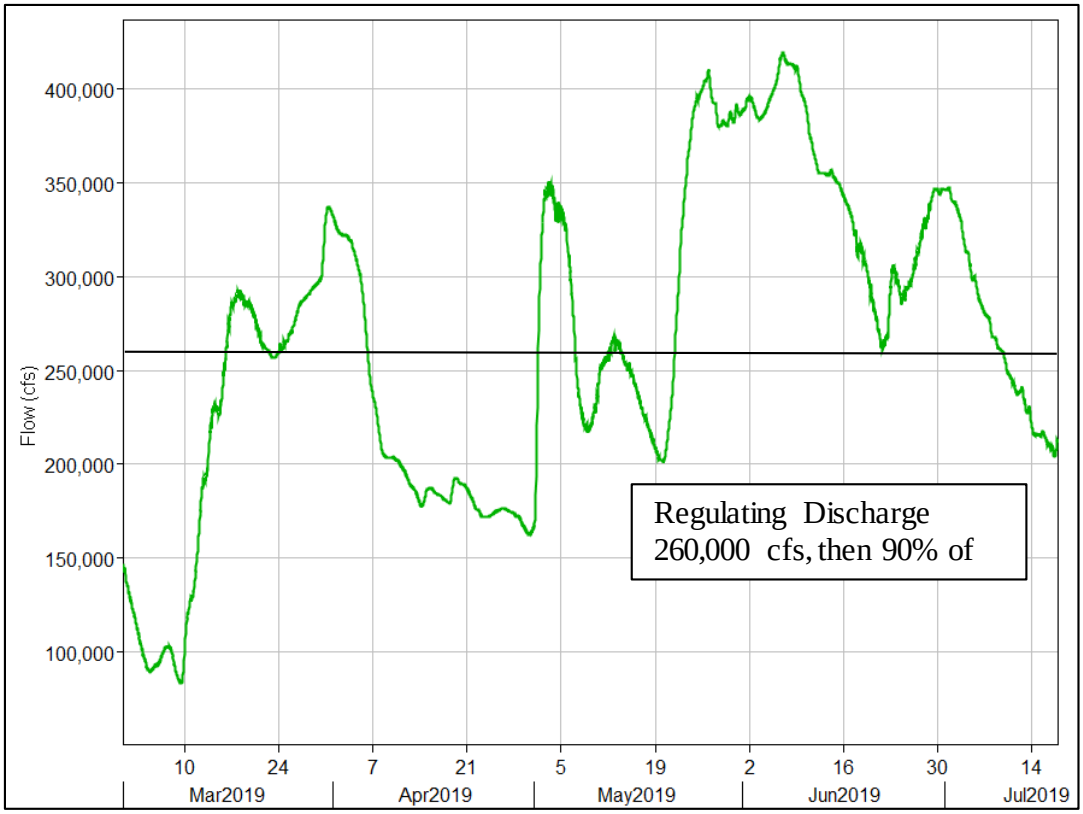


Figure 5f-14. Missouri River at Hermann flow for March through July 2019.

3. Spring (April through June 2019)

Plots of the April through June reservoir elevation, inflow, and outflow are shown in Figures 15 through 21. Although a large portion of the basin received five to eight inches of total precipitation in April, inflows remained relatively low due to the timing and distribution of rain events. Figure 22 through Figure 24 document the monthly rainfall accumulations during this period as percent of monthly normal. All the reservoirs were within a few feet of multipurpose by late April. In the days that followed, four widespread rain events increased inflows into the reservoirs. The first two events occurred back to back from May 1st through May 11th, the third event from May 20th through May 31st, and the forth from June 22nd through June 26th. Wet soil conditions and over 10 inches of total precipitation in May brought large inflows into the reservoirs in the basin. Some relief in mid-May allowed all the reservoirs except Pomme de Terre to be drawn down one to three feet. The USGS gage at State Line on the Marais des Cygnes River was above phase III criteria three times between May 1st and June 30th, limiting releases to low flow for Melvern, Pomona, and Hillsdale. Truman elevations rose up into phase II by May 5th, phase III by May 27th, and surcharge and a new maximum pool elevation by early June. Beginning in mid-May a significant amount of the total outflow from Truman was spilled through the tainter gates, although the figures in this report only communicate total release. For a large portion of May into mid-June tandem balance restrictions with Truman constrained releases from the upper basin lakes of Melvern, Pomona, Hillsdale, Stockton, and Pomme de Terre. At Stockton, construction work on one of the four tainter gates was impacted when the May 1st event overtopped the temporary bulkhead. This disrupted the ongoing tainter gate wire rope maintenance/replacement work, which in turn eliminated the ability to operate all four

tainter gates equally, in support of surcharge operations. Due to the increased risk associated with being unable to operate the overtopped tainter gate, increased hydropower releases were made under an approved deviation. The deviation permitted increased releases in order to lower the reservoir sufficiently for the tainter gate to be unbraced, lowered, and the control linkages brought back into service. These emergency repairs were successfully completed in early June. Between April 30th and May 15th Truman rose from elevation 708.8 feet to 727.5 feet due to increased inflows and constrained releases. Flows in excess of 260,000 cfs at Hermann persisted for a large portion of May through mid-July (see figure 11). Because of conditions at Hermann, on 02 May 2019, Water Management personnel coordinated with Ameren to schedule releases from Bagnell Dam so as not to draft their pool, per the inter agency memorandum of agreement. Releases were made from May 14th to the 20th then reduced to zero, due to high flows on the Missouri River at Hermann and the Osage River at St. Thomas. Truman reservoir experienced eight consecutive days of inflows over 100,000 cfs from May 22nd through May 29thwith no opportunity to make releases 21 May through 26 May. There was soon sufficient water on the ground to forecast that Truman would exceed its remaining flood control storage. On 27 May 2019 operations transitioned from flood control to surcharge with surcharge releases starting that day. The top of the flood control pool is at elevation 739.6 feet, coincident with the top of the tainter gates when they are closed. As the pool rises into Surcharge it is essential, from a dam safety perspective, to open all the tainter gates some small increment in order to prevent them from overtopping. Through conversations with Operations Division, Dam Safety, and Water Management, it was decided that maintaining one foot of freeboard by operating all four tainter gates in unison, would be sufficient to prevent overtopping. This would account for uncertainties associated with wind/wave action and the need to coordinate changes in tainter gate settings with Project staff to coincide with shift changes, in as much as circumstances permitted. From mid-May through mid-September, the total release indicated for Truman sometimes included significant amounts of water spilled through the tainter gates. Releases from the tainter gates and hydropower generation were adjusted as needed to maintain freeboard on the tainter gates throughout the period of surcharge operations, 27 May through 10 June. The reservoir elevation at Truman exceeded the top of flood control storage and rose into surcharge storage on June 3rd, hovering near that threshold till 10 June, by which time the flow at Hermann subsided to 90% of its former crest. This permitted the re-establishment of flood control releases to the extent that channel space became available downstream. Backwater conditions at St. Thomas on the Osage River somewhat limited the transition from surcharge back to flood control releases on 10 June. By 18 June, flows and stages on the Missouri River at Hermann had subsided so that backwater at St Thomas was no longer a consideration. As conditions at St Thomas and Hermann improved through mid-June, total release from Truman was quickly anticipated to, and did, exceed 50,000 cfs. Our forecast of anticipated increased releases on exiting surcharge was closely coordinated, as always, with Ameren, in accordance with the reporting and coordinating requirements of our inter agency memorandum of agreement.

Notably, Melvern, Pomona, Hillsdale, Pomme de Terre, and Truman all established new record pool elevations in early June 2019. Melvern's record pool was 1055.60 feet on 04 June exceeding the previous record of 1053.45 feet on 13 June 1995. Pomona's record pool was 1001.80 feet on 09 June exceeding the previous record of 998.4 feet on 12 June 1995. Hillsdale's record pool was 929.39 feet on 07 June exceeding the previous record of 928.51 feet on 21 October 1986. Pomme de Terre's record pool was 864.69 feet on 18 June exceeding the

previous record of 864.58 feet on 27 September 1993. Truman's record pool was 739.72 feet on 04 June exceeding the previous record of 738.72 feet on 12 October 1986.
Through the month of June, channel space below Melvern and Pomona afforded only limited opportunities for release of water, consequently, only marginal reductions in reservoir elevations were achieved, ranging from no more than 1-5 feet below maximum pool. Conditions below Truman gradually improved at St Thomas and Hermann, allowing a gradual increase in releases that declined the reservoir from surcharge down through phase III and into phase II, a nearly 6 feet decline, by 01 July. Hillsdale, Stockton and Pomme de Terre would not make any appreciable, sustained releases until July, and their pools declined only slightly below their early June crest elevations.

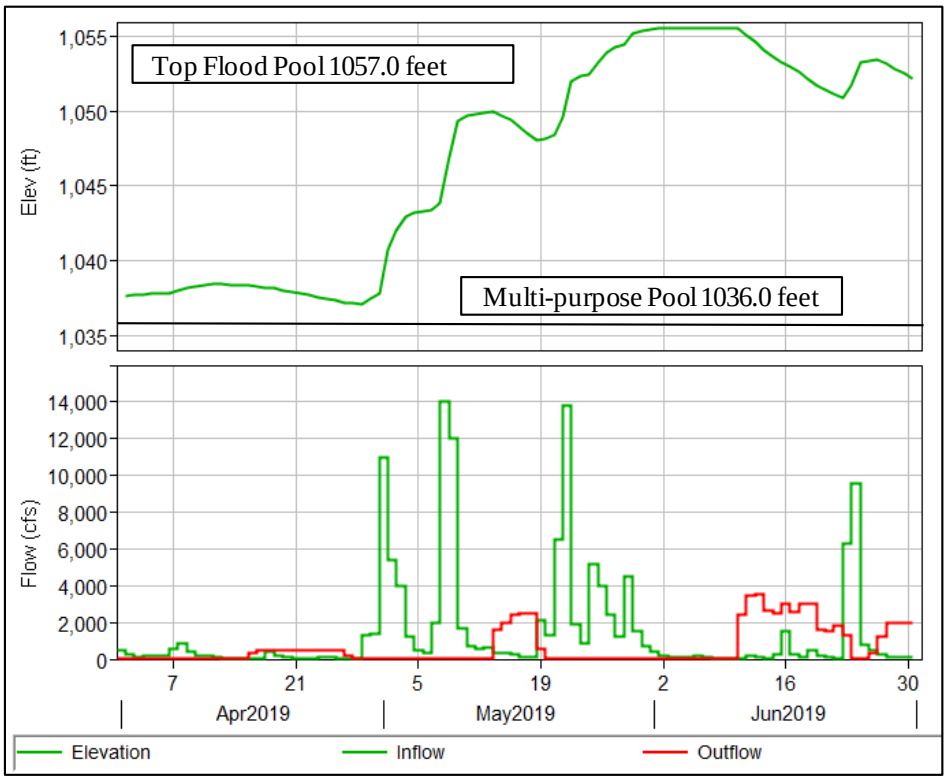


Figure 5f-15. Melvern April through June 2019 reservoir elevation, inflow, and outflow.

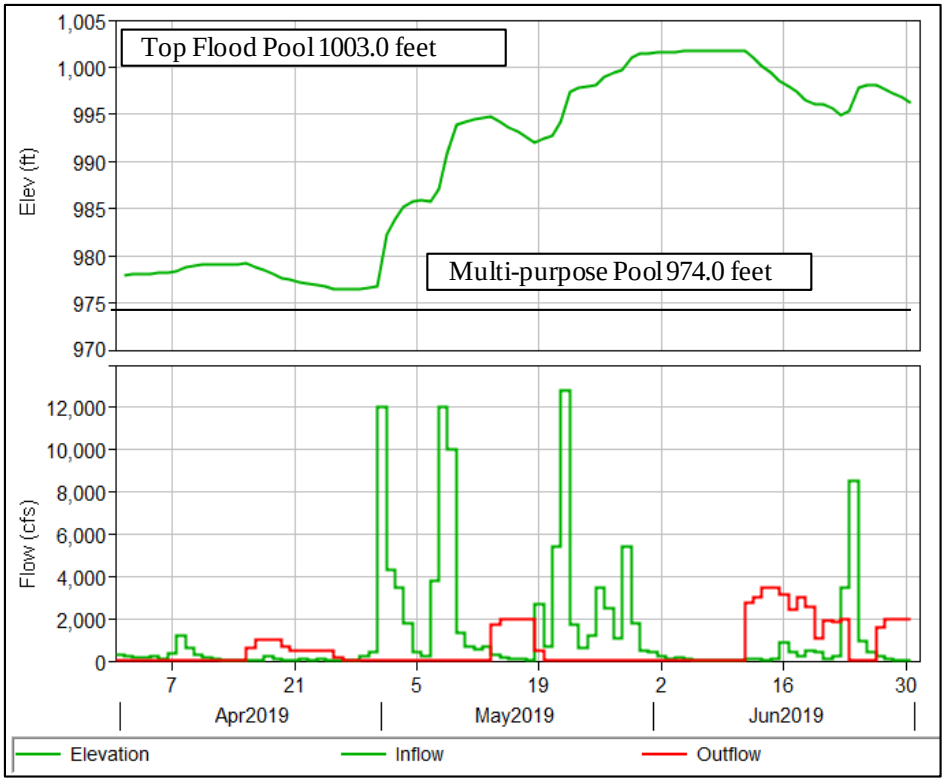


Figure 5f-16. Pomona April through June 2019 reservoir elevation, inflow, and outflow.

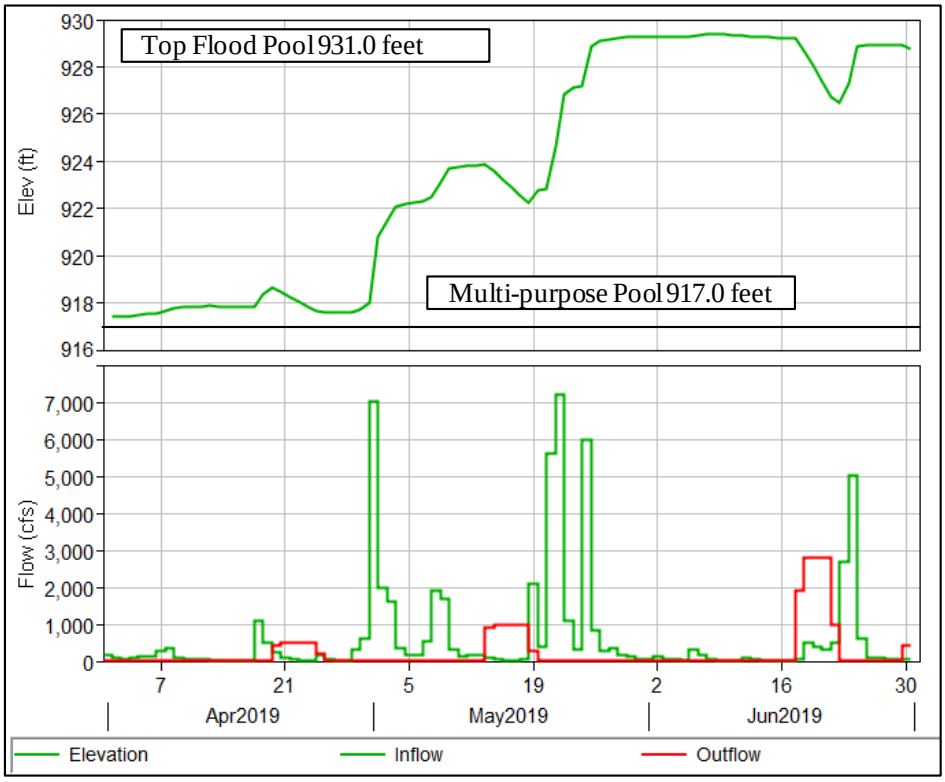


Figure 5f-17. Hillsdale April through June 2019 reservoir elevation, inflow, and outflow.

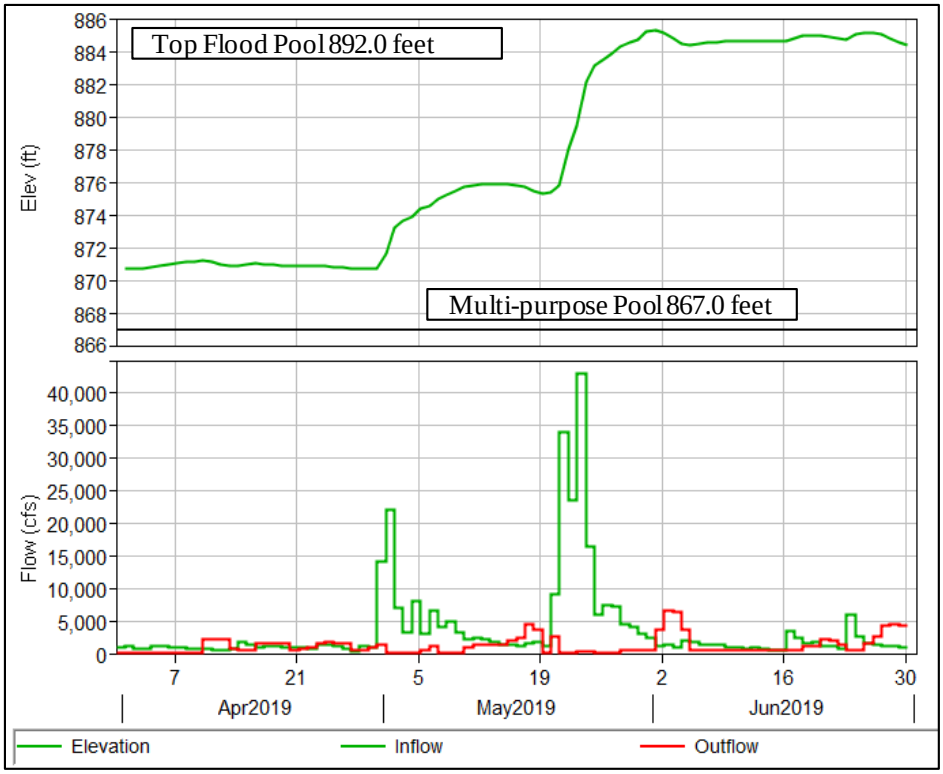


Figure 5f-18. Stockton April through June 2019 reservoir elevation, inflow, and outflow.

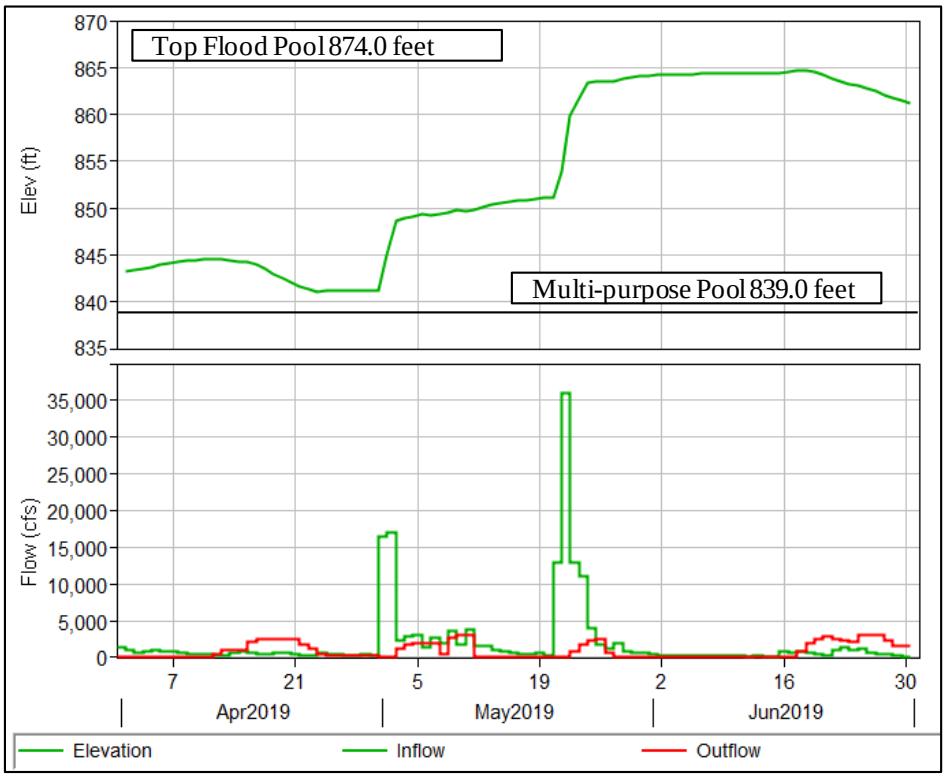


Figure 5f-19. Pomme de Terre April through June 2019 reservoir elevation, inflow, and outflow.

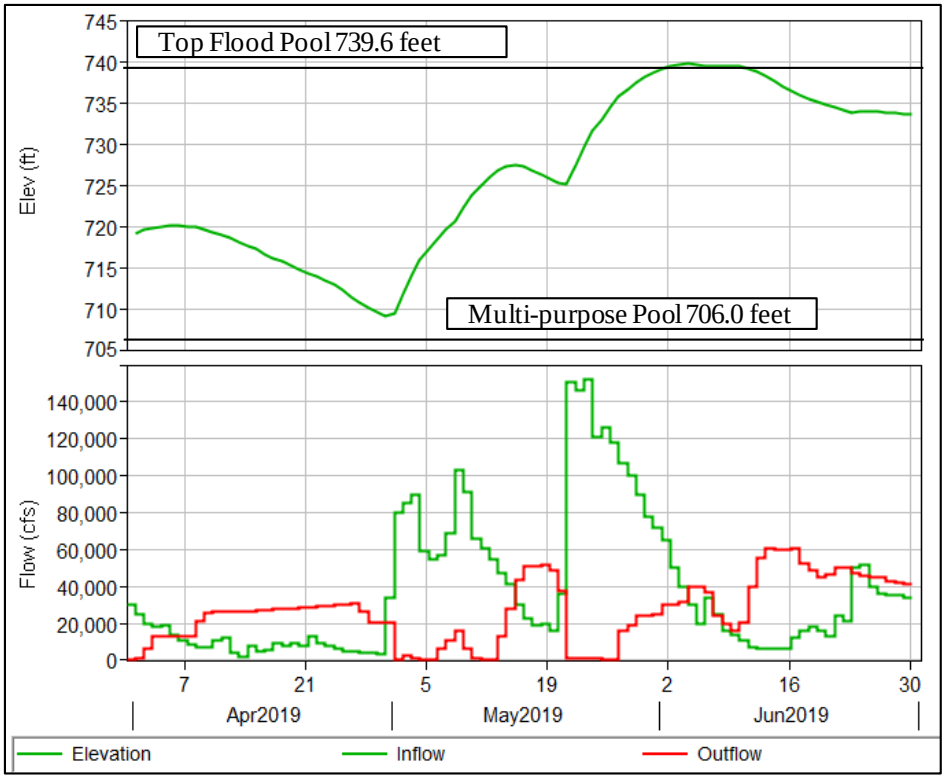


Figure 5f-20. Harry S Truman April through June 2019 reservoir elevation, inflow, and outflow.

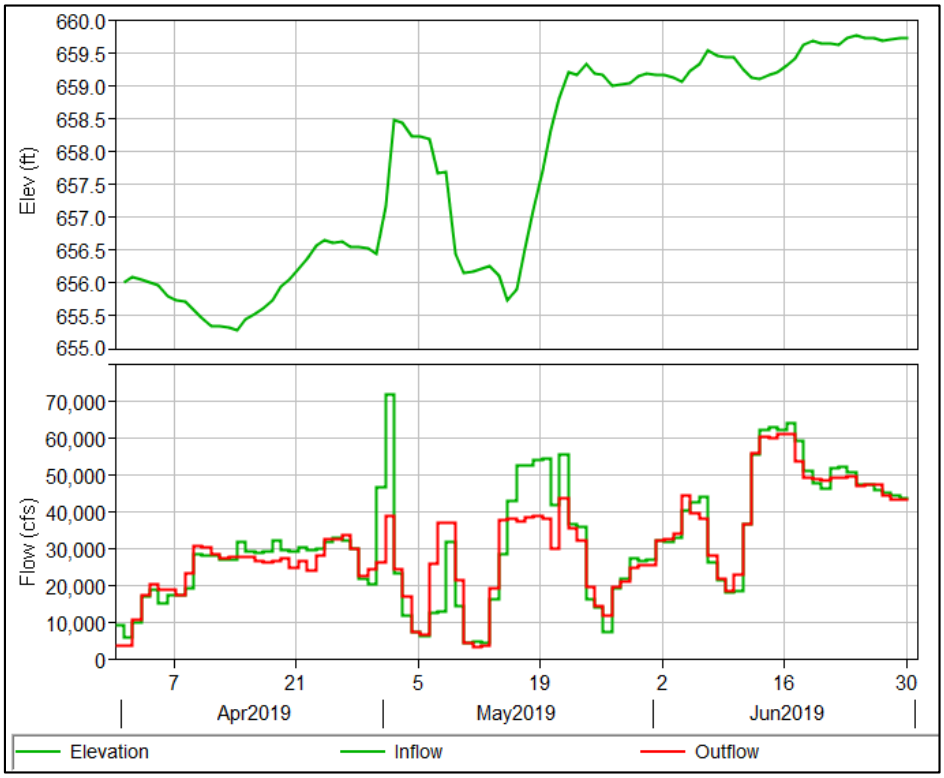


Figure 5f-21. Lake of the Ozarks (owned and operated by Ameren) April through June 2019 reservoir elevation, inflow, and outflow.

Figures 5f-22 - 24 show the April, May, and June cumulative precipitation for this region.

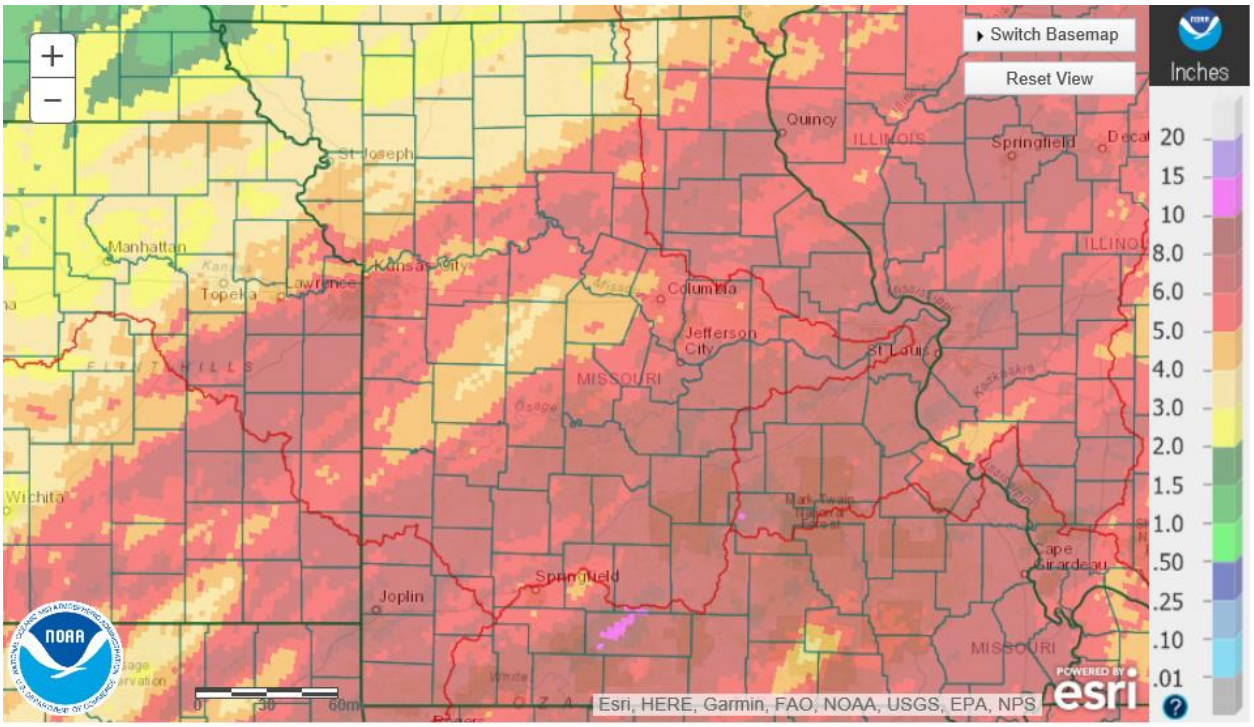


Figure 5f-22. April 2019 NOAA cumulative observed precipitation map.

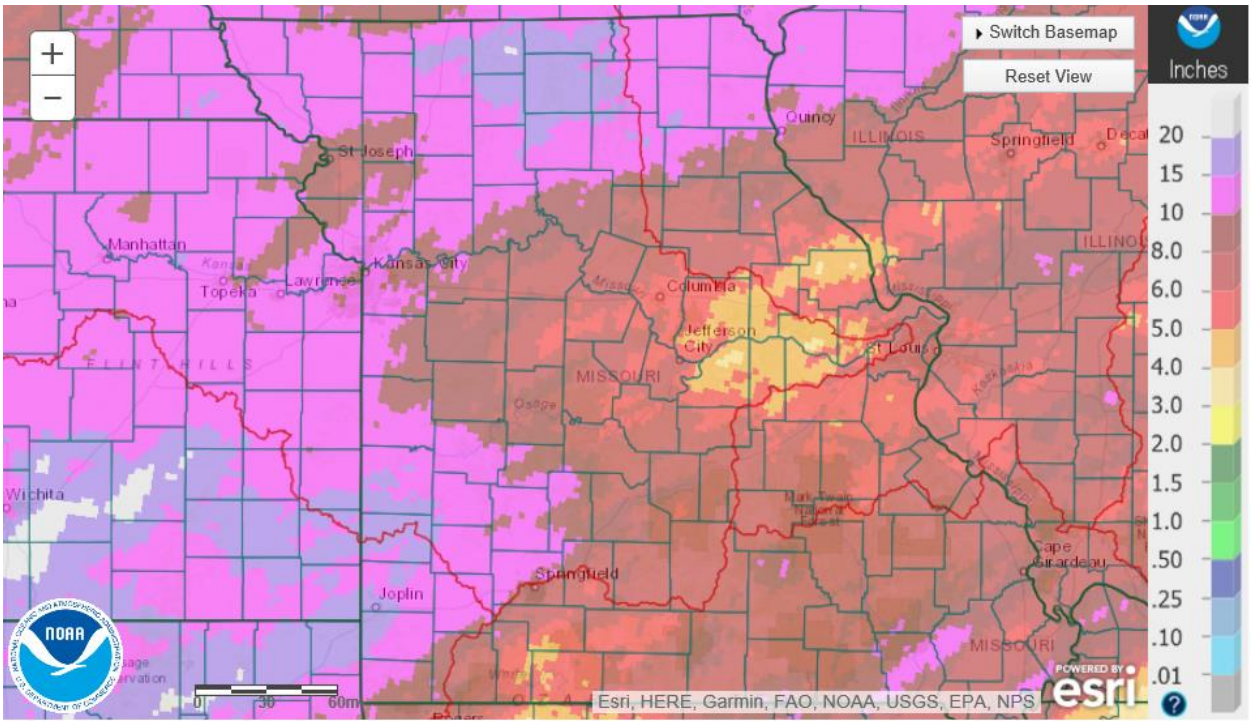


Figure 5f-23. May 2019 NOAA cumulative observed precipitation map.

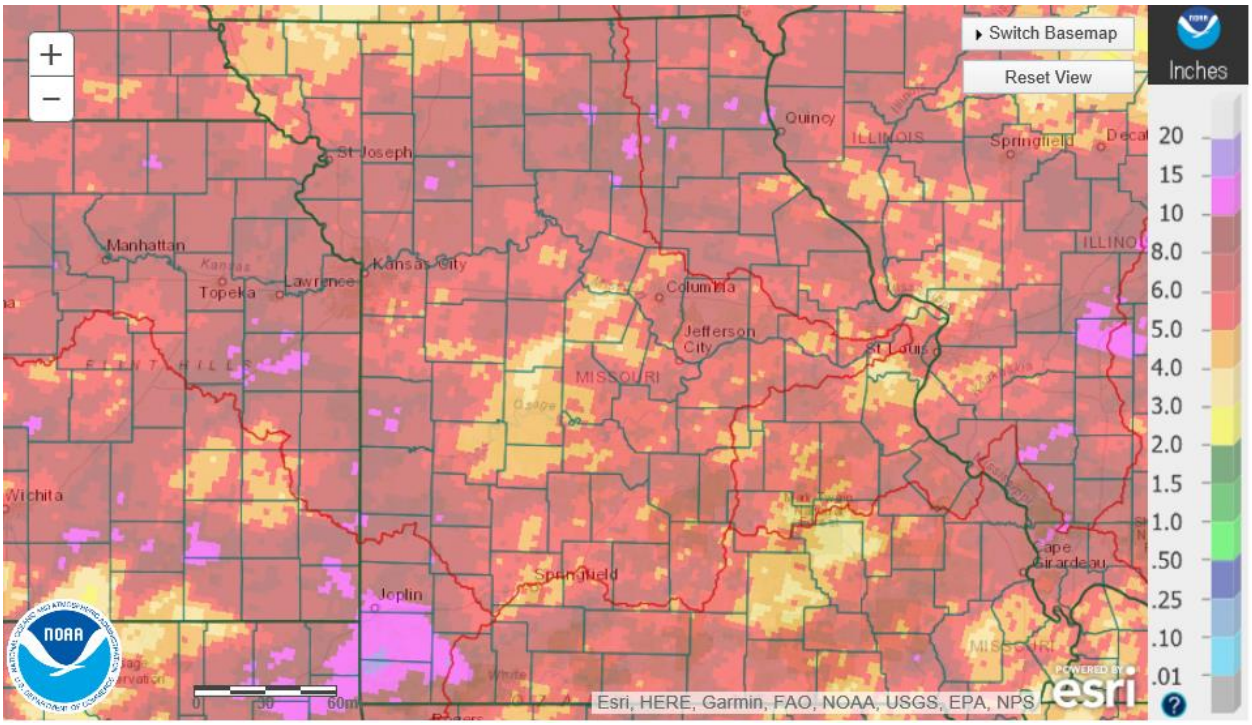


Figure 5f-24. June 2019 NOAA cumulative observed precipitation map.

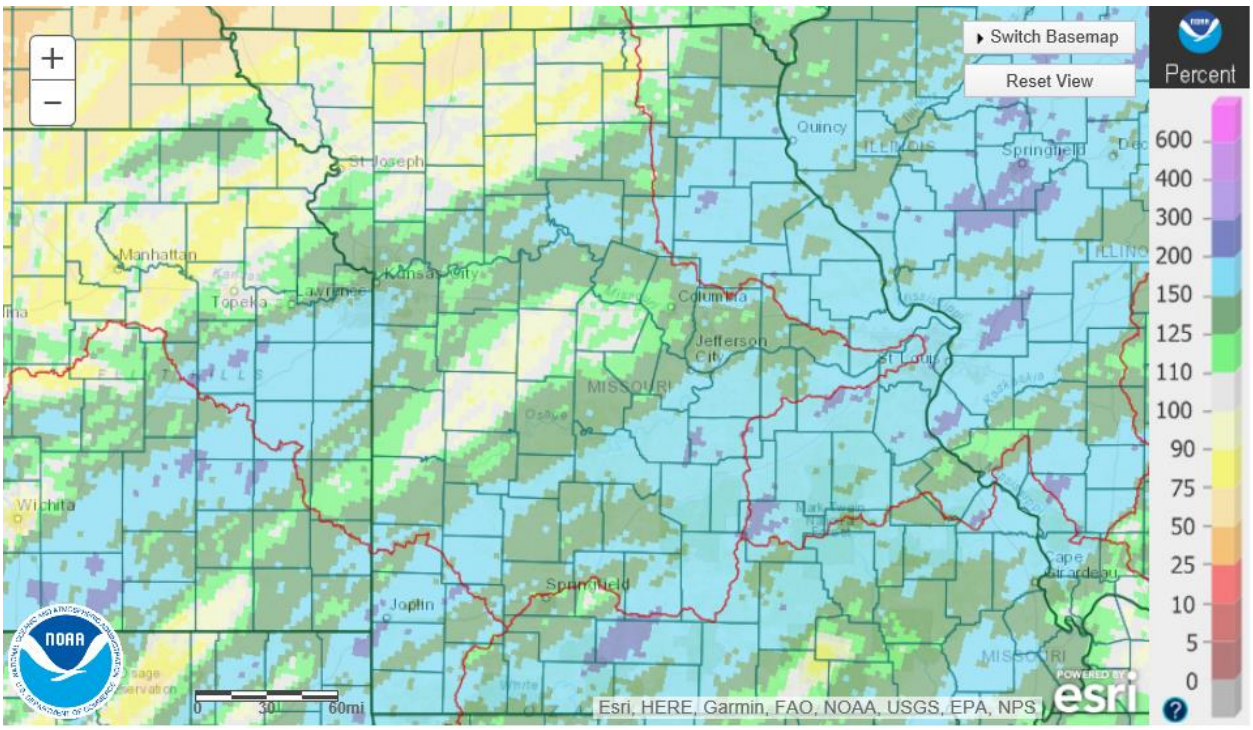


Figure 5f-25. April 2019 NOAA percent of normal precipitation map.

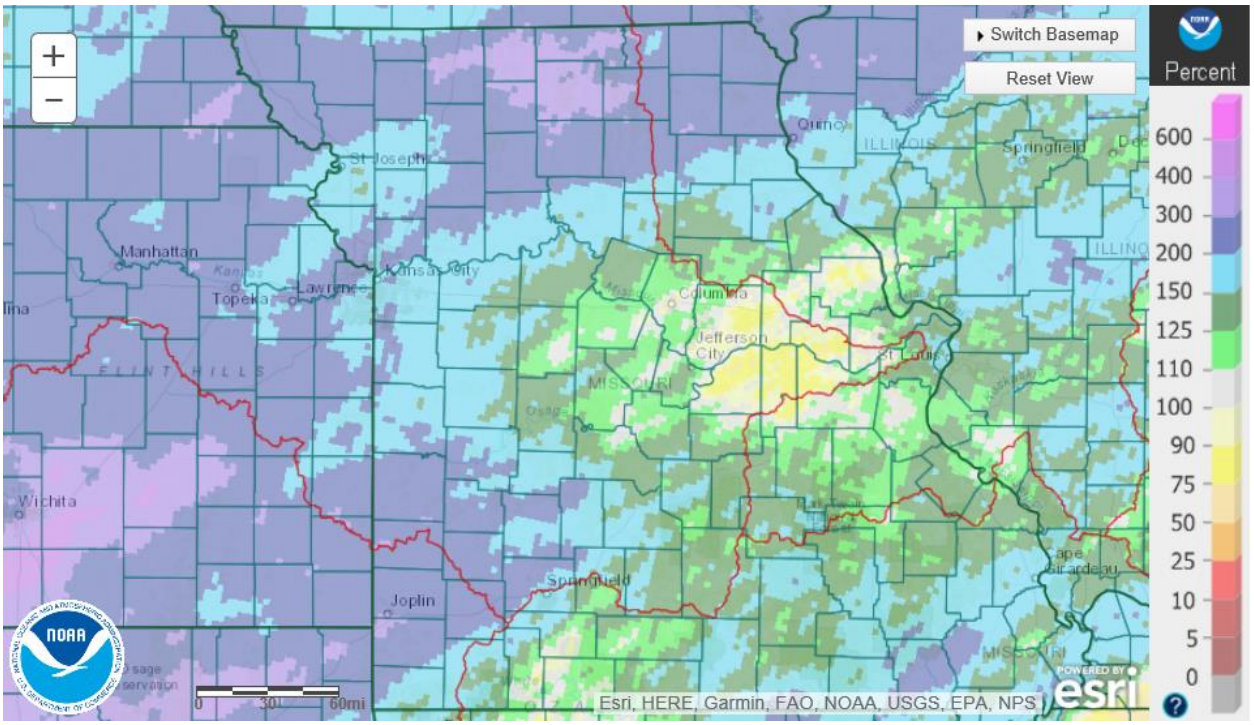


Figure 5f-26. May 2019 NOAA percent of normal precipitation map.

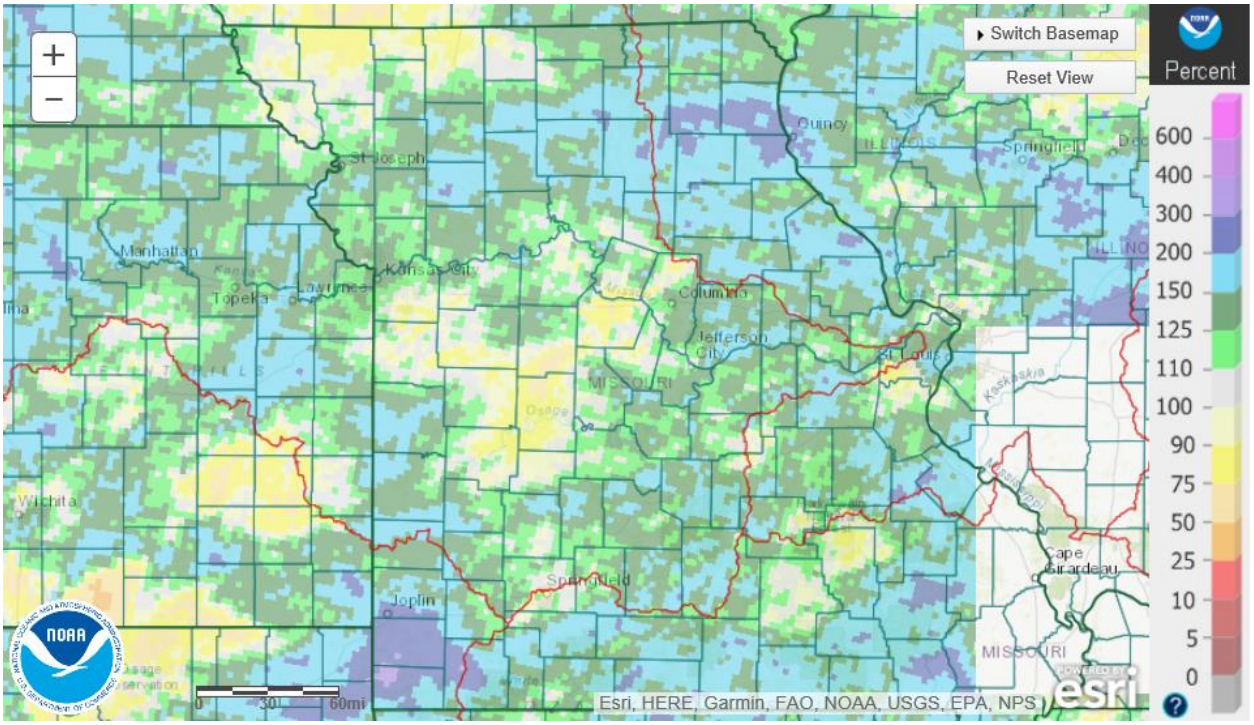


Figure 5f-27. June 2019 NOAA percent of normal precipitation map.

Above normal precipitation was observed in parts of the basin from April through June as seen in Figure 22 through Figure 27. Some areas were 200 to 300 percent above average in May, but

large areas were between 150 and 200 percent above average in May and June. The largest accumulations fell on western portions of the basin with May monthly totals above 15 inches in some areas.

4. Summer (July through September 2019)

Plots of the July through September reservoir elevation, inflow, and outflow are shown in Figures 28 through 34. Figure 35 through Figure 37 depict cumulative monthly precipitation, in inches, while Figure 38 through Figure 40 communicate these same monthly totals as percent of average. After setting record pool elevations across the Osage Basin in June, all of the Osage reservoirs began July well above multi-purpose pool. In general, pools declined significantly through July, controlled by tandem balance relationship with Truman. Throughout the month of August, pools temporarily stabilized in the upper reservoirs with passage of inflows until Truman could be evacuated further and re-establish favorable conditions for increased releases from upstream projects. In late August, however, Melvern, Pomona, and Hillsdale were shut off several times due to flows exceeding downstream control point criteria at Pomona, Ottawa, and State Line. Consequently, their reservoir elevations were again on the rise. September brought drier conditions to the basin, allowing increased releases from all the reservoirs. By the end of September, Stockton and Pomme de Terre had evacuated all their 2019 flood control storage, and every other reservoirs in the Osage River basin was within only a few feet of multipurpose. Throughout this period, there were no significant inflow events to Lake of the Ozarks in combination with Truman releases, which required extraordinary coordination with Ameren.

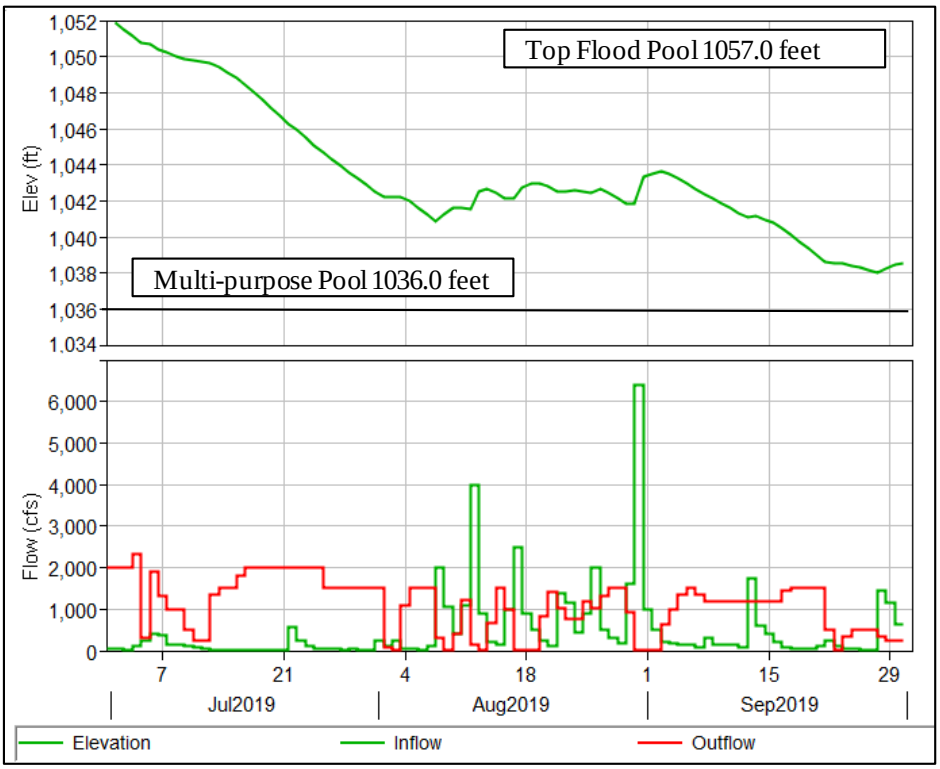


Figure 5f-28. Melvern July through September 2019 reservoir elevation, inflow, and outflow.

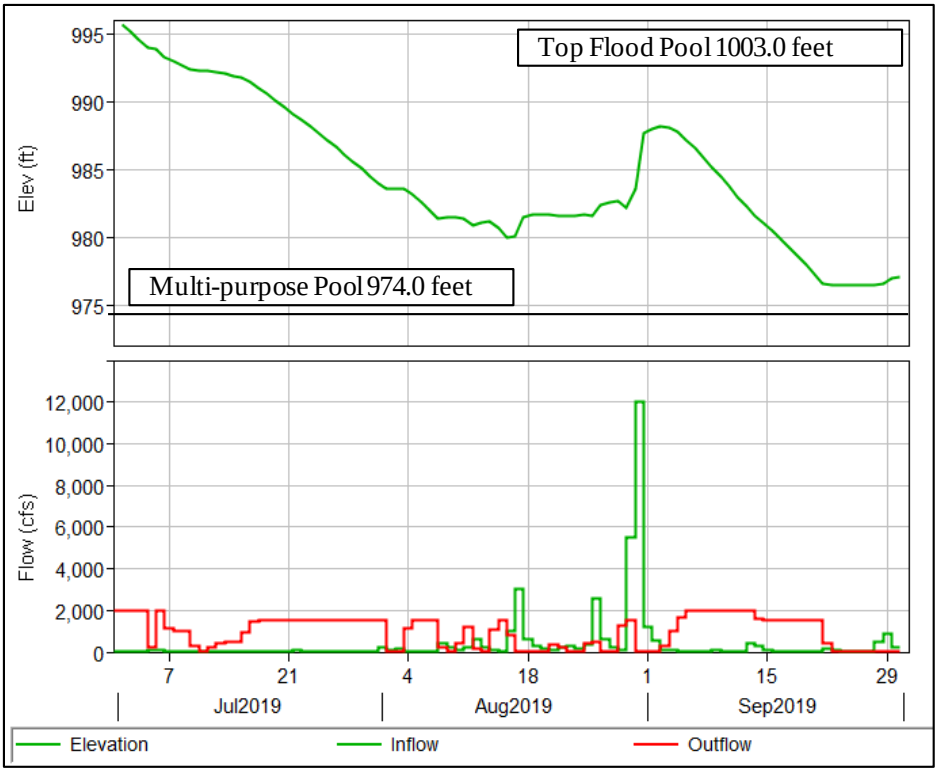


Figure 5f-29. Pomona July through September 2019 reservoir elevation, inflow, and outflow.

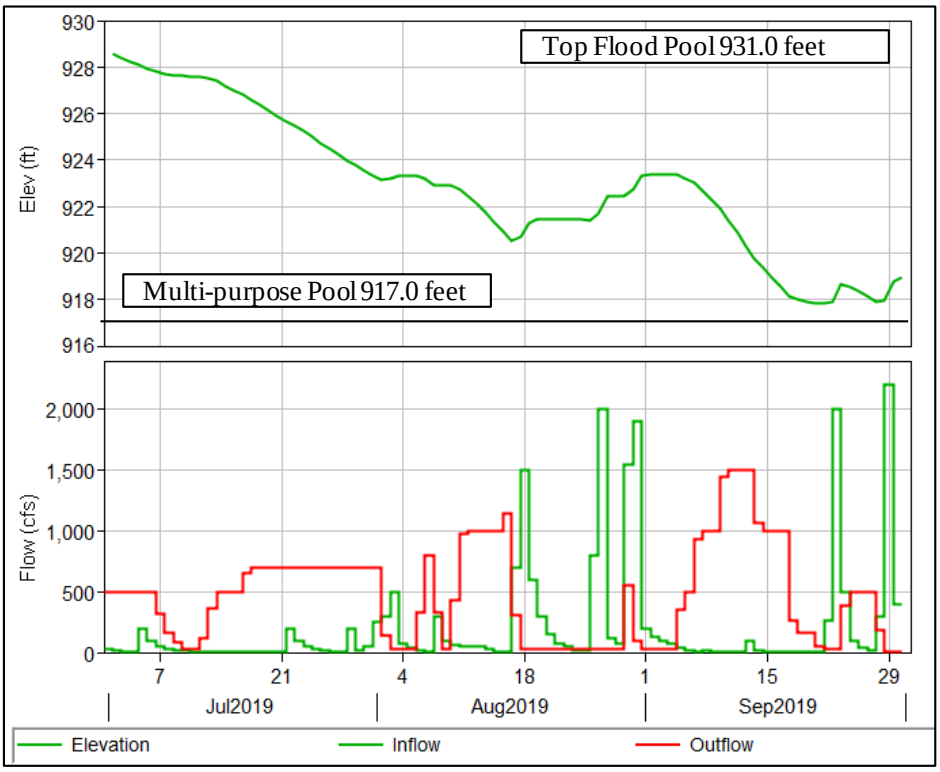


Figure 5f-30. Hillsdale July through September 2019 reservoir elevation, inflow, and outflow.

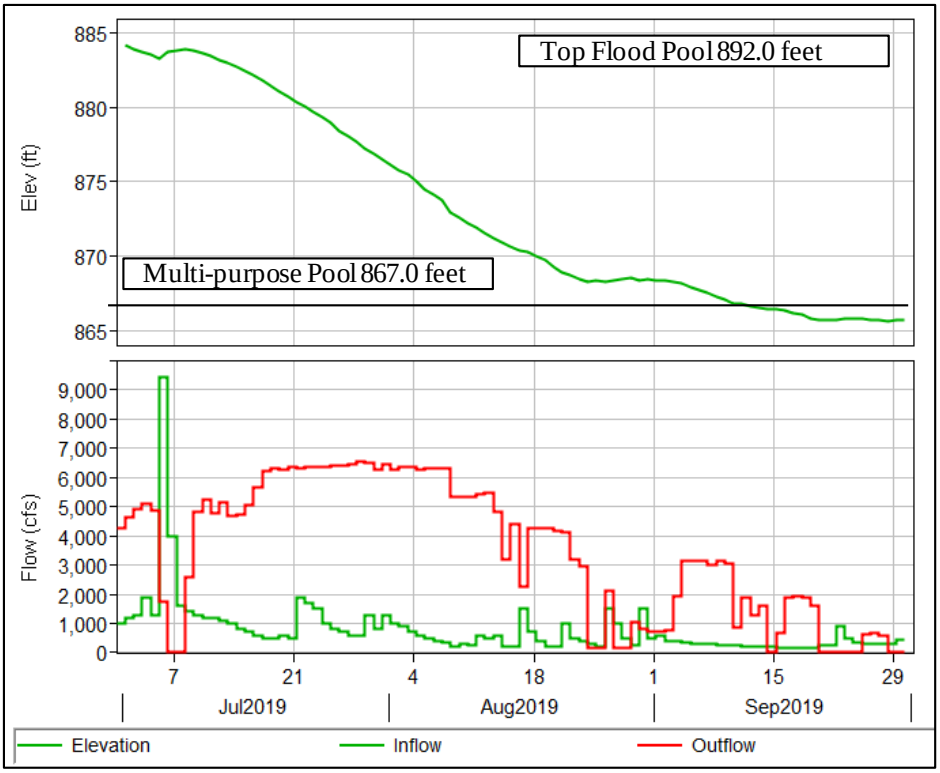


Figure 5f-31. Stockton July through September 2019 reservoir elevation, inflow, and outflow.

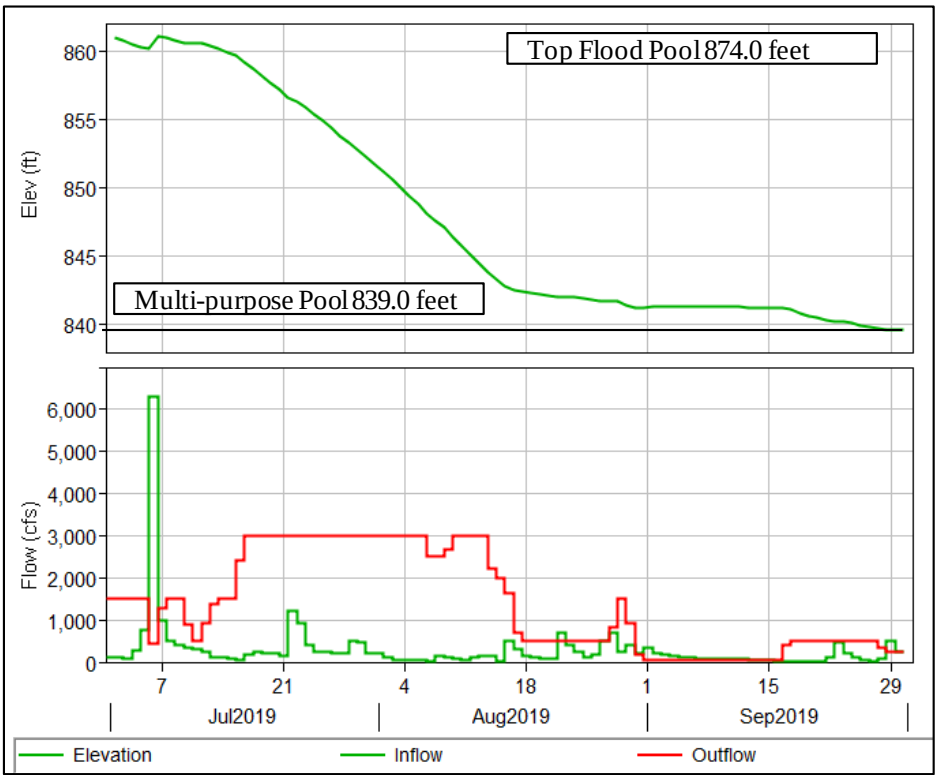


Figure 5f-32. Pomme de Terre July through September 2019 reservoir elevation, inflow, and outflow.

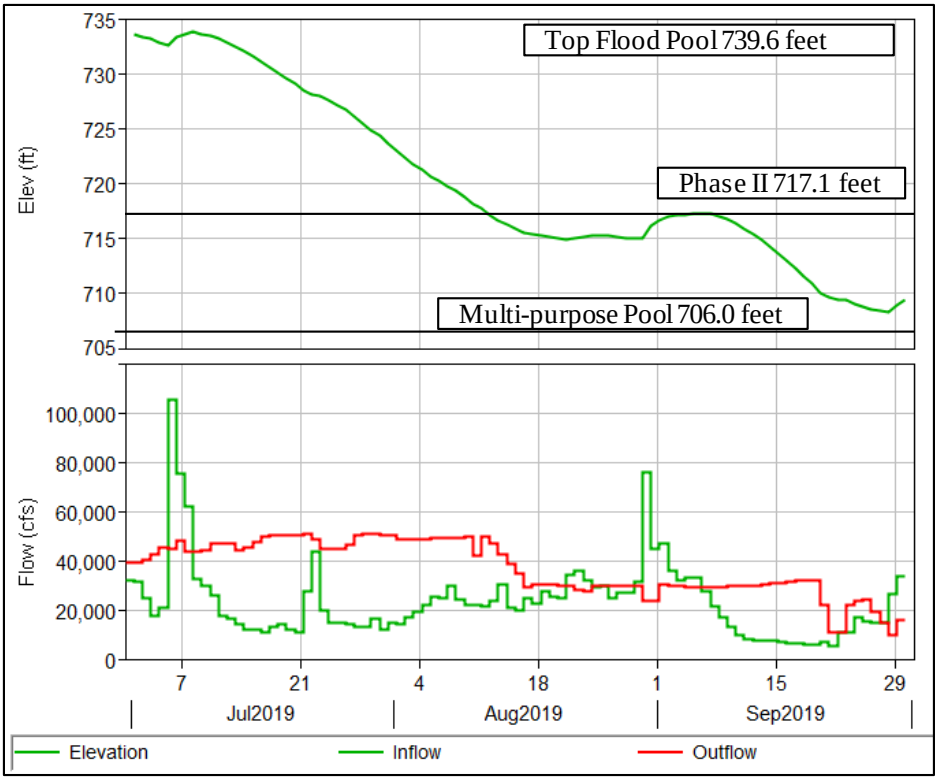


Figure 5f-33. Harry S Truman July through September 2019 reservoir elevation, inflow, and outflow.

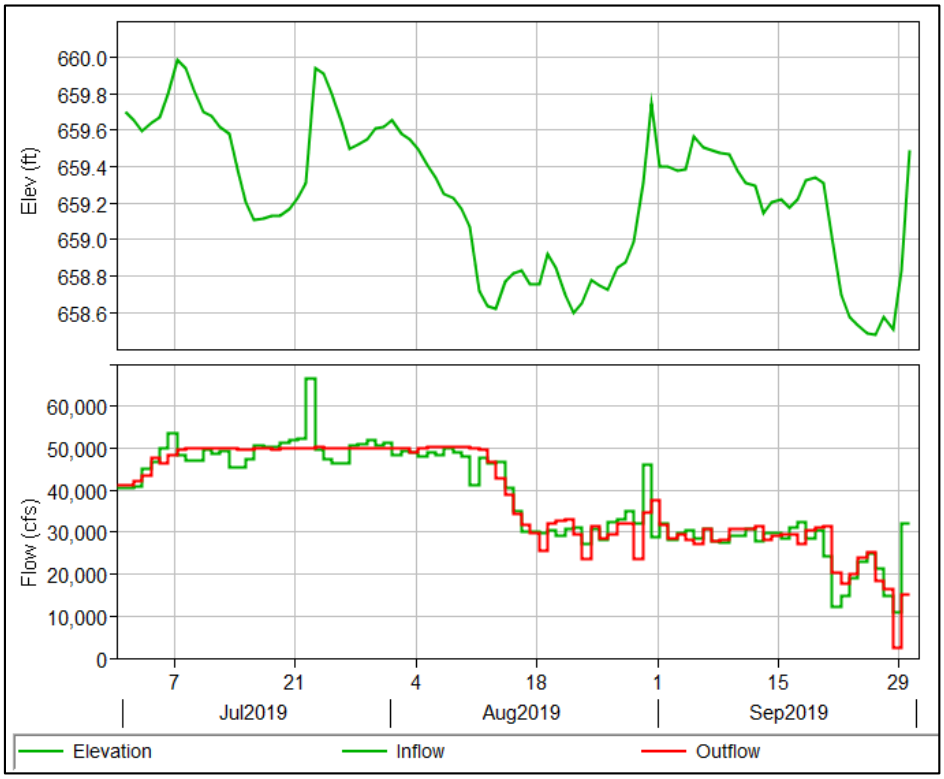


Figure 5f-34. Lake of the Ozarks (owned and operated by Ameren) July through September 2019 reservoir elevation, inflow, and outflow.

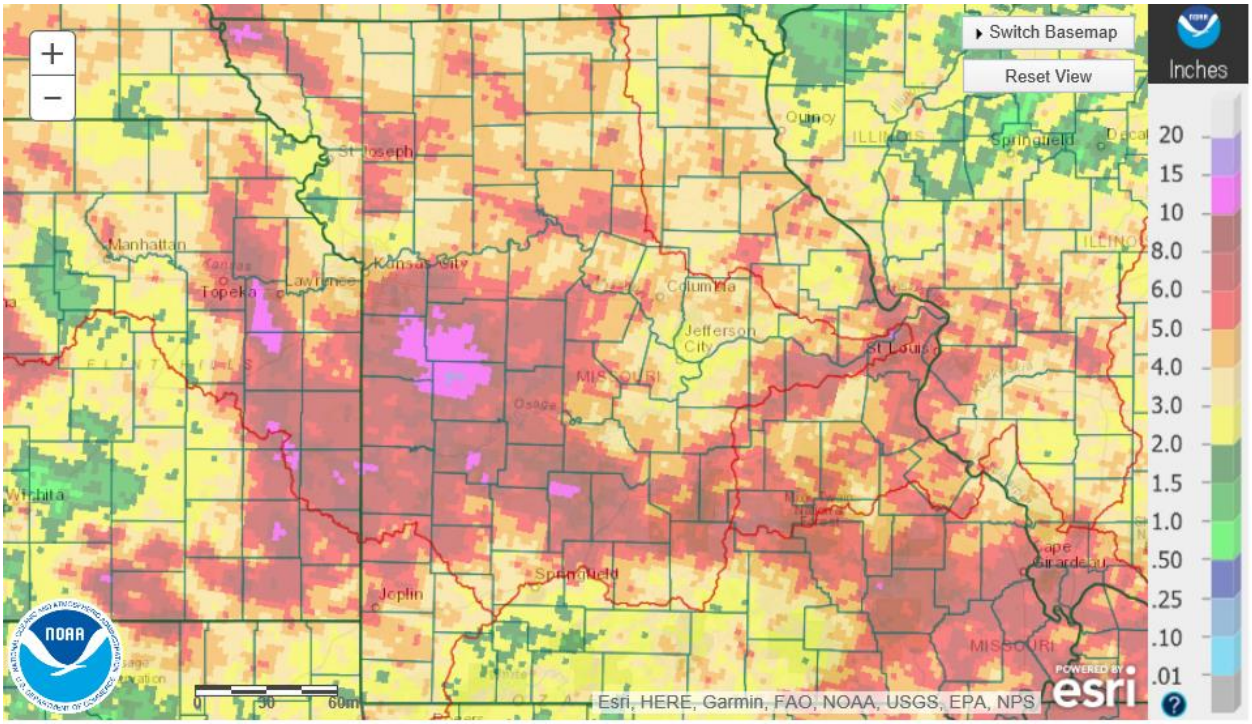


Figure 5f-35. July 2019 NOAA cumulative observed precipitation map.

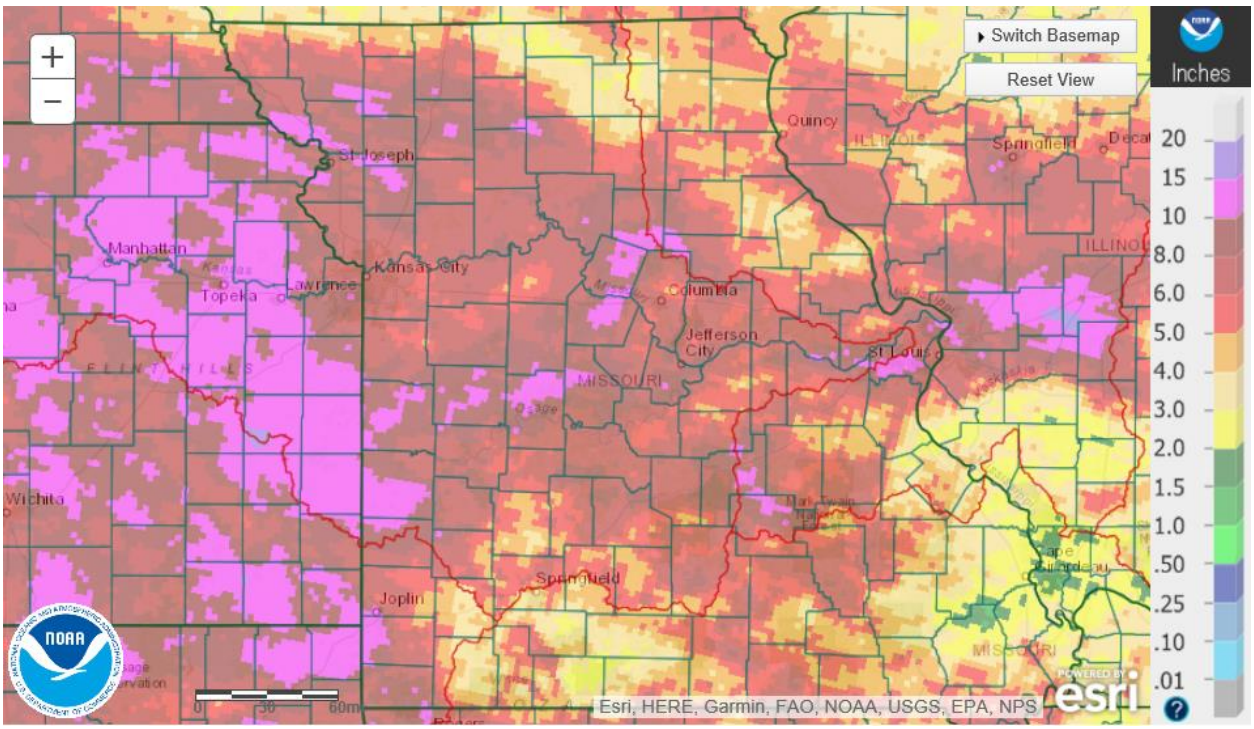


Figure 5f-36. August 2019 NOAA cumulative observed precipitation map.

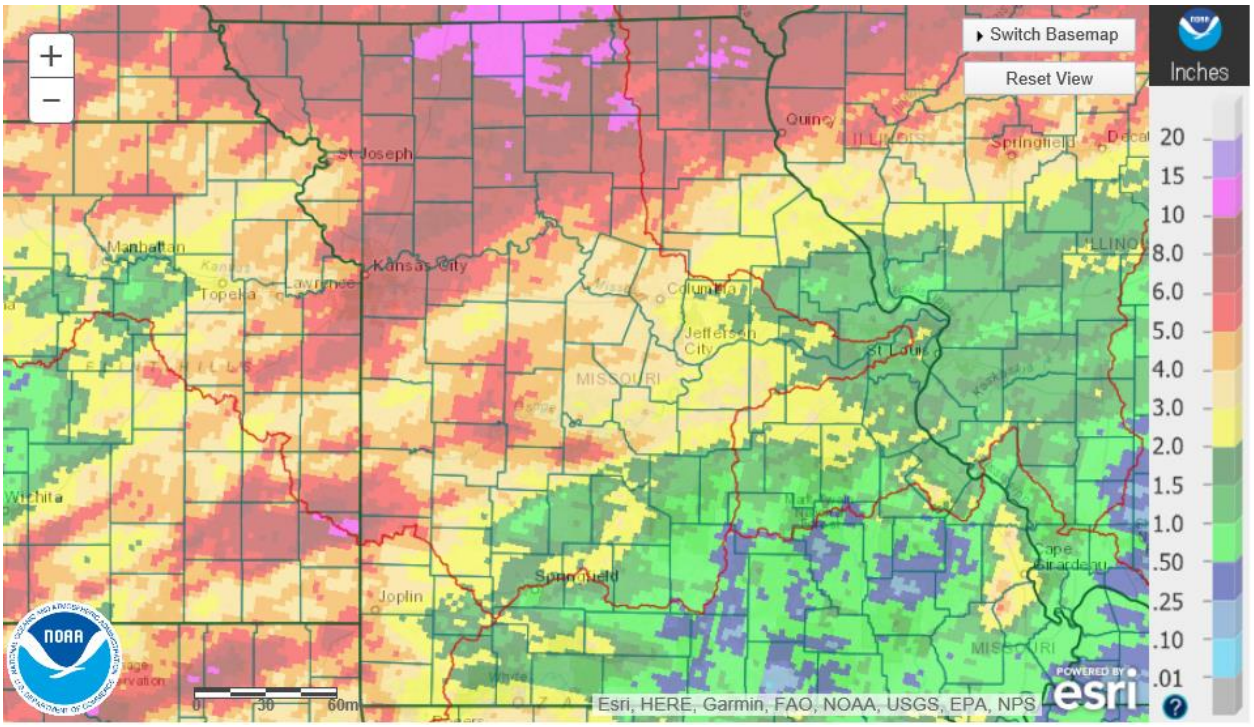


Figure 5f-37. September 2019 NOAA cumulative observed precipitation map.

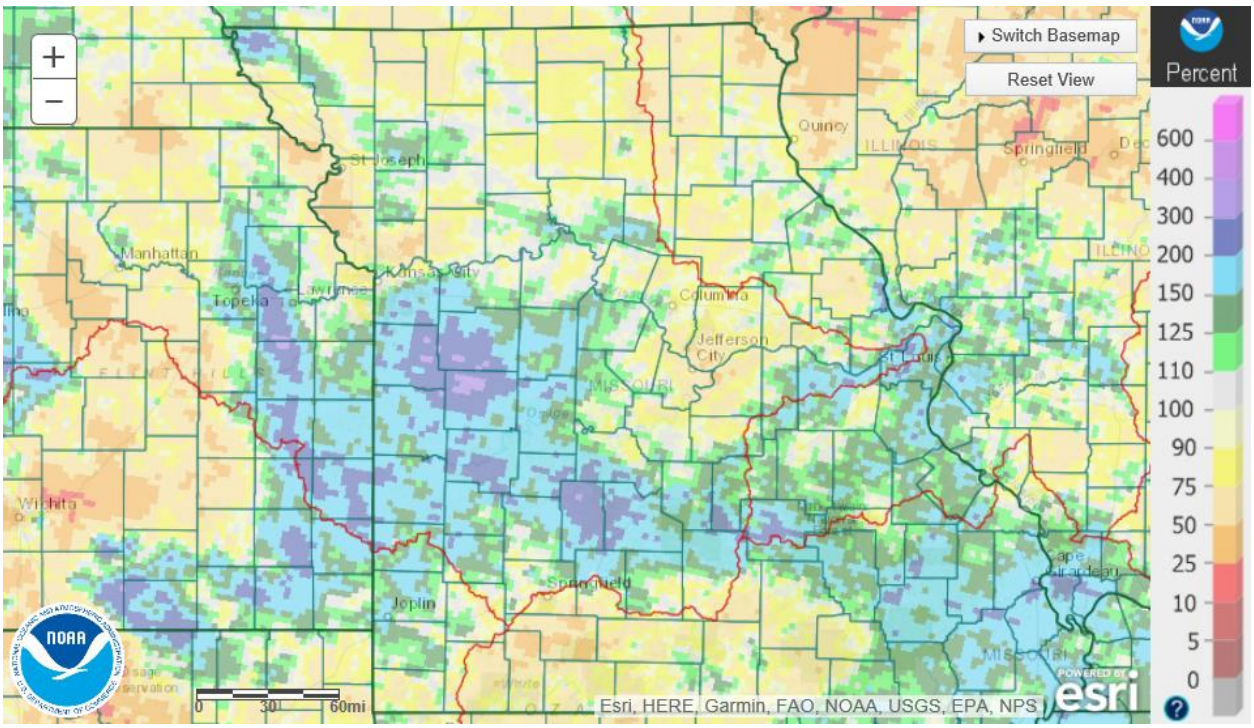


Figure 5f-38. July 2019 NOAA percent of normal precipitation map.

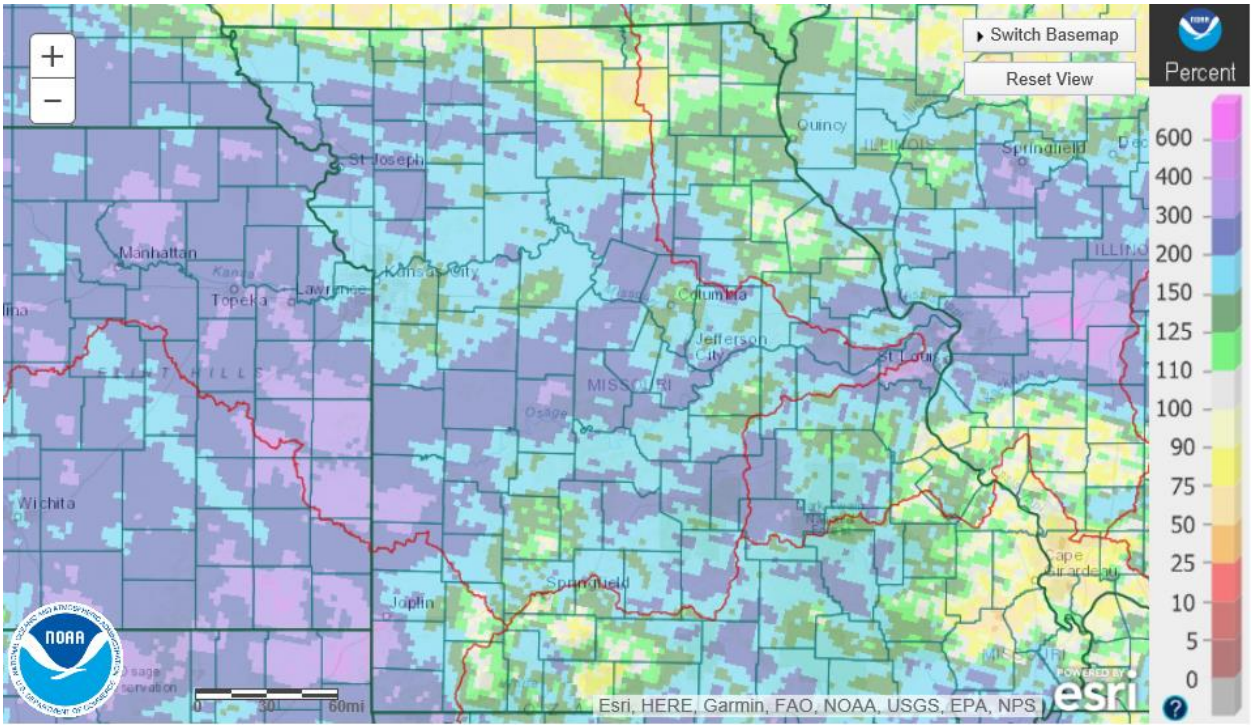


Figure 5f-39. August 2019 NOAA percent of normal precipitation map.

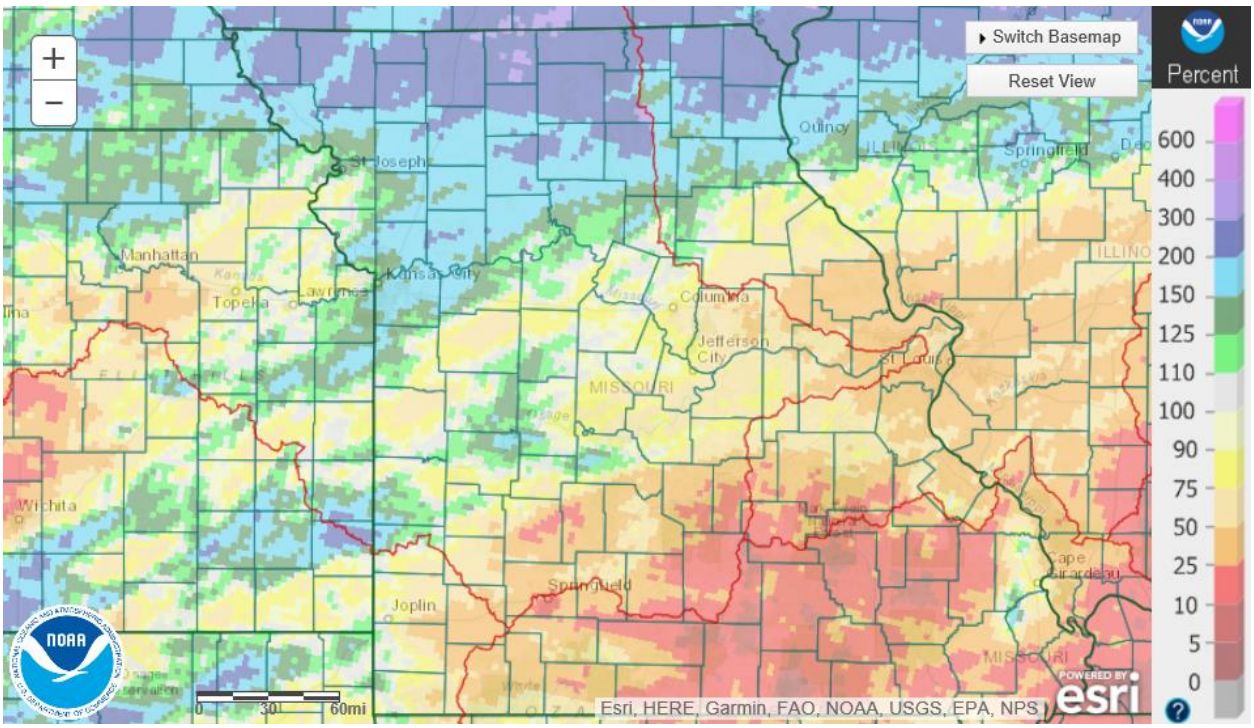


Figure 5f-40. September 2019 NOAA percent of normal precipitation map.

Precipitation across the basin in July ranged from slightly below to slightly above average. August precipitation was more uniformly average to slightly above average, while the basin experienced largely below average precipitation throughout September.

5.Winter (October, November, December)

Figure 41 through Figure 44 depict reservoir elevation, inflows and outflows for the four District projects still evacuating 2019 flood storage as of 01 October 2019 (Melvern, Pomona, Pomme de Terre, and Truman). As there were no extraordinary inflows to consider with regards to Ameren's Bagnell Dam, this period contains no graph reporting conditions on Lake of the Ozarks. Figure 45 through Figure 47 present monthly precipitation, but only as percent of monthly average.

By mid-October, Melvern and Pomona releases were reduced to pass inflows, stabilizing the pools at their respective, autumn, water level management plan target elevation. Pomme de Terre received inflow events throughout this period, and again accumulated water in flood control storage that carried over into the new calendar year. By early November, Truman had evacuated all accumulated 2019 flood control storage. With continued rains, wet soils, and moderate temperatures, modest amounts of additional water in flood control storage carried over into the new calendar year.

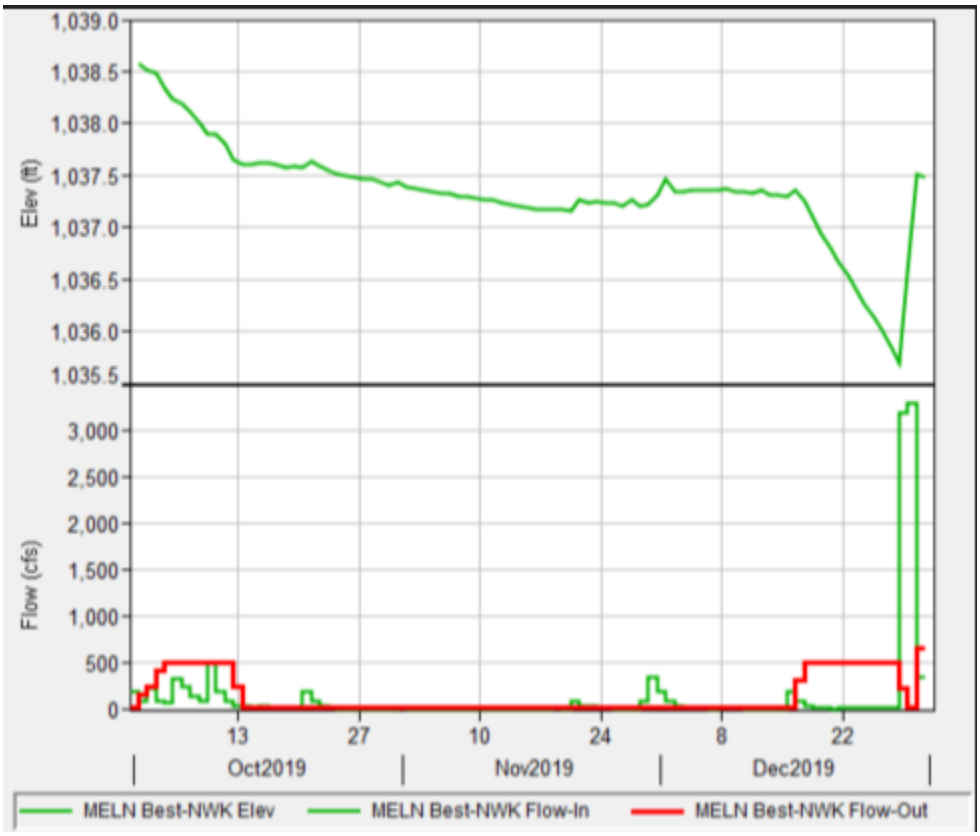


Figure 5f-41. Melvern October though December reservoir elevation, inflow and outflow

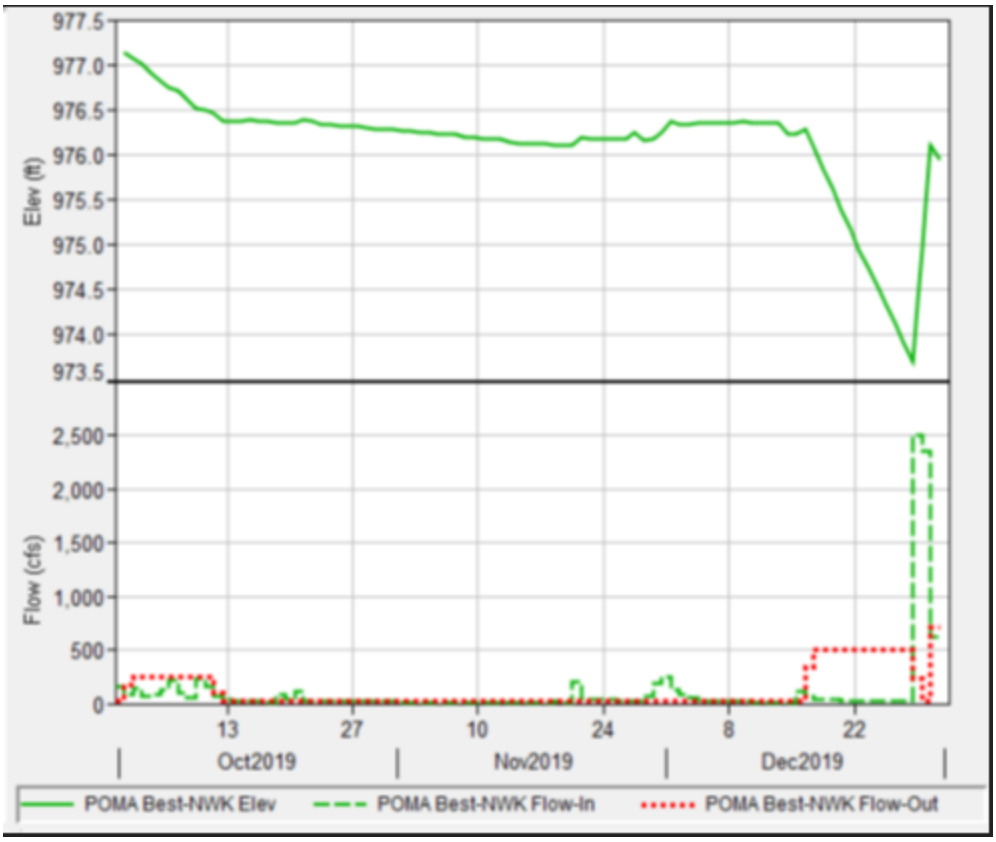


Figure 5f-42. Pomona October through December reservoir elevation, inflow and outflow

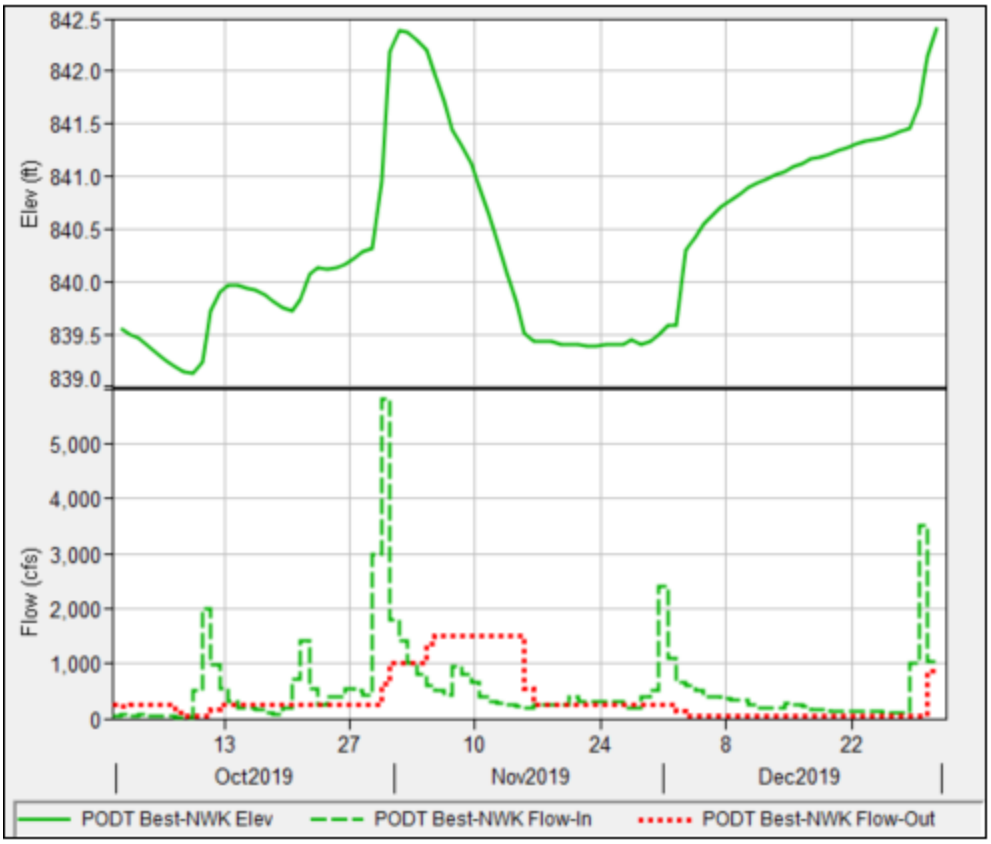


Figure 5f-43. Pomme de Terre October through December reservoir elevation, inflow and outflow

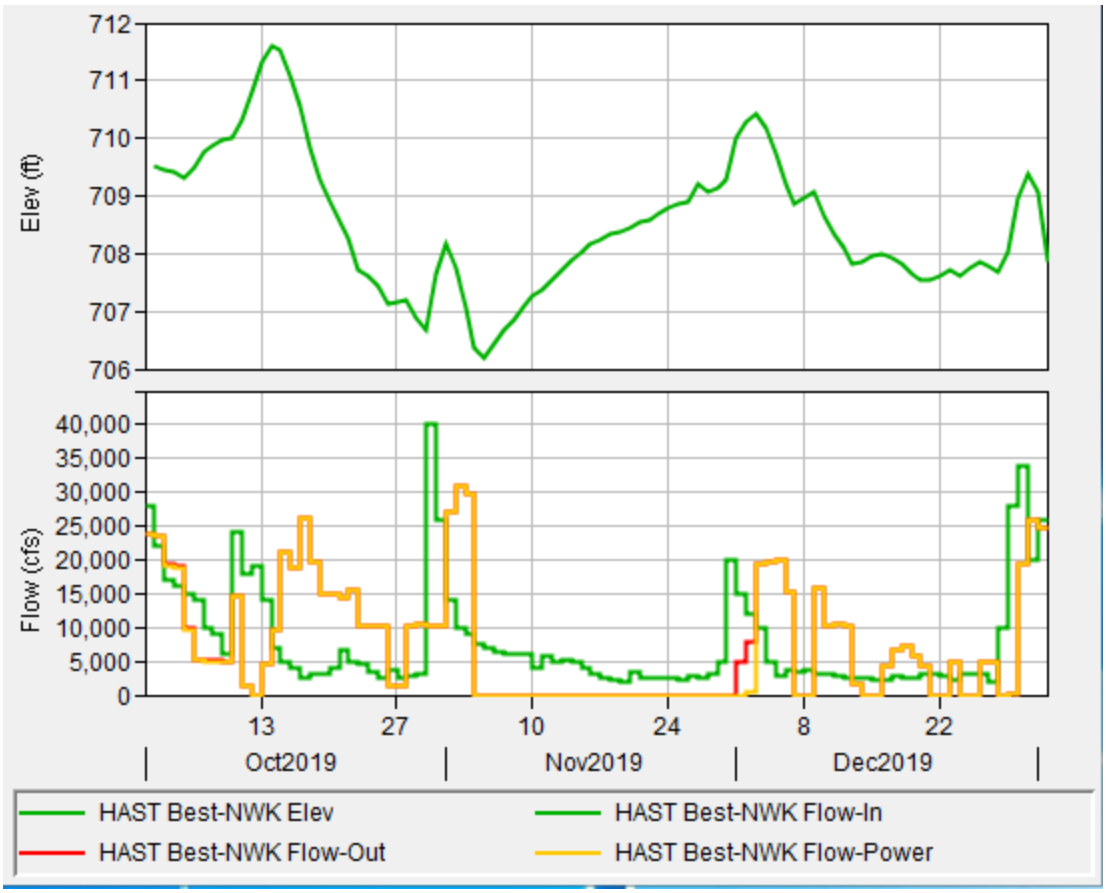


Figure 5f-44. Truman October through December reservoir elevation, inflow and outflow

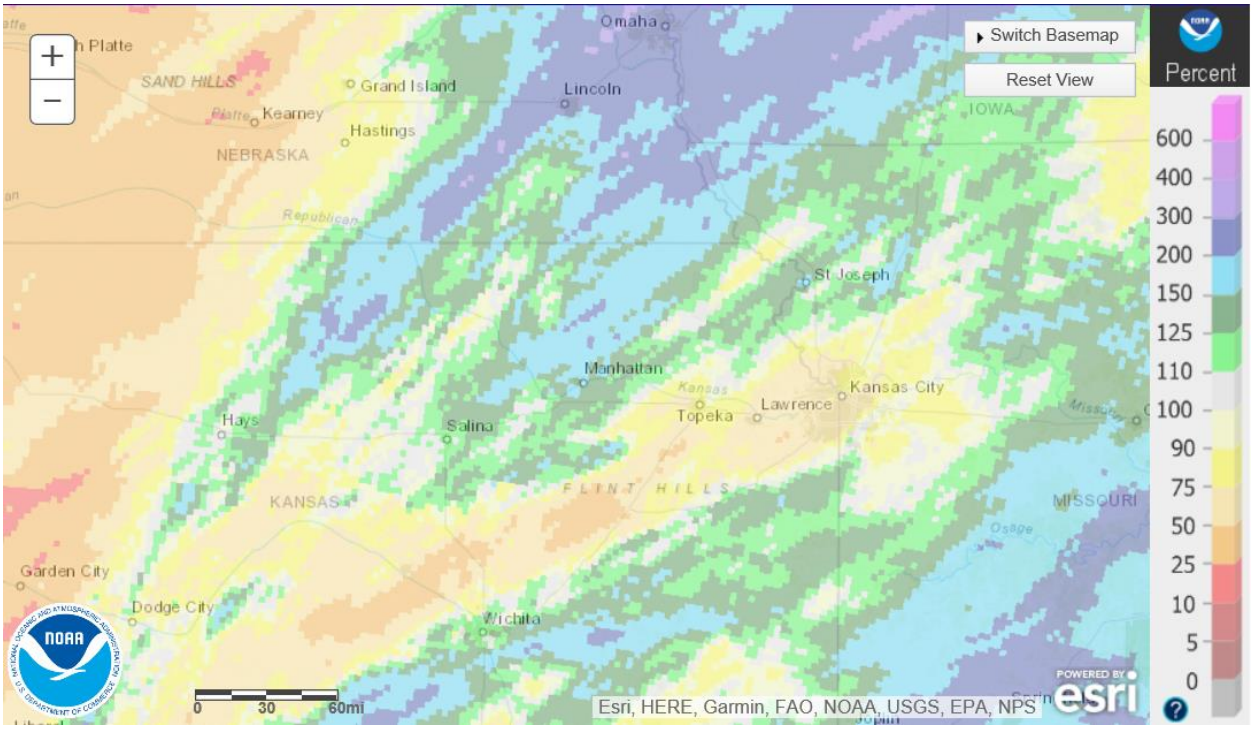


Figure 5f-45. October 2019 precipitation

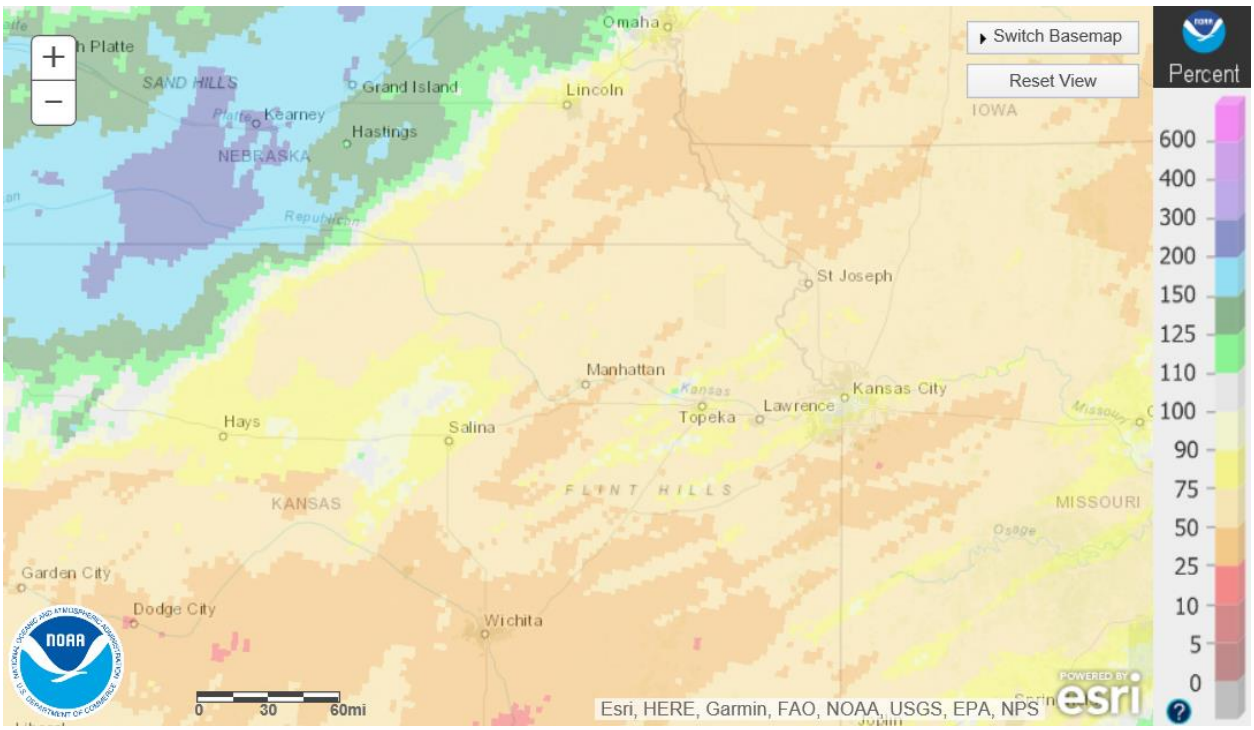


Figure 5f-46. November 2019 precipitation

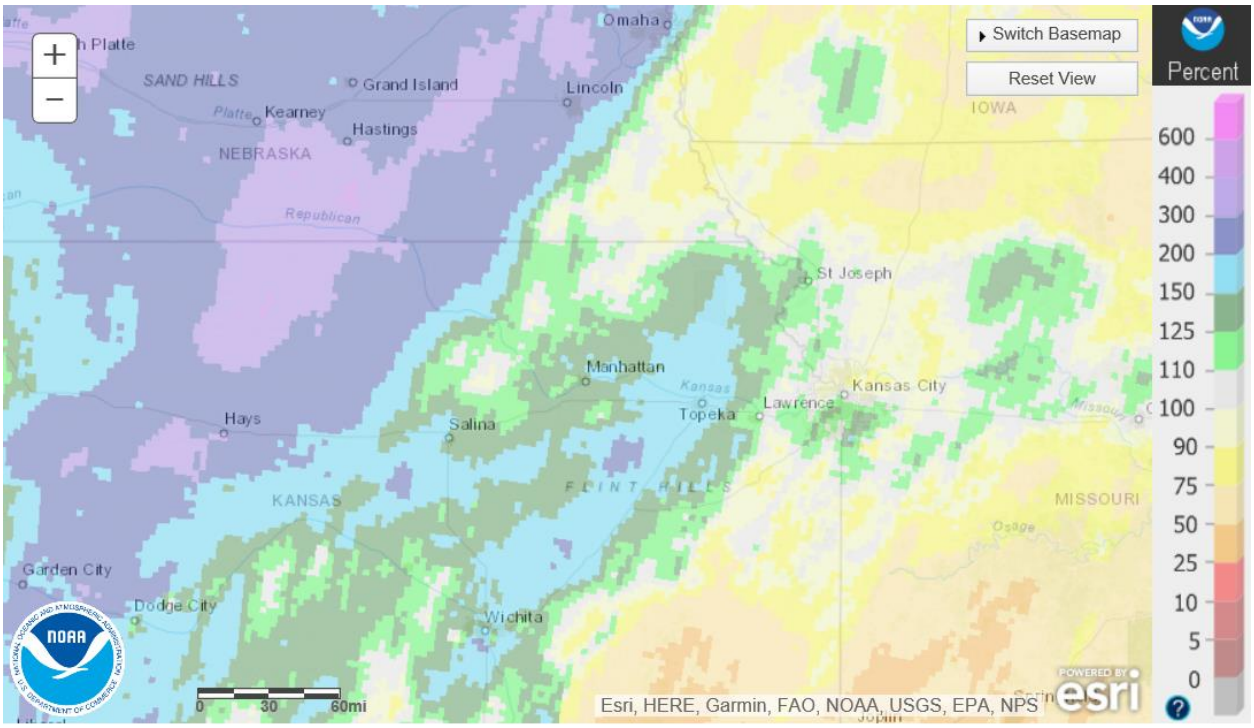


Figure 5f- 47. December 2019 precipitation

Other Reports

Plates 2A-E list project data showing the date impoundment of storage began, the date the multipurpose pool (the active conservation pool in USBR projects) first filled, and the current status of Standing Instructions for Regulation of Storage in Corps of Engineers Lakes.

6. HYDROLOGIC DATA COLLECTION.

The primary objectives of Kansas City District's hydrologic data program is to provide information on precipitation and stream flow characteristics occurring over and within a particular area for a given period of time. These data are used for many purposes, including the design, construction, and maintenance of a wide variety of structures in and along streams; the management of lake releases during floods; the production of hydropower; the design and maintenance of navigation facilities; the control of pollution; the management of flood plains; the development of recreational facilities; the design of highway bridges and culverts; the establishing and administering of water rights and compacts; and the resolving of political, social, and legal water problems. As with any program, however, the restraint on funds and manpower, and the usefulness of the data obtained will determine to what extent the program will, or should, be pursued at any particular point in time. The overall program of observing, monitoring, and collecting hydrologic and meteorological data in the District is quite extensive yet flexible to meet operational and economic needs. Brief descriptions of some types of data collection now being utilized are presented in the following paragraphs.

6a. Collection and Processing of Water Control Data.

Hydrologic data such as precipitation, stream flow, and lake information are collected in the Kansas City District by: individual observers, Corps project offices, the National Weather Service, the Geological Survey, the Bureau of Reclamation, and certain state agencies. Several different methods of communication are used in the Kansas City District to receive this data including: electronic transfer, e-mail, and telephone. The electronic transfer of data uses SFTP between agency computers and data transmitted through a satellite downlink and a Local Readout Ground Station (LRGS). Data received by the District is entered onto the Water Management Section's Corps Water Management System (CWMS) by both automated and manual methods, depending on the data source. CWMS and Software developed by Water Management Section staff provides a means to view, screen, and process the data for graphical and reporting purposes. The data is then uploaded to the MSC CWMS in Omaha. Daily data and project reports are also available to the public at the Section's web site,

http://www.nwk.usace.army.mil/locations/watermanagement.aspx.

6b. Automatic Remote Sensors.

Data Collection Platforms (DCP's) are the primary means by which Kansas City District obtains remote sensing data on stream stages and lake elevations. The DCP is a device that collects the information from a stage/elevation sensor and transmits the data to a GOES satellite for subsequent retrieval by the National Environmental Satellite, Data, and Information Service (NESDIS) at Wallops Island, Virginia. NESDIS then rebroadcasts all data over a single high-speed channel on a Domestic Communications Satellite (DOMSAT). The Water Management Section receives DCP data from NESDIS or directly from the DCP's with a DOMSAT receiver station. Maintenance of the DCP's is performed by the USGS under contract with the Corps of Engineers

6c. Cooperative Streamgaging Programs.

Constraints on funds and manpower do not allow the Corps to administer an independent data collection program that satisfies all of its needs. Therefore, assistance is sought from other cooperating agencies. A nationwide program of data collection at selected stream gauging stations has been administered for a number of years by the U.S. Geological Survey (USGS). Arrangements have also been made with the USGS through which they supplement their network of reporting stations, or increase the frequency of reports, to better satisfy Corps needs. The program, designated the "Cooperative Hydrologic Reporting Network," is administered by the USGS and supported by funds transferred from the Corps and by National Streamflow Information Program (NSIP) funds. Arrangements for the services provided are made with USGS data chiefs in each state and submitted annually to the Chief of Engineers, through the Division Commander and the Hydraulic Engineering Center, for review and approval.

The Cooperative Stream Gauging Program with the four U.S. Geological Survey districts (Kansas, Nebraska, Iowa, and Missouri) includes 93 stations. Kansas City District funding for this program during FY 2020 is $1,105,215, a 0.2% increase from FY 2019. Currently all gages are operated and maintained by USGS.

Fiscal year expenses for data collected in FY 2018 and FY 2019, and the programmed expenses for FY 2020 are shown in ***Table 6.1*** below.

Table 2.1: Data Collection Expenditures

State	FY 2018	FY 2019	FY 2020
Missouri	$573,320	$570,020	$574,470
Iowa	$99,450	$99,200	$96,920
Nebraska	$58,725	$59,425	$59,425
Kansas	$374,400	$374,400	$374,400
Total	$1,105,895	$1,103,045	$1,105,215

6d. Sediment Observations.

Revised elevation-storage and elevation-area curves were implemented on 01 January 2019 for Melvern and Pomme De Terre Reservoirs and made active in the water management database. The Melvern survey was conducted in 2017 and was a combination of bathymetry for the below water portion of the survey and LiDAR for the areas above the water surface. The Pomme de Terre survey was a combination of bathymetry (collected in June 2017) for the below water portion of the survey and LiDAR (collected in December 2017) for the areas above the water surface.

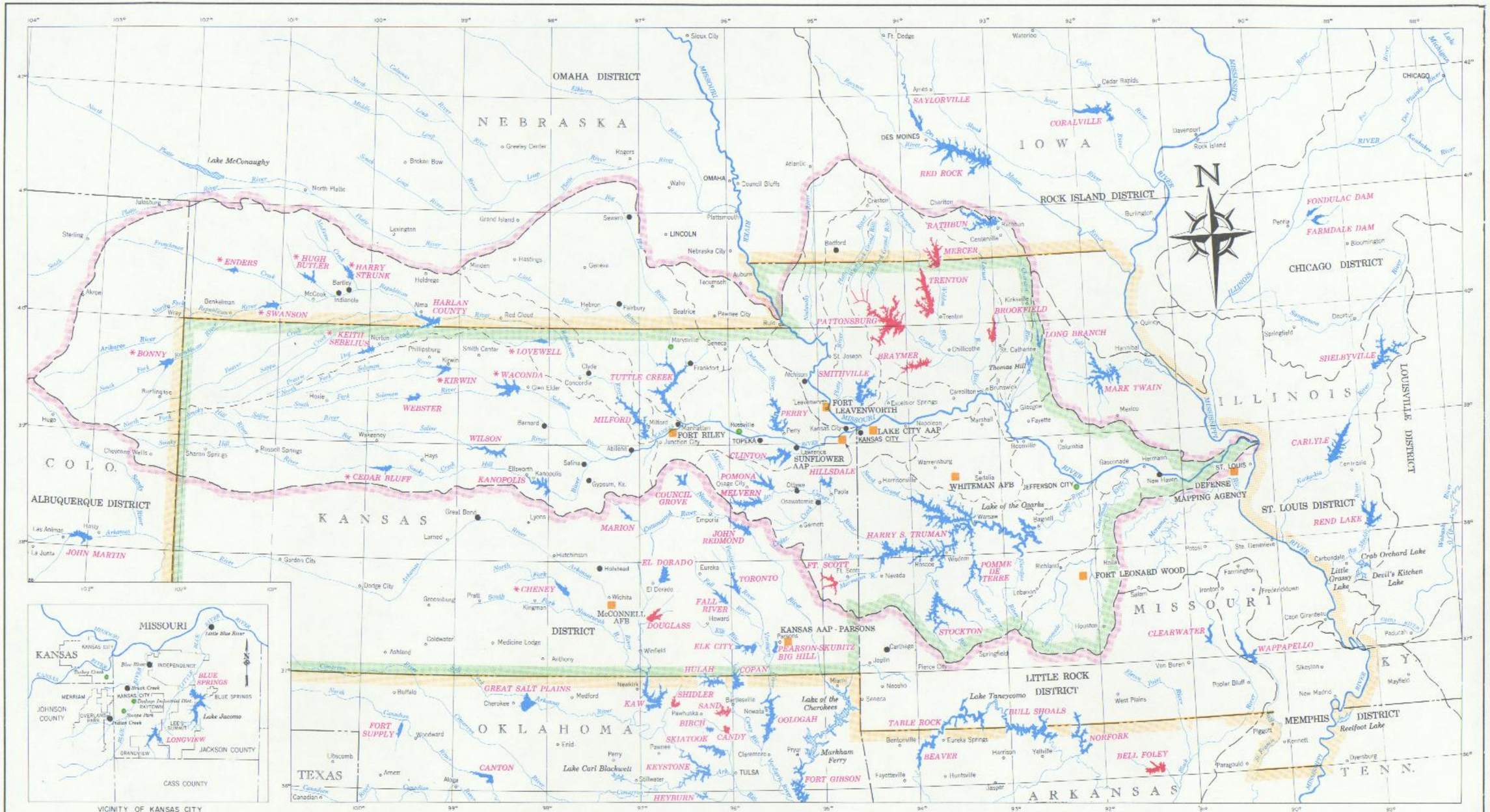
7. PERSONNEL AND FUNDING.

7a. Personnel.

Authorized positions of the Water Management Section at the close of the fiscal year (September 30, 2019) consisted of one Supervisory Hydraulic Engineer, three Hydraulic Engineers, and three Hydrologic Technicians. At the end of this reporting period, the Section had two vacant positions. A listing of personnel in the Section at the end of the report period by name and title is shown in ***Table 5***.

Table 7.1 : Water Management Section Personnel

Employee	Grade
Chris Purzer (1)	GS-13
Debbie Noble (4)	GS-11
Jerry Holtz (4)	GS-11
Steve Teachout (4)	GS-11
Brian Twombly (2)	GS-13
Paul Simon (2)	GS-12
Phanna Cea (2)	GS-11
Job Title	
(1) Supervisory Hydraulic Engineer	
(2) Hydraulic Engineer	
(3) Hydrologist	
(4) Hydrologic Technician	



DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT
CORPS OF ENGINEERS

FEBRUARY 1994
FILE NO. K-1-734

PLATE 1

SUBJECT	MELVERN LAKE	POMONA LAKE	HILLSDALE LAKE	STOCKTON LAKE	POMME DE TERRE LAKE	HARRY S. TRUMAN RESERVOIR
GENERAL						
Location of Dam	Near Melvern, KS	Near Pomona, KS	Near Paola, KS	Near Stockton, MO	Near Hermitage MO	Near Warsaw, MO
Stream / River	Marais des Cygnes River	110 Mile Creek	Big Bull Creek	Sac River	Pomme de Terre River	Osage River
Miles above Mouth	175.4	8.3	18.2	51.4	45.6	175.1
Contributing Drainage Area, square miles	349	322	144	1,160	611	8,914 (4)
Approximate Length of Full Reservoir, miles	22	12	15	24	28	122
Shoreline, miles (1)	101	52	51	298	113	958
Maximum Discharge of Record nr Dam Site	68,500 cfs (July 11, 1951)	38,600 cfs (July 11, 1951)	45,200 cfs (July 11, 1951)	120,000 cfs (May 19, 1943)	70,000 cfs (Aug 8, 1927)	259,000 cfs (May 17, 1943)
Date of Closure	October 2, 1970	July 19, 1962	June 15, 1980	September 23, 1968	June 28, 1960	July 21, 1977
Date Storage Began	August 1, 1972	October 18, 1963	September 19, 1981	December 12, 1969	October 29, 1961	February 7, 1979
Date Multipurpose Level Reached	April 4, 1975	June 5, 1965	February 23, 1985	December 18, 1971	June 15, 1963	November 29, 1979
Operating Agency	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers
DAM AND EMBANKMENT						
Top of Dam Elevation, feet msl	1,078.0	1,031.0	952.2	911.0 for concrete section 912.0 for embankment	906.0	756.0
Length of Dam, feet (net)	9,650	7,750	8,700 plus 3,300 dike	5,100 plus 5,600 dike	4,630 plus 2,790 dike	5,000 plus 7,500 dike
Damming Height, feet (2)	105	83	79	132	124	105
Type of Fill	Earth	Earth	Earth	Rock Shell	Earth	Earth
Fill Quantity, cubic yards	9,100,000	5,200,000	6,964,000	7,100,000	5,800,000	8,500,000
SPILLWAY						
Location	Left Abutment	Right Abutment	Right Abutment	Left Abutment	Right Abutment	Center of Dam
Crest Elevation, feet msl	1,057.0	1,006.0	935.0	861.5	874.0	692.3
Width, Feet	200	200	50	160	170	160
Number, Size, and Type of Gates	None	None	None	4 - 40'x30.5' Tainter	None	4 - 40'x47.3' Tainter
Discharge Capacity, Top of Surcharge Pool	36,000 cfs	50,300 cfs	4,750 cfs	182,500 cfs	73,000 cfs	284,000 cfs
RESERVOIR (3)						
Surcharge Pool Elevation and Area	1,073.0 ft msl 23,531 ac	1,025.4 ft msl 16,582 ac	948.0 ft msl 11,330 ac	906.2 ft msl 48,045 ac	900.2 ft msl 25,454 ac	751.1 ft msl 295,946 ac
Flood Control Pool Elevation and Area	1,057.0 ft msl 13,937 ac	1,003.0 ft msl 8,964 ac	931.0 ft msl 7,730 ac	892.0 ft msl 38,288 ac	874.0 ft msl 15,999 ac	739.6 ft msl 209,352 ac
Multipurpose Pool Elevation and Area	1,036.0 ft msl 6,930 ac	974.0 ft msl 3,941 ac	917.0 ft msl 4,827 ac	867.0 ft msl 24,777 ac	839.0 ft msl 7,790 ac	706.02 ft msl (5) 55,460 ac
Surcharge Storage, AF	1,073.0 - 1,057.0 296,468	1,025.4 - 1,003.0 276,552	948.0 - 931.0 161,672	906.2 - 892.0 612,149	900.2 - 874.0 535,798	751.1 - 739.6 2,907,938
Flood Control Storage, AF	1,057.0 - 1,036.0 208,126	1,003.0 - 974.0 183,942	931.0 - 917.0 86,504	892.0 - 867.0 789,886	874.0 - 839.0 391,489	739.6 - 706.02 4,008,231
Multipurpose Storage, AF	1,036.0 - 965.0 147,972	974.0 - 930.0 55,514	917.0 - 852.5 77,415	867.0 - 765.0 866,842	839.0 - 750.0 218,639	706.02 - 631.0 1,181,754
Gross Storage, AF	1,057.0 - 965.0 356,098	1,003.0 - 930.0 239,456	931.0 - 852.5 163,919	892.0 - 765.0 1,656,728	874.0 - 750.0 610,128	739.6 - 631.0 5,189,985
Design Sediment Reserve Storage	26,000 AF for 100 years	28,000 AF for 100 years	11,000 AF for 100 years	25,000 AF for 100 years	13,000 AF for 50 years	244,000 AF for 100 years
Measured Sediment Inflow	4,064 AF (1972 to 1985)	7,045 AF (1963 to 1989)	1,928 AF (1981 to 1993)	8,953 AF (1969 to 1987)	4,358 AF (1961 to 1974)	22,321 AF (1979 to 1992)
OUTLET WORKS						
Location	Right Abutment	Right Abutment	Left Abutment		Right Abutment	
River Outlet Type	Gated Horseshoe Conduit	Gated Horseshoe Conduit	Gated Oblong Conduit	None	Gated Tunnel	None
Number and Size of Conduit	1 - 11.5'	1 - 13.5'	1 - 15.92'x11.67'		1 - 14'	
Length of Conduit, feet	754	720.5	685		560	
Entrance Invert Elevation	962.0 ft msl	925.0 ft msl	868.0 ft msl		750.0 ft msl	
Discharge Capacity, Top of Surcharge Pool	6,700 cfs	9,200 cfs	8,200 cfs		12,750 cfs	
Discharge Cap, Top of Flood Control Pool	6,235 cfs	8,170 cfs	7,400 cfs		11,500 cfs	
Discharge Cap, Top of Multipurpose Pool	5,520 cfs	6,400 cfs	6,150 cfs		9,650 cfs	
Service Gates, Number and Size	2 - 6'x12'	2 - 6.5'x14'	2 - 5.33'x15.92'		2 - 6.5'x14'	
Emergency Gates, Number and Size	2 - 6'x12'	2 - 6.5'x14'	1 - 5.33'x15.92'		1 - 6.5'x14'	
Low Flow Gates, Number and Size	2 - 2'x2'	2 - 2'x2'	2 - 2'x2'	2 - 24" dia	1 - 24" Butterfly	
Provision for Power	None	None	None	3 - 20'x40'		12 - 17'x26.5'
POWER FACILITIES						
Generator Turbine Units, Number				1		6
Generator Name Plate Capacity, kw				45,200		160,000
Turbine Rating, hp				75,600 (56 ft head)		254,400
Turbine Type				Kaplan (Vertical Shaft)		Kaplan (Inclined Shaft)
Maximum (Full Pool) Head and Discharge				112 ft (6,300 cfs)		79.2 ft (31,800 cfs)
Avg (Power & MP Pool) Head, Discharge				85 ft (7,900 cfs)		42.5 ft (65,000 cfs)
Minimum Head and Discharge				62 ft (11,000 cfs)		41 ft (68,000 cfs)
Reversible Pump Turbines				None		6
Total Dynamic Head, feet						50
Discharge with 5 Units at Max Head, cfs						27,500
Maximum Power Required, hp						197,000
Maximum Drawdown, feet msl				845		704

REMARKS

(1) With pool at multipurpose level.
(2) Damming height is from the original riverbed to the top of the flood control pool.
(3) Based on latest available storage data. The revision dates of the current area - capacity tables are indicated below with the effective dates in parentheses:
Melvern, February 1986 (effective March 1, 1986)
Pomona, March 1990 (effective April 1, 1990)
Hillsdale, 1969 (initial)
Stockton, February 1988 (effective May 1, 1988)
Pomme de Terre, February 1985 (effective Mar 85)
Harry S. Truman, April 1993 (effective Mar 94)
(4) The total drainage area above Truman Dam is 11,500 square miles. The indicated total is the local drainage area below the upstream dams.
(5) In 1994, 1000 AF of flood control storage at Truman Reservoir was reallocated to water supply.
The top of the multipurpose pool was adjusted from 706.0 to 706.018

TOTALS	
420,888 ac	
294,270 ac	
103,725 ac	
4,790,577 AF	
5,668,178 AF	
2,548,136 AF	
8,216,314 AF	

ac = acres
AF = acre-feet
ft = feet
msl = elevation above mean sea level
cfs = cubic feet per second
kw = kilowatts
hp = horsepower

SUMMARY OF ENGINEERING DATA
OSAGE RIVER BASIN PROJECTS

U.S. Army Corps of Engineers
Kansas City District
December 2019

Plate 2A

SUBJECT	SMITHVILLE LAKE	LONGVIEW LAKE	BLUE SPRINGS LAKE	RATHBUN LAKE	LONG BRANCH LAKE
GENERAL					
Location of Dam	Near Smithville, MO	Kansas City, MO	Kansas City, MO	Near Rathbun, IA	Near Macon, MO
Stream / River	Little Platte River	Little Blue River	East Fork Little Blue River	Chariton River	East Fork Little Chariton River
Miles above Mouth	13.6	42.9	28.8	142.3	78
Contributing Drainage Area, square miles	213	50.3	32.8	549	109
Approximate Length of Full Reservoir, miles	18	3.5	2.5	14	9
Shoreline, miles (1)	175	24	12	155	24.2
Maximum Discharge of Record near Dam Site	76,600 cfs (July 20, 1965)	18,700 cfs (August 13, 1982)	11,000 cfs (August 13, 1982)	21,800 cfs (March 31, 1960)	30,000 cfs (April 21, 1973)
Date of Closure	July 13, 1976	June 16, 1983	August 12, 1986	September 29, 1967	September 3, 1976
Date Storage Began	October 19, 1979	September 16, 1985	September 27, 1988	November 21, 1969	August 2, 1978
Date Multipurpose Level Reached	June 11, 1982	September 23, 1986	March 18, 1990	October 10, 1970	May 19, 1981
Operating Agency	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers
DAM AND EMBANKMENT					
Top of Dam Elevation, feet msl	895.0	926.6	840.0	946.0	826.0
Length of Dam, feet (net)	4,000	1,900	2,500	10,600	3,550
Damming Height, feet (2)	80.2	110	70	82	71
Type of Fill	Rolled Earth	Earth	Earth and Rock	Rolled Earth	Rolled Earth
Fill Quantity, cubic yards	3,200,000	2,500,000	1,200,000	4,700,000	1,855,000
SPILLWAY					
Location	Right Abutment	Left Abutment	Left Abutment	Right Abutment	Right Abutment
Crest Elevation, feet msl	880.2	911.3	823.6	926.0	809.0
Width, feet	50	200	300	500	50
Number, Size, and Type of Gates	None	None	None	None	None
Discharge Capacity, Top of Surcharge Pool	4,800 cfs	22,970 cfs	37,800 cfs	45,600 cfs	9,860 cfs (4)
RESERVOIR (3)					
Surcharge Pool Elevation and Area	891.1 ft msl 14,614 ac	922.9 ft msl 3,207 ac	837.7 ft msl 1,200 ac	940.0 ft msl 31,135 ac	821.2 ft msl 6,610 ac (4)
Flood Control Pool Elevation and Area	876.2 ft msl 9,992 ac	909.0 ft msl 1,965 ac	820.3 ft msl 982 ac	926.0 ft msl 22,452 ac	801.0 ft msl 3,663 ac
Multipurpose Pool Elevation and Area	864.2 ft msl 7,113 ac	891.0 ft msl 927 ac	802.0 ft msl 722 ac	904.0 ft msl 10,427 ac	791.0 ft msl 2,429 ac
Recreation Pool Elevation and Area		870.0 ft msl 432 ac			
Surcharge Storage	891.1 - 876.2 179,253 AF	922.9 - 909.0 35,370 AF	837.7 - 820.3 19,535 AF	940.0 - 926.0 367,971 AF	821.2 - 801.0 101,959 AF (4)
Flood Control Storage	876.2 - 864.2 101,798 AF	909.0 - 891.0 24,810 AF	820.3 - 802.0 15,669 AF	926.0 - 904.0 349,455 AF	801.0 - 791.0 30,327 AF
Multipurpose Storage	864.2 - 810.0 141,772 AF	891.0 - 870.0 13,579 AF	802.0 - 760.0 10,888 AF	904.0 - 857.0 221,966 AF	791.0 - 750.0 34,189 AF
Recreation Storage		870.0 - 810.0 8,555 AF			
Gross Storage	876.2 - 810.0 243,570 AF	909.0 - 810.0 46,944 AF	820.3 - 760.0 26,557 AF	926.0 - 857.0 571,421 AF	801.0 - 750.0 64,516 AF
Design Sediment Reserve Storage	52,300 AF for 100 years	2,000 AF for 100 years	300 AF for 100 years	24,000 AF for 100 years	4,000 AF for 100 years
Measured Sediment Inflow	4,987 AF (1979 to 1993)	20 AF/year (estimated)	3 AF/year (estimated)	240 AF/year (estimated)	483 AF (1978 to 1988)
OUTLET WORKS					
Location	Right Abutment	Left Abutment	Right Abutment	Right Abutment	Right Abutment
River Outlet Type	Rectangular Conduit	Concrete Arch	Arch Conduit	Horseshoe Conduit	Concrete Arch
Number and Size of Conduit	1 - 8'x9'	1 - 5.5'x5'	1 - 3.5'x4.75'	1 - 11'	1 - 6'x5.5'
Length of Conduit, feet	696	916	485	539	450
Entrance Invert Elevation	805.0 ft msl	816.0 ft msl	768.5 ft msl	855.0 ft msl	760.0 ft msl
Drop Inlet Crest Elevation		891	802.0 ft msl		
Low Flow Gate Intake Elevation		875 - 861	791.5		
Discharge Cap, Top Flood Control Pool	3,150 cfs	1,200 cfs	570 cfs	5,160 cfs (5)	910 cfs
Discharge Cap, Top of Multipurpose Pool	2,940 cfs	0 (except low flow outlets)	0 (except low flow outlets)	4,220 cfs (5)	495 cfs
Service Gates, Number and Size	2 - 4.25'x9.25' Slide			2 - 6'x12' Slide	2 - 24" Slide
Emergency Gates, Number and Size	2 - 4.25'x9.25' Slide	1 - 6'x7'	1-4.5'x5'	2 - 6'x12' Slide	1 - 6'x6'
Low Flow Gates, Number, Size, Type		2 - 24" Knife Valves	1-2' Knife Valve		
Low Flow Gates, Number and Size	1 - 2'x2'	2 - 24" Knife Valves	1-2' Knife Valve	2 - 2' x2' Slide	1 - 18" Slide
Provision for Power	None	None	None	None	None
Provision for Water Supply	1 - 5.75' Pipe A portion of MP storage pumped from pool	None	None	No pipe outlets, water supply released to river	No pipe outlets, water supply pumped from pool.

REMARKS

(1) With pool at multipurpose level.
(2) Damming height is from original riverbed to top of flood pool.
(3) Based on latest available storage data. The revision dates of the current area capacity tables are indicated below with the effective dates in parentheses:
Smithville Lake, February 1990 (effective March 1, 1990)
Longview Lake, May 1970 (initial)
Blue Springs Lake, September 1974 (initial)
Rathbun Lake, January 2000 (effective December 1, 2000)
Long Branch Lake, January 1989 (effective October 1, 1989)
(4) Spillway flood routing at Long Branch Lake revised for Emergency Action Plan, dated 1981.
(5) Flows above 1,800 cfs result in overtopping of the outlet stilling basin walls

TOTALS
56,766 ac
39,054 ac
21,618 ac
432 ac
704,088 AF
522,059 AF
422,394 AF
8,555 AF
953,008 AF

ac = acres
AF = acre-feet
ft = feet
msl = elevation above mean sea level
cfs = cubic feet per second

SUMMARY OF ENGINEERING DATA
LOWER MISSOURI RIVER BASIN PROJECTS

U.S. Army Corps of Engineers
Kansas City District
December 2004

Plate 2B

SUBJECT	MILFORD LAKE	TUTTLE CREEK LAKE	PERRY LAKE	CLINTON LAKE	TOTALS
GENERAL					
Location of Dam	Near Junction City, KS	Near Manhatten, KS	Near Perry, KS	Near Lawrence, KS	
Stream / River	Republican River	Big Blue River	Delaware River	Wakanusa River	
Miles above Mouth	7.7	10	5.3	22.2	
Contributing Drainage Area, square miles	17,388 (4)	9,628	1,117	367	
Approximate Length of Full Reservoir, miles	30	50	20	17	
Shoreline, miles (1)	163	112	160	82	
Maximum Discharge of Record near Dam Site	171,000 cfs (June 3, 1935)	98,000 cfs (June 1951)	94,600 cfs (June 1951)	24,200 cfs (July 1951)	
Date of Closure	August 24, 1964	July 20, 1959	August 2, 1966	August 23, 1975	
Date Storage Began	January 16, 1967	March 7, 1962	January 15, 1969	November 30, 1977	
Date Multipurpose Level Reached	July 14, 1967	April 29, 1963	June 3, 1970	April 3, 1980	
Operating Agency	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	
DAM AND EMBANKMENT					
Top of Dam Elevation, feet msl	1,213.0	1,159.0	946.0	928.0	
Length of Dam, feet (net)	6,300	7,487	7,750	9,250	
Damming Height, feet (2)	110.2	134	95	114	
Type of Fill	Earth	Earth, Rock	Earth	Earth	
Fill Quantity, cubic yards	15,000,000	21,000,000	8,000,000	10,423,000	
SPILLWAY					
Location	Right Abutment	Left Abutment	Left Abutment	Left Abutment	
Crest Elevation, feet msl	1,176.2	1,116.0	922.0	907.4	
Width, feet	1,250	1,059	300	500	
Number, Size, and Type of Gates	None	18 - 40'x20' Tainter	None	None	
Discharge Capacity, Top of Surcharge Pool	560,000 cfs	579,000 cfs	65,000 cfs	44,200 cfs	
RESERVOIR (3)					
Surcharge Pool Elevation and Area	1,208.2 ft msl 62,343 ac	1,151.4 ft msl 70,030 ac	941.2 ft msl 43,255 ac	921.4 ft msl 18,198 ac	193,826 ac
Flood Control Pool Elevation and Area	1,176.2 ft msl 33,170 ac	1,136.0 ft msl 53,050 ac	920.6 ft msl 25,746 ac	903.4 ft msl 13,688 ac	125,654 ac
Multipurpose Pool Elevation and Area	1,144.4 ft msl 15,498 ac	1,075.0 ft msl 12,617 ac	891.5 ft msl 10,227 ac	875.5 ft msl 7,205 ac	45,547 ac
Surcharge Storage	1,208.2 - 1,176.2 1,475,913 AF	1,151.4 - 1,136.0 959,939 AF	941.2 - 920.6 695,362 AF	921.4 - 903.4 286,875 AF	3,418,089 AF
Flood Control Storage	1,176.2 - 1,144.4 757,874 AF	1,136.0 - 1,075.0 1,884,312 AF	920.6 - 891.5 515,520 AF	903.4 - 875.5 292,496 AF	3,450,202 AF
Multipurpose Storage	1,144.4 - 1,080.0 373,152 AF	1,075.0 - 1,020.0 257,014 AF	891.5 - 835.0 200,004 AF	875.5 - 828.0 118,699 AF	948,869AF
Gross Storage	1,176.2 - 1,080.0 1,131,026 AF	1,136.0 - 1,020.0 2,141,326 AF	920.6 - 835.0 715,524 AF	903.4 - 828.0 411,195 AF	4,399,071 AF
Design Sediment Reserve Storage	160,000 AF for 100 years	240,312 AF for 50 years	140,000 AF for 100 years	28,500 AF for 100 years	
Measured Sediment Inflow	47,935 AF (1967 to 1994)	216,145 AF (1962 to 2000)	49,057 AF (1969 to 1993)	3,421 AF (1977 to 1991)	
OUTLET WORKS					
Location	Right Abutment	Right Abutment	Near Center of Dam	Left Abutment	
River Outlet Type	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	
Number and Size of Conduit	1 - 21'	2 - 20'	1 - 23.5'	1 - 12.5'x13' Arch	
Length of Conduit, feet	615.5	860	592	710	
Entrance Invert Elevation	1,080.0 ft msl	1,003.0 ft msl	833.0 ft msl	828.0 ft msl	
Gated Sluice, Number and Size	None	None	None	None	
Discharge Cap, Top of Flood Control Pool	23,100 cfs	45,900 cfs	27,500 cfs	7,570 cfs	
Discharge Cap, Top of Multipurpose Pool	18,600 cfs	31,300 cfs	21,200 cfs	5,900 cfs	
Service Gates, Number and Size	2 - 10.5'x21'	4 - 10'x20'	2 - 11.75'x23.5'	2 - 6.33'x12.67'	
Emergency Gates, Number and Size	2 - 10.5'x21'	1 - 10'x20'	2 - 11.75'x23.5'	1 - 6.33'x12.67'	
Low Flow Gates, Number and Size	2 - 2'x2'	2 - 24" Butterfly Valve	2 - 2'x2'	1 - 24" Knife Gate Value	
Water Supply Gate, Number and Size	None	None	None	1 - 54"x54" Slide Gate	
Provision for Irrigation	None	None	None	None	
Provision for Power	None	None	None	None	
Provision for Water Supply	No pipe outlets, water supply released to river	No pipe outlets, water supply released to river	No pipe outlets, water supply released to river	36" Steel Pipe	

REMARKS

(1) With pool at multipurpose level.
(2) Damming height is from the original riverbed to the top of the flood control pool.
(3) Based on latest available storage data. The revision dates of the current area - capacity tables are indicated below with the effective dates in parentheses:
Milford Lake, March 1982 (effective March 10, 1982)
Tuttle Creek Lake, October 2000 (effective February 1, 2001)
Perry Lake, May 1990 (effective June 1, 1990)
Clinton Lake, December 1991 (effective March 1, 1994)
(4) Total drainage area above Milford is 38,621 square miles. The indicated total is the local drainage area below Harlan County Dam.

ac = acres
AF = acre-feet
ft = feet
msl = elevation above mean sea level
cfs = cubic feet per second

SUMMARY OF ENGINEERING DATA
LOWER KANSAS RIVER BASIN PROJECTS

U.S. Army Corps of Engineers
Kansas City District
December 2004

Plate 2C

SUBJECT	BONNY RESERVOIR	SWANSON LAKE	ENDERS RESERVOIR	HUGH BUTLER LAKE	HARRY STRUNK LAKE	KEITH SEBELIUS LAKE (Norton Dam)	HARLAN COUNTY LAKE	LOVEWELL RESERVOIR	REMARKS
GENERAL									(1) With pool at MP level.
Location of Dam	Near Hale, CO	Near Trenten, NE	Near Enders, NE	Near McCook, NE	Near Cambridge, NE	Near Norton, KS	Nr Republican City, NE	Near Lovewell, KS	(2) Damming height is
Stream / River	S. Fk Republican River	Republican River	Frenchman Creek	Red Willow Creek	Medicine Creek	Prairie Dog Creek	Republican River	White Rock Creek	from original riverbed to
Miles above Mouth	60.4	359	81.7	18.7	11.9	74.9	232.3	19.3	top of flood control pool.
Contributing Drainage Area, sq mi	1,435	2,506 below Bonny	786	310	642	688	7,169 below u/s dams (5)	358	(3) Based on latest storage
Approx Length of Full Resv, miles	5.5	9.0	6.0	7.5	8.5	9.5	17	11	data. Date of current area
Shoreline, miles (1)	15.0	30	26	35	29	32	54	44	capacity tables given below
Max. Disch. of Record nr Dam Site	103,000 (May 31, 1935)	200,000 (May 31, 1935)	Insufficient Data	30,000 (June 22, 1947)	120,000 (June 1947)	37,500 (May 28, 1953)	260,000 (June 1, 1935)	23,300 (July 10, 1950)	with effective date in ( ).
Date of Closure	July 6, 1950	May 4, 1953	October 23, 1950	September 5, 1961	August 8, 1949	January 28, 1964	July 22, 1951	May 29, 1957	Bonny, Mar 51 (initial)
Date Storage Began	July 6, 1950	May 4, 1953	October 23, 1950	September 5, 1961	August 8, 1949	October 5, 1964	November 14, 1952	October 2, 1957	Swanson, Feb 84 (Jan 84)
Date Multipurpose Level Reached	March 19, 1954	May 15, 1957	January 29, 1952	May 21, 1967	April 2, 1951	June 21, 1967	June 14, 1957	May 20, 1958	Enders, May 97 (Jan 1, 99)
Operating Agency	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Corps of Engineers	Bureau of Reclamation	Butler, May 97 (Jan 1, 99)
DAM AND EMBANKMENT									Strunk, Oct 82 (Feb 1, 83)
Top of Dam Elevation, feet msl	3,742.0	2,793.0	3,137.5	2,634.0	2,415.0	2,347.0	1,982.0	1,616.0	Sebelius, Sep 00 (Jan 02)
Length of Dam, feet (Less Spillway)	9,141.5	8,600	2,242	3,159	5,665	6,344	11,830	8,392	Harlan, Jan 01 (Jan 1, 01)
Damming Height, feet (2)	93.0	80.0	93.0	About 85	86	85.5	98.5	70.3	Lovewell, Jun 95 (Jan 97)
Type of Fill	Earth	Earth	Earth	Earth	Earth	Earth	Earth	Earth	(4) Bartley Div Dam, Rep
Fill Quantity, cubic yards	8,853,000	8,130,000	1,950,000	3,122,000	2,730,000	3,740,000	13,400,000	3,000,000	R. below Red Willow Ck,
SPILLWAY									conc ogee weir w/2-10x16
Location	Left Abutment	Left Abutment	Right Abutment	Right Abutment	Left Abutment	Right Abutment	Center of Dam	Right Abutment	gates to rivr, 2-10'x3' gates
Crest Elevation, feet msl	3,710.0	2,743.0	3,097.0	2,604.9	2,386.2 (see also below)	2,296.0	1,943.5	1,575.3	to canal, max cap 130 cfs.
Width, feet	121.5	142	361	31.5 (circ morning glory)	229	106	856	53	Franklin pumps on Rep R.
Number, Size, and Type of Gates	None (see notes below)	3 - 42' x 30' Radial	6 - 50' x 30' Radial	None	None	3 - 30'x36.35' Radial	18 - 40'x30' Radial	2 - 25'x20' Radial	blw Harlan Cty, cap 40 cfs.
Disch. Cap. Top of Surcharge Pool	73,300 cfs (with sluice)	126,000 cfs	202,000 cfs (with notch)	4,910 cfs	99,000 cfs (with notch)	96,000 cfs	480,000 cfs	35,000 cfs	Courtland Div Dam, Rep R
RESERVOIR (3)									**TOTALS**
Surcharge Pool Elev (ft msl), Area	3,736.2 8,579 ac	2,785.0 10,035 ac	3,129.5 ft msl 2,567 ac	2,628.0 ft msl 4,079 ac	2,408.9 ft msl 5,784 ac	2,341.0 ft msl 6,713 ac	1,975.5 ft msl 24,339 ac	1,610.3 ft msl 7,635 ac	69,731 ac
Flood Cntrl Pool Elev (ft msl), Area	3,710.0 5,036 ac	2,773.0 7,940 ac	3,127.0 ft msl 2,405 ac	2,604.9 ft msl 2,681 ac	2,386.2 ft msl 3,483 ac	2,331.4 ft msl 5,316 ac	1,973.5 ft msl 23,431 ac	1,595.3 ft msl 5,024 ac	55,316 ac
MP, or Top Cons Pool Elev, Area	3,672.0 2,042 ac	2,752.0 4,952 ac	3,112.3 ft msl 1,707 ac	2,581.8 ft msl 1,621 ac	2,366.1 ft msl 1,840 ac	2,304.3 ft msl 2,181 ac	1,945.73 msl 13,305 ac	1,582.6 ft msl 2,988 ac	30,636 ac
Inactive Pool Elev (ft msl), Area	3,638.0 331 ac	2,720.0 1,455 ac	3,082.4 ft msl 627 ac	2,558.0 ft msl 715 ac	2,343.0 ft msl 680 ac	2,280.4 ft msl 575 ac	1,932.5 ft msl 9,282 ac	1,571.7 ft msl 1,495 ac	15,160 ac
Dead Stor Pool Elev (ft msl), Area	3,635.5 242 ac	2,710.0 396 ac	3,080.0 ft msl 567 ac	2,552.0 ft msl 536 ac	2,335.0 ft msl 444 ac	2,275.0 ft msl 317 ac	1,885.0 ft msl 0 ac	1,562.07 ft msl 494 ac	2,996 ac
Surcharge Storage, AF	3,736.2 - 3,710 178,259	2,785 - 2,773 107,610	3,129.5 - 3,127 6,230	2,628.0 - 2,604.9 76,806	2,408.9 - 2,386.2 105665	2,341.0 - 2,331.4 58,287	1,975.5 - 1,973.5 47,767	1,610.3 - 1,595.3 94,104	674,728 AF
Flood Control Storage, AF	3,710.0 - 3,672 128,820	2,773 - 2,752 134,006	3,127.0 - 3,112.3 30,029	2,604.9 - 2,581.8 48,862	2,386.2-2,366.1 52,724	2,331.4 - 2,304.3 99,231	1,973.5 - 45.73 500,000	1,595.3 - 1,582.6 50,458	1,044,130 AF
MP, or Active Conserv Storage, AF	3,672.0 - 3,638 39,206	2,752 - 2,720 99,855	3,112.3 - 3,082.4 33,981	2,581.8 - 2,558 27,310	2,366.1 - 2,343 26,757	2,304.3 - 2,280.4 30,516	1,945.73 - 32.5 150,000	1,582.6 - 1,571.7 24,070	431,695 AF
Inactive Storage, AF	3,638.0 - 3,635.5 716	2,720 - 2,710 10,312	3,082.4 - 3,080 1,432	2,558.0 - 2,552 3,736	2,343.0 - 2,335 4,489	2,280.4 - 2,275 2,357	1,932.5 - 1,890 164,111	1,571.7 - 1,562.07 9,985	197,138 AF
Dead Storage, AF	3,635.5 - 3,617 1,418	2,710 - 2,701 2,118	3,080.0 - 3,050 7,516	2,552.0 - 2,527 5,185	2,335.0 - 2,318.5 3,408	2,275.0 - 2,262 1,636	Sluice crest at 1,885 0	1,562.07 - 1,550.0 1,659	23,692 AF
Gross Storage, AF	3,710.0 - 3,617 170,160	2,773 - 2,701 246,291	3,127.0 - 3,050 72,958	2,604.9 - 2,527 85,086	2,386.2 - 2,318.5 87,378	2,331.4 - 2,262 133,740	1,973.5 - 1,890 814,111	1,595.3 - 1,550.0 86,172	1,695,896 AF
Design Sediment Reserve Storage	8,000 AF for 50 years	51,000 AF for 50 years	4,000 AF for 100 years	10,000 AF for 50 years	15,000 AF for 50 years	6,000 AF for 50 years	200,000 AF for 100 yrs	8,000 AF for 50 years	
Measured Sediment Inflow	160 AF/year (estimated)	7,659 AF (1953 to 1982)	1,572 AF (1950 to 1997)	1,616AF (1961 to 1997)	4,397 AF (1949 to 1981)	1,617 AF (1964 to 2000)	38,548 AF (1952 - 00)	6,021 AF (1957 to 1995)	
OUTLET WORKS									at Guide Rock, conc ogee
Location	Left Abutment	Left Abutment	Right Abutment	Right Abutment	Right Abutment	Left Abutment	Center of Dam	Right Abutment	w/2-20'x12' gates to river
River Outlet Type	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	Gated Sluices	Spillway gates used for	5-10'x6' gates to Courtland
Number and Size of Conduit	1 – 56" Cond to 26" Pipe	2 - 6' x 7.5'	1 - 84" Cond to 84"Pipe	1 - 82"	1 – 84" Cond to 44" Pipe	1 – 48" Cond to 38" Pipe	9 - 5'x8' thru Spillway	river releases. Gated	canal (cap 751 cfs), 1-10x6
Length of Conduit, feet	831.5	86.74	516	553.5	553	495 to Gate, 145 to Basin		wasteway with 1-10'x9'	gate to Superior (cap 139).
Entrance Crest Elevation	3,635.5 ft msl	2,710.0 ft msl	3,080.0 ft msl	2,552.0 ft msl	2,335.0 ft msl	2,275.0 ft msl	1,885.0 ft msl	radial gate from outlet	Other private diversion
Disch Cap, Top of Flood Cntrl Pool	140 cfs (approx)	4,300 cfs	1,430 cfs	1,170 cfs	398 cfs (max elev 2,379)	312 cfs	20,700 cfs	canal to stilling basin.	weirs exist on some creeks
Disch Cap, Top of MP (Consv) Pool	103 cfs	3,500 cfs	1,300 cfs	990 cfs	361 cfs	257 cfs	17,370 cfs	Wasteway is not used.	like Riverside blw Enders
Service Gates, Number, Size, Type	1 - 24" Hollow Jet Valve	2 - 6' x 7.5' Slide Gates	2-60" Hollow Jet Valves	2 - 42" Slide Gates	1 - 39" Slide Gate	1 - 33" Slide Gate	9 - 5' x 8' Slide Gates	None	but div capacity minimal.
Provision for Irrigation	1 - 32" Pipe to 24" Valve	1 - 56" Pipe to 4' Gate	None	None	None	None	1-5.5'; 1-2.83' Conduits	1 - 8'x10' Gated Outlet	(5) 13,536 sq mi total
Provision for Power	None	None	None	None	None	None	12'x12' Plug for 9' Cond	None	contributing with u/s dams.
Provision for Municipal Supply	None	None	None	None	None	1 - 16" Pipe to 16" Gate	None	None	ac = acres ft = feet
Other Outlet	1 - 40" Capped Conduit	None	None	None	None	None	1-18" outlet for low flow	Note: Inflow to lake also	AF = acre-feet
							regulation in mono 20.	provided from gated	cfs = cubic feet per sec
	Notes: Spillway also has	Notes: Irrigation outlet	Notes: Spillway has	Note: Concrete ogee weir	Notes: Spillway also has	Notes: Concrete ogee	Franklin Canal conduit to	Courtland Canal outlet.	msl = elev abv mean sea lvl
	16.5'x21.5' sluice, with	in right abutment.	an uncontrolled notch w/	diversion dam 13 miles	an uncontrolled notch w/	weir diversion dam 17.6	2-36" gates, cap 520 cfs.		
	1 - 16.5' x 10.75' gate,		crest elevation at 3112.3.	downstream, w/ 1-6'x18'	crest elevation at 2366.1.	miles downstream, with	Naponee Canal conduit		
	crest elev 3,672.0. The		Concrete ogee weir	radial gate to river, and	Concrete ogee weir div-	1 – 6'x18' radial gate to	to 1-24" valve, cap 40		
	56" gated outlet conduit		diversion dam 52 miles	2 - 5'x4' regulating gates	erosion dam at mile	river, 2 – 6'x5' gates to	cfs. See also note (4)		
					301.6				
	feeds all three gated sub		d/s, w/ 2-14' x 9.5' gates	to canal (max cap 90 cfs)	on Rep. R. blw Med Ck.	Main Canal (cap 100 cfs)			
	outlets. Capacity of irrig		plus 30" gated condut to	Bartley Diversion Dam	2-10'x14' gates to river	and 2 – 5'x4' gates to			
	pipe outlet limited to		river, and 2- 10'x6' gates	located below Rep. R.	and 4-10'x14' gates to	South Canal (capacity			
	34.5 cfs by canal cap.		to canal (cap 400 cfs).	confluence. See note (4)	canal (max cap 325 cfs).	36 cfs).			

SUMMARY OF ENGINEERING DATA
REPUBLICAN RIVER BASIN PROJECTS

U.S. Army Corps of Engineers
Kansas City District
December 2004

Plate 2D

SUBJECT	WACONDA LAKE	KIRWIN RESERVOIR	WEBSTER RESERVOIR	WILSON LAKE	KANOPOLIS LAKE	CEDAR BLUFF RESERVOIR
GENERAL						
Location of Dam	Near Glen Elder, KS	Near Kirwin, KS	Near Stockton, KS	Near Wilson, KS	Near Ellsworth, KS	Near Ellis, KS
Stream / River	Solomon River	North Fork Solomon River	South Fork Solomon River	Saline River	Smoky Hill River	Smoky Hill River
Miles above Mouth	172.4	67.8	92.4	153.9	183.7	333.4
Contributing Drainage Area, sq miles	2,559 below u/s dams (4)	1,367	1,150	1,917	2,330 blw Cedar Bluff (6)	5,365
Approx Length of Full Reservoir, miles (1)	24	9	7	24	12	9
Shoreline, miles (1)	100	37	27	100	41	50
Maximum Discharge of Record nr Dam Site	125,000 cfs (July 1951)	24,000 cfs (Sep 1919)	55,200 cfs (July 1951)	25,700 cfs (Jul-Aug 1928)	61,000 cfs (June 1938)	98,000 cfs (May 1938)
Date of Closure	October 18, 1967	March 7, 1955	May 3, 1956	September 3, 1963	July 26, 1946	November 13, 1950
Date Storage Began	July 24, 1968	October 5, 1955	May 3, 1956	December 29, 1964	February 17, 1948	November 13, 1950
Date Multipurpose Level Reached	May 16, 1973	July 2, 1957	June 18, 1957	March 12, 1973	July 19, 1948	June 21, 1951
Operating Agency	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Corps of Engineers	Corps of Engineers	Bureau of Reclamation
DAM AND EMBANKMENT						
Top of Dam Elevation, feet msl	1,500.0	1,779.0	1,944.0	1,592.0	1,537.0	2,198.0
Length of Dam, feet (Less Spillway)	14,631	12,246	10,604	5,600	15,360	12,409.5
Damming Height, feet (2)	107.9	95	84.7	114	102	102
Type of Fill	Earth	Earth	Earth	Earth	Earth	Earth
Fill Quantity, cubic yards	8,050,000	9,537,000	8,145,000	8,500,000	15,200,000	8,490,000
SPILLWAY						
Location	Right Abutment	Right Abutment	Left Abutment	Right Abutment	Right Abutment	Right Abutment
Crest Elevation, feet msl	1,467.4	1,757.3	1,884.6	1,582.0	1,507.0	2,166.0
Width, feet	644	400 (uncontrolled)	116	450 (uncontrolled)	500 (uncontrolled)	150.5 (uncontrolled length)
Number, Size, and Type of Gates	12 - 50'x21.76' Radial	None, but see note below	3 – 33.33'x39.51' Radial	None	None	Gated orifice, see note blw
Discharge Capacity at Top of Surcharge Pool	278,000 cfs	96,000 cfs (sluices closed)	138,000 cfs	15,700 cfs	172,000 cfs	84,000 cfs (with orifice)
RESERVOIR (3)						
Surcharge Pool Elevation (ft msl), Area	1,492.9 ft msl 38,242 ac	1,773.0 ft msl 14,660 ac	1,938.0 ft msl 11,270 ac	1,587.5 ft msl 33,600 ac	1,531.8 ft msl 24,788 ac	2,192.0 ft msl 16,510 ac
Flood Control Pool Elevation (ft msl), Area	1,488.3 ft msl 33,682 ac	1,757.3 ft msl 10,639 ac	1,923.7 ft msl 8,475 ac	1,554.0 ft msl 20,152 ac	1,508.0 ft msl 14,015 ac	2,166.0 ft msl 10,790 ac
Multipurpose, or Top Cons Pool Elev, Area	1,455.6 ft msl 12,602 ac	1,729.25 ft msl 5,073 ac	1,892.45 ft msl 3,766 ac	1,516.0 ft msl 8,637 ac	1,463.0 ft msl 2,975 ac	2,144.0 ft msl 6,869 ac
Inactive Pool Elevation (ft msl), Area	1,428.0 ft msl 3,020 ac	1,697.0 ft msl 1,006 ac	1,860.0 ft msl 904 ac			2,107.8 ft msl 1,907 ac
Dead Storage Pool Elevation (ft msl), Area	1,407.8 ft msl 63 ac	1,693.0 ft msl 765 ac	1,855.5 ft msl 440 ac			2,090.0 ft msl 755 ac
Surcharge Storage, AF	1,492.9 - 1,488.3 166,572	1,773.0 - 1,757.3 198,392	1,938.0 - 1,923.7 140,819	1,587.5 - 1,554.0 899,749	1,531.8 - 1,508.0 484,912	2,192.0 - 2,166.0 353,250
Flood Control Storage, AF	1,488.3 - 1,455.6 722,986	1,757.3 - 1,729.25 215,175	1,923.7 - 1,892.45 183,401	1,554.0 - 1,516.0 530,152	1,508.0 - 1,463.0 365,143	2,166.0 - 2,144.0 191,891
MP, or Active Conservation Storage, AF	1,455.6 - 1,428.0 193,183	1,729.25 - 1,697.0 89,675	1,892.45-1,860.0 71,971	1,516.0 - 1,435.0 236,188	1,463.0 - 1,430.0 48,378	2,144.0 - 2,107.8 143,877
Inactive Storage, AF	1,428.0 - 1,407.8 25,989	1,697.0 - 1,693.0 3,546	1,860.0 - 1,855.5 2,975			2,107.8 - 2,090.0 24,172
Dead Storage, AF	1,407.8 - 1,395.0 248	1,693.0 - 1,680.0 4,969	1,855.5 - 1,849.0 1,256			2,090.0 - 2,078.0 4,402
Gross Storage, AF	1,488.3 - 1,395.0 942,406	1,757.3 - 1,680.0 313,365	1,923.7 - 1,849.0 259,603	1,554.0 - 1,435.0 766,340	1,508.0 - 1,430.0 413,521	2,166.0 - 2,078.0 364,342
Design Sediment Reserve Storage	23,750 AF for 50 years	14,950 AF for 100 years	18,600 AF for 100 years	40,000 AF for 100 years	51,500 AF for 50 years	26,000 AF for 100 years
Measured Sediment Inflow	22,597 AF (1968 to 2001)	1,278 AF (1955 to 1996)	1,267 AF (1956 to 1996)	15,066 AF (1964 to 1995)	28,704 AF (1948 to 1993)	13,044 AF (1950 to 2000)
OUTLET WORKS						
Location	Left Abutment	Center of Dam	Right Abutment	Right Abutment	Right Abutment	Left Abutment
River Outlet Type	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit	Gated Conduit (7)	Gated Conduit to River
Number and Size of Conduit	1 - 12.5'	7' Cond to 60" pipe (5)	4.5' Conduit to 48" pipe	1 - 12'	1 - 14'	1 - 5.5'
Length of Conduit, feet	575	(5)	538	1,097	2,443	863.5
Entrance Crest Elevation	1,407.8 ft msl	1,693 ft msl	1,855.5 ft msl	1,450.0 ft msl	1,415.0 ft msl	2,090.0 ft msl
Gated Sluice, Number and Size	None	See note below	None	None	None	8 - 5'x5', gated (8)
Discharge Cap, Top of Flood Control Pool	5,200 cfs	220 cfs (5)	480 cfs	6,500 cfs	6,400 cfs (7)	3,520 cfs (outlet, sluices) (8)
Disch Cap, Top of MP (Conservation) Pool	4,000 cfs	220 cfs (5)	385 cfs	5,300 cfs	4,500 cfs (7)	7,949 cfs (outlet, sluices) (8)
Service Gates, Number, Size, Type	2 - 6.5'x8' Slide Gates	1 - 4'x5' to stilling well (5)	1 - 3.5'x3.5' Slide Gate	2 - 6'x12' Service Gates	2 - 6'x12'	1 - 4'x5'
Emergency Gates, Number and Size	1 - 9'x12' Slide Gates	1 - 4'x5' (5)	1 - 3.5'x3.5' Slide Gate	2 - 6'x12' Slide Gates	1 - 6'x12'	1 - 4'x5'
Low Flow Gates, Number and Size	None	None	None	2 - 2'x2' Slide Gates	None	None
Provision for Irrigation	None	2 - 5.5'x8' openings (5)	None	None	None	1 - 4'x5' (8)
Provision for Power	None	None	None	None	Provision future penstock	None
Provision for Municipal Supply	No pipe outlets, water supply released to river	None	None	None	Pump outlet near tower	See (9), supplied by release to river, pump to Big Ck.
		Note: 15 - 5' x 5' gated sluices located in concrete ogee section below spillway crest. Crest elevation at sluice entrance = 1,720.0. Discharge capacity at top of conserv pool = 4,800 cfs, top, flood pool = 15,350 cfs.	Note: When reservoir elevation is below 1,860, the outlet gate openings must be reduced to prevent air entrainment in conduit.	Note: Low flow gates are mounted in the service gates		Note: Spillway also has a gated orifice section at center with 1 - 14.5' x 9.58' radial gate, crest elev 2,144. Spillway cap includes ogee and orifice. Sluices located in ogee section below crest.

Abbreviations
ac = acres
AF = acre-feet
ft = feet
msl = elevation above mean sea level
cfs = cubic feet per second
MP = multipurpose pool elevation

REMARKS

(1) With pool at multipurpose or full conservation level.
(2) Damming height is height from original river bed to top of flood control pool.
(3) Based on latest available storage data. The dates of the current area - capacity tables are indicated below along with the effective dates in parenthesis:
Waconda, July 2001 (effective January 1, 2003)
Kirwin, May 1996 (effective January 1, 1998)
Webster, May 1996 (effective January 1, 1998)
Wilson, December 1984 (effective January 1, 1985)
Kanopolis, February 1983 (effective March 1, 1983)
Cedar Bluff, March 2001 (effective January 1, 2002)
(4) Total DA with Kirwin and Webster = 5,076 sq miles
(5) 7' conduit from intake tower to gate chamber. 4'x5' emergency gate to 60" pipe. Entrance to stilling well controlled by 4'x5' slide gate. From stilling well, 42" river outlet pipe controlled by 36" gate. River outlet capacity at top of MP pool and flood control pool about 220 cfs. Length of combined pipes from intake to stilling well about 500'. About 200' more to stilling basin. Canal releases from two openings at top of stilling well. Canal capacity is about 175 cfs, but combined capacity with river outlet about 395 cfs.
(6) Total contrib. DA with Cedar Bluff = 7,695 sq miles

TOTALS
139,070 ac
97,753 ac
39,922 ac
2,243,694 AF
2,208,748 AF
783,272 AF
56,682 AF
10,875 AF
3,059,577 AF

(7) In addition to the gated conduit, Kanopolis has an uncontrolled port opening 3.5'x13.75' in the 10' pier separating the two service gate openings. Crest elevation of the port is 1,463 ft msl. The max discharges given for the outlet is the combined total of the port and gates.
(8) River outlet crest elev is 2,090 ft msl. Crest elev of sluices under spillway is 2,134.82 ft msl. River outlet capacity at MP is 804 cfs, at top of flood pool is 909 cfs. Cedar Bluff also has an irrig canal outlet on Y junction from river outlet, 5.5' pipe to control house, canal flow controlled by 4'x5' gate (not used since 1978, irrigation district disbanded in 1994). Also a hatchery supply line from 18" valve on canal outlet, capacity 10 cfs. Lake storage owned by KS, for benefit of recreation and F&W. All releases coordinated with Kansas KDWP.
(9) 2,000 AF annual storage supply contract for Russell.

SUMMARY OF ENGINEERING DATA
SMOKY HILL RIVER BASIN PROJECTS

U.S. Army Corps of Engineers
Kansas City District
December 2004

Plate 2E

APPENDIX A
CORPS OF ENGINEERS PROJECTS

BLUE SPRINGS LAKE

CLINTON LAKE

HARLAN COUNTY LAKE

HARRY S TRUMAN RESERVOIR

HILLSDALE LAKE

KANOPOLIS LAKE

LONG BRANCH LAKE

LONGVIEW LAKE

MELVERN LAKE

MILFORD LAKE

PERRY LAKE

POMME DE TERRE LAKE

POMONA LAKE

RATHBUN LAKE

SMITHVILLE LAKE

STOCKTON LAKE

TUTTLE CREEK LAKE

WILSON LAKE

BLUE SPRINGS LAKE
2019 REGULATION

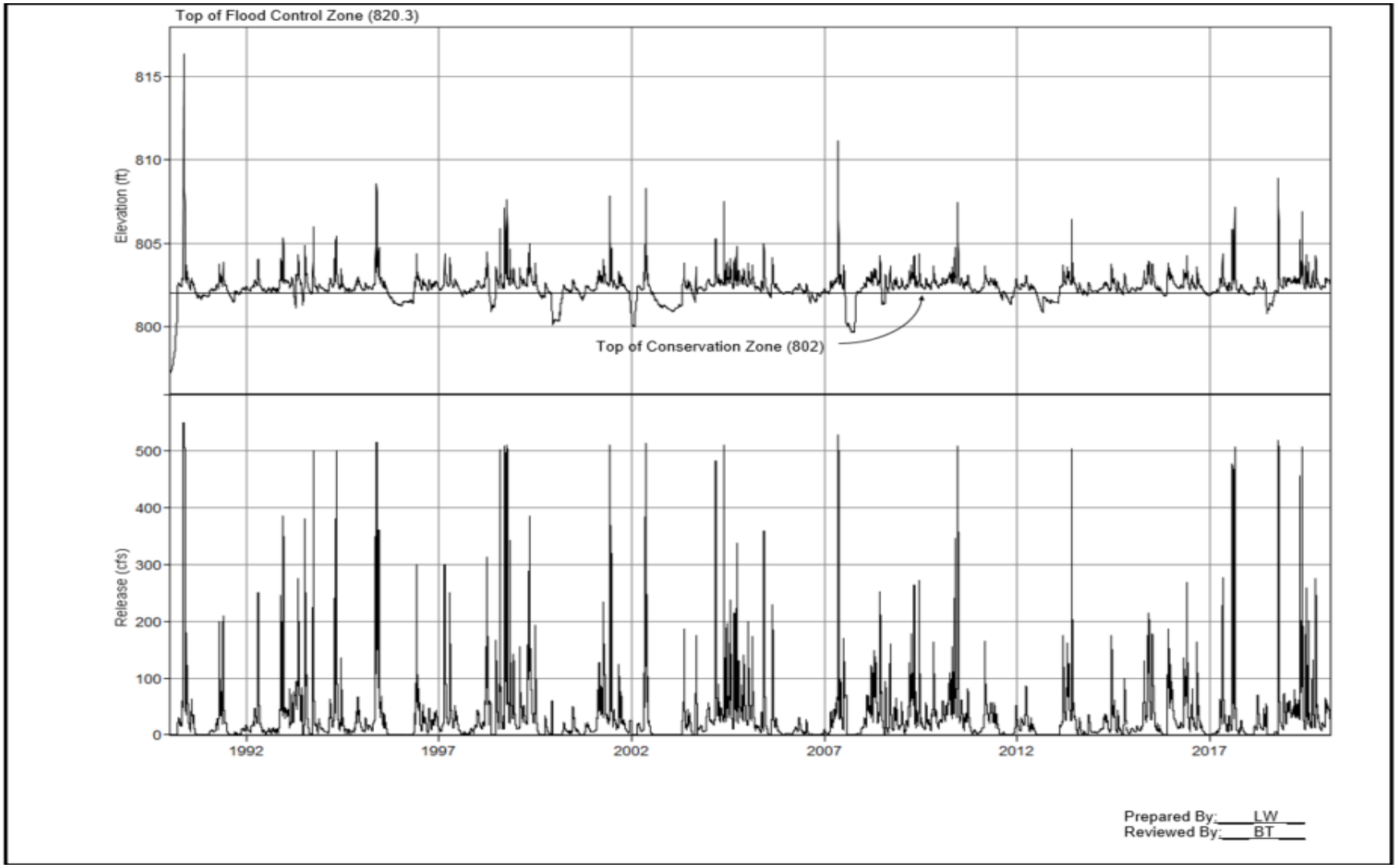


FIGURE A-1. BLUE SPRINGS DAM HISTORICAL POOL ELEVATIONS AND RELEASES

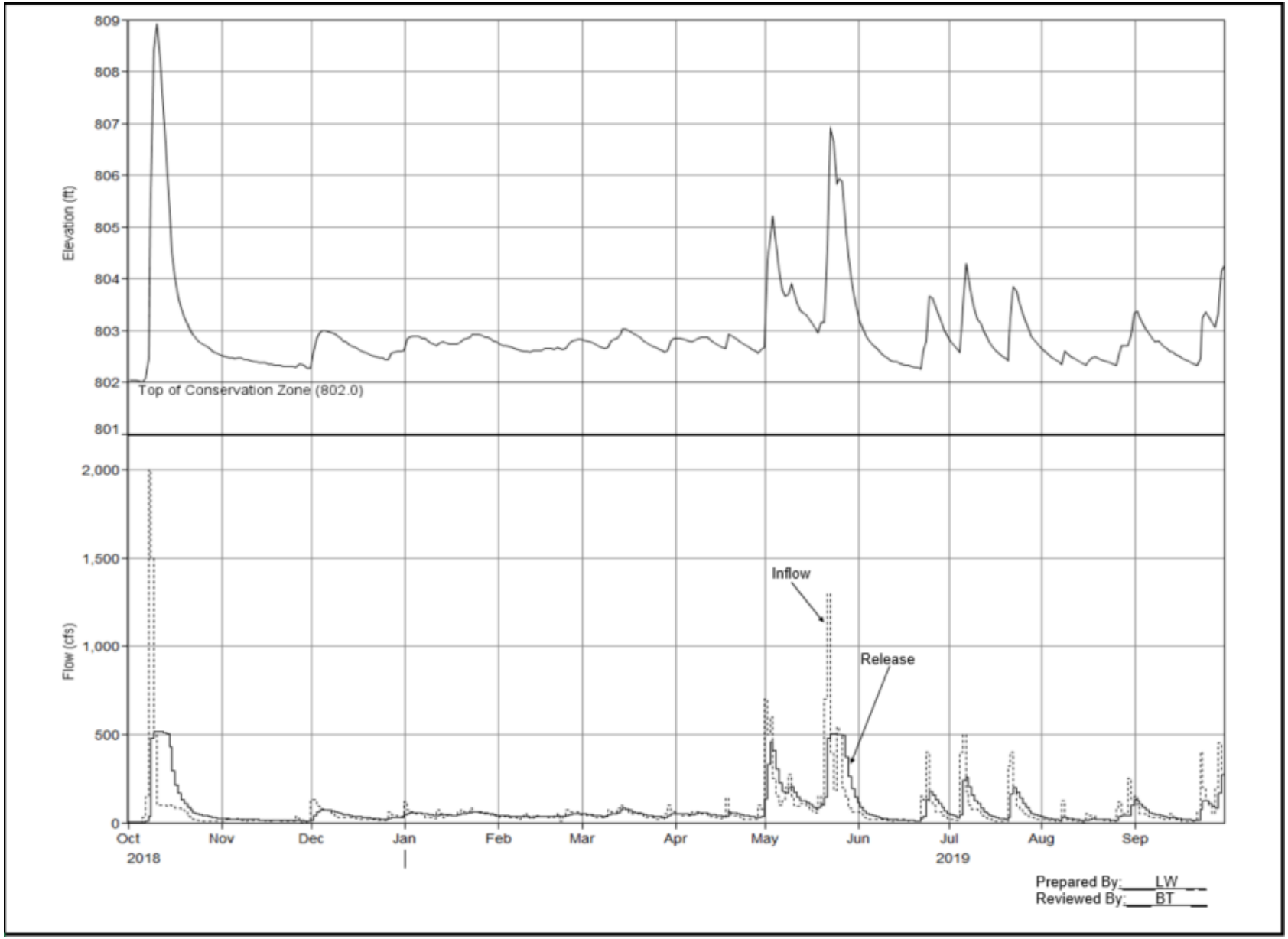


FIGURE A-2. BLUE SPRINGS DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE A-1. BLUE SPRINGS HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:

	Daily Inflow	Date
Highest	5325 cfs	15-May-90
2nd	2100 cfs	07-May-07
3rd	2070 cfs	05-Oct-98
	Daily Outflow	**Date**
Highest	550 cfs	15-May-90
2nd	529 cfs	08-May-07
3rd	518 cfs	11-Oct-18
	Pool	**Date**
Highest	816.4 ft	17-May-90
2nd	811.1 ft	08-May-07
3rd	808.9 ft	10-Oct-18

b. Minimums of Record (since initial fill)

	Pool	Date
Lowest	799.7 ft	16-Sep-07
2nd	800.0 ft	18-Jan-02
3rd	800.1 ft	15-Dec-99

c. Report Period

Total Inflow		**Total Outflow**	
57,420 ac-ft	217% of norm	53,681 ac-ft	226% of norm
Peak Daily Inflow		**Peak Daily Outflow**	
2000 cfs	08-Oct-18	518 cfs	11-Oct-18
Peak Pool Elev		**Min Pool Elev**	
808.9 ft	10-Oct-18	802.0 ft	05-Oct-18

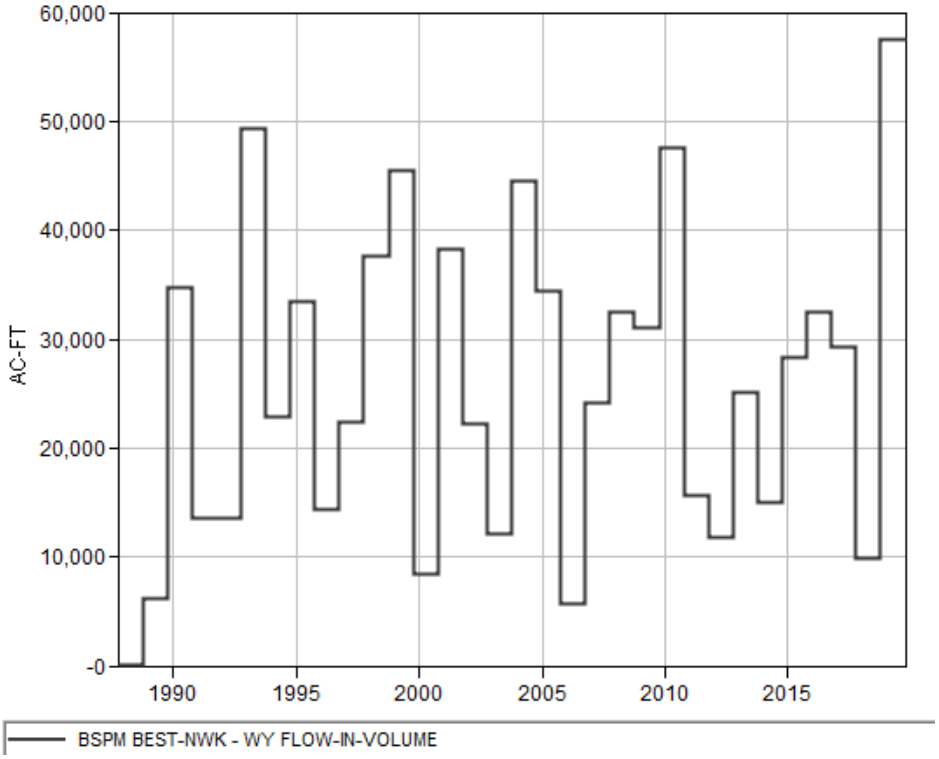


FIGURE A-3. BLUE SPRINGS PERIOD OF RECORD ANNUAL INFLOW

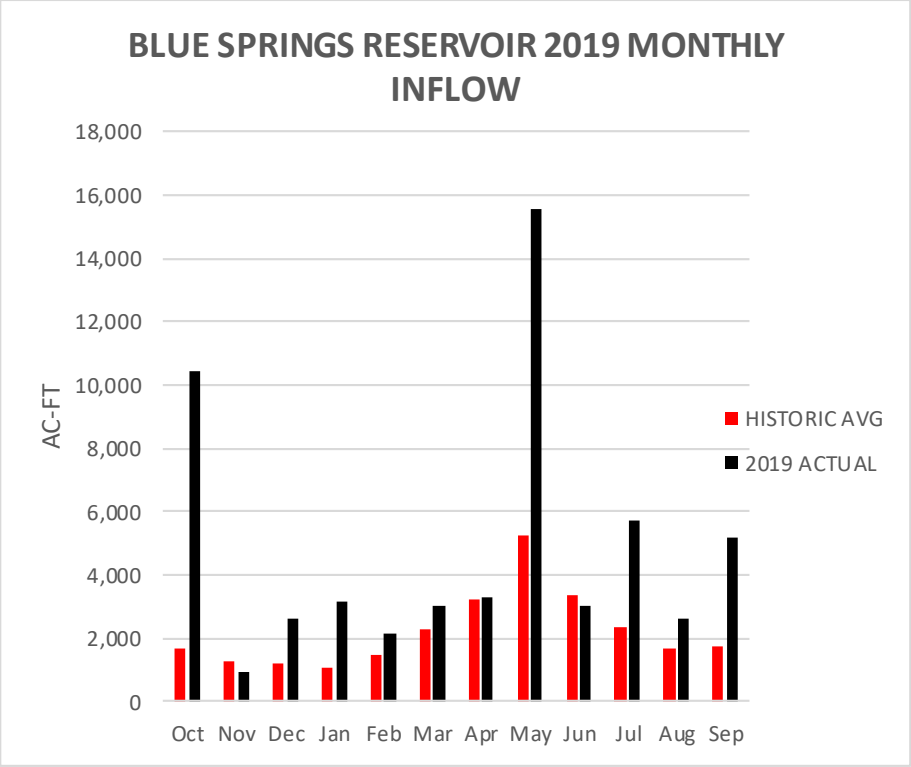


FIGURE A-4. BLUE SPRINGS 2019 MONTHLY INFLOWS

CLINTON LAKE 2019 REGULATION

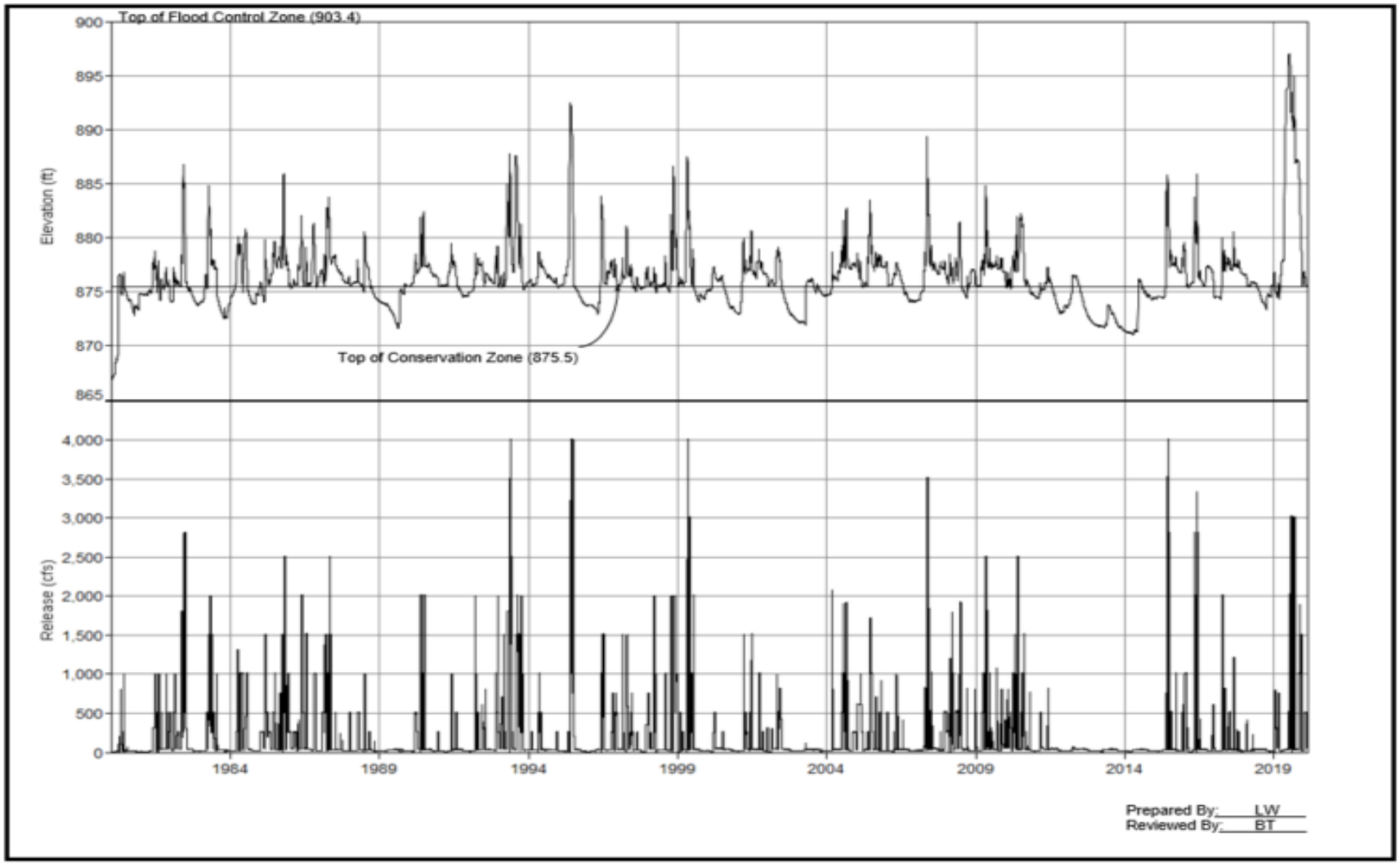


FIGURE A-5. CLINTON DAM HISTORICAL POOL ELEVATIONS AND RELEASES

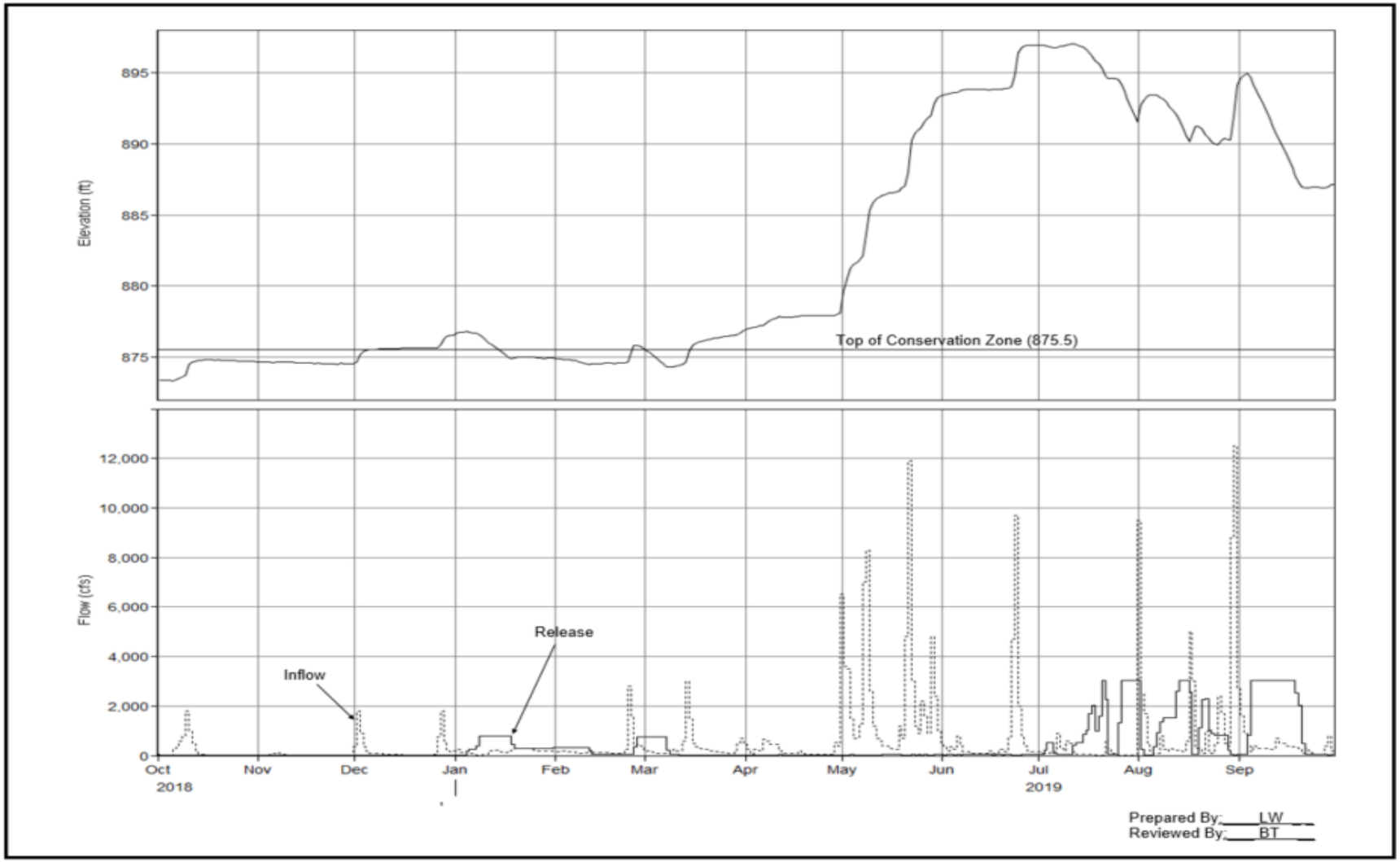


FIGURE A-6. CLINTON DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE A-2. CLINTON HISTORIC ELEVATIONS AND FLOW RECORDS

a. Maximums of Record:			b. Minimums of Record (since initial fill)			
	Daily Inflow - Date			**Pool - Date**		
Highest	24000 cfs	08-May-07	Lowest	871.0 ft	12-Apr-14	
2nd	20000 cfs	02-Nov-98	2nd	871.6 ft	17-Aug-89	
3rd	16000 cfs	18-May-95	3rd	871.7 ft	16-Apr-13	
	Daily Outflow - Date					
Highest	4012 cfs	11-Jun-15	**c. Report Period**			
2nd	4011 cfs	15-Jun-95	**Total Inflow**		**Total Outflow**	
3rd	4010 cfs	09-May-99	433,995 ac-ft	239% of norm	294,935 ac-ft	190% of norm
	Pool - Date		**Peak Daily Inflow**		**Peak Daily Outflow**	
Highest	897.0 ft	11-Jul-19	12500 cfs	31-Aug-19	3025 cfs	27-Jul-19
2nd	892.5 ft	30-May-95	**Peak Pool Elev**		**Min Pool Elev**	
3rd	889.3 ft	12-May-07	897.0 ft	11-Jul-19	873.3 ft	05-Oct-18

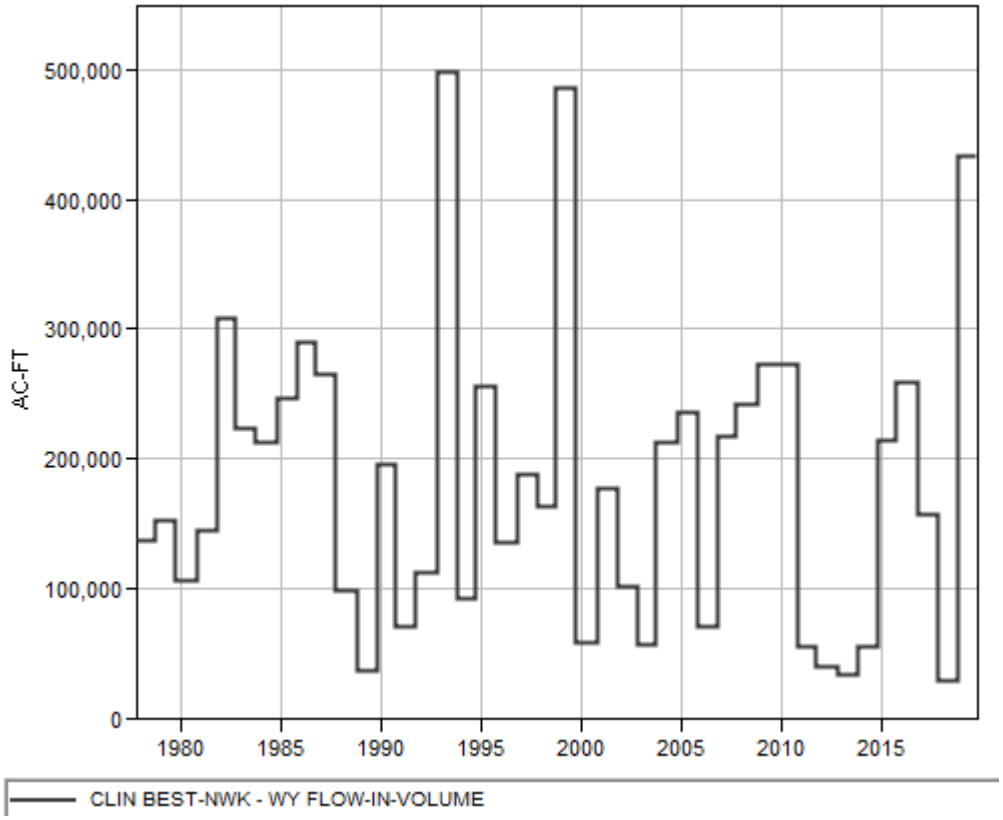


FIGURE A-7. CLINTON PERIOD OF RECORD ANNUAL INFLOWS

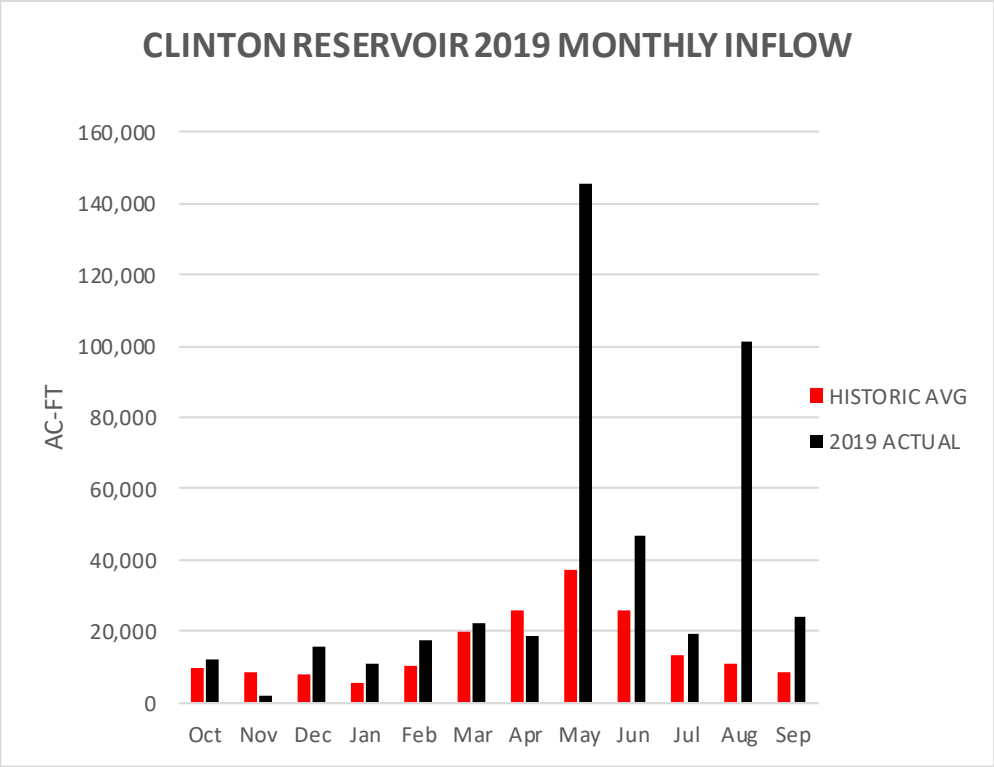


FIGURE A-8. CLINTON 2019 MONTHLY INFLOWS

HARLAN COUNTY LAKE
2019 REGULATION

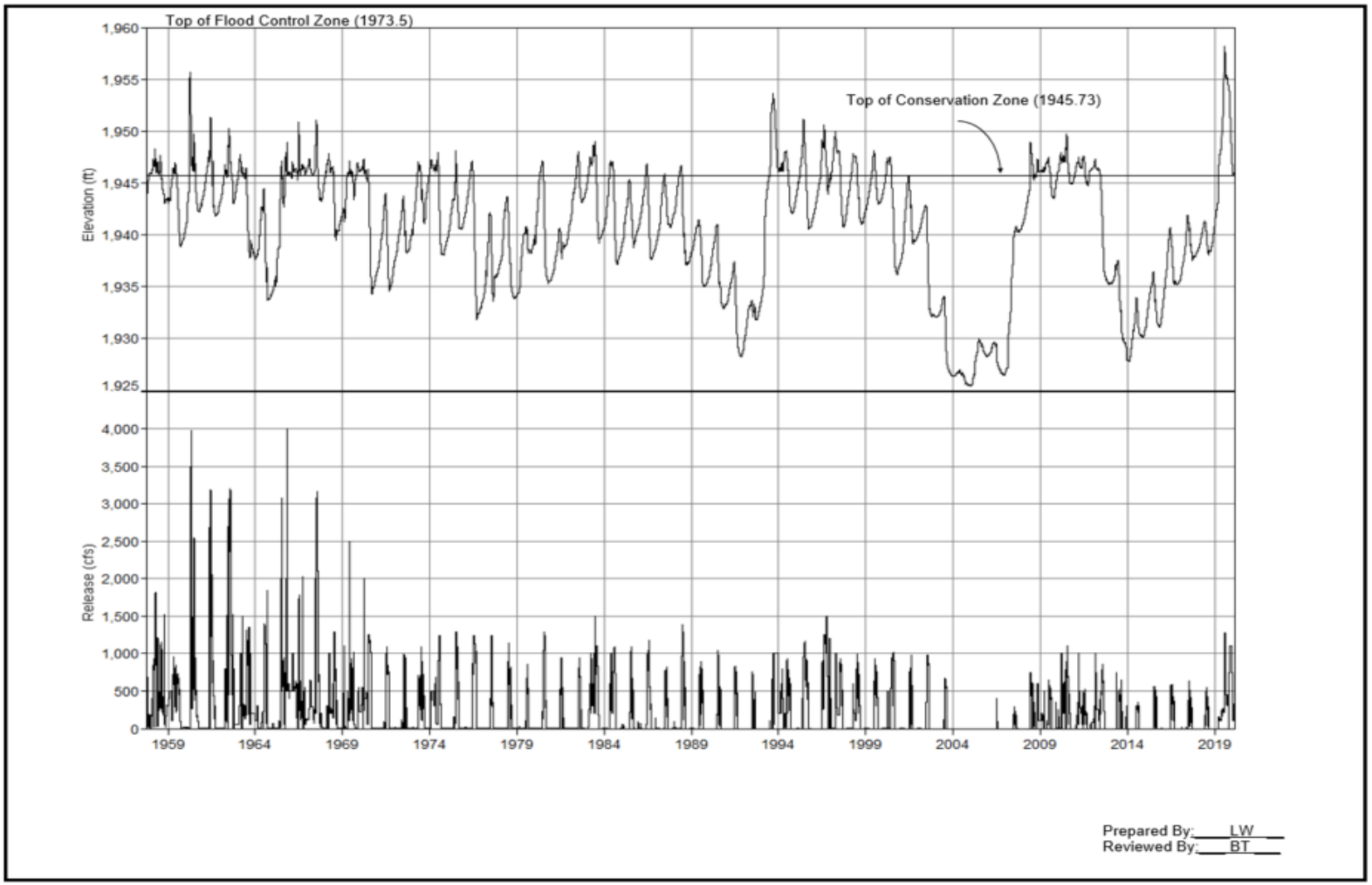


FIGURE A-9. HARLAN COUNTY DAM HISTORICAL POOL ELEVATIONS AND RELEASES

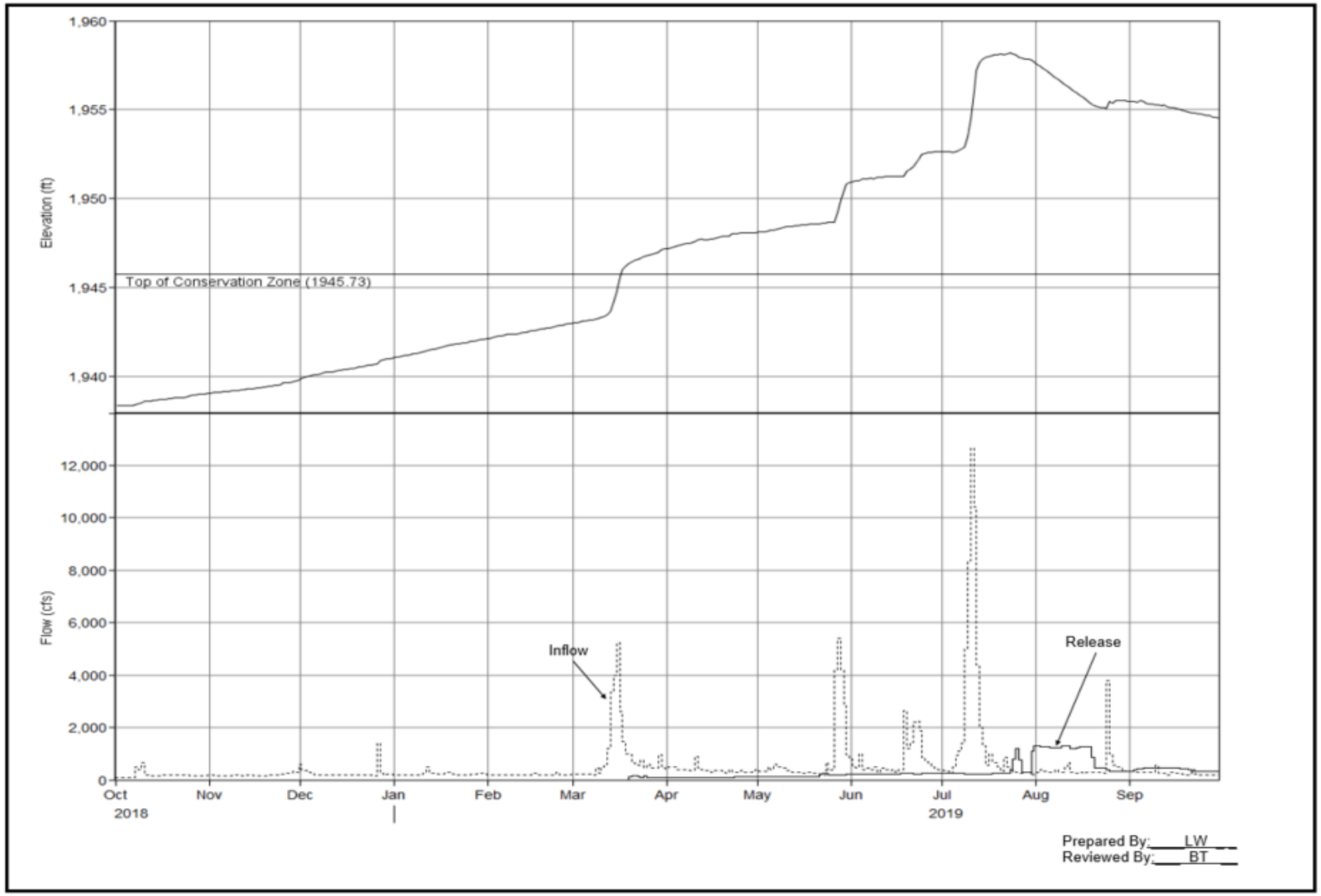


FIGURE A-10. HARLAN COUNTRY DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE A-3. HARLAN COUNTY HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:			b. Minimums of Record (since initial fill)		
	Daily Inflow - Date			**Pool - Date**	
Highest	20200 cfs	25-Jun-66	Lowest	1925.4 ft	01-Jan-05
2nd	18630 cfs	17-Jun-57	2nd	1926.3 ft	31-Dec-03
3rd	13870 cfs	24-May-60	3rd	1926.5 ft	07-Dec-06
	Daily Outflow - Date				
Highest	4278 cfs	21-Jul-57	**c. Report Period**		
2nd	4000 cfs	02-Nov-65	**Total Inflow**		**Total Outflow**
3rd	3970 cfs	03-May-60	401,800 ac-ft	202% of norm	132,159 ac-ft 88% of norm
	Pool - Date		**Peak Daily Inflow**		**Peak Daily Outflow**
Highest	1958.2 ft	23-Jul-19	12660 cfs	11-Jul-19	1282 cfs 01-Aug-19
2nd	1955.7 ft	05-Apr-60	**Peak Pool Elev**		**Min Pool Elev**
3rd	1955.1 ft	30-Jun-57	1958.2 ft	23-Jul-19	1938.4 ft 01-Oct-18

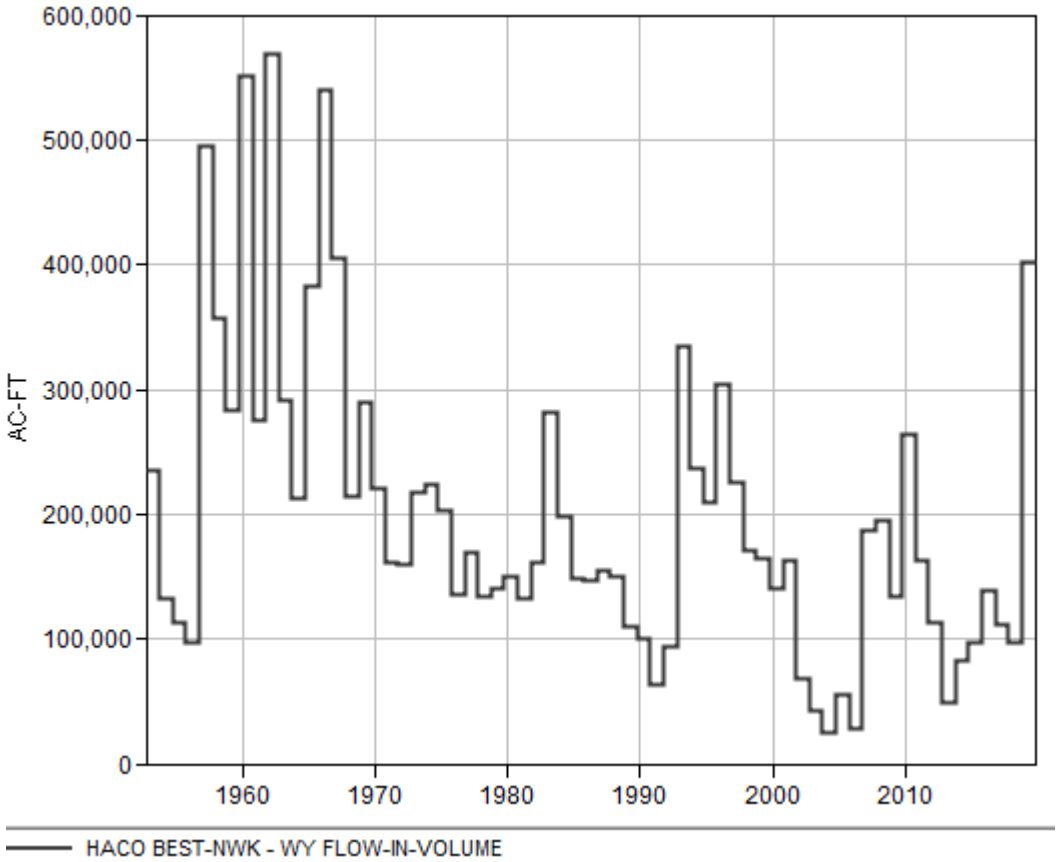


FIGURE A-11. HARLAN COUNTY PERIOD OF RECORD ANNUAL INFLOWS

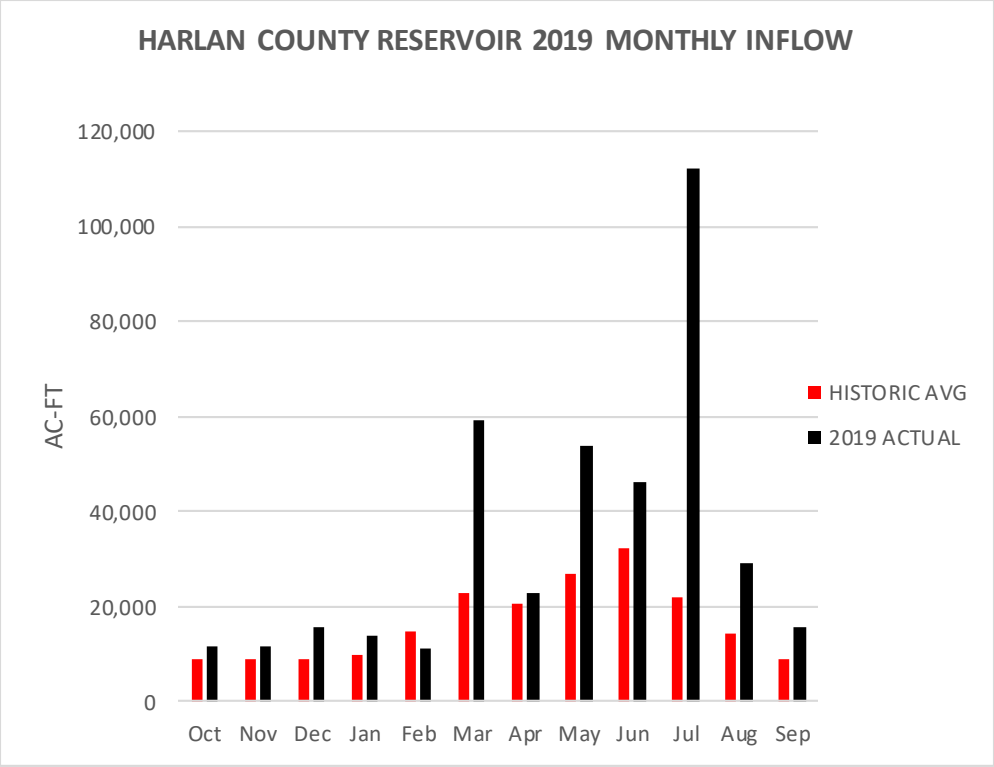


FIGURE A-12. HARLAN COUNTY 2019 MONTHLY INFLOWS

HARRY S TRUMAN RESERVOIR 2019 REGULATION

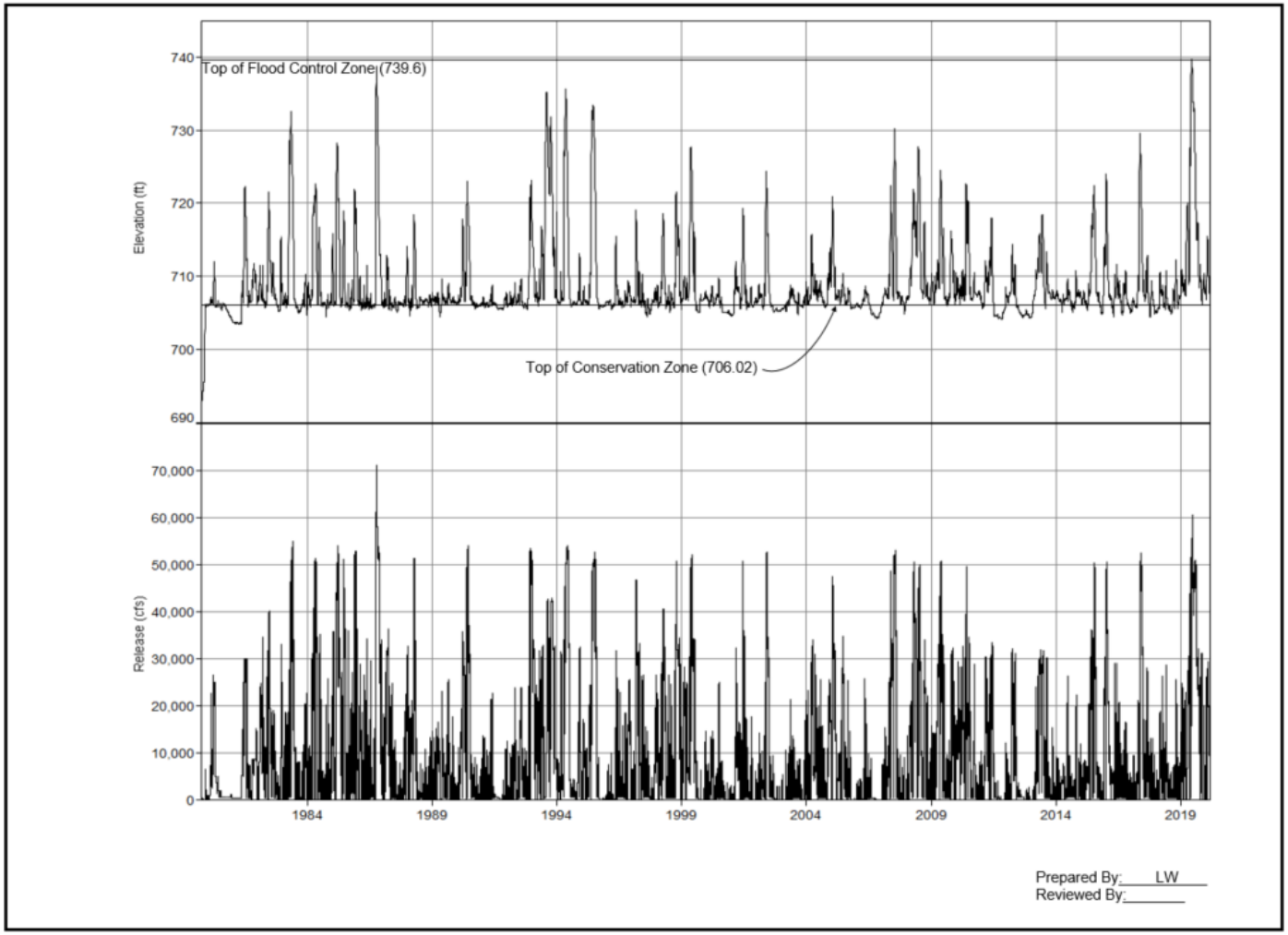


FIGURE A-13. HARRY S. TRUMAN DAM HISTORICAL POOL ELEVATIONS AND RELEASES

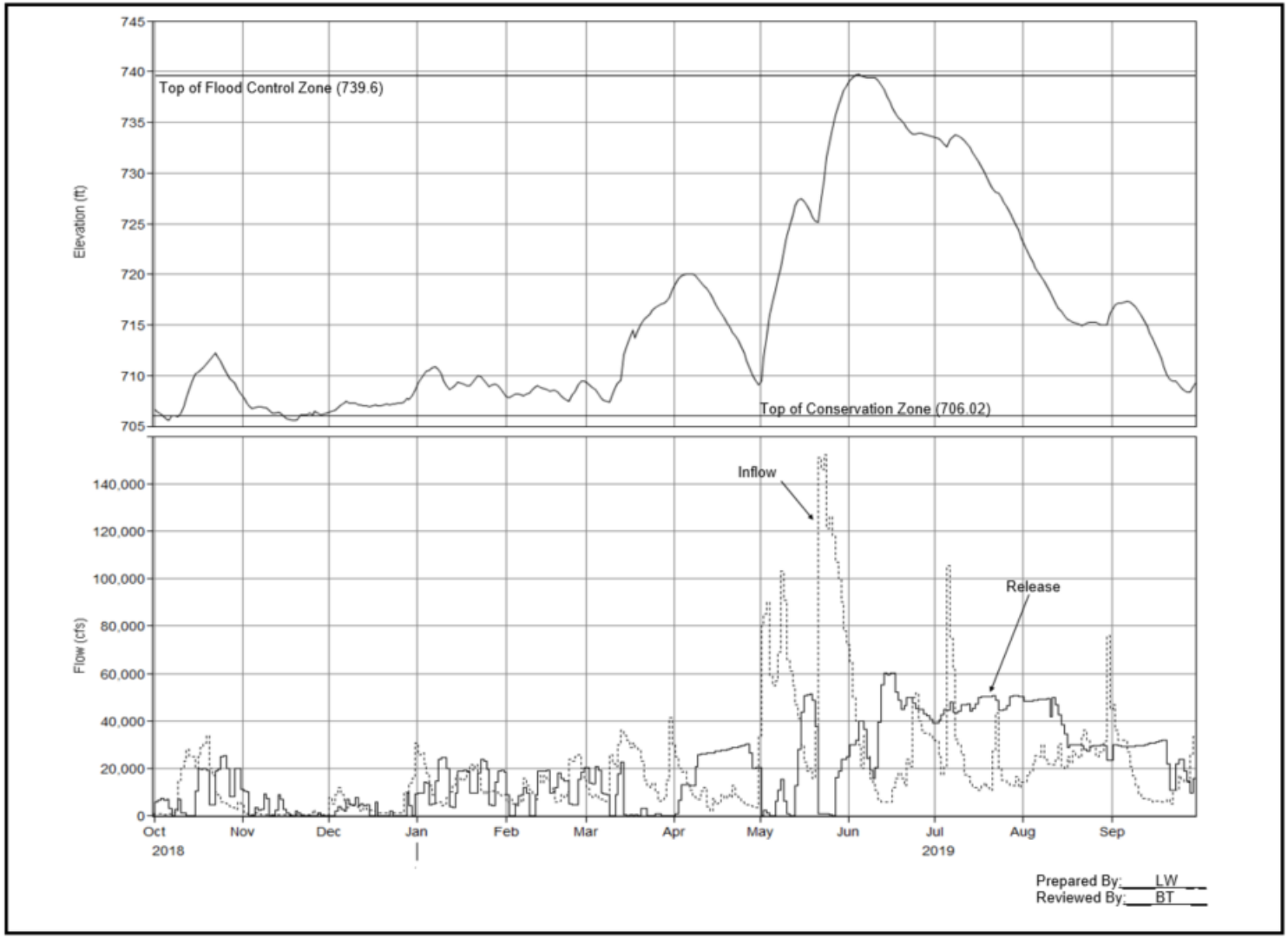


FIGURE A-14. HARRY S. TRUMAN DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE A-4. HARRY S. TRUMAN HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:			b. Minimums of Record (since initial fill)			
	Daily Inflow - Date			**Pool - Date**		
Highest	444770 cfs	04-Oct-86	Lowest	703.4 ft	10-Apr-81	
2nd	293200 cfs	12-Apr-94	2nd	704.1 ft	01-Nov-11	
3rd	241200 cfs	18-May-95	3rd	704.2 ft	25-Oct-06	
	Daily Outflow - Date					
Highest	71125 cfs	21-Oct-86	**c. Report Period**			
2nd	60446 cfs	14-Jun-19	**Total Inflow**		**Total Outflow**	
3rd	54863 cfs	03-Jun-83	14,784,307 ac-ft	206% of norm	14,295,243 ac-ft	206% of norm
	Pool - Date		**Peak Daily Inflow**		**Peak Daily Outflow**	
Highest	739.7 ft	04-Jun-19	152000 cfs	24-May-19	60446 cfs	14-Jun-19
2nd	738.7 ft	12-Oct-86	**Peak Pool Elev**		**Min Pool Elev**	
3rd	735.6 ft	10-May-94	739.7 ft	04-Jun-19	705.5 ft	06-Oct-18

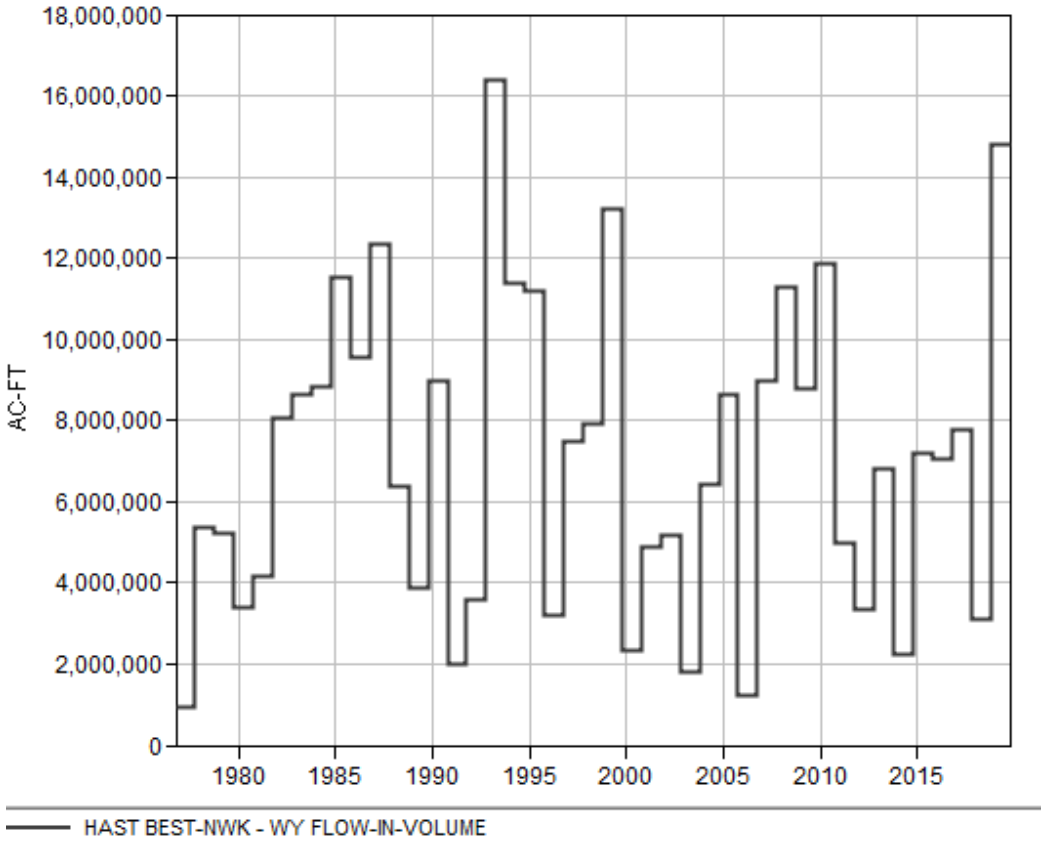


FIGURE A-15. HARRY S. TRUMAN PERIOD OF RECORD ANNUAL INFLOWS

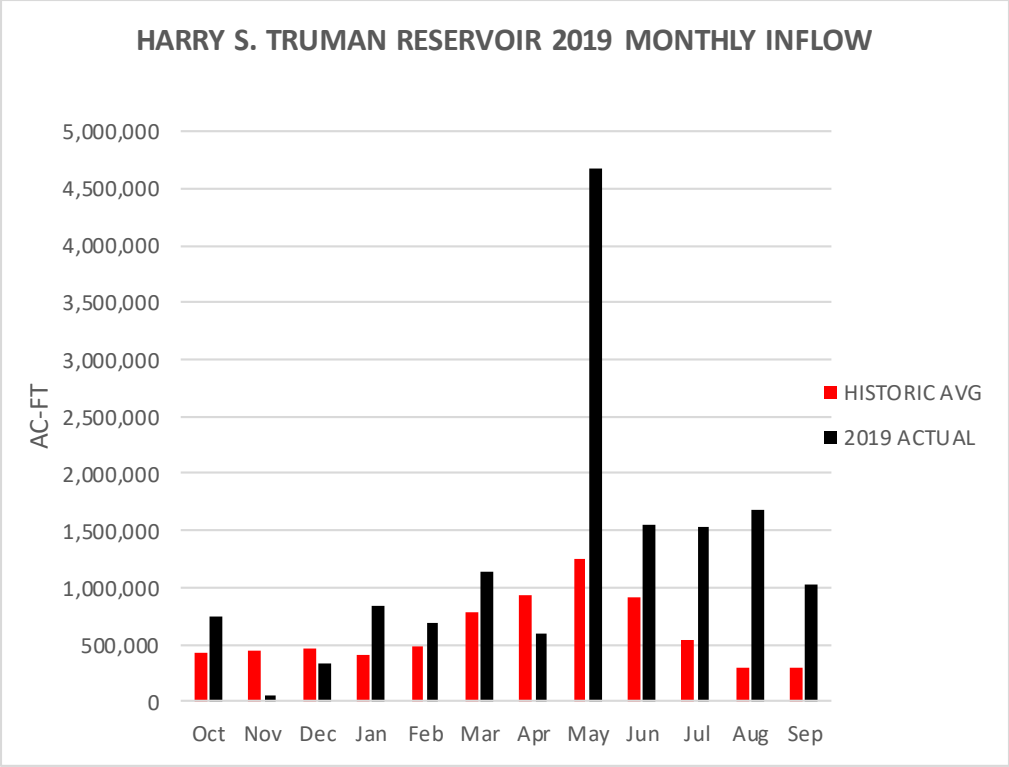


FIGURE A-16 HARRY S. TRUMAN 2019 MONTHLY INFLOWS

HILLSDALE LAKE 2019 REGULATION

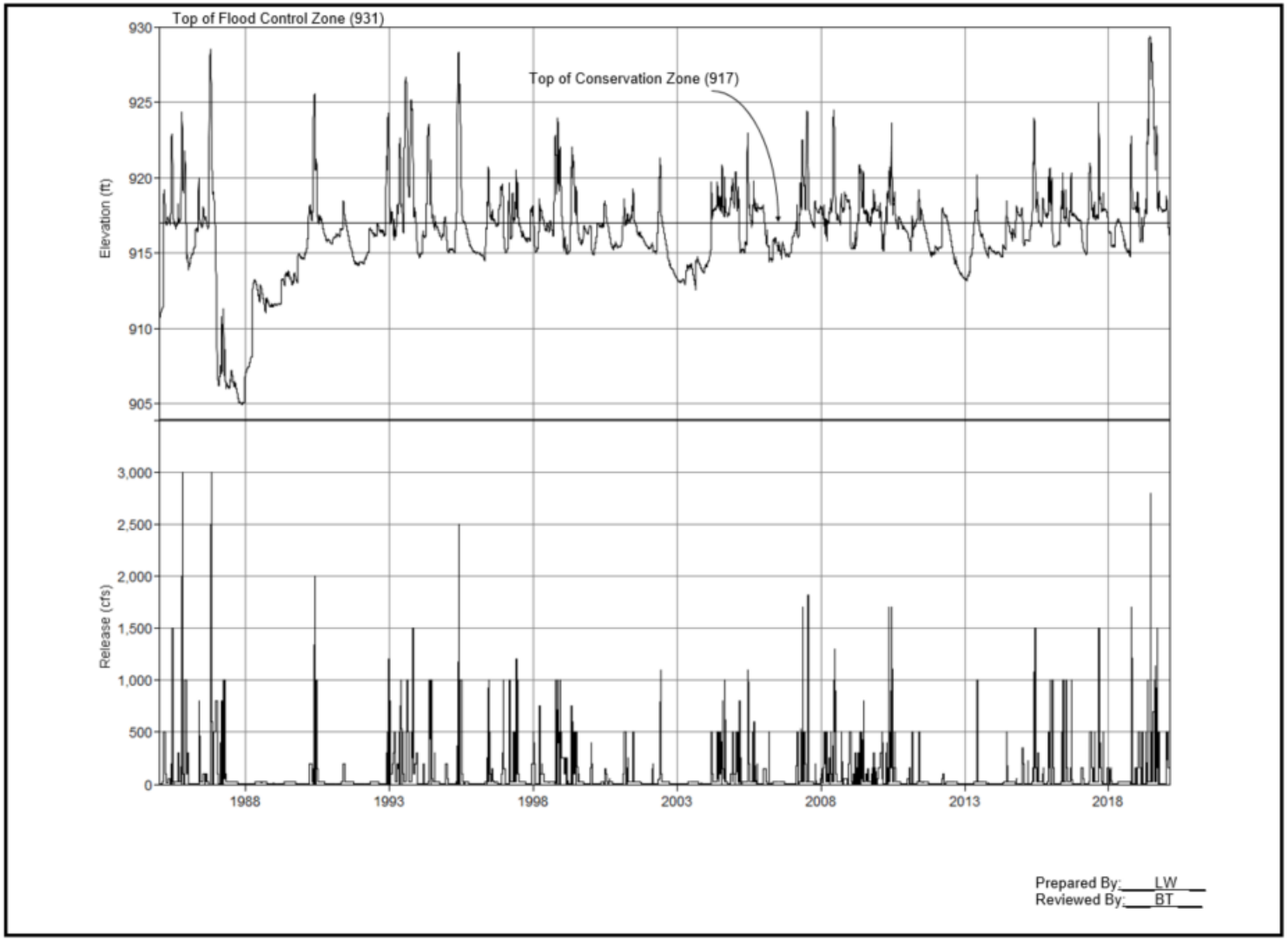


FIGURE A-17. HILLSDALE DAM HISTORICAL POOL ELEVATIONS AND RELEASES

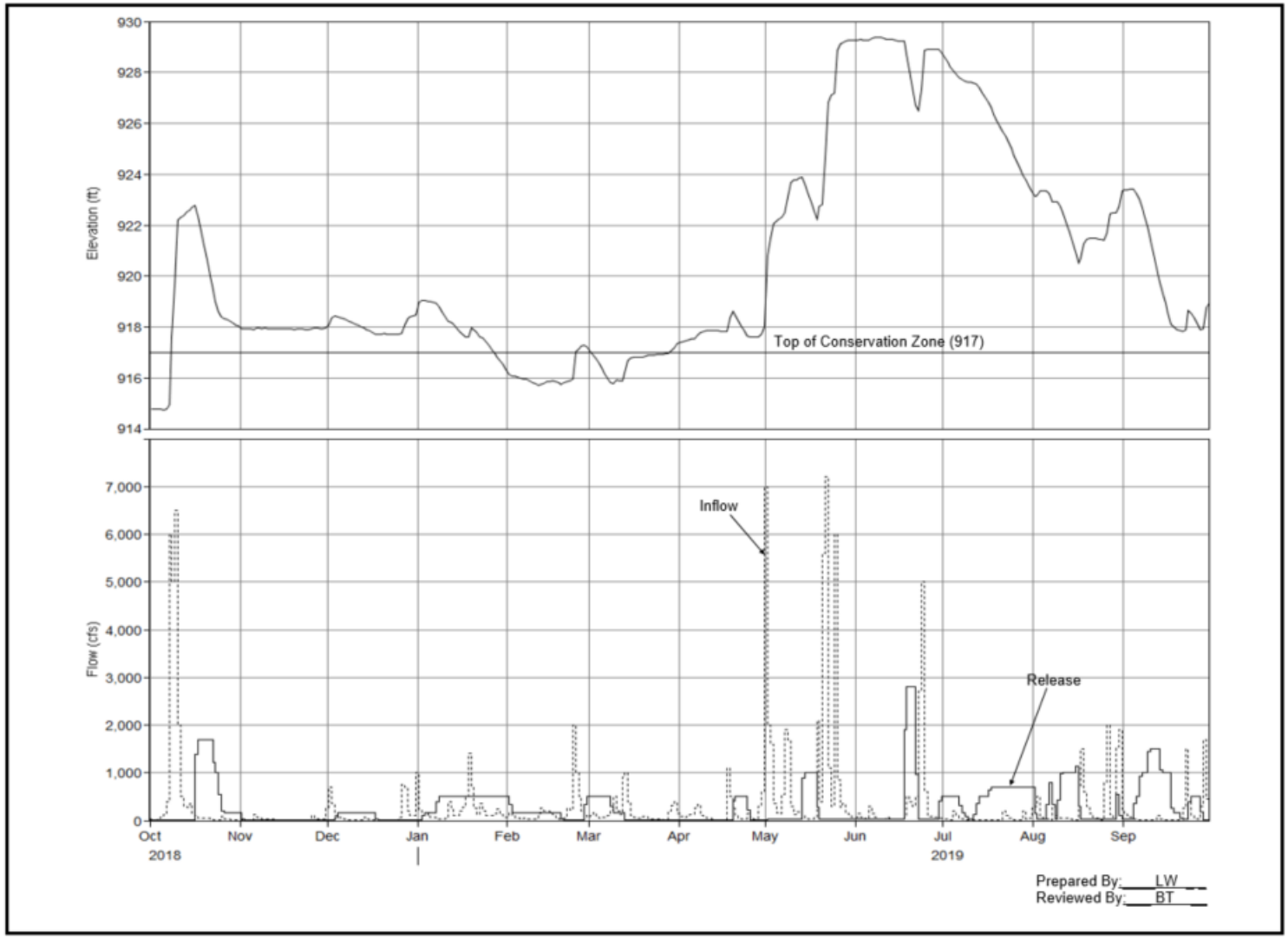


FIGURE A-18. HILLSDALE DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE A-5. HILLSDALE HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:

	Daily Inflow	Date
Highest	15100 cfs	16-May-90
2nd	11300 cfs	17-May-95
3rd	10500 cfs	22-Aug-17
	Daily Outflow	**Date**
Highest	3000 cfs	24-Oct-85
2nd	3000 cfs	29-Oct-86
3rd	2800 cfs	19-Jun-19
	Pool	**Date**
Highest	929.4 ft	07-Jun-19
2nd	928.5 ft	21-Oct-86
3rd	928.3 ft	30-May-95

b. Minimums of Record (since initial fill)

	Pool	Date
Lowest	905.0 ft	15-Nov-87
2nd	912.6 ft	28-Aug-03
3rd	913.2 ft	28-Jan-13

c. Report Period

Total Inflow		**Total Outflow**	
241,472 ac-ft	258% of norm	201,643 ac-ft	261% of norm
Peak Daily Inflow		**Peak Daily Outflow**	
7200 cfs	22-May-19	2800 cfs	19-Jun-19
Peak Pool Elev		**Min Pool Elev**	
929.4 ft	07-Jun-19	914.7 ft	05-Oct-18

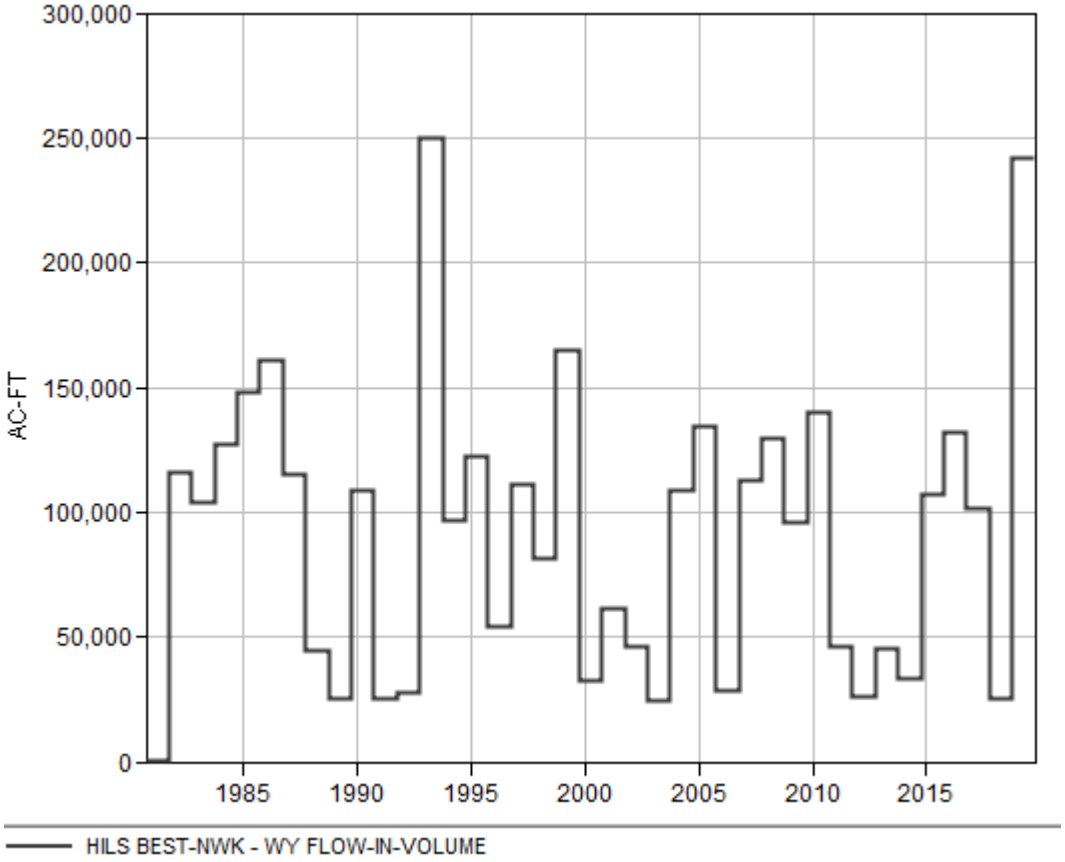


FIGURE A-19. HILLSDALE PERIOD OF RECORD ANNUAL INFLOW

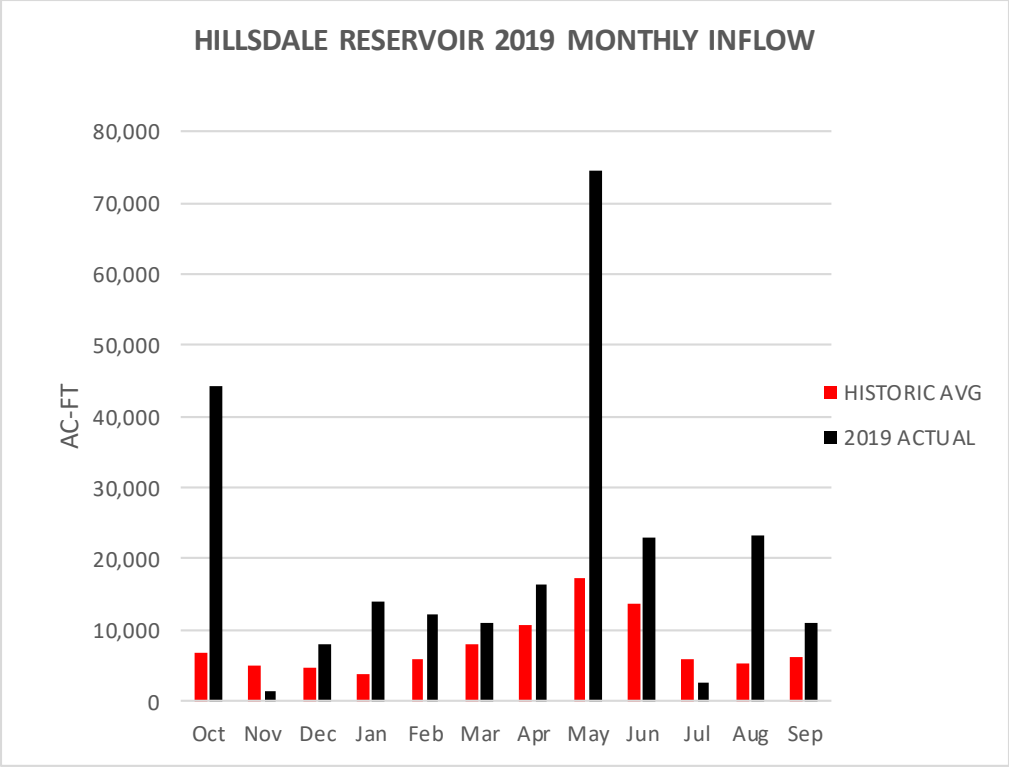


FIGURE A-20. HILLSDALE 2019 MONTHLY INFLOWS

KANOPOLIS LAKE 2019 REGULATION

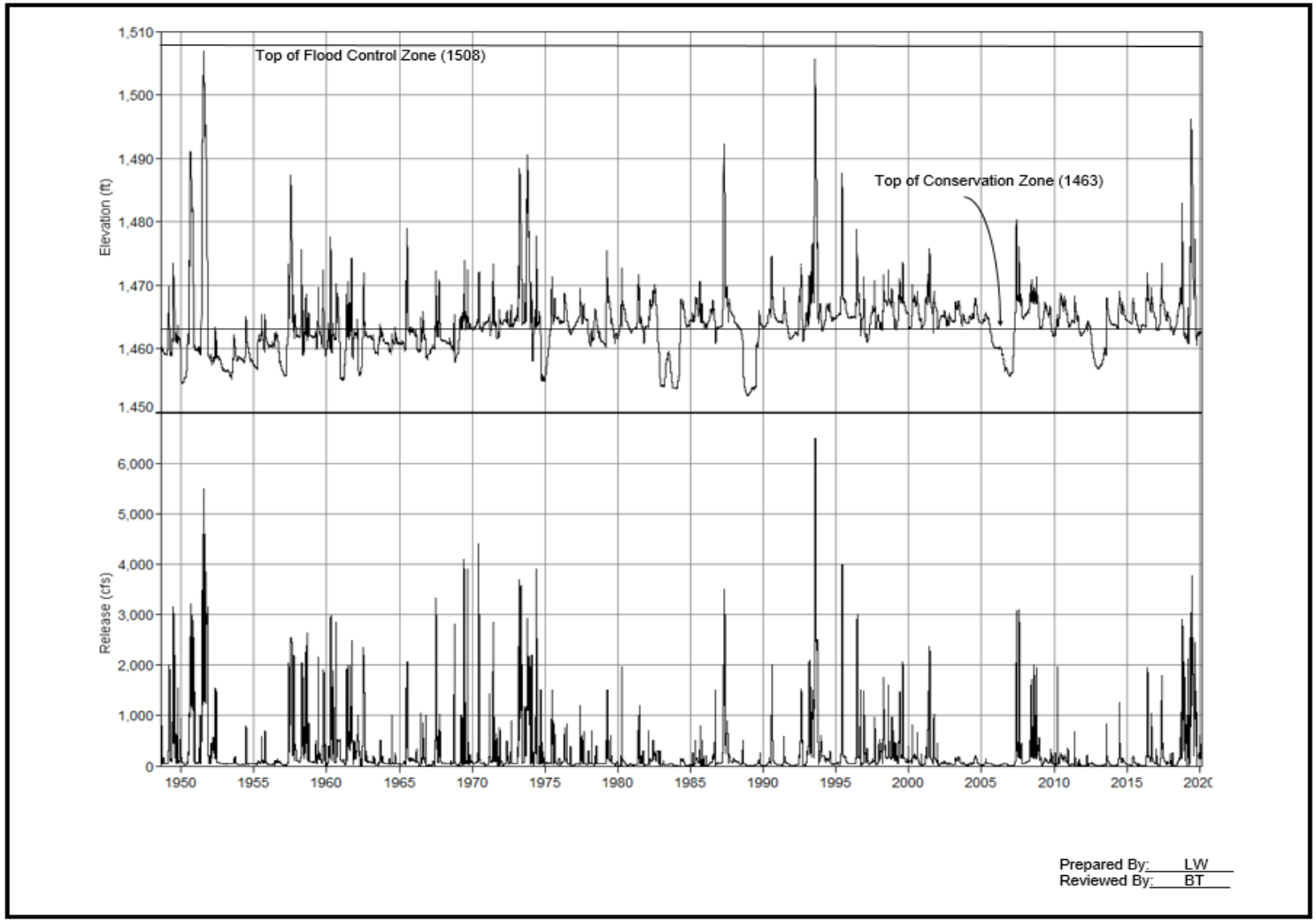


FIGURE A-21. KANOPOLIS DAM HISTORICAL POOL ELEVATIONS AND RELEASES

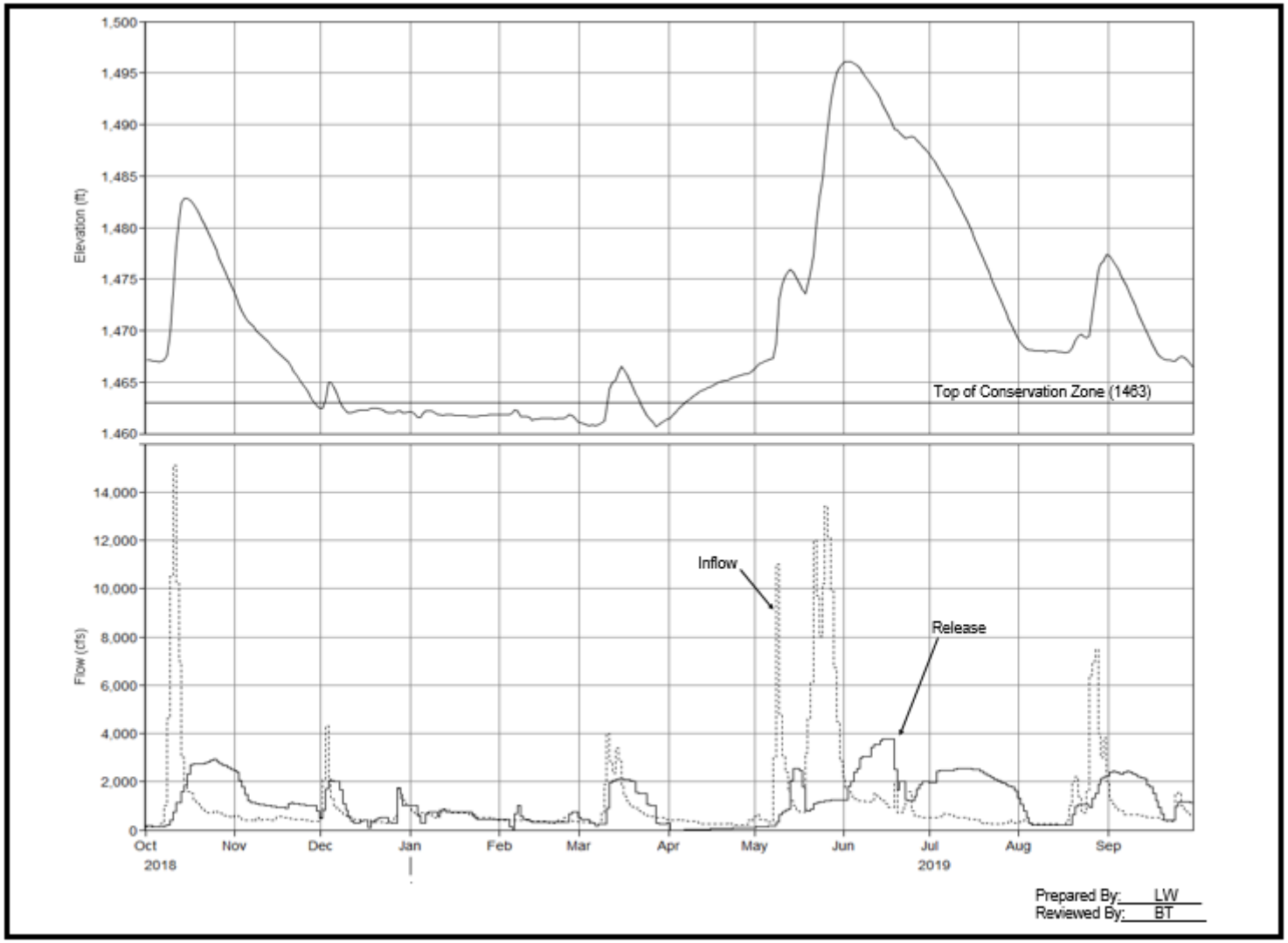


FIGURE A-22. KANOPOLIS DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE A-6. KANOPOLIS HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:

	Daily Inflow - Date	
Highest	27507 cfs	24-Jul-93
2nd	23600 cfs	07-May-07
3rd	20100 cfs	12-Jul-51
	Daily Outflow - Date	
Highest	6500 cfs	26-Jul-93
2nd	5500 cfs	14-Jul-51
3rd	4400 cfs	17-Jun-70
	Pool - Date	
Highest	1506.9 ft	14-Jul-51
2nd	1505.7 ft	26-Jul-93
3rd	1496.1 ft	02-Jun-19

b. Minimums of Record (since initial fill)

	Pool - Date	
Lowest	1452.6 ft	11-Dec-88
2nd	1453.6 ft	06-Jan-84
3rd	1454.4 ft	05-Feb-50

c. Report Period

Total Inflow		**Total Outflow**	
863,076 ac-ft	412% of norm	844,981 ac-ft	437% of norm
Peak Daily Inflow		**Peak Daily Outflow**	
15100 cfs	11-Oct-18	3776 cfs	15-Jun-19
Peak Pool Elev		**Min Pool Elev**	
1496.1 ft	02-Jun-19	1460.7 ft	27-Mar-19

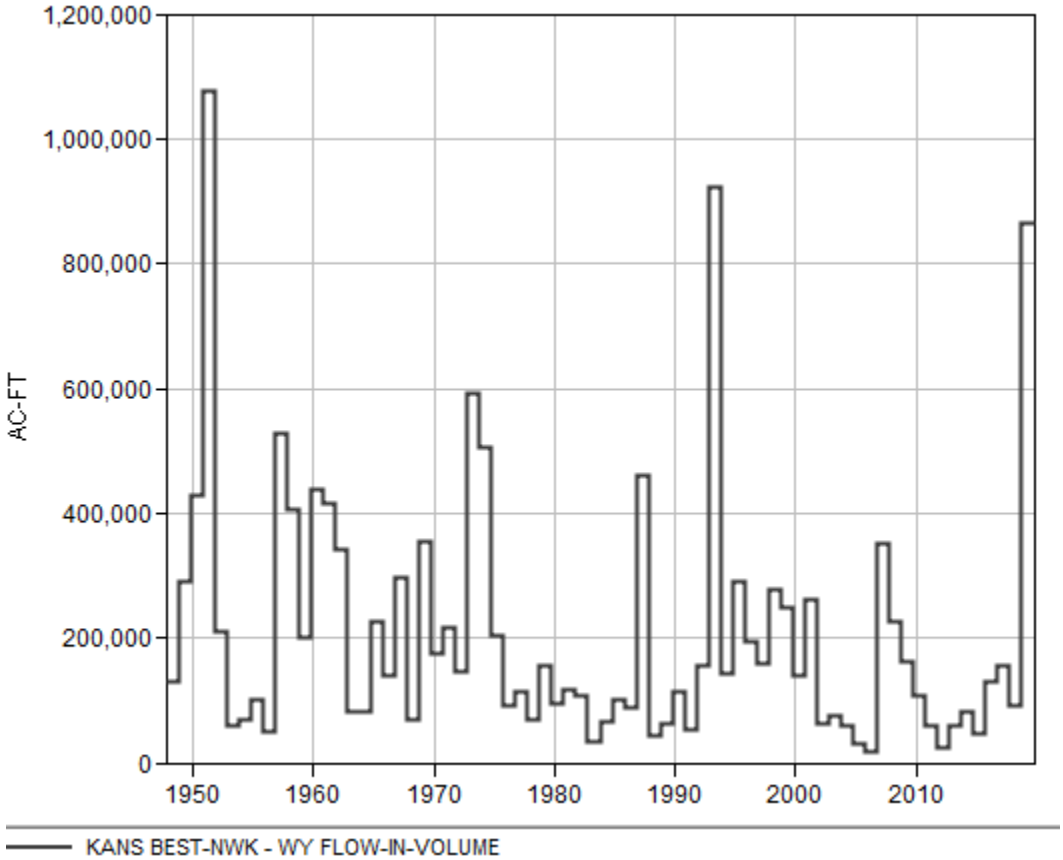


FIGURE A-23. KANOPOLIS PERIOD OF RECORD ANNUAL INFLOWS

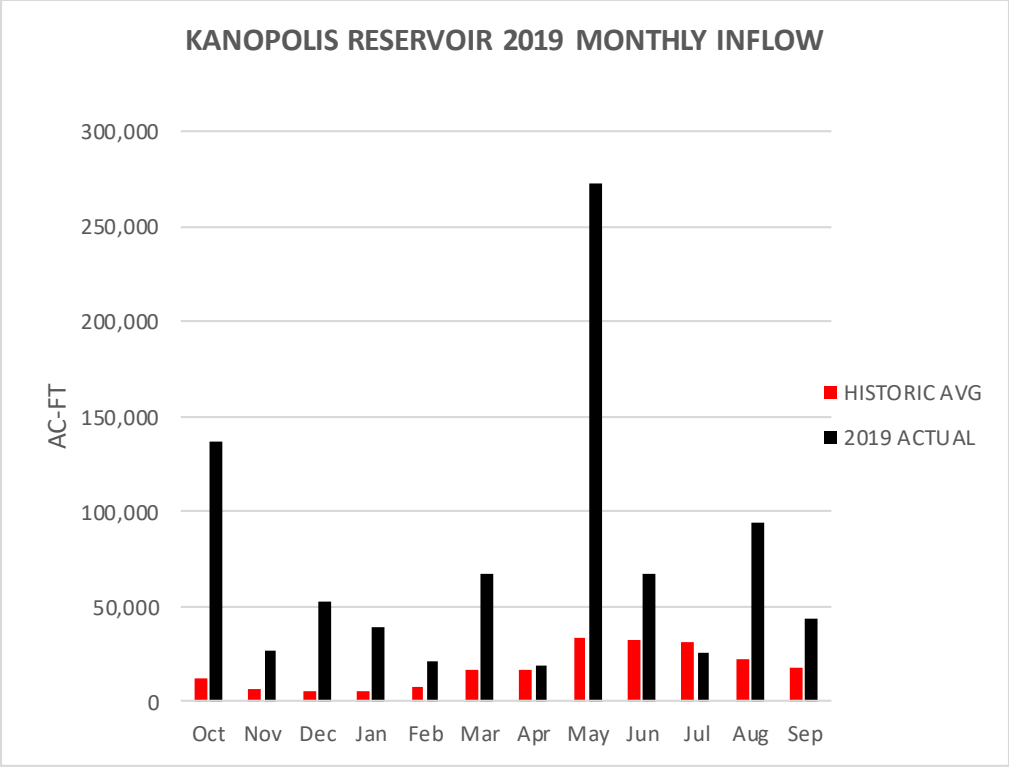


FIGURE A-24. KANOPOLIS 2019 MONTHLY INFLOWS

LONG BRANCH LAKE
2019 REGULATION

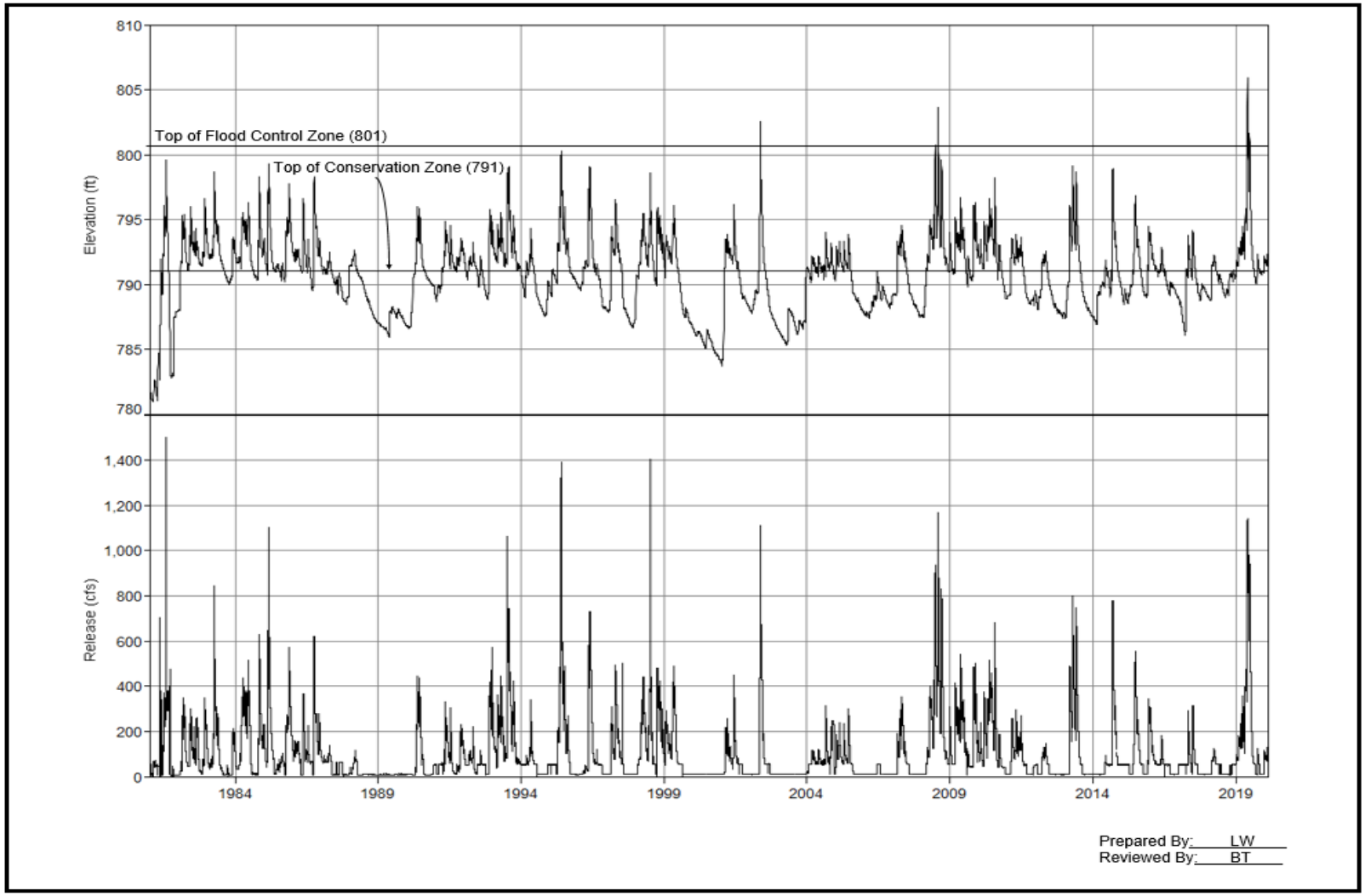


FIGURE A-25. LONG BRANCH DAM HISTORICAL POOL ELEVATIONS AND RELEASES

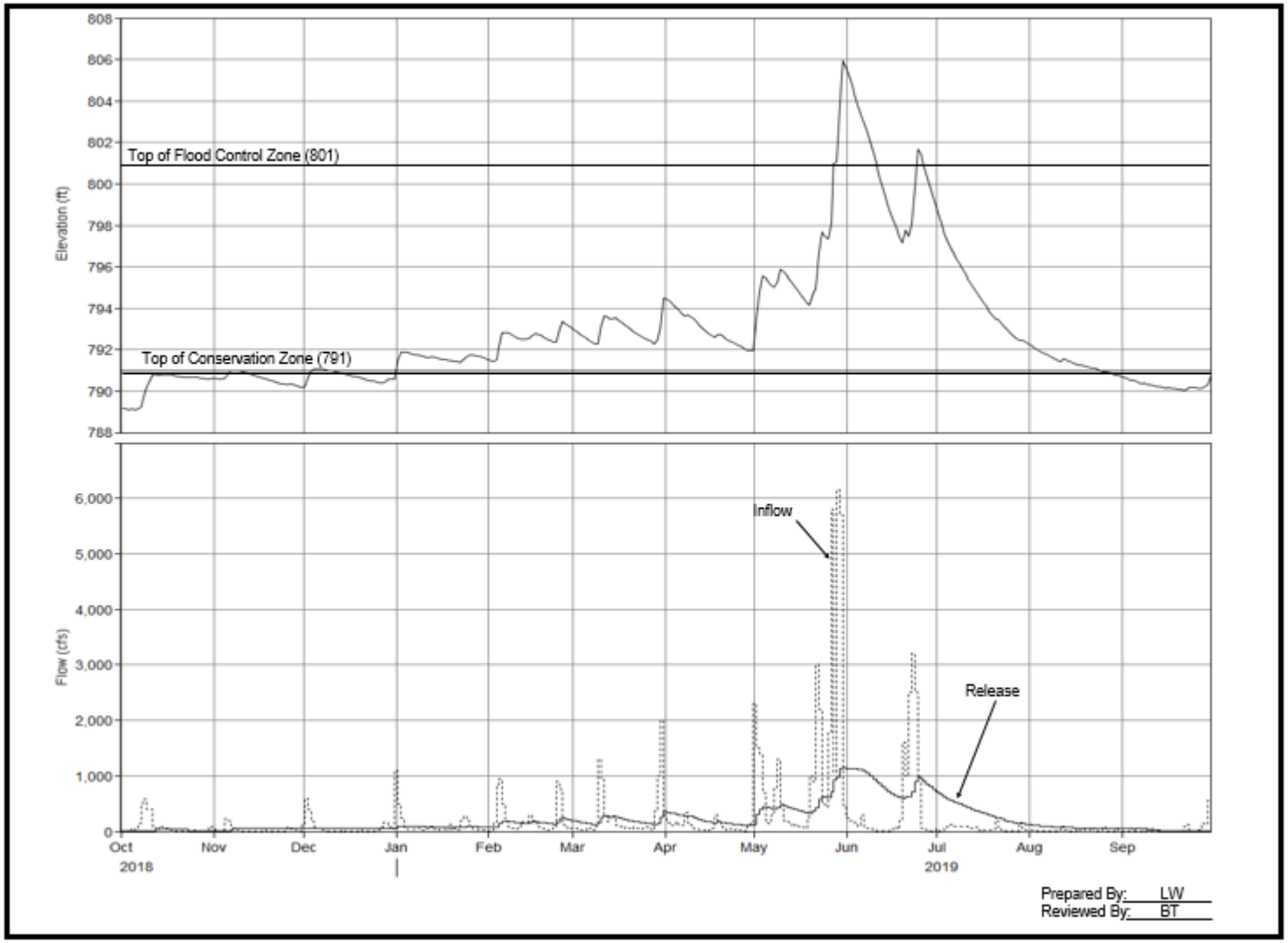


FIGURE A-26. LONG BRANCH DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE A-7. LONG BRANCH HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:			b. Minimums of Record (since initial fill)			
	Daily Inflow - Date			**Pool - Date**		
Highest	9000 cfs	11-Sep-14	Lowest	782.8 ft	11-Oct-81	
2nd	8900 cfs	13-May-02	2nd	783.7 ft	12-Jan-01	
3rd	8100 cfs	26-Jul-08	3rd	785.3 ft	16-Apr-03	
	Daily Outflow - Date					
Highest	1500 cfs	28-Jul-81	**c. Report Period**			
2nd	1404 cfs	07-Jul-98	**Total Inflow**		**Total Outflow**	
3rd	1393 cfs	28-May-95	166,602 ac-ft	217% of norm	156,391 ac-ft	225% of norm
	Pool - Date		**Peak Daily Inflow**		**Peak Daily Outflow**	
Highest	805.9 ft	30-May-19	6150 cfs	29-May-19	1141 cfs	31-May-19
2nd	803.6 ft	30-Jun-08	**Peak Pool Elev**		**Min Pool Elev**	
3rd	802.6 ft	13-May-02	805.9 ft	30-May-19	789.1 ft	03-Oct-18

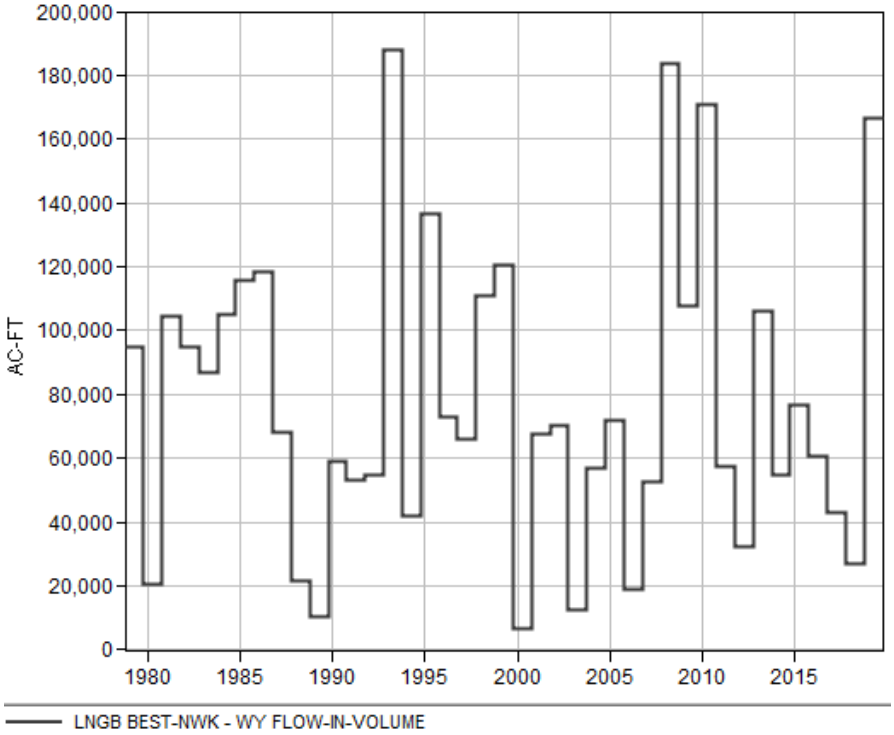


FIGURE A-27. LONG BRANCH PERIOD OF RECORD ANNUAL INFLOWS

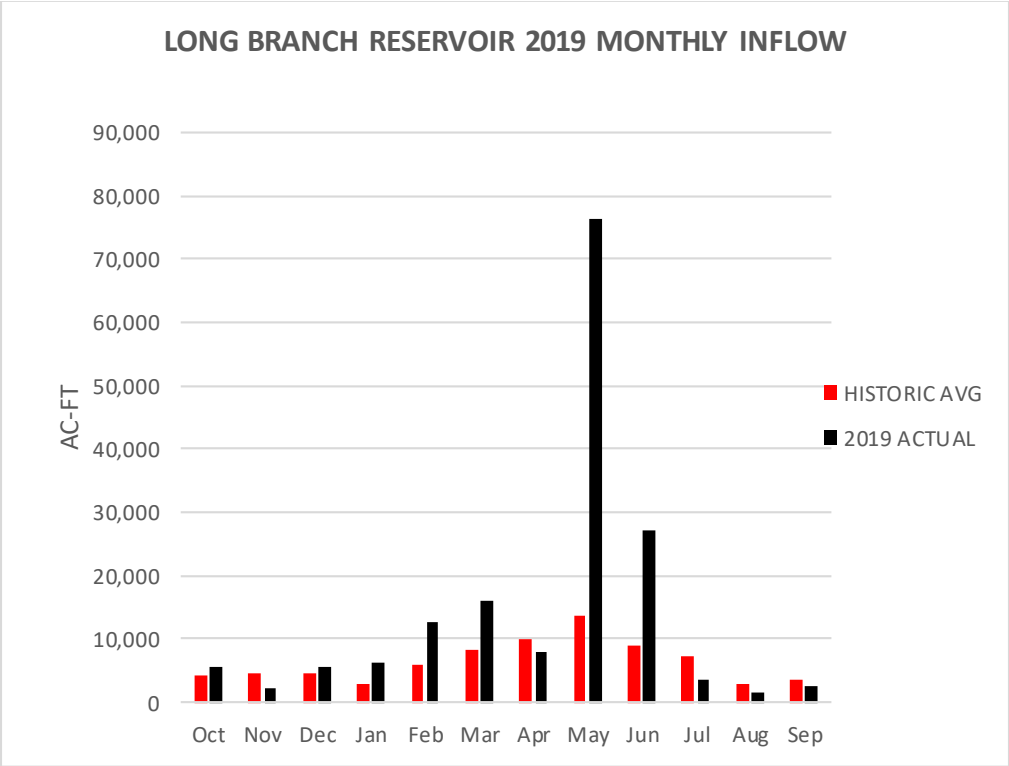


FIGURE A-28. LONG BRANCH 2019 MONTHLY INFLOWS

LONGVIEW LAKE
2019 REGULATION

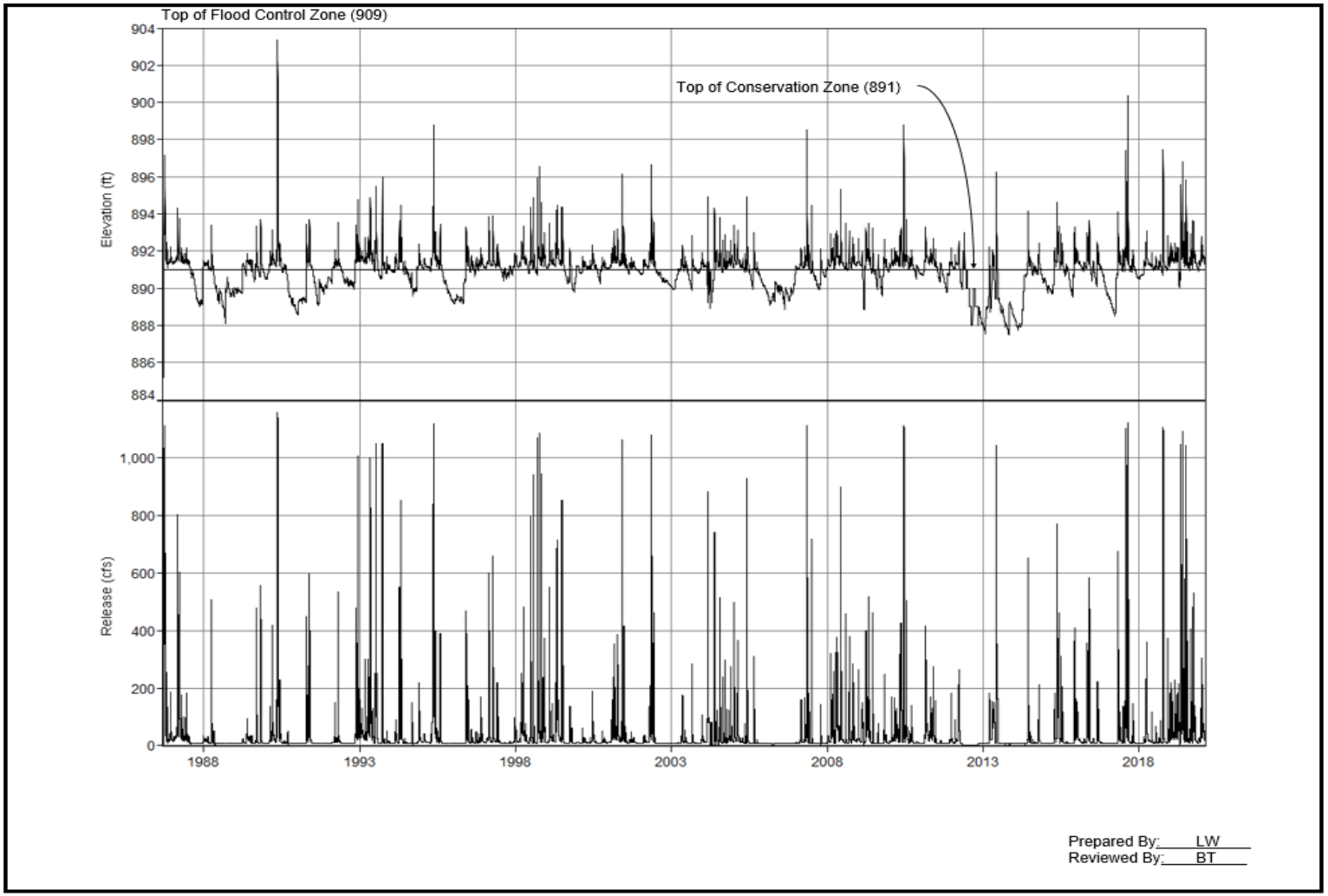


FIGURE A-29. LONGVIEW DAM HISTORICAL POOL ELEVATIONS AND RELEASES

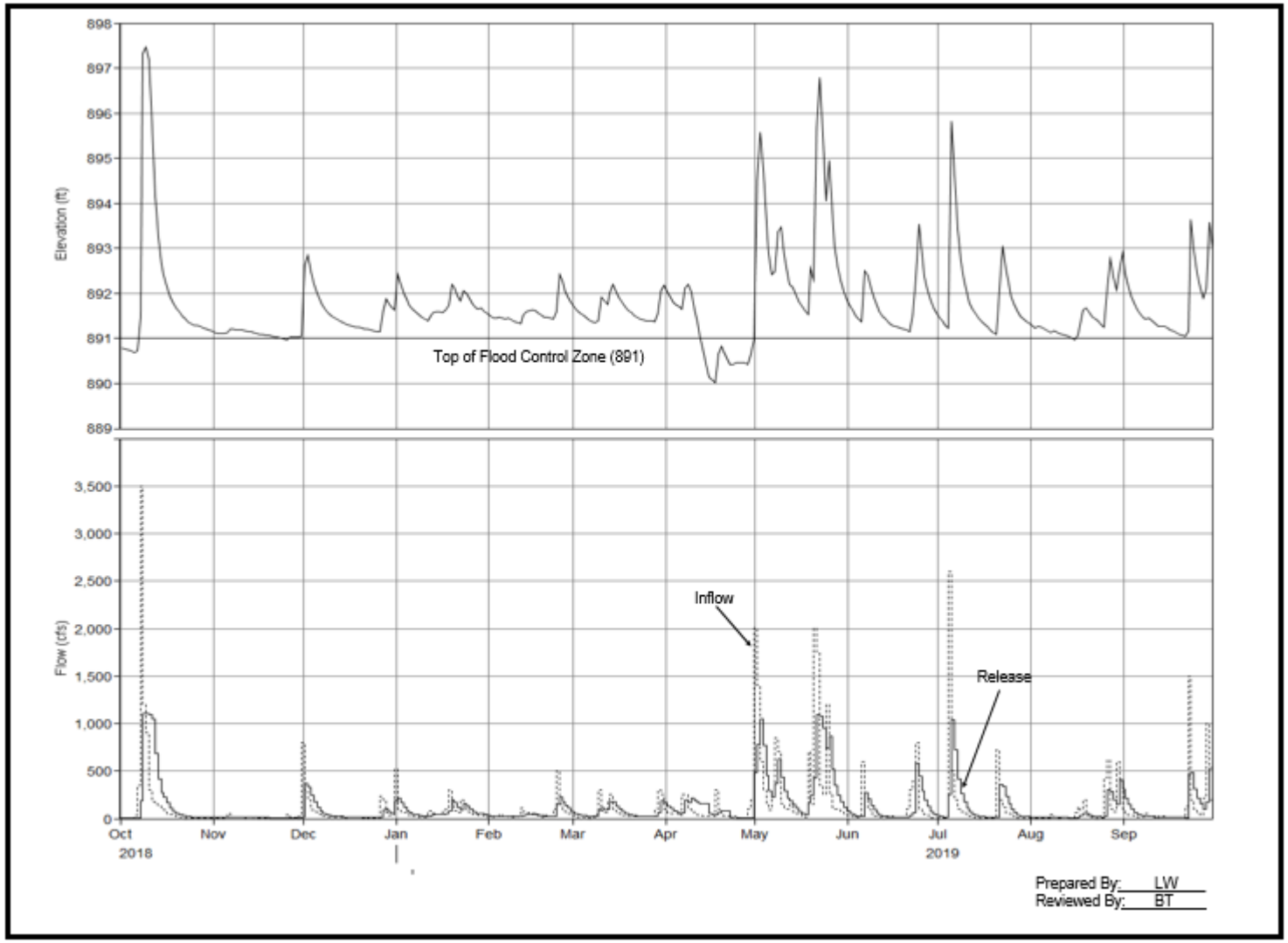


FIGURE A-30. LONGVIEW DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE A-8. LONGVIEW HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:

	Daily Inflow - Date	
Highest	8115 cfs	16-May-90
2nd	5800 cfs	22-Aug-17
3rd	4250 cfs	07-May-07
	Daily Outflow - Date	
Highest	1158 cfs	16-May-90
2nd	1122 cfs	23-Aug-17
3rd	1118 cfs	20-May-95
	Pool - Date	
Highest	903.4 ft	16-May-90
2nd	900.3 ft	22-Aug-17
3rd	898.8 ft	18-May-95

b. Minimums of Record (since initial fill)

	Pool - Date	
Lowest	887.5 ft	28-Oct-13
2nd	887.6 ft	28-Jan-13
3rd	888.1 ft	14-Sep-88

c. Report Period

Total Inflow		**Total Outflow**	
93,281 ac-ft	265% of norm	88,374 ac-ft	279% of norm
Peak Daily Inflow		**Peak Daily Outflow**	
3500 cfs	08-Oct-18	1107 cfs	10-Oct-18
Peak Pool Elev		**Min Pool Elev**	
897.5 ft	09-Oct-18	890.0 ft	17-Apr-19

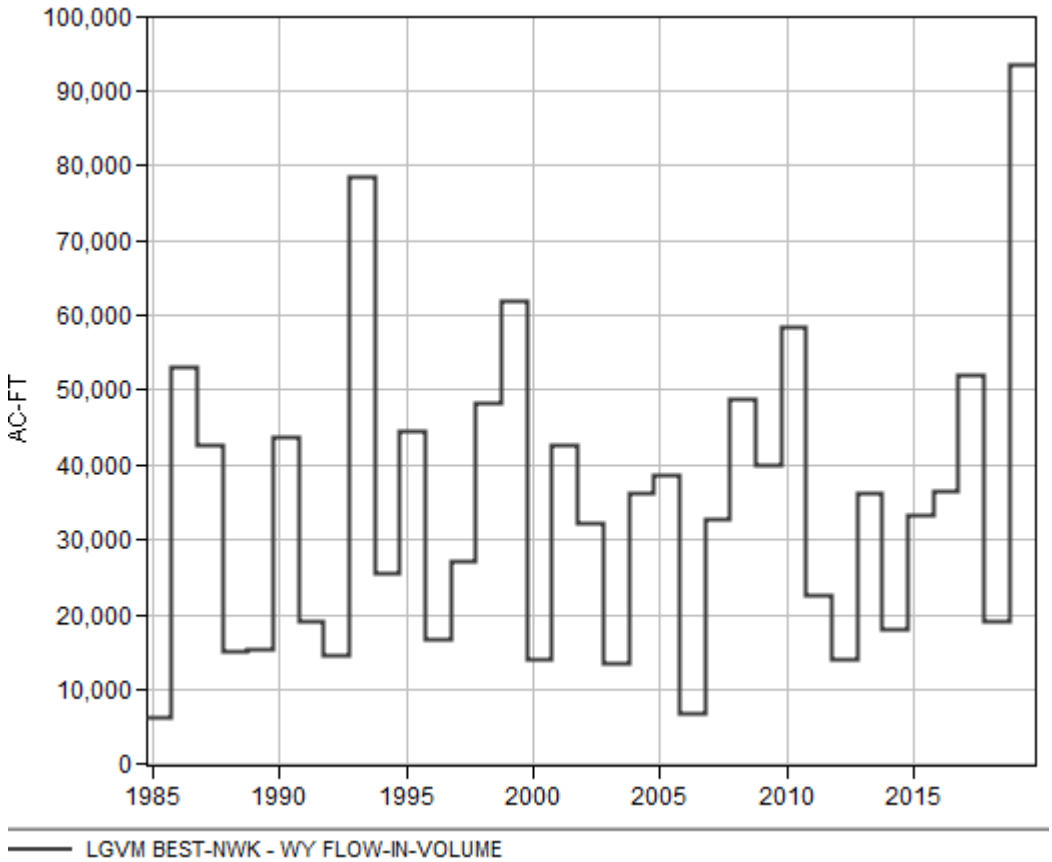


FIGURE A-31. LONGVIEW PERIOD OF RECORD ANNUAL INFLOWS

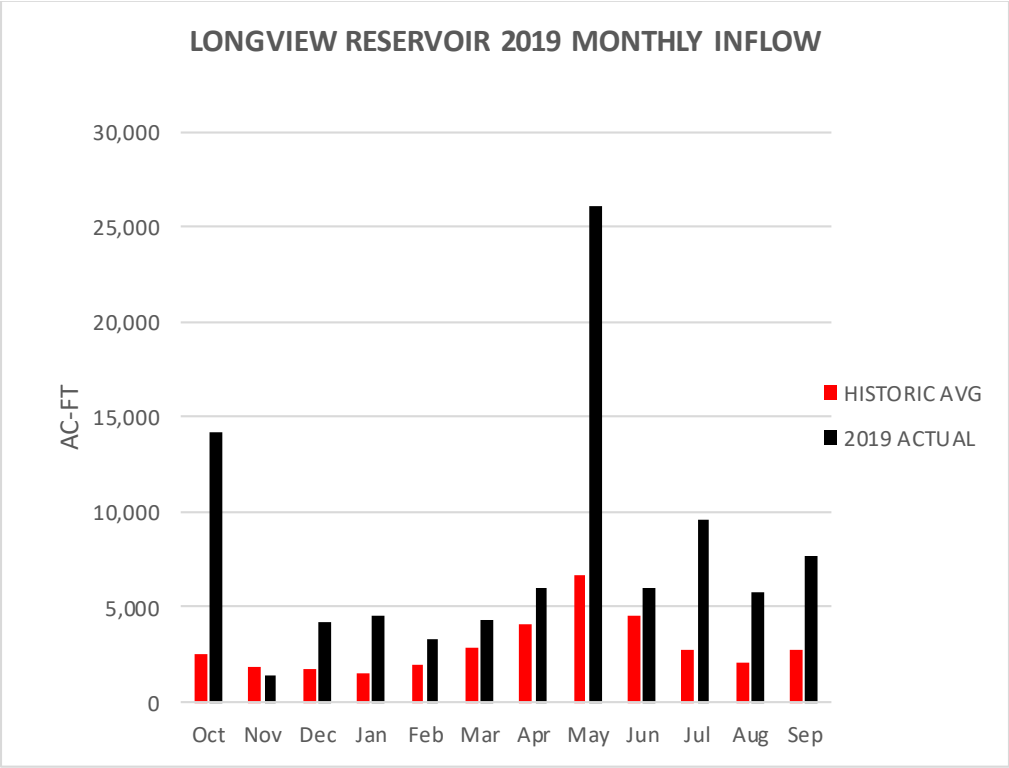


FIGURE A-32. LONGVIEW 2019 MONTHLY INFLOWS

MELVERN LAKE
2019 REGULATION

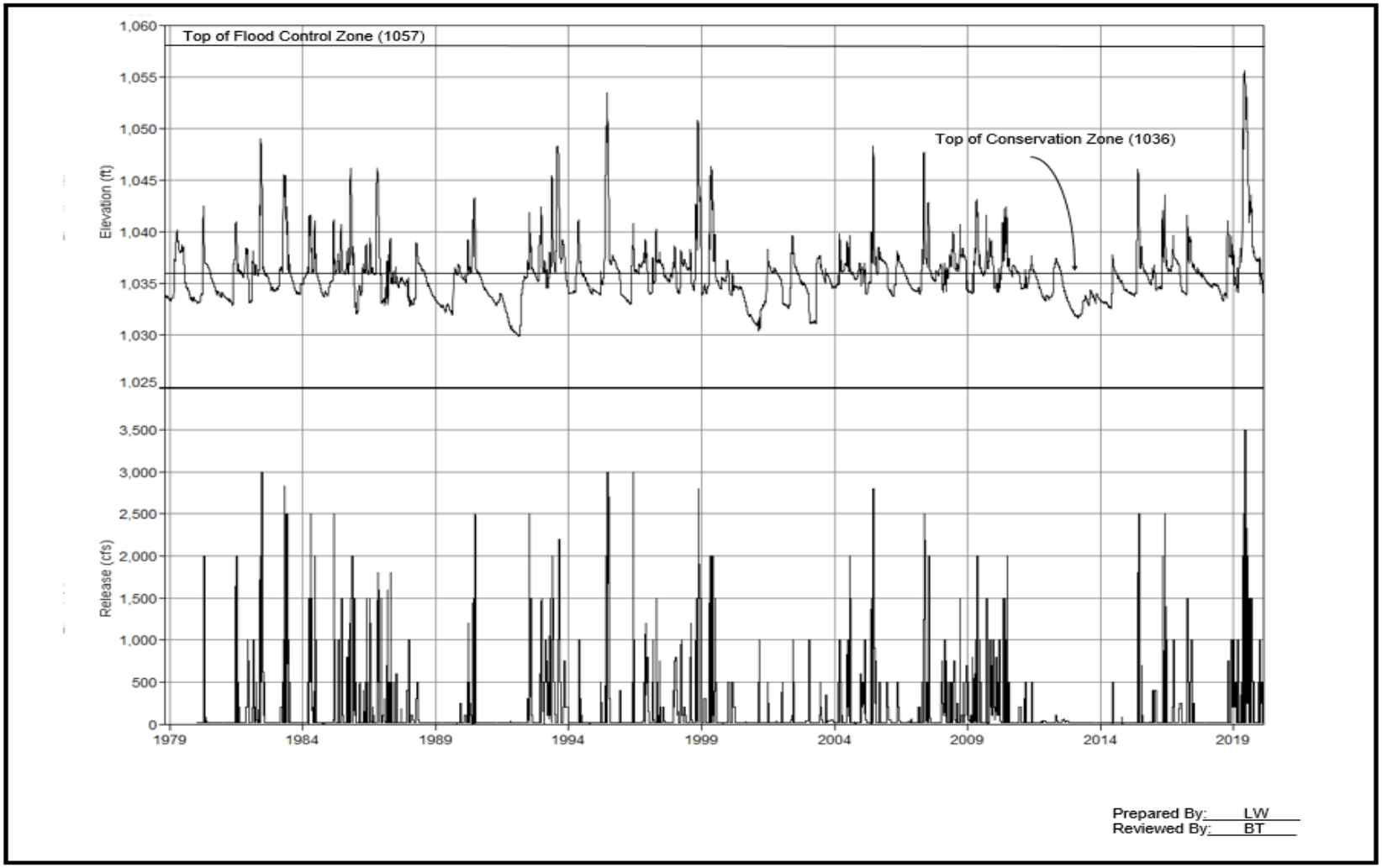


FIGURE A-33. MELVERN DAM HISTORICAL POOL ELEVATIONS AND RELEASES

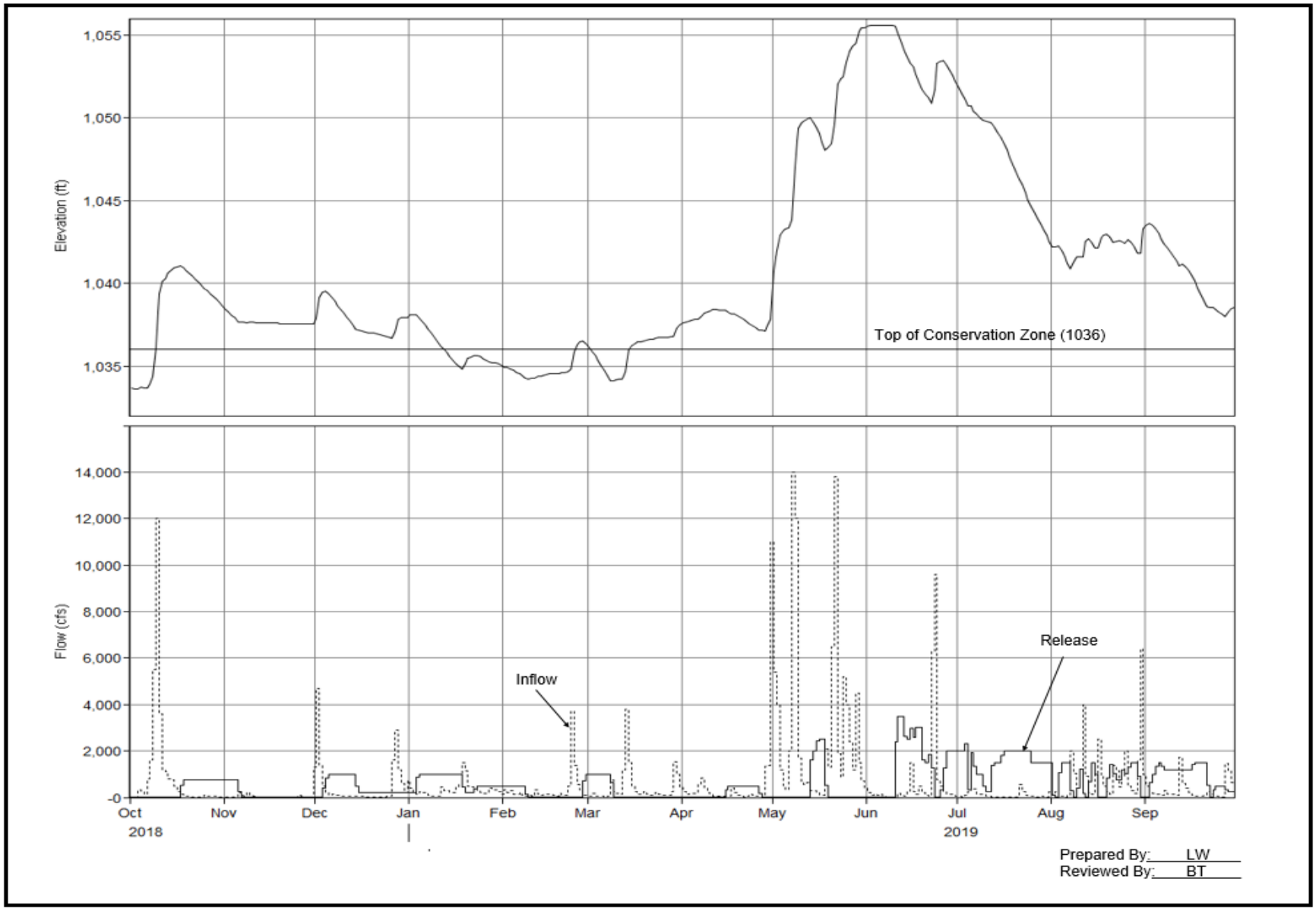


FIGURE A-34. MELVERN DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE A-9. MELVERN HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:			b. Minimums of Record (since initial fill)			
	Daily Inflow - Date			**Pool - Date**		
Highest	27810 cfs	02-Nov-98	Lowest	1029.9 ft	11-Feb-92	
2nd	21000 cfs	08-May-07	2nd	1030.4 ft	21-Feb-01	
3rd	18430 cfs	11-Oct-85	3rd	1030.4 ft	16-May-77	
	Daily Outflow - Date					
Highest	3500 cfs	13-Jun-19	**c. Report Period**			
2nd	3000 cfs	13-Jun-82	**Total Inflow**		**Total Outflow**	
3rd	3000 cfs	16-Jun-95	507,560 ac-ft	309% of norm	441,373 ac-ft	322% of norm
	Pool - Date		**Peak Daily Inflow**		**Peak Daily Outflow**	
Highest	1055.6 ft	06-Jun-19	14000 cfs	08-May-19	3500 cfs	13-Jun-19
2nd	1053.5 ft	13-Jun-95	**Peak Pool Elev**		**Min Pool Elev**	
3rd	1050.8 ft	11-Nov-98	1055.6 ft	01-Jun-19	1033.6 ft	02-Oct-18

Note: Daily outflows peak at 3000 cfs during three separate events: 1982, 1995, and 05-Jun-1996.

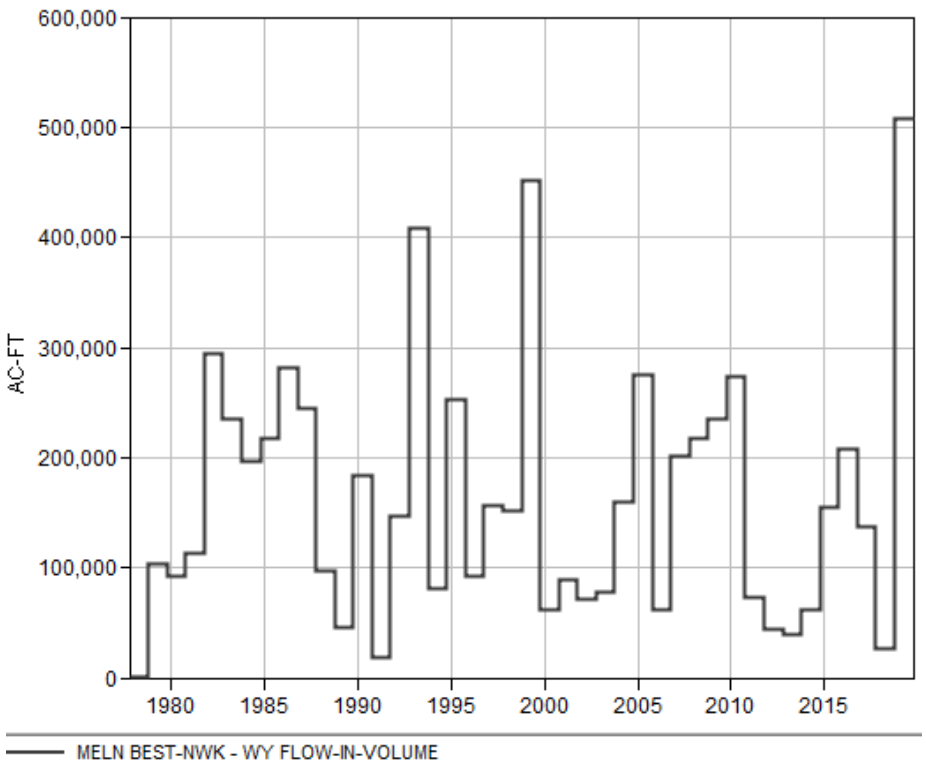


FIGURE A-35. MELVERN PERIOD OF RECORD ANNUAL INFLOWS

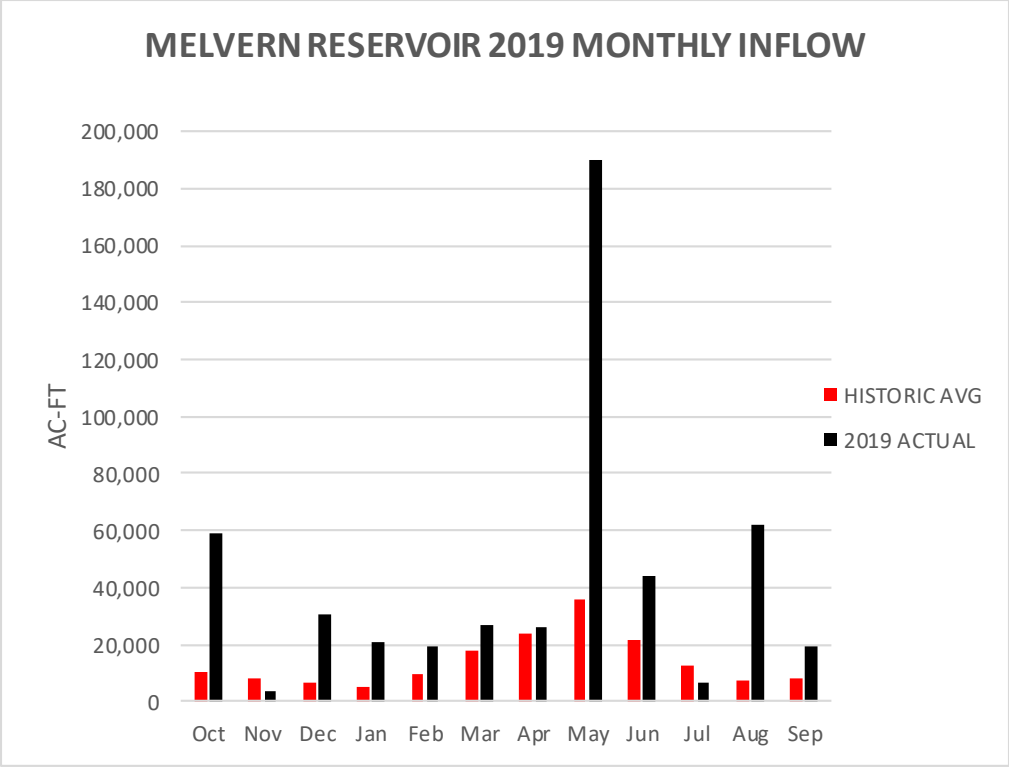


FIGURE A-36. MELVERN 2019 MONTHLY INFLOWS

MILFORD LAKE
2019 REGULATION

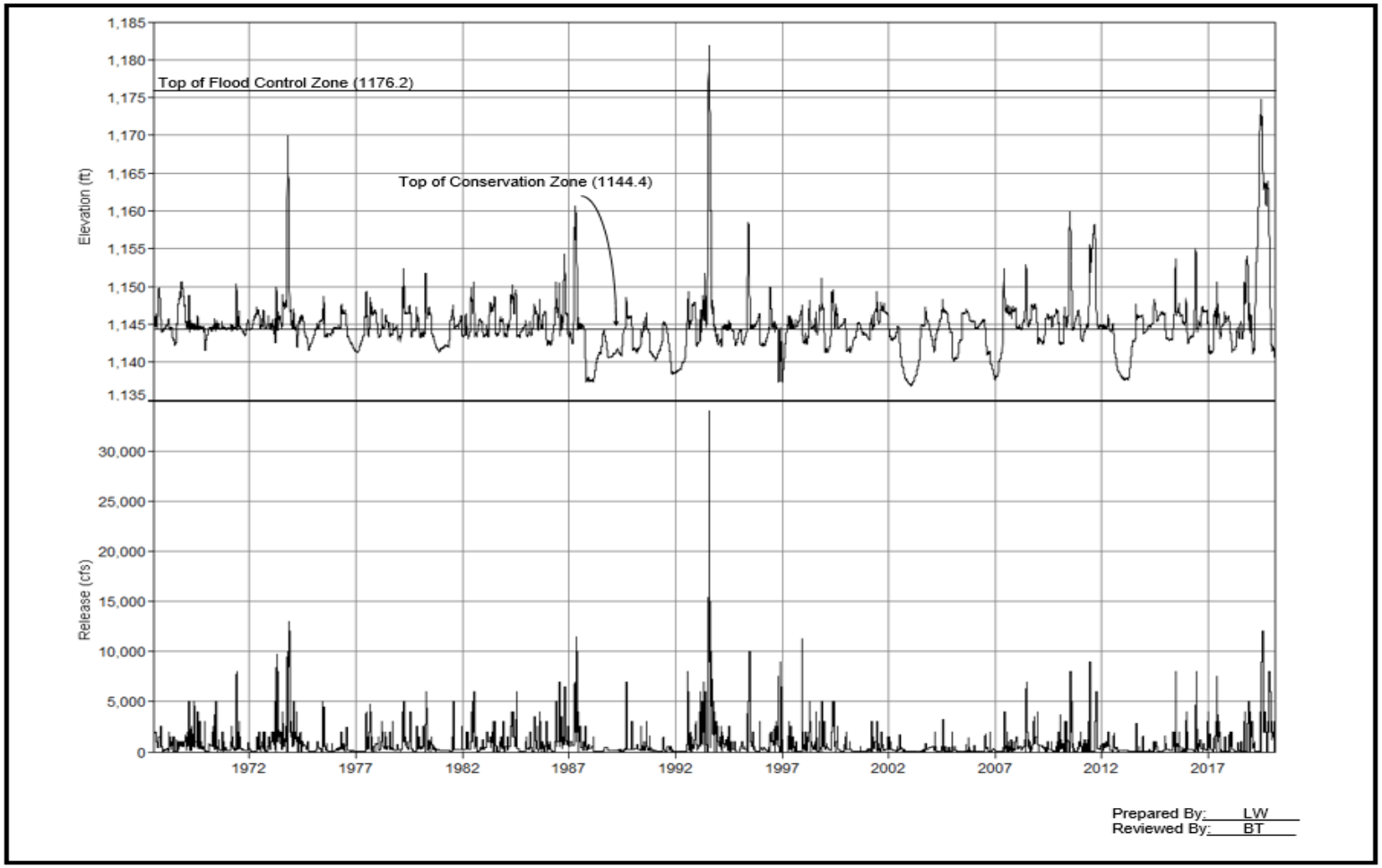


FIGURE A-37. MILFORD DAM HISTORICAL POOL ELEVATIONS AND RELEASES

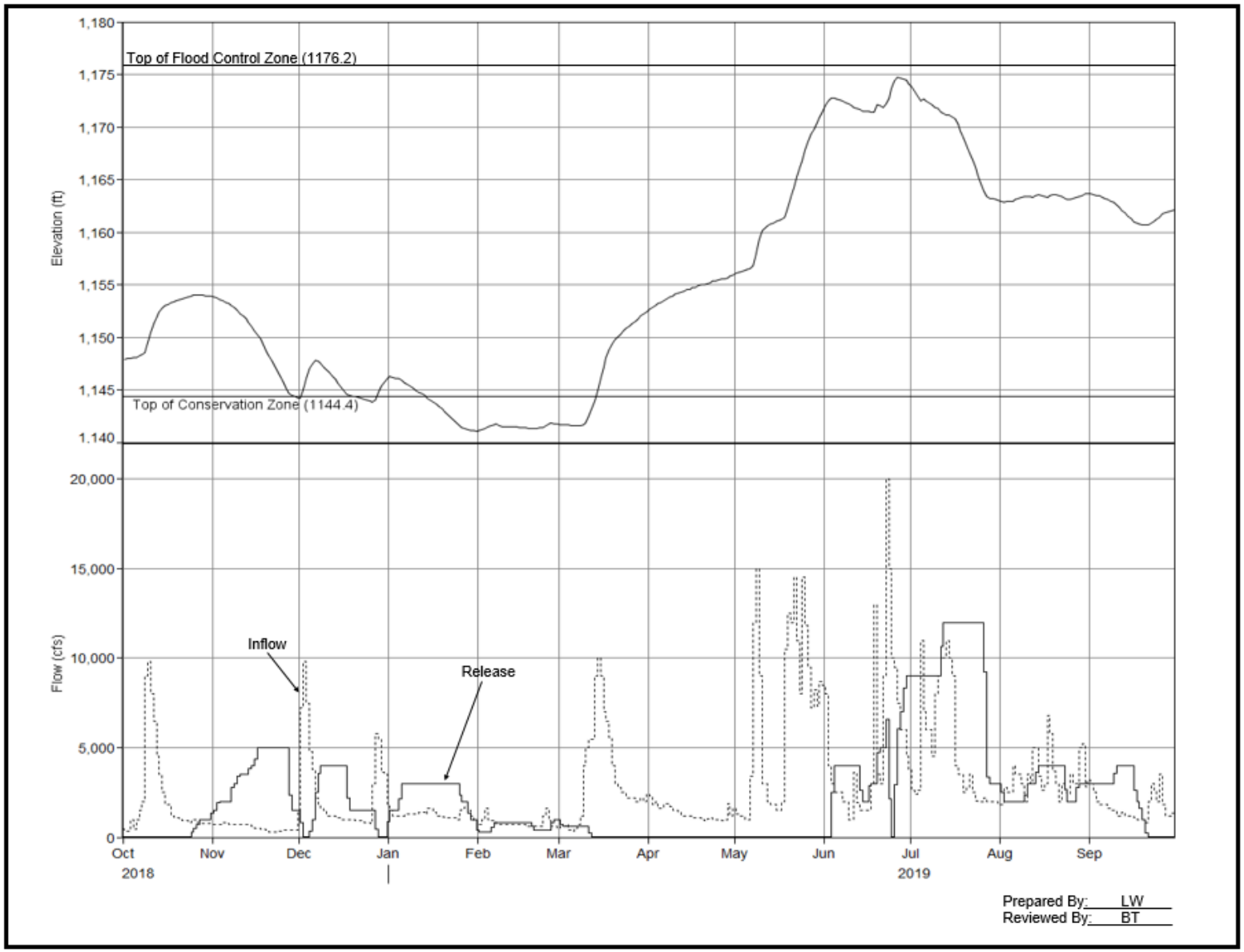


FIGURE A-38. MILFORD DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE A-10. MILFORD HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:

	Daily Inflow - Date	
Highest	42900 cfs	25-Jul-93
2nd	33650 cfs	12-Oct-73
3rd	32800 cfs	03-Jun-11
	Daily Outflow - Date	
Highest	34000 cfs	27-Jul-93
2nd	13000 cfs	15-Nov-73
3rd	12000 cfs	13-Jul-19
	Pool - Date	
Highest	1181.9 ft	25-Jul-93
2nd	1174.8 ft	26-Jun-19
3rd	1169.9 ft	18-Oct-73

b. Minimums of Record (since initial fill)

	Pool - Date	
Lowest	1136.9 ft	13-Jan-03
2nd	1137.3 ft	26-Feb-88
3rd	1137.3 ft	04-Nov-96

c. Report Period

Total Inflow		**Total Outflow**	
2,053,139 ac-ft	310% of norm	1,666,941 ac-ft	283% of norm
Peak Daily Inflow		**Peak Daily Outflow**	
20000 cfs	23-Jun-19	12000 cfs	13-Jul-19
Peak Pool Elev		**Min Pool Elev**	
1174.8 ft	26-Jun-19	1141.1 ft	31-Jan-19

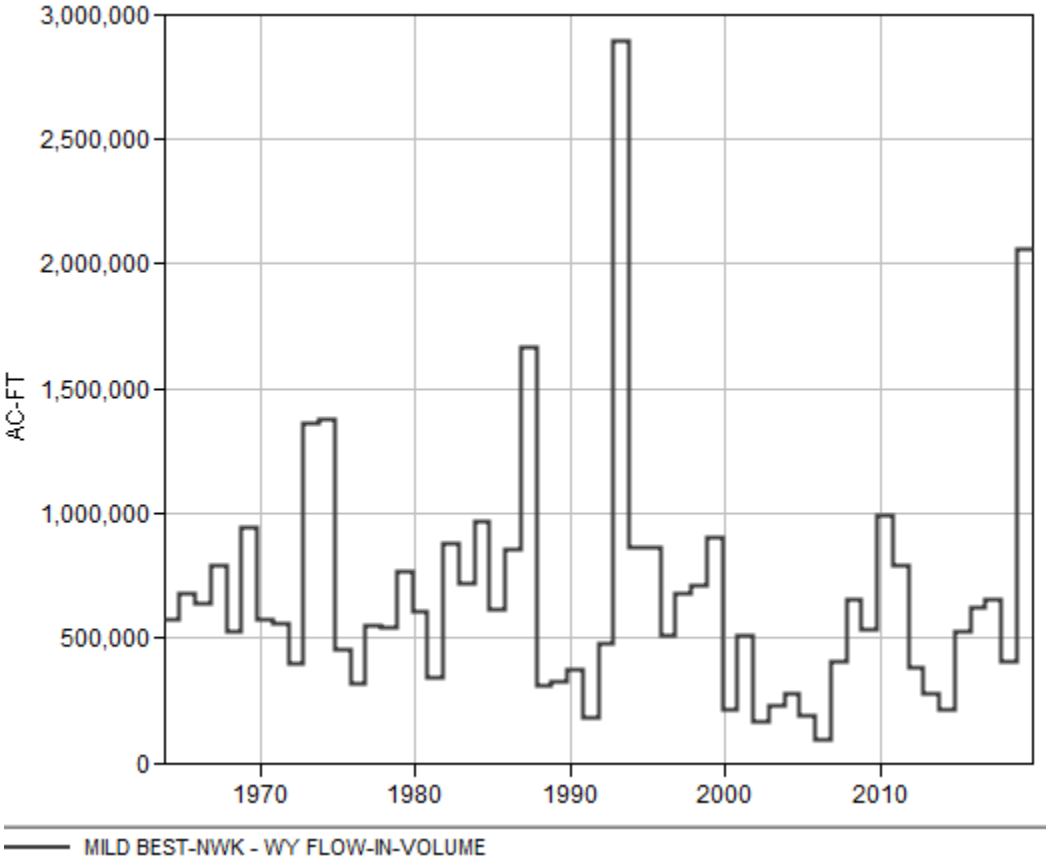


FIGURE A-39. MILFORD PERIOD OF RECORD ANNUAL INFLOWS

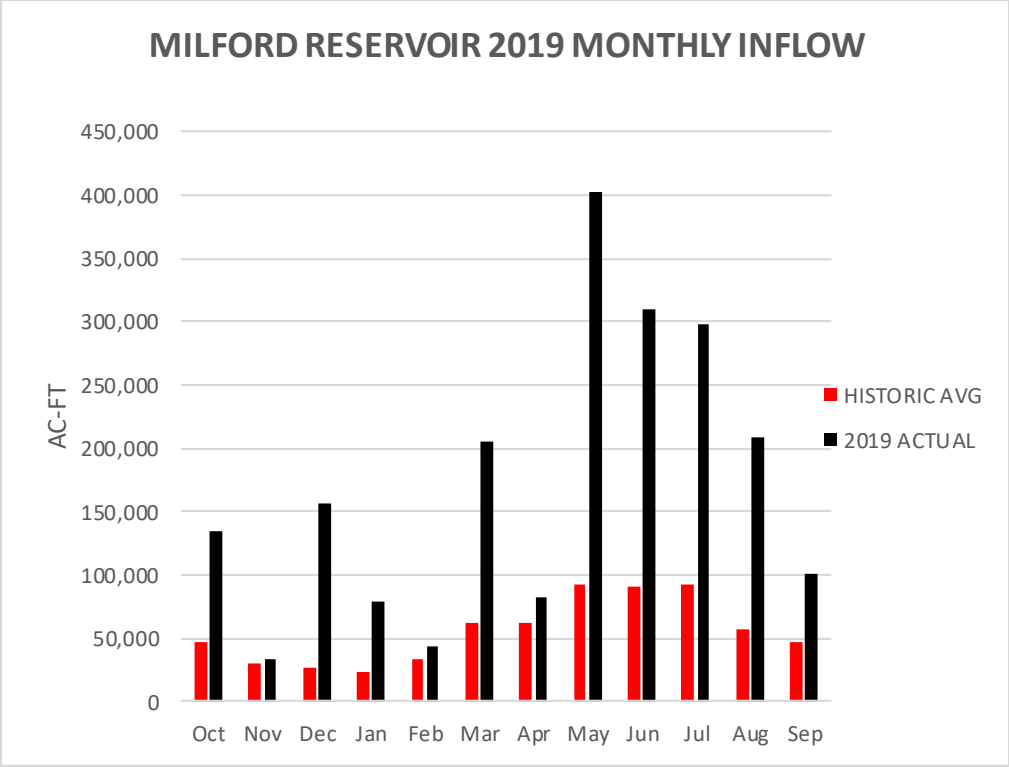


FIGURE A-40. MILFORD 2019 MONTHLY INFLOWS

PERRY LAKE
2019 REGULATION

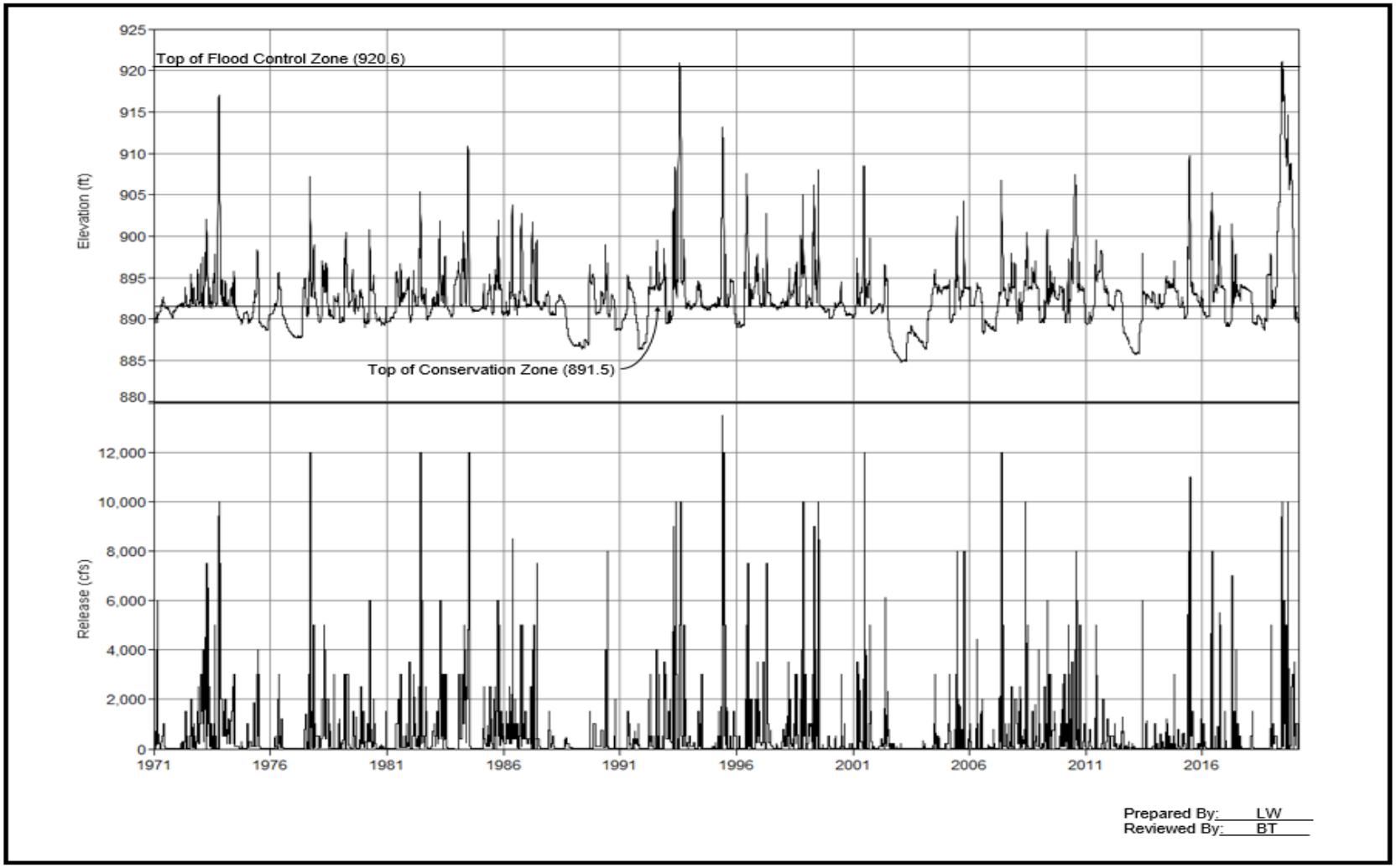


FIGURE A-41. PERRY DAM HISTORICAL POOL ELEVATIONS AND RELEASES

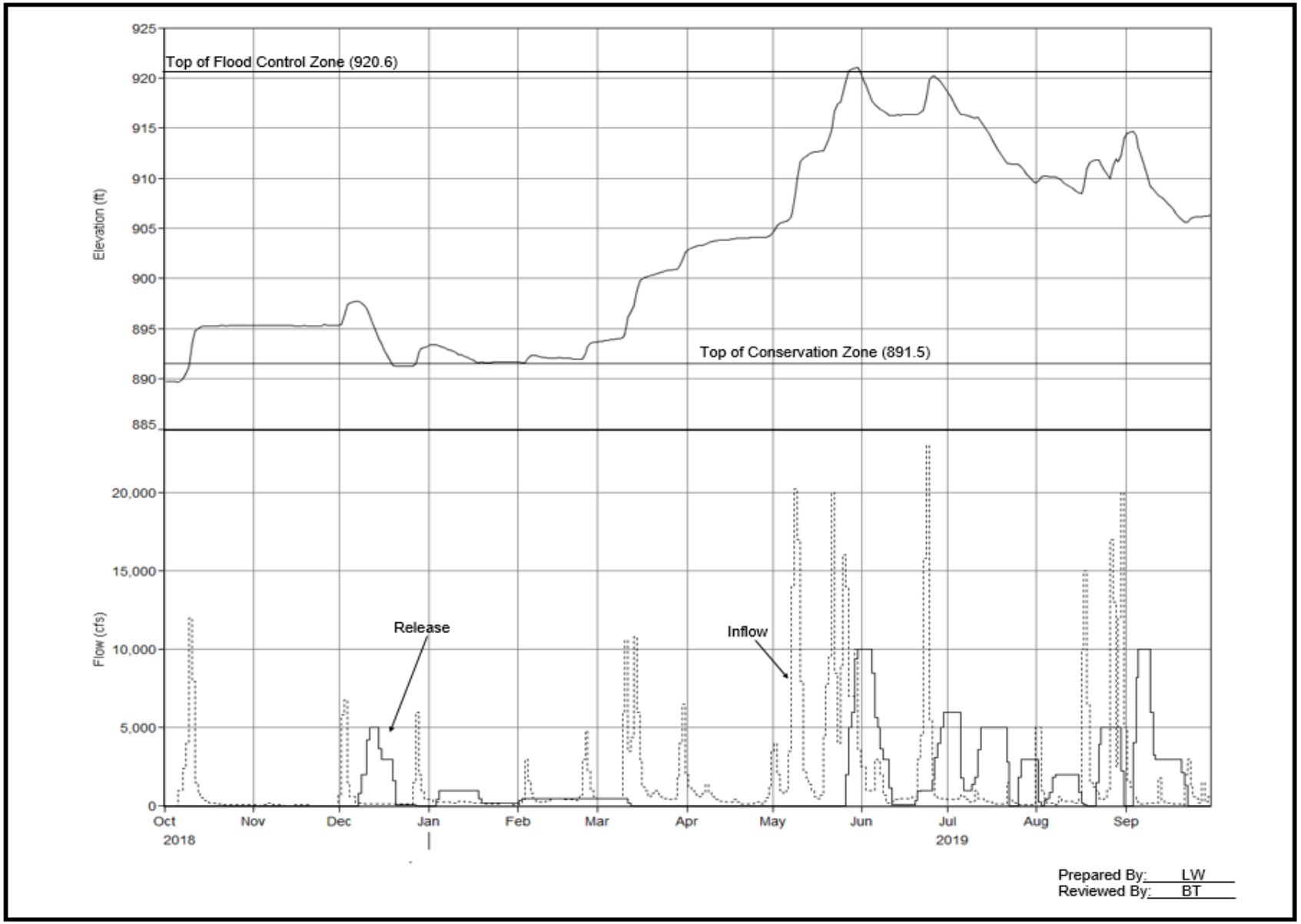


FIGURE A-42. PERRY DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE A-11. PERRY HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:			b. Minimums of Record (since initial fill)			
	Daily Inflow - Date			**Pool - Date**		
Highest	59850 cfs	12-Oct-73	Lowest	884.8 ft	30-Jan-03	
2nd	48000 cfs	03-Oct-05	2nd	885.7 ft	21-Feb-13	
3rd	46500 cfs	29-Jun-99	3rd	886.3 ft	14-Nov-91	
	Daily Outflow - Date					
Highest	16000 cfs	18-Jun-67	**c. Report Period**			
2nd	13479 cfs	01-Jun-95	**Total Inflow**		**Total Outflow**	
3rd	12500 cfs	03-Aug-68	1,220,906 ac-ft	230% of norm	944,208 ac-ft	195% of norm
	Pool - Date		**Peak Daily Inflow**		**Peak Daily Outflow**	
Highest	921.0 ft	30-May-19	23000 cfs	24-Jun-19	10000 cfs	31-May-19
2nd	920.9 ft	25-Jul-93	**Peak Pool Elev**		**Min Pool Elev**	
3rd	917.0 ft	19-Oct-73	921.0 ft	30-May-19	889.7 ft	05-Oct-18

Note: The peak daily outflow of 12000 cfs occurred during five separate events: 17Sep1977, 13Jun1982, 11Jul1984, 25Jun2001, and 23May2007

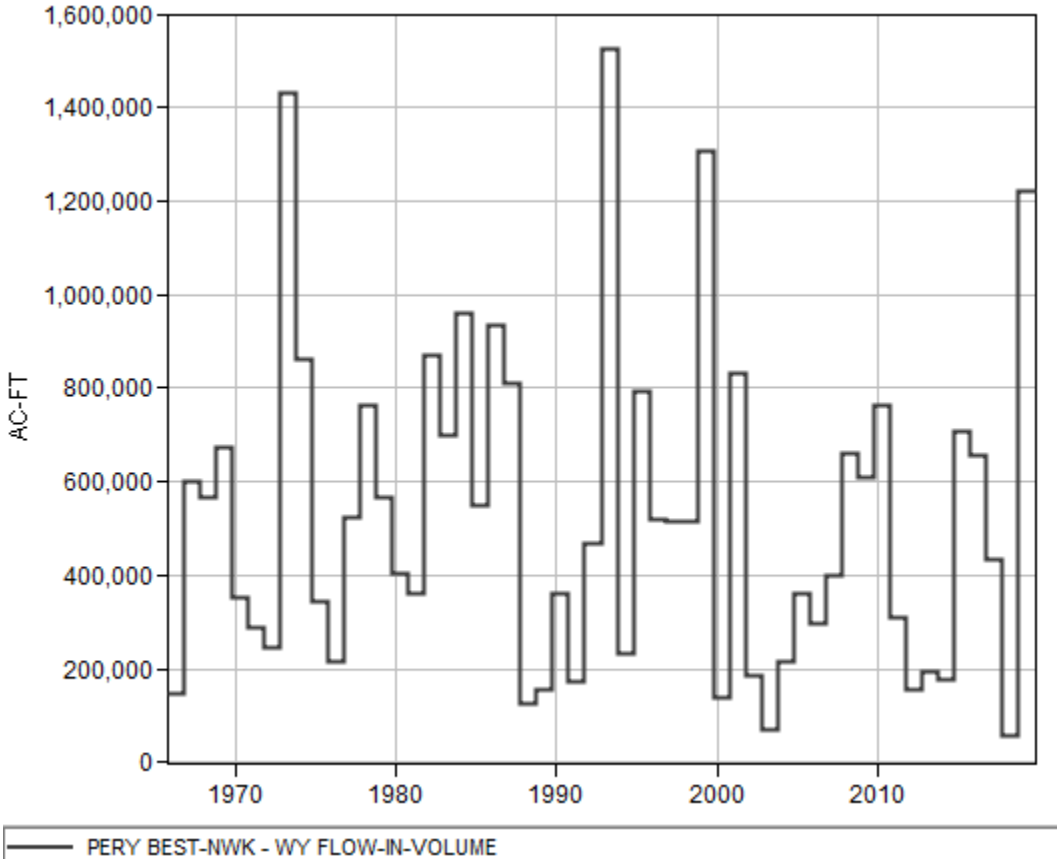


FIGURE A-43. PERRY PERIOD OF RECORD ANNUAL INFLOWS

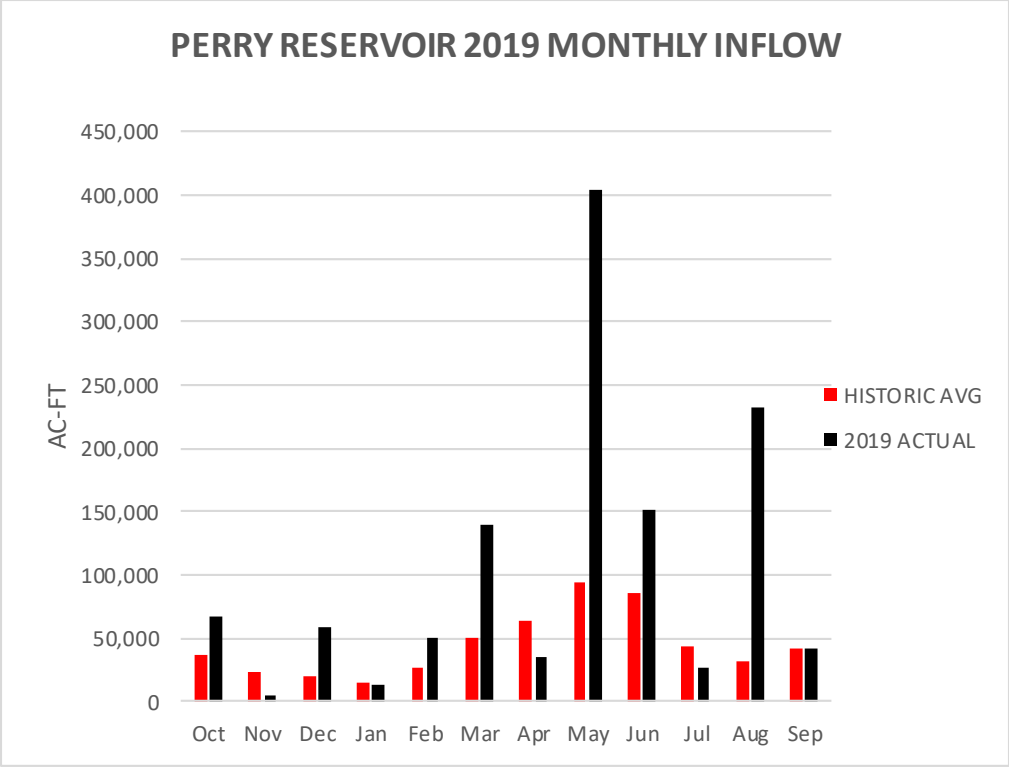


FIGURE A-44. PERRY 2019 MONTHLY INFLOWS

POMME DE TERRE LAKE
2019 REGULATION

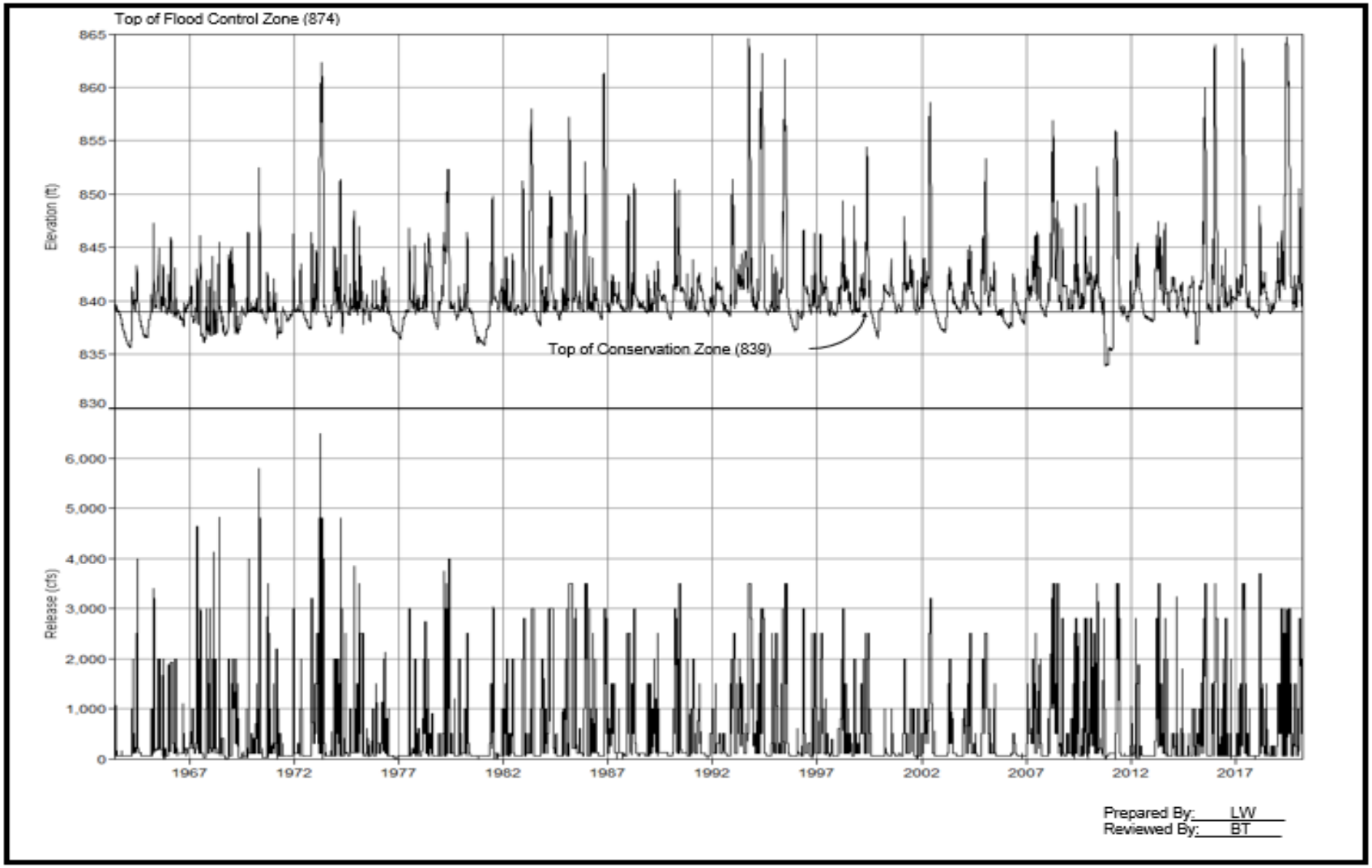


FIGURE A-45. POMME DE TERRE DAM HISTORICAL POOL ELEVATIONS AND RELEASES

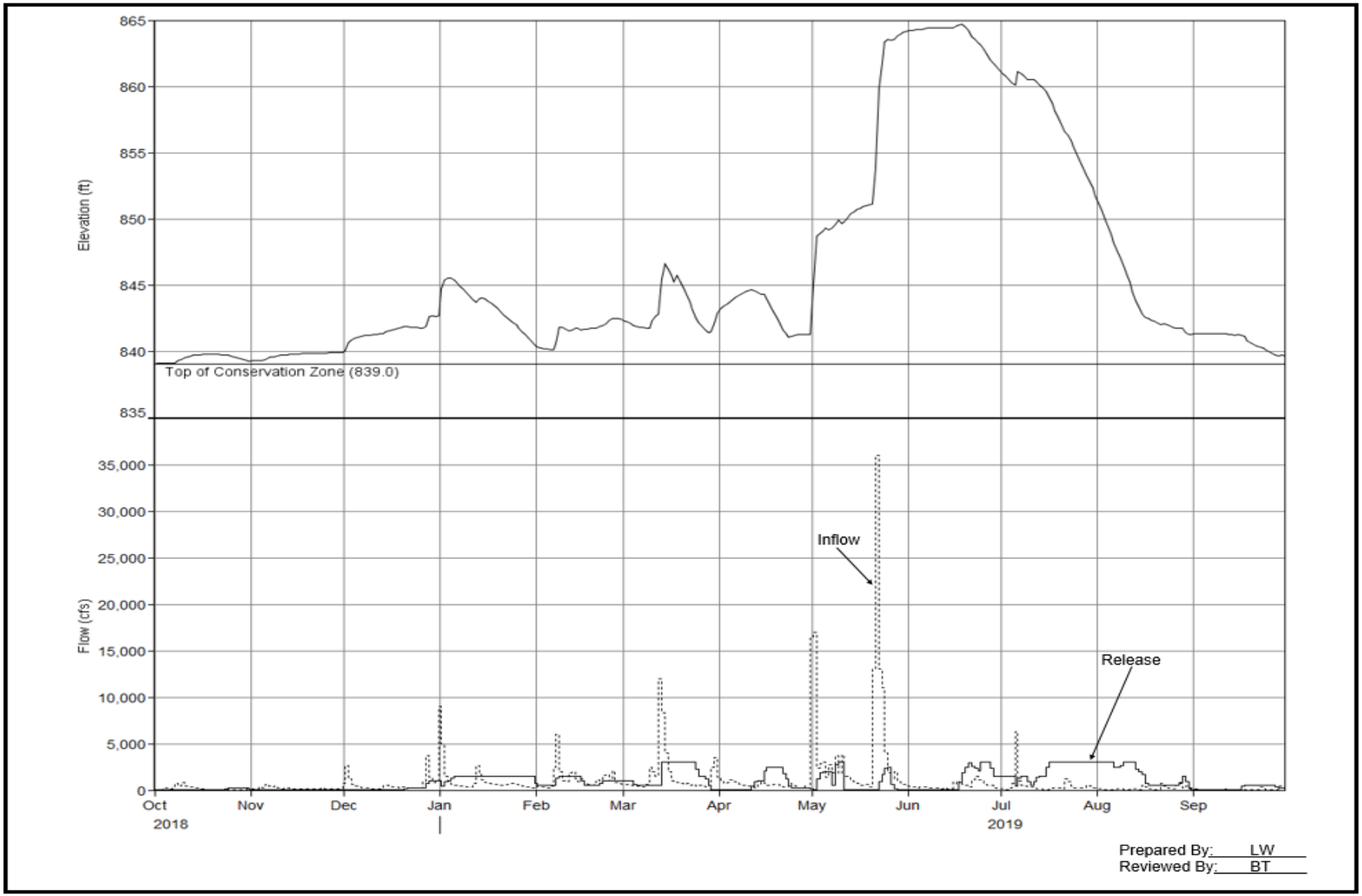


FIGURE A-46. POMME DE TERRE DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE A-12. POMME DE TERRE HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:

	Daily Inflow - Date	
Highest	64000 cfs	28-Dec-15
2nd	52500 cfs	25-Sep-93
3rd	46450 cfs	12-Apr-94
	Daily Outflow - Date	
Highest	9000 cfs	09-May-61
2nd	6500 cfs	10-Apr-73
3rd	5800 cfs	07-May-70
	Pool - Date	
Highest	864.7 ft	18-Jun-19
2nd	864.6 ft	27-Sep-93
3rd	863.9 ft	30-Dec-15

b. Minimums of Record (since initial fill)

	Pool - Date	
Lowest	833.9 ft	01-Nov-10
2nd	835.6 ft	03-Mar-64
3rd	835.8 ft	08-Feb-81

c. Report Period

Total Inflow		**Total Outflow**	
705,330 ac-ft	164% of norm	666,929 ac-ft	166% of norm
Peak Daily Inflow		**Peak Daily Outflow**	
36000 cfs	22-May-19	3000 cfs	14-Mar-19
Peak Pool Elev		**Min Pool Elev**	
864.7 ft	18-Jun-19	839.1 ft	03-Oct-18

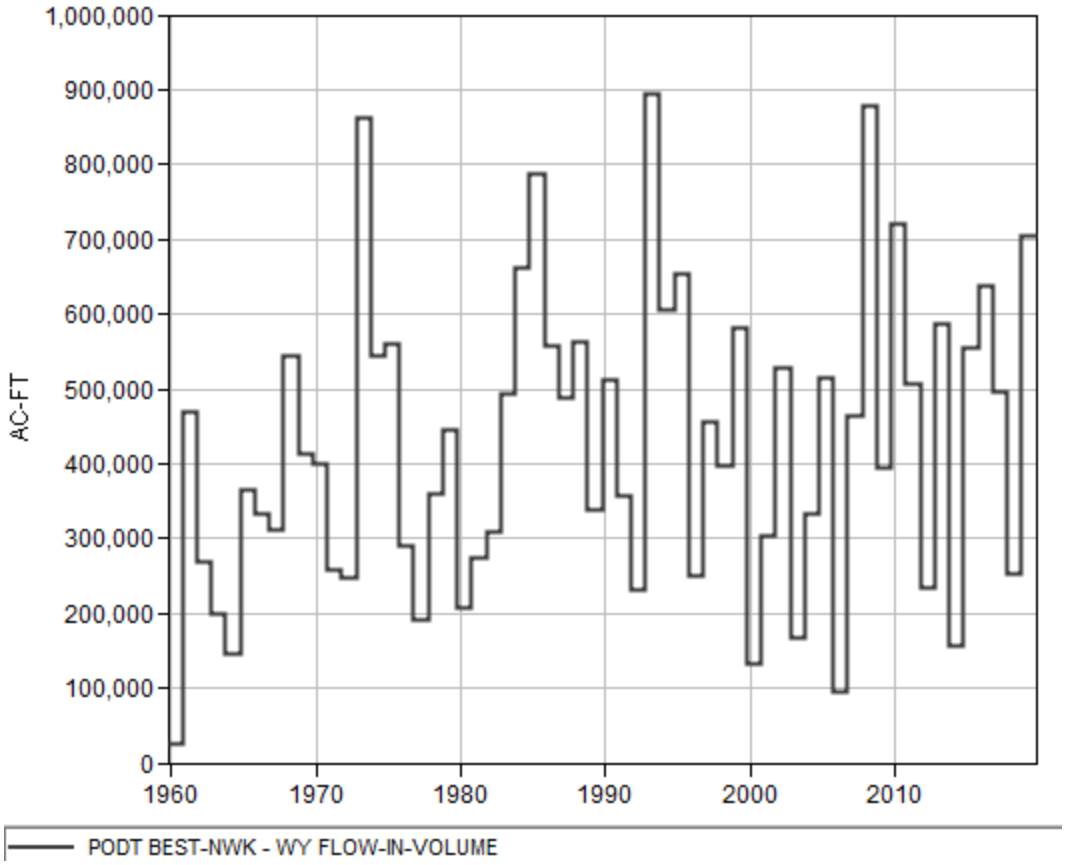


FIGURE A-47. POMME DE TERRE PERIOD OF RECORD ANNUAL INFLOWS

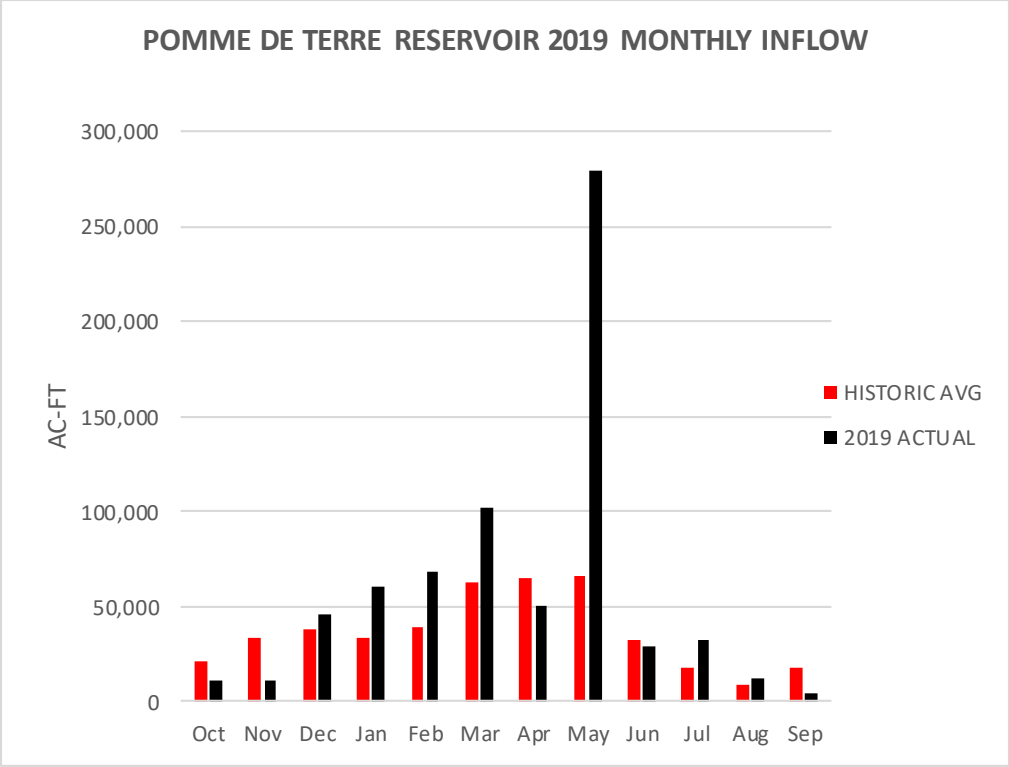


FIGURE A-48. POMME DE TERRE 2019 MONTHLY INFLOWS

POMONA LAKE
2019 REGULATION

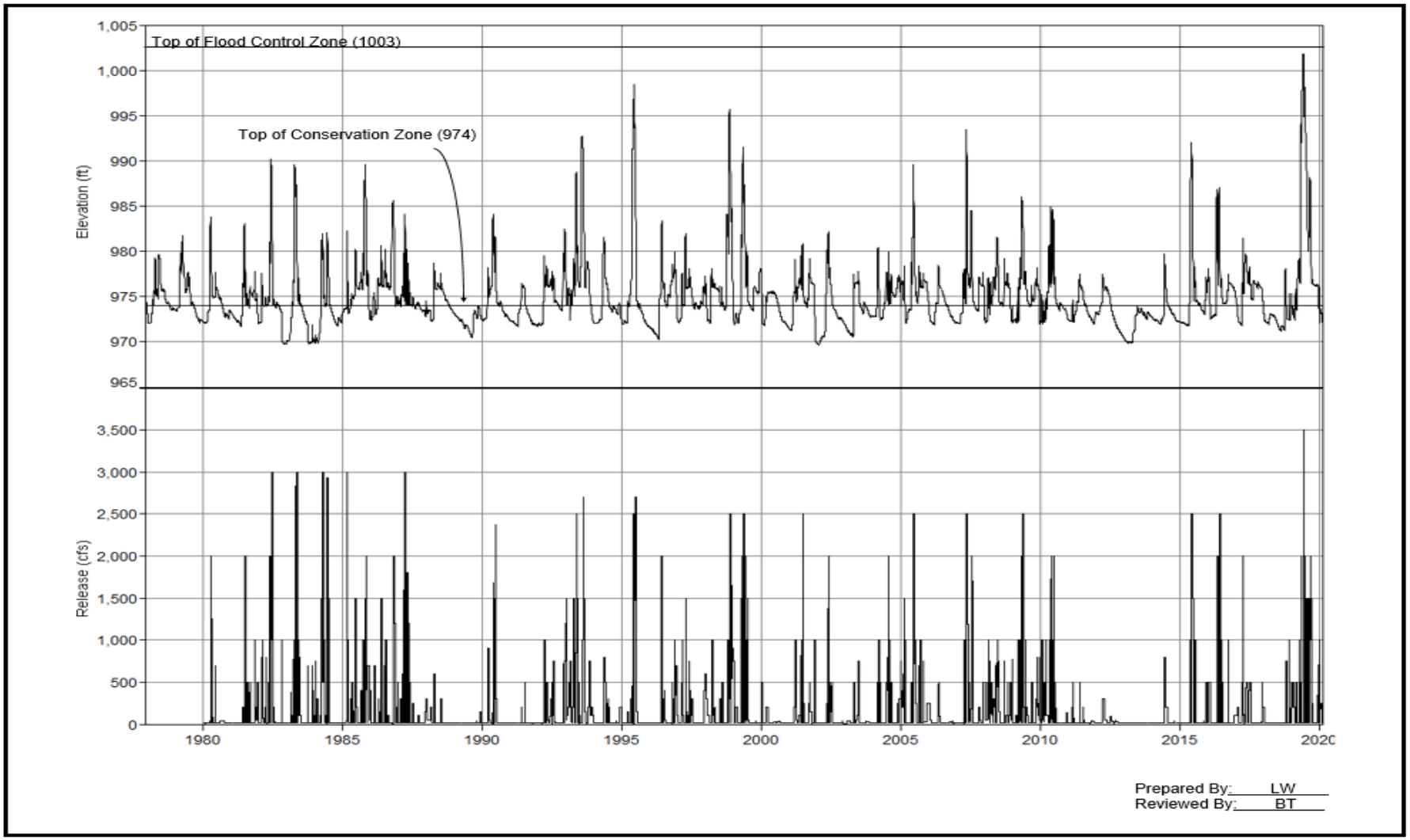


FIGURE A-49. POMONA DAM HISTORICAL POOL ELEVATIONS AND RELEASES

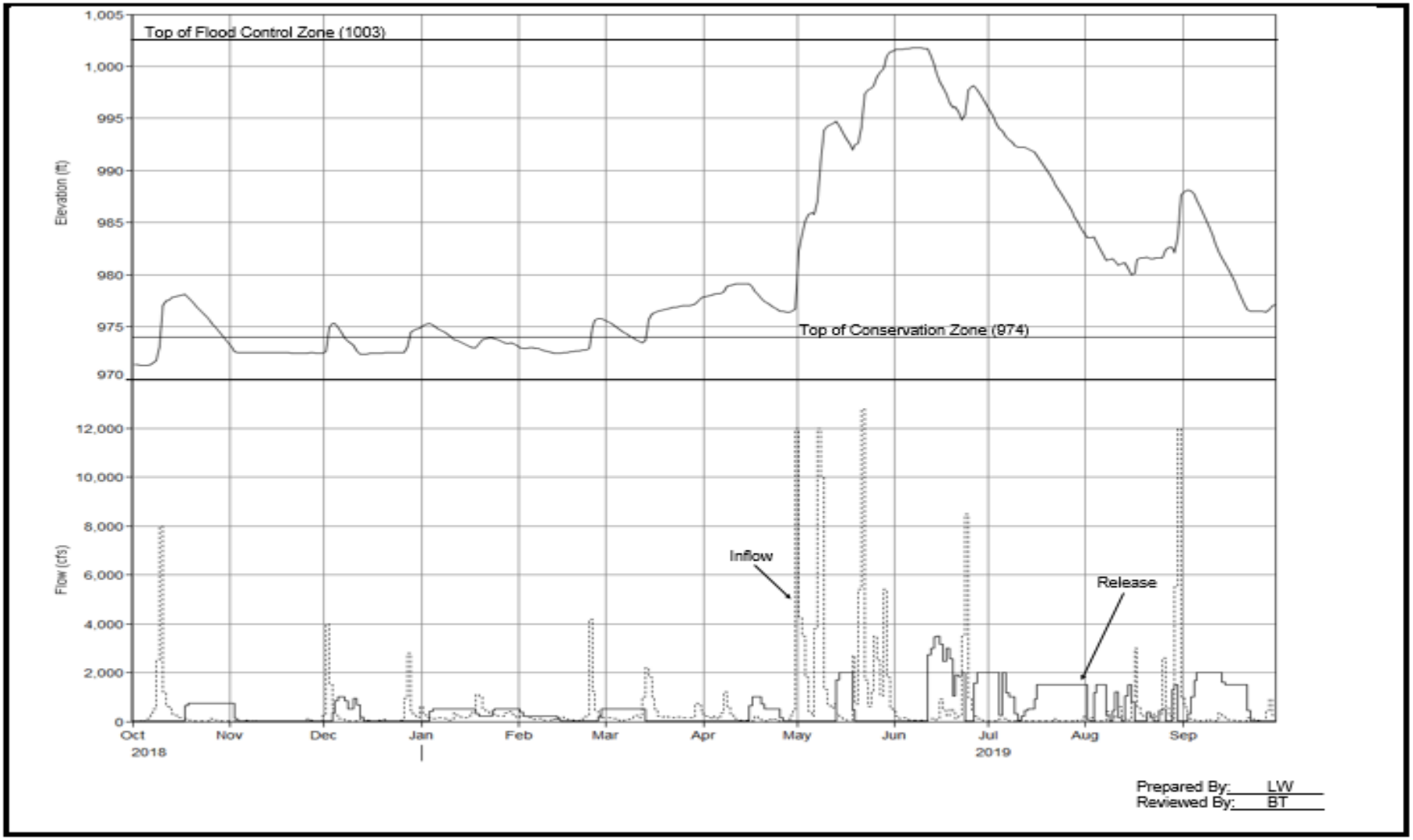


FIGURE A-50. POMONA DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE A-13. POMONA HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:

	Daily Inflow	Date
Highest	25000 cfs	08-May-07
2nd	24635 cfs	02-Nov-98
3rd	17225 cfs	18-May-95
	Daily Outflow	**Date**
Highest	3500 cfs	15-Jun-19
2nd	3000 cfs	13-Jun-82
3rd	3000 cfs	07-May-83
	Pool	**Date**
Highest	1001.8 ft	06-Jun-19
2nd	998.4 ft	13-Jun-95
3rd	995.7 ft	11-Nov-98

b. Minimums of Record (since initial fill)

	Pool	Date
Lowest	969.7 ft	27-Jan-02
2nd	969.8 ft	22-Dec-82
3rd	969.8 ft	18-Oct-83

c. Report Period

Total Inflow		Total Outflow	
413,177 ac-ft	281% of norm	371,201 ac-ft	283% of norm
Peak Daily Inflow		**Peak Daily Outflow**	
12800 cfs	22-May-19	3500 cfs	15-Jun-19
Peak Pool Elev		**Min Pool Elev**	
1001.8 ft	06-Jun-19	971.3 ft	05-Oct-18

Note: Daily outflow peaked at 3000 cfs during five separate events: 13Jun1982, 07May1983, 17Apr1984, 02Mar1985, and 29Mar1987.

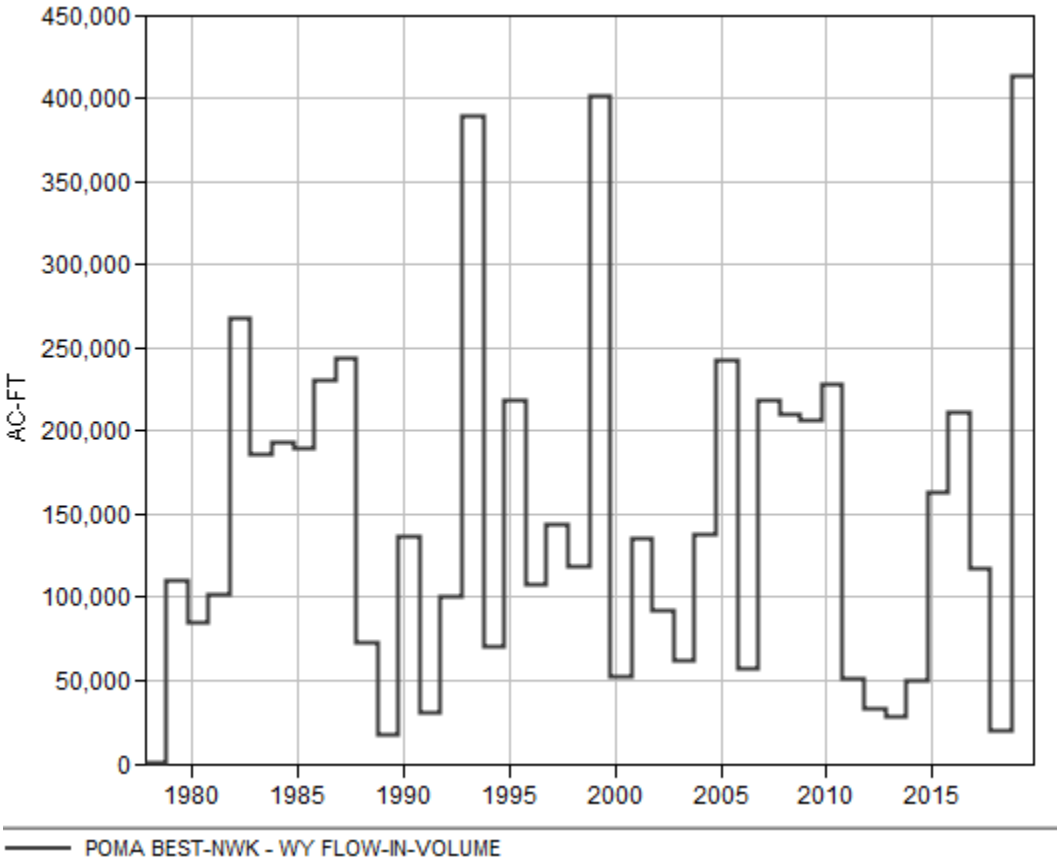


FIGURE A-51. POMONA PERIOD OF RECORD ANNUAL INFLOWS

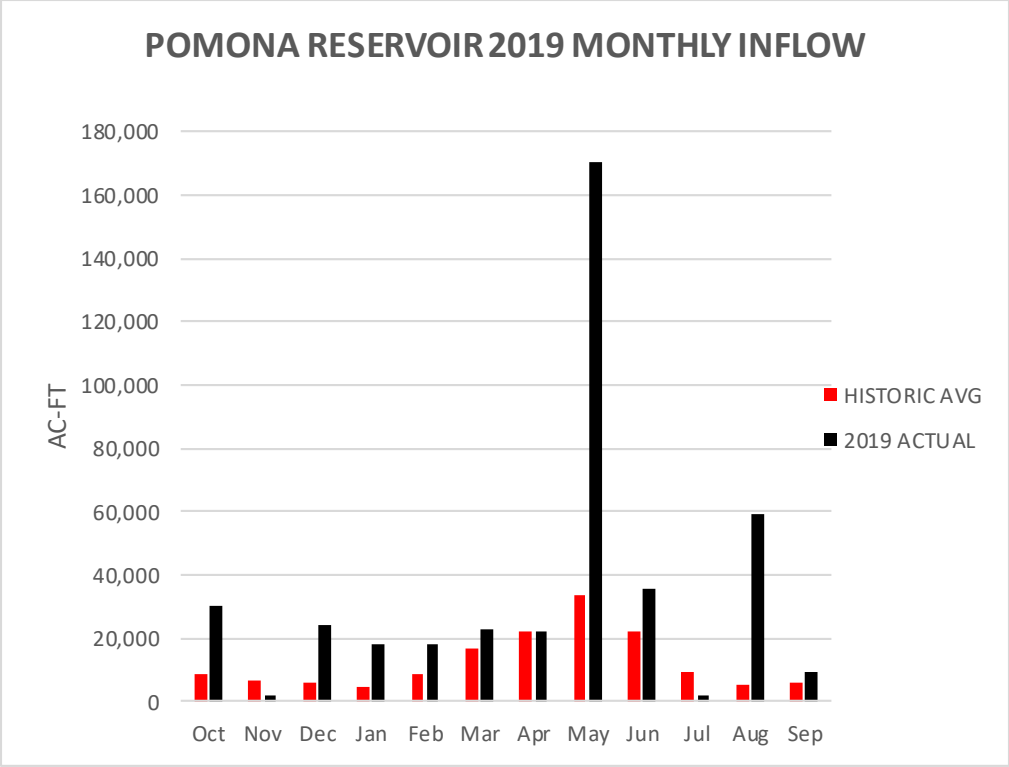


FIGURE A-52. POMONA 2019 MONTHLY INFLOWS

RATHBUN LAKE
2019 REGULATION

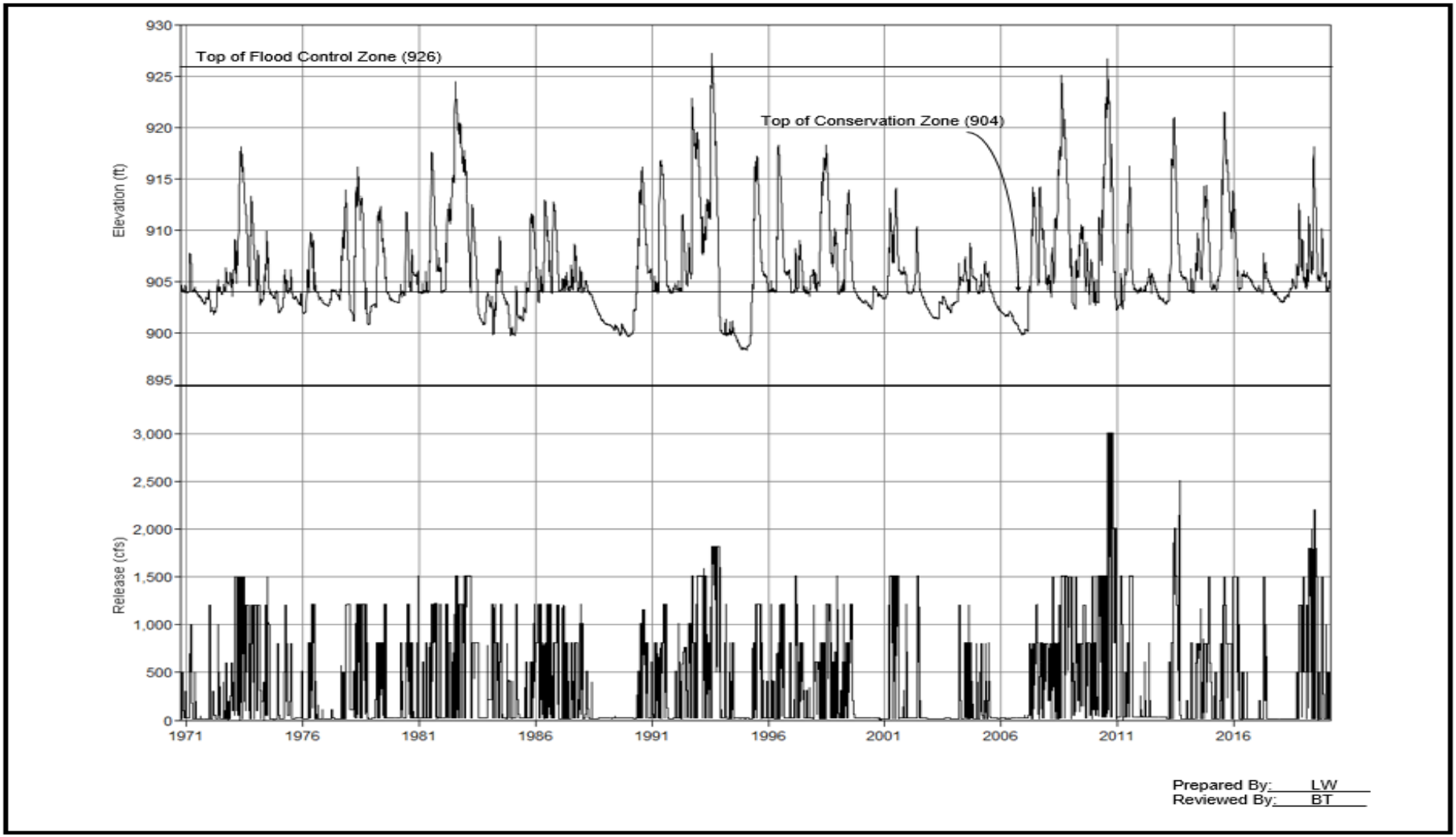


FIGURE A-53. RATHBUN DAM HISTORICAL POOL ELEVATIONS AND RELEASES

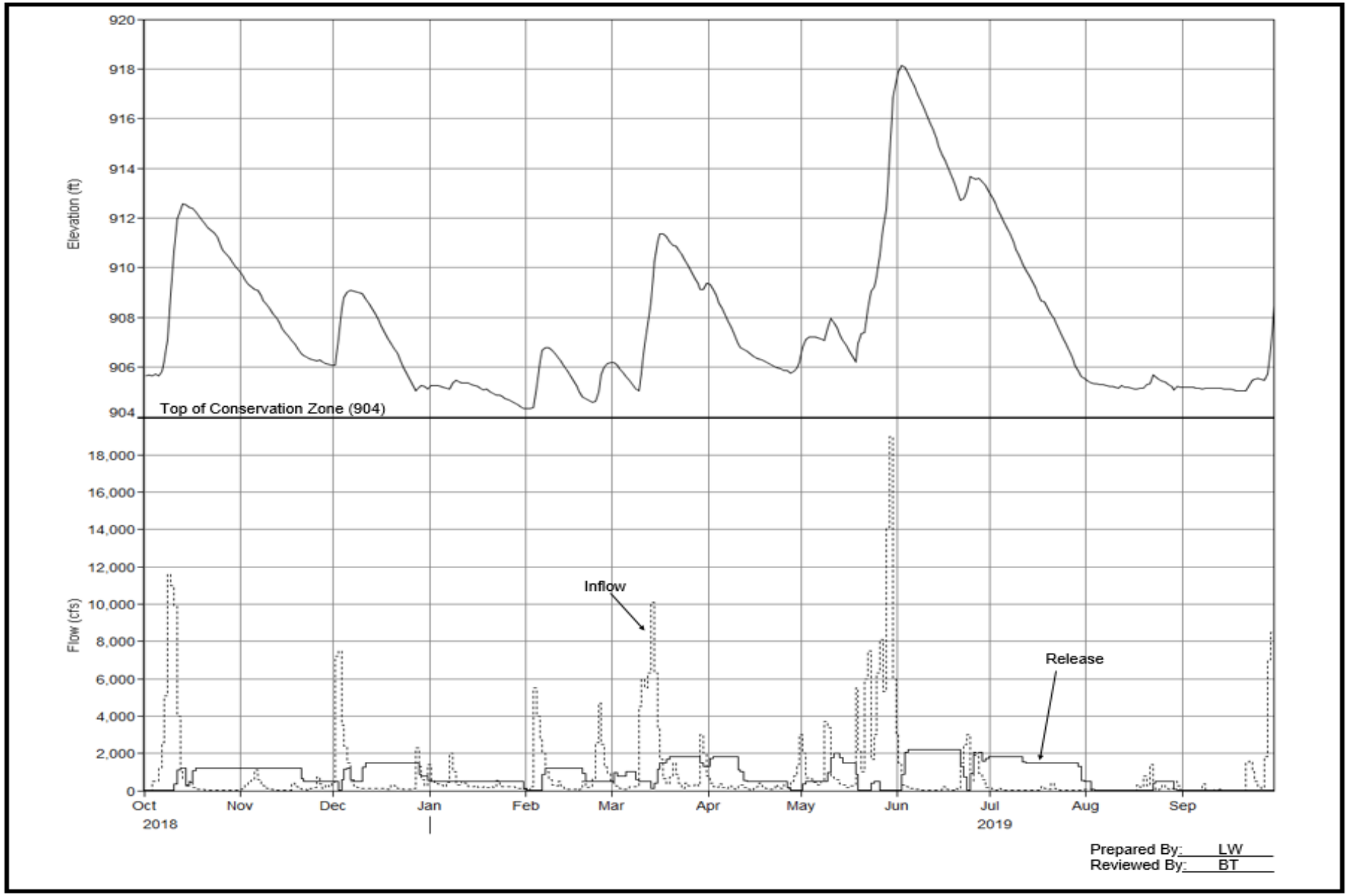


FIGURE A-54. RATHBUN DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE A-14. RATHBUN HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:			b. Minimums of Record (since initial fill)			
	Daily Inflow - Date			**Pool - Date**		
Highest	73250 cfs	16-Sep-92	Lowest	898.4 ft	26-Jan-95	
2nd	34900 cfs	05-Jul-81	2nd	899.7 ft	02-Jan-90	
3rd	26750 cfs	06-Jul-93	3rd	899.8 ft	17-Feb-85	
	Daily Outflow - Date					
Highest	3006 cfs	24-Jul-10	**c. Report Period**			
2nd	2506 cfs	28-Aug-13	**Total Inflow**		**Total Outflow**	
3rd	2350 cfs	27-Apr-68	687,669 ac-ft	215% of norm	623,468 ac-ft	220% of norm
	Pool - Date		**Peak Daily Inflow**		**Peak Daily Outflow**	
Highest	927.2 ft	28-Jul-93	19000 cfs	30-May-19	2202 cfs	05-Jun-19
2nd	926.7 ft	25-Jul-10	**Peak Pool Elev**		**Min Pool Elev**	
3rd	925.1 ft	01-Aug-08	918.1 ft	02-Jun-19	904.3 ft	01-Feb-19

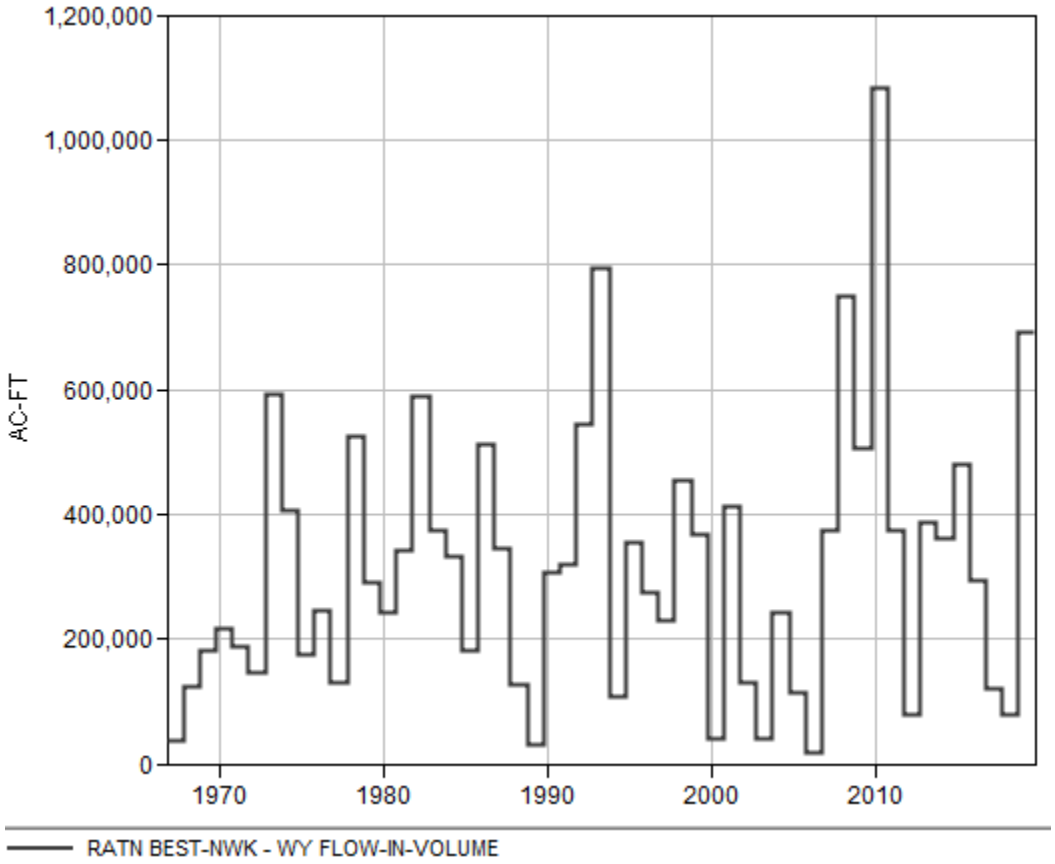


FIGURE A-55. RATHBUN PERIOD OF RECORD ANNUAL INFLOWS

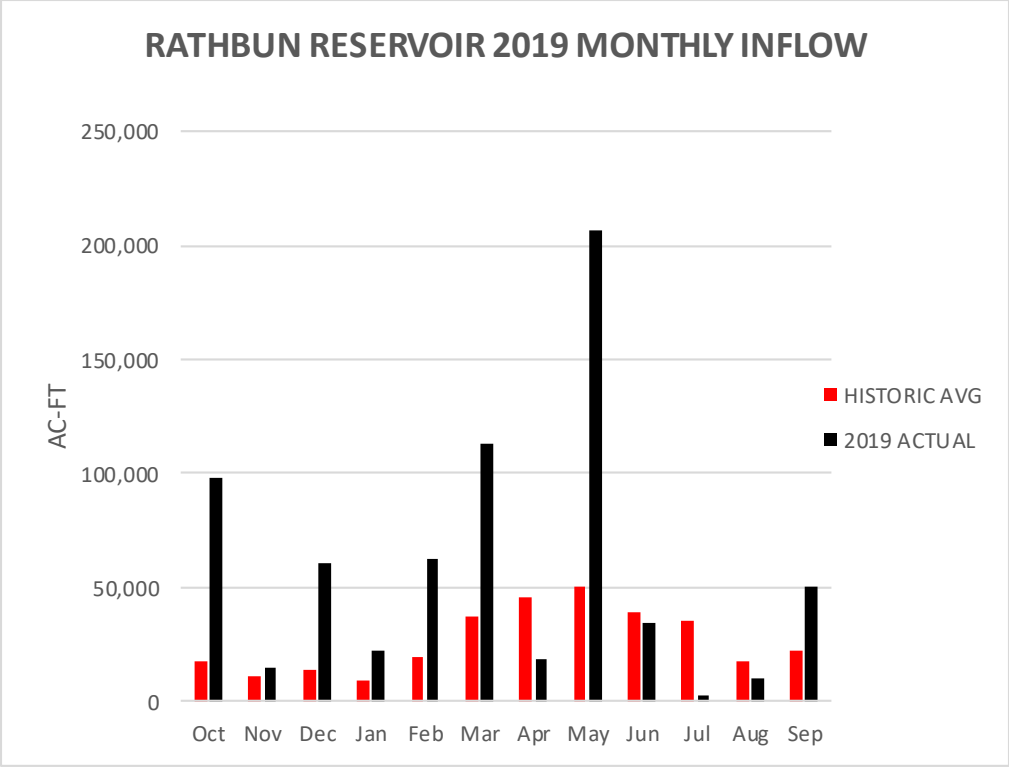


FIGURE A-56. RATHBUN 2019 MONTHLY INFLOWS

SMITHVILLE LAKE
2019 REGULATION

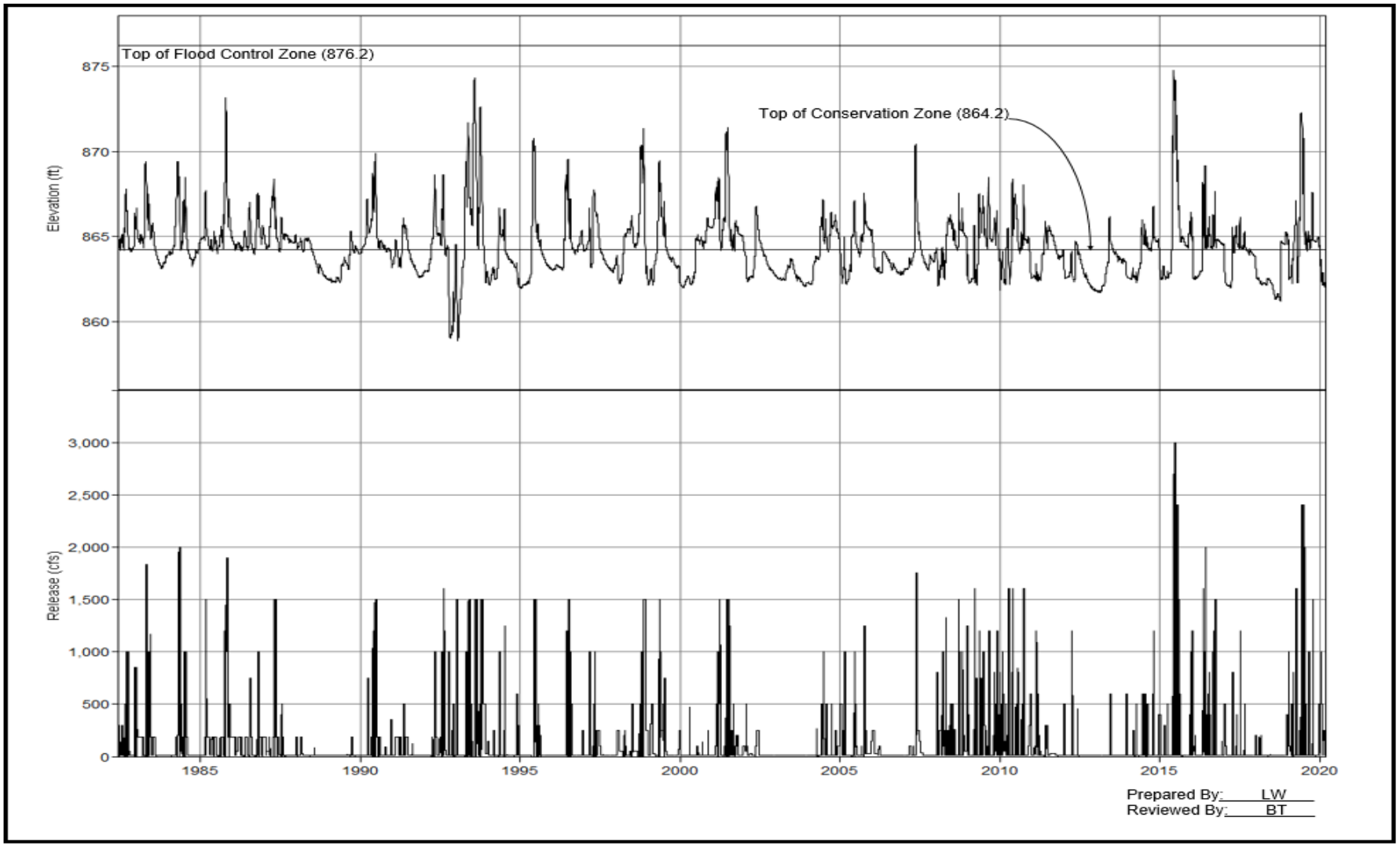


FIGURE A-57. SMITHVILLE DAM HISTORICAL POOL ELEVATIONS AND RELEASES

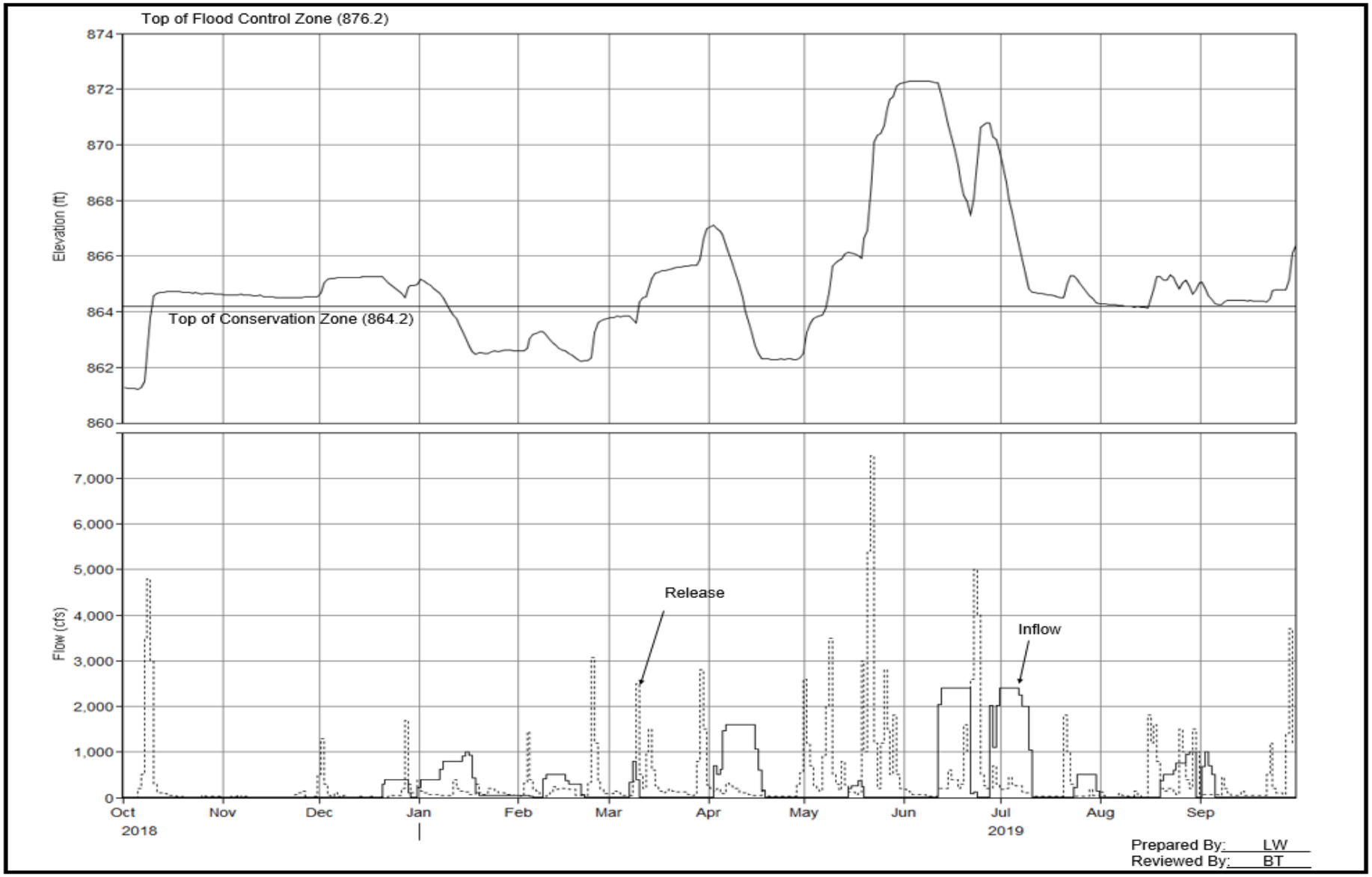


FIGURE A-58. SMITHVILLE DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE A-15. SMITHVILLE HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:

	Daily Inflow	Date
Highest	14500 cfs	05-Jun-15
2nd	12120 cfs	10-Oct-85
3rd	12020 cfs	23-Sep-93
	Daily Outflow	**Date**
Highest	3000 cfs	11-Jun-15
2nd	2400 cfs	13-Jun-19
3rd	2000 cfs	05-Jun-16
	Pool	**Date**
Highest	874.8 ft	08-Jun-15
2nd	874.3 ft	28-Jul-93
3rd	873.2 ft	16-Oct-85

b. Minimums of Record (since initial fill)

	Pool	Date
Lowest	858.9 ft	19-Jan-93
2nd	861.2 ft	05-Oct-18
3rd	861.7 ft	18-Feb-13

c. Report Period

Total Inflow		**Total Outflow**	
276,438 ac-ft	221% of norm	216,786 ac-ft	217% of norm
Peak Daily Inflow		**Peak Daily Outflow**	
7500 cfs	22-May-19	2400 cfs	13-Jun-19
Peak Pool Elev		**Min Pool Elev**	
872.3 ft	06-Jun-19	861.2 ft	04-Oct-18

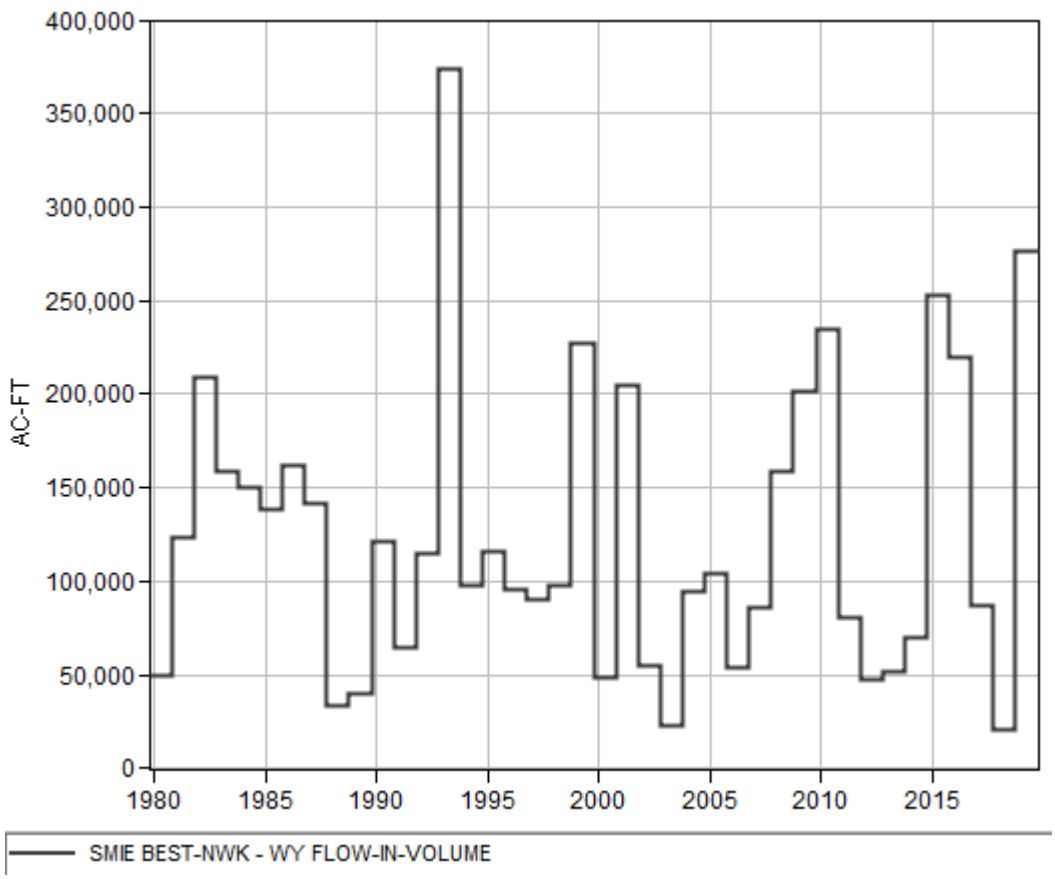


FIGURE A-59. SMITHVILLE PERIOD OF RECORD ANNUAL INFLOWS

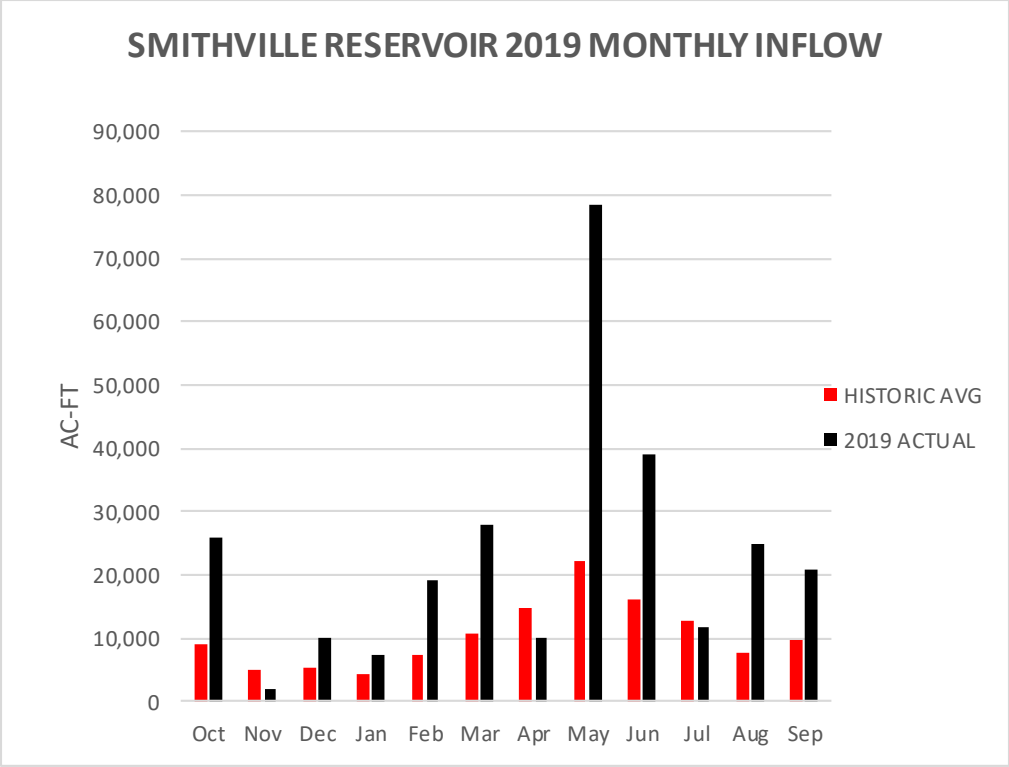


FIGURE A-60. SMITHVILLE 2019 MONTHLY INFLOWS

STOCKTON LAKE
2013 REGULATION

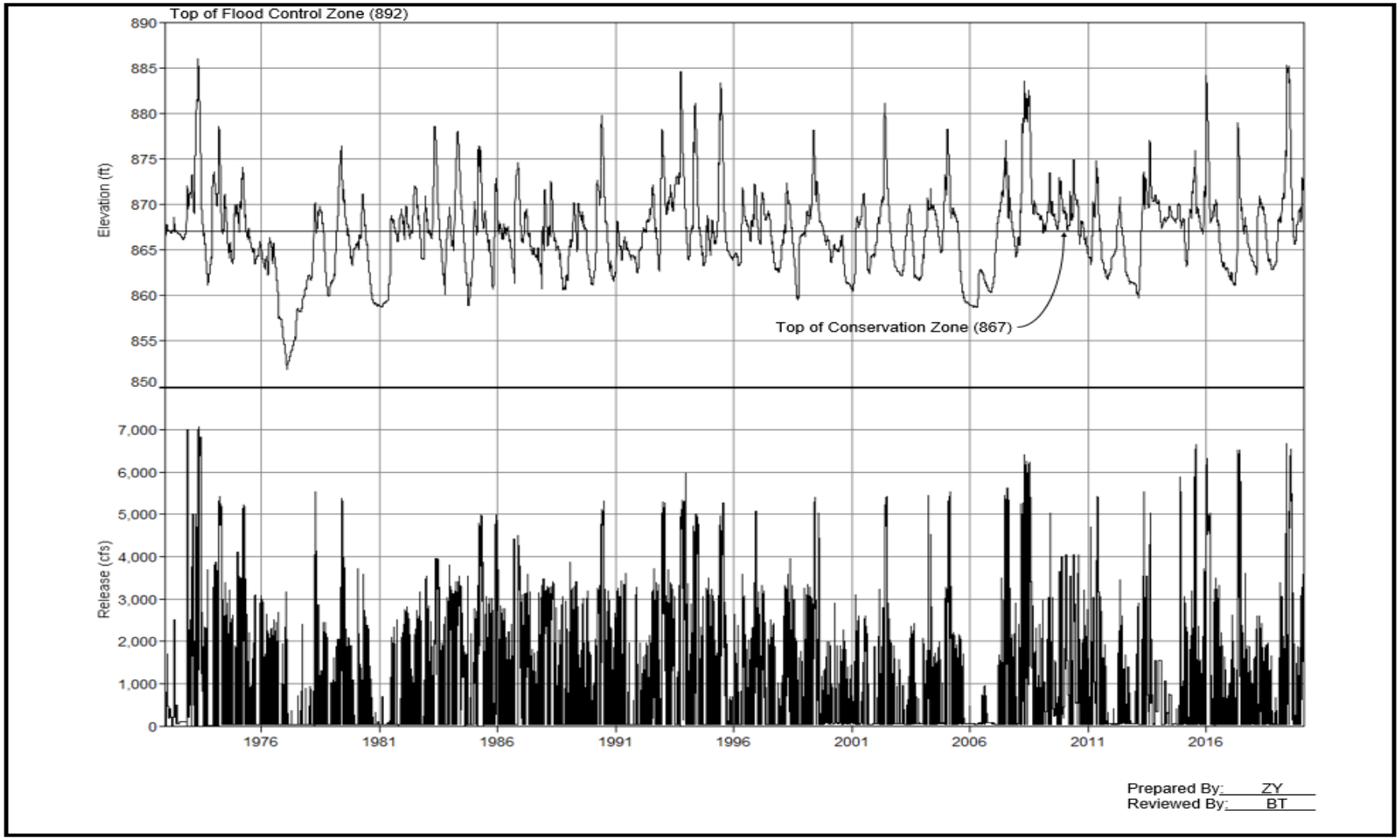


FIGURE A-61. STOCKTON DAM HISTORICAL POOL ELEVATIONS AND RELEASES

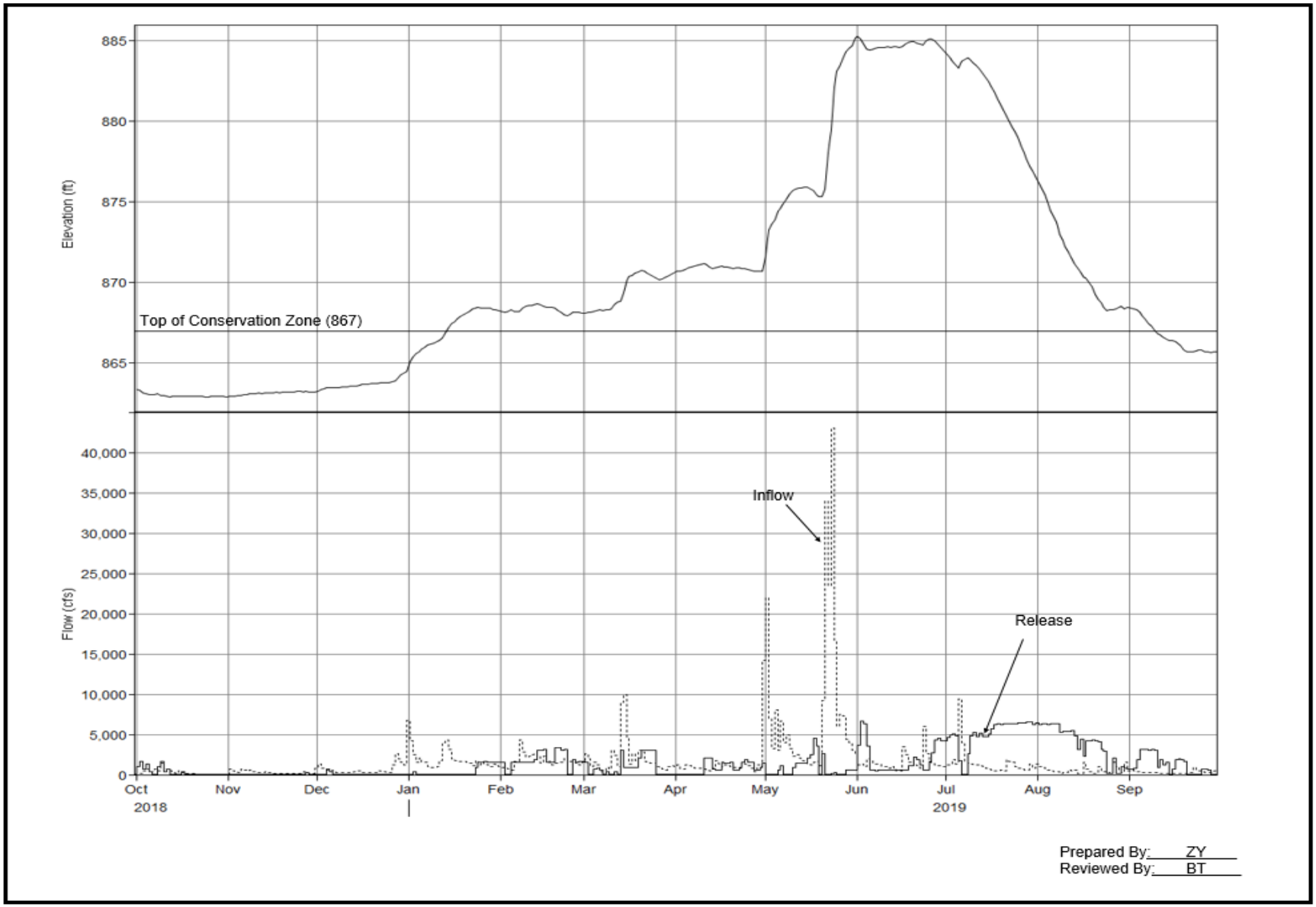


FIGURE A-62. STOCKTON DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE A-16. STOCKTON HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:			b. Minimums of Record (since initial fill)			
	Daily Inflow - Date			**Pool - Date**		
Highest	95800 cfs	28-Dec-15	Lowest	851.9 ft	02-Feb-77	
2nd	84890 cfs	25-Sep-93	2nd	858.7 ft	07-Mar-06	
3rd	70170 cfs	01-Oct-86	3rd	858.7 ft	01-Feb-81	
	Daily Outflow - Date					
Highest	10960 cfs	17-Nov-68	**c. Report Period**			
2nd	10000 cfs	13-Oct-69	**Total Inflow**		**Total Outflow**	
11th	7060 cfs	15-May-73	1,212,724 ac-ft	144% of norm	1,059,632 ac-ft	142% of norm
	Pool - Date		**Peak Daily Inflow**		**Peak Daily Outflow**	
Highest	885.9 ft	28-Apr-73	43000 cfs	24-May-19	6671 cfs	03-Jun-19
20th	885.3 ft	01-Jun-19	**Peak Pool Elev**		**Min Pool Elev**	
32nd	884.5 ft	05-Oct-93	885.3 ft	01-Jun-19	862.9 ft	31-Oct-18

Note: The first and second record maximum daily outflows occurred before the normal pool was reached.

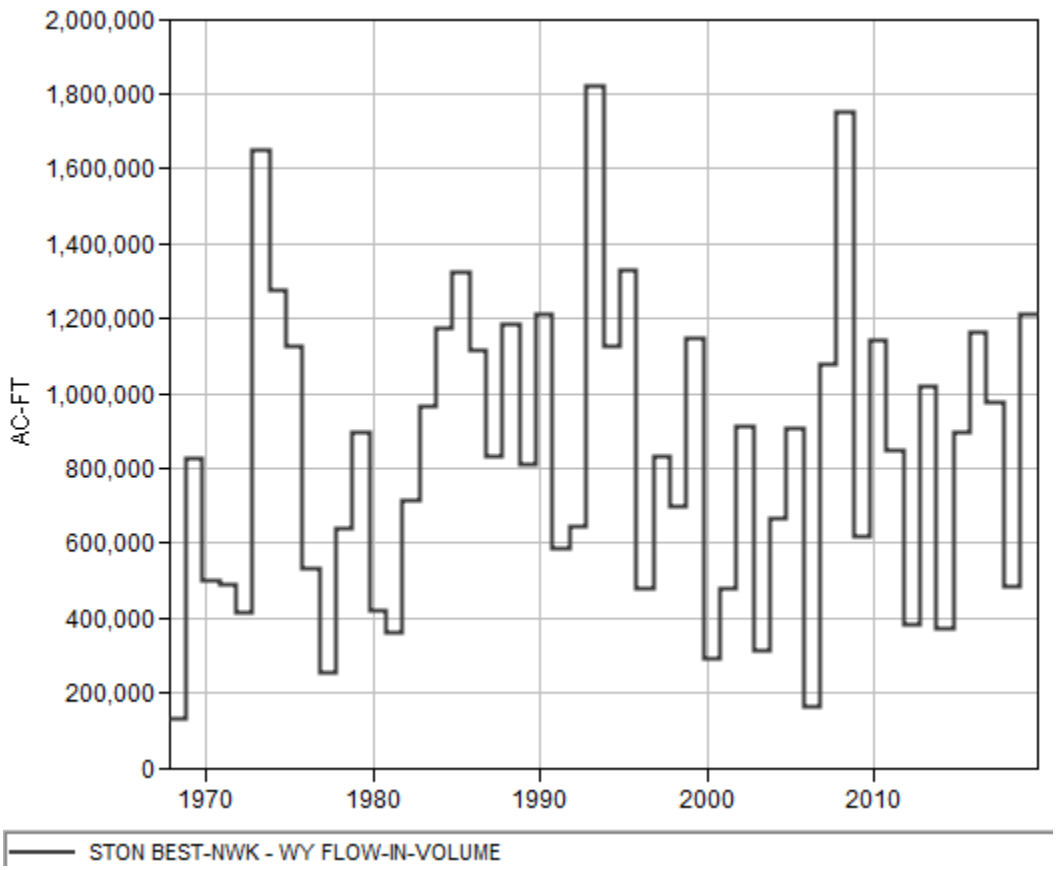


FIGURE A-63. STOCKTON PERIOD OF RECORD ANNUAL INFLOWS

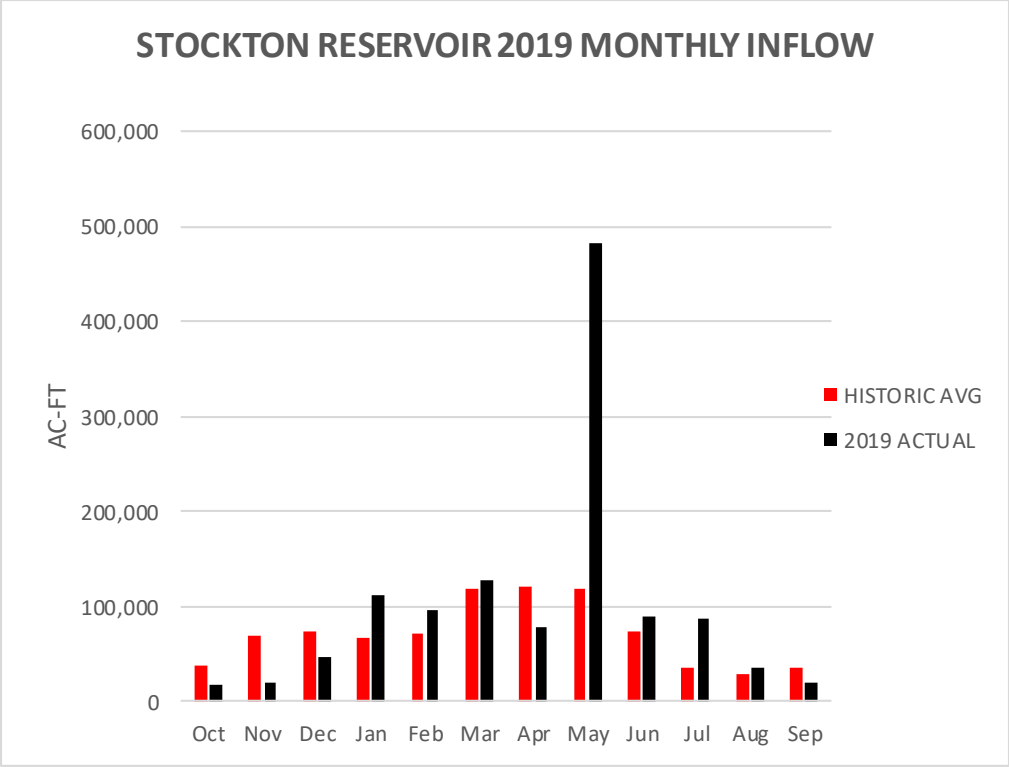


FIGURE A-64. STOCKTON 2019 MONTHLY INFLOWS

TUTTLE CREEK LAKE
2019 REGULATION

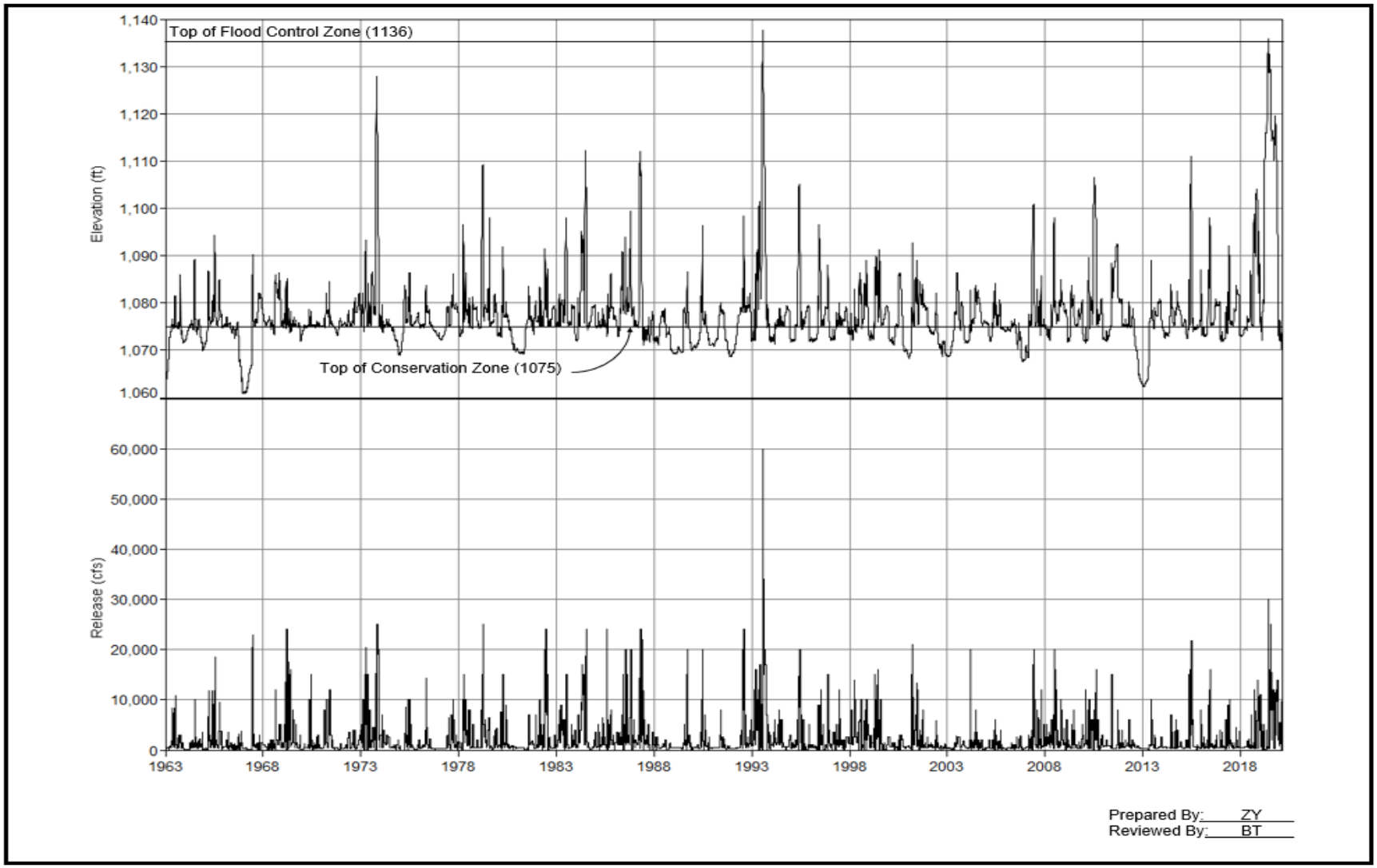


FIGURE A-65. TUTTLE CREEK DAM HISTORICAL POOL ELEVATIONS AND RELEASES

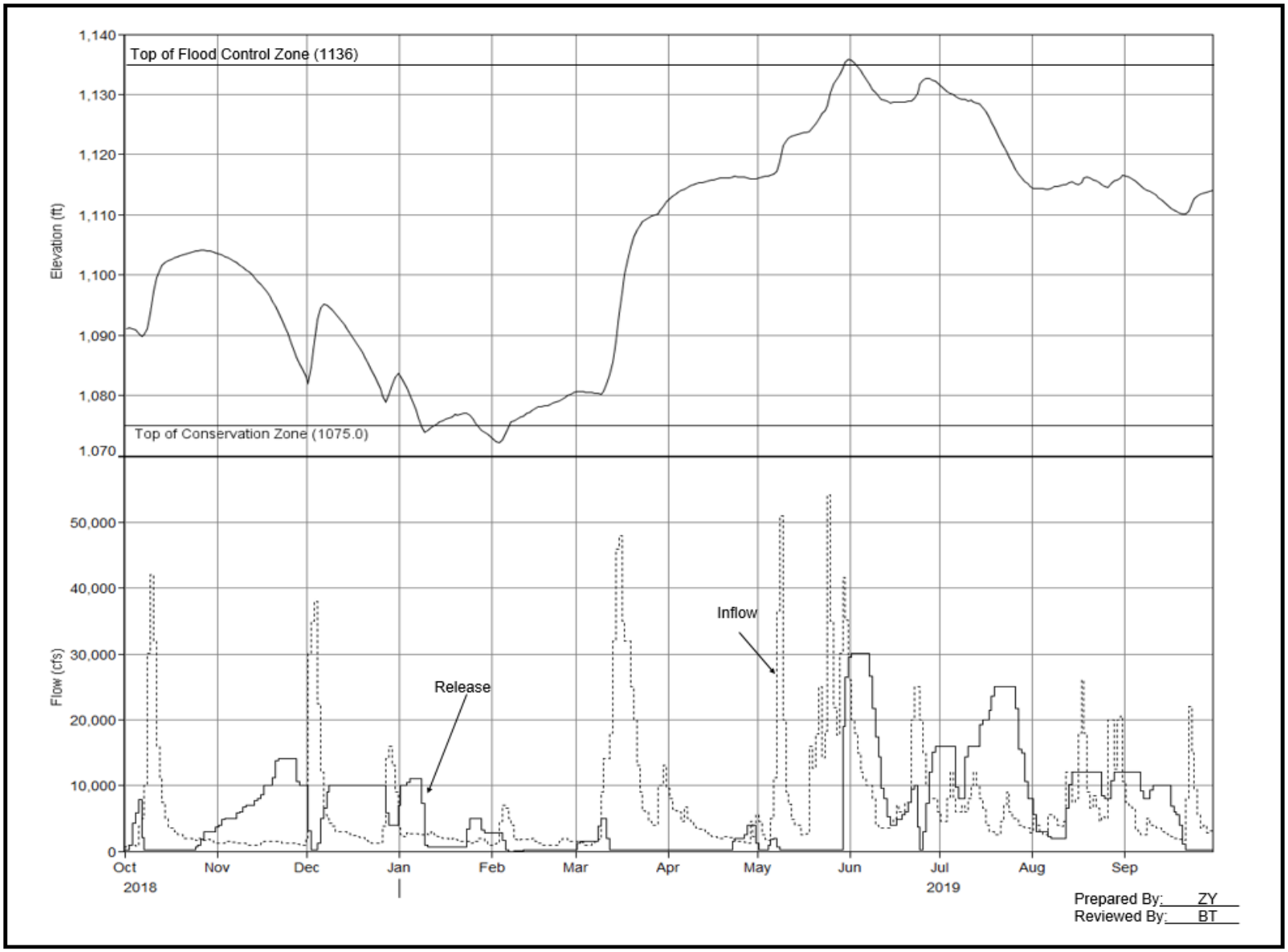


FIGURE A-66. TUTTLE CREEK DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE A-17. TUTTLE CREEK HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:

	Daily Inflow - Date	
Highest	98200 cfs	12-Oct-73
3rd	95400 cfs	06-Jul-93
5th	80300 cfs	28-Jul-92
	Daily Outflow - Date	
Highest	60000 cfs	25-Jul-93
2nd	30000 cfs	02-Jun-19
3rd	29800 cfs	07-Apr-60
	Pool - Date	
Highest	1137.7 ft	23-Jul-93
2nd	1135.8 ft	31-May-19
3rd	1127.9 ft	19-Oct-73

b. Minimums of Record (since initial fill)

	Pool - Date	
Lowest	1060.9 ft	02-Jan-67
2nd	1062.3 ft	16-Jan-13
3rd	1067.6 ft	03-Nov-06

c. Report Period

Total Inflow		**Total Outflow**	
5,177,710 ac-ft	298% of norm	4,405,954 ac-ft	265% of norm
Peak Daily Inflow		**Peak Daily Outflow**	
54200 cfs	25-May-19	30000 cfs	02-Jun-19
Peak Pool Elev		**Min Pool Elev**	
1135.8 ft	31-May-19	1072.1 ft	03-Feb-19

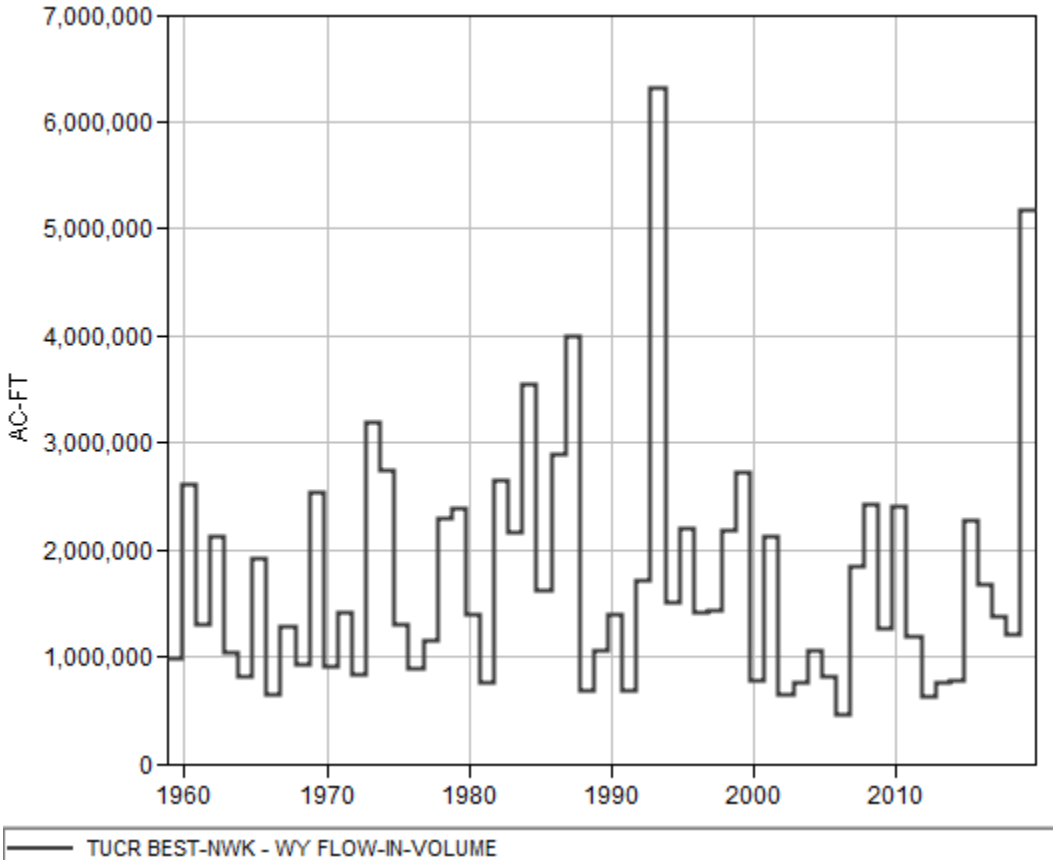


FIGURE A-67. TUTTLE CREEK PERIOD OF RECORD ANNUAL INFLOWS

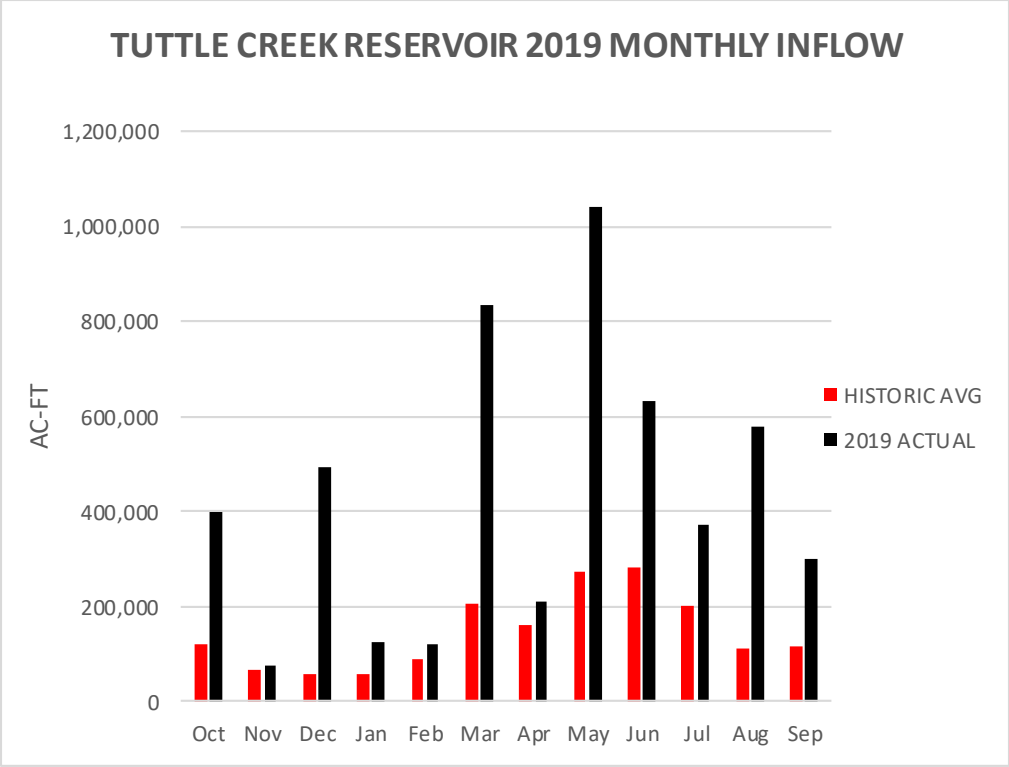


FIGURE A-68. TUTTLE CREEK 2019 MONTHLY INFLOWS

WILSON LAKE
2019 REGULATION

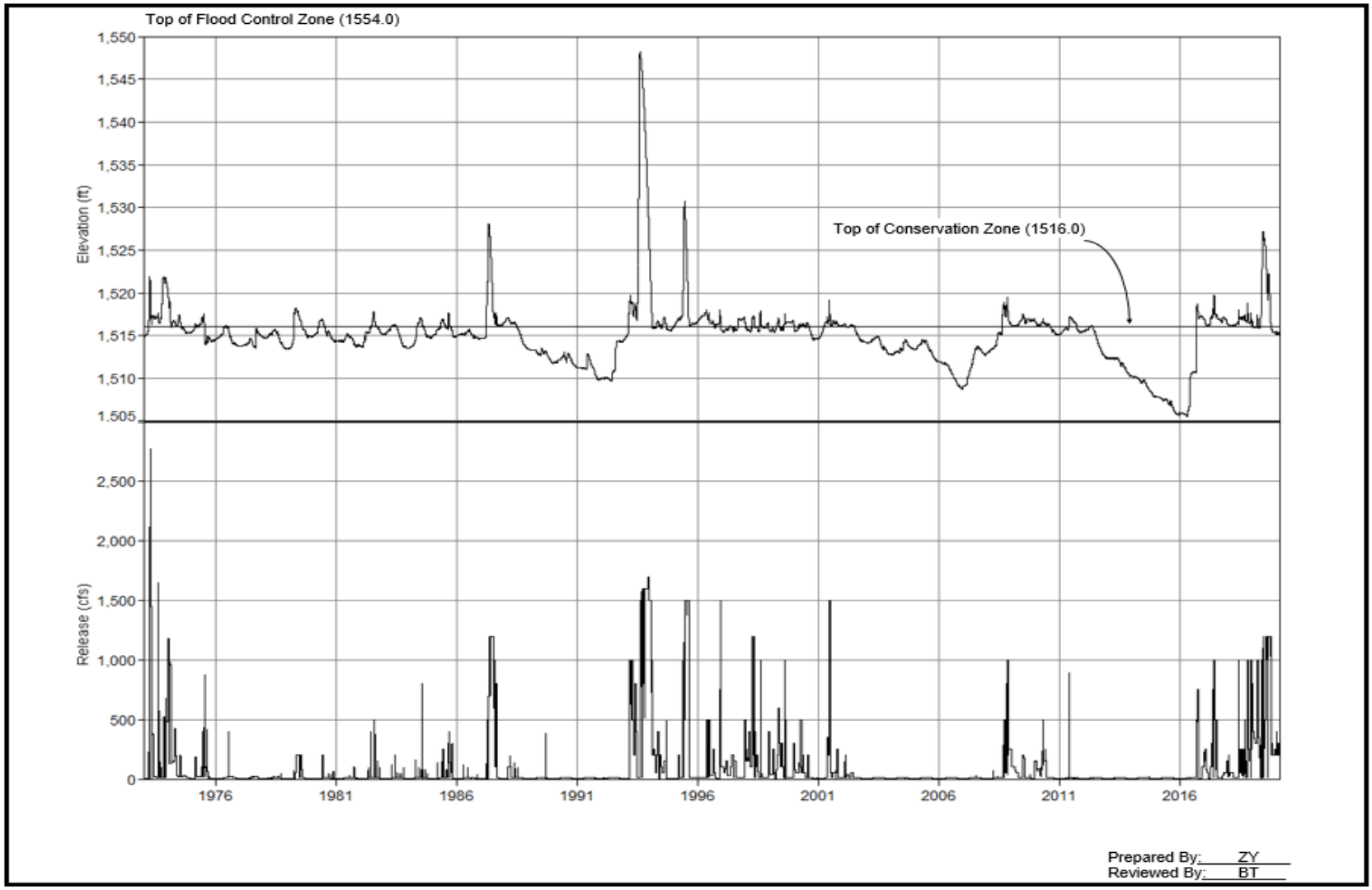


FIGURE A-69. WILSON DAM HISTORICAL POOL ELEVATIONS AND RELEASES

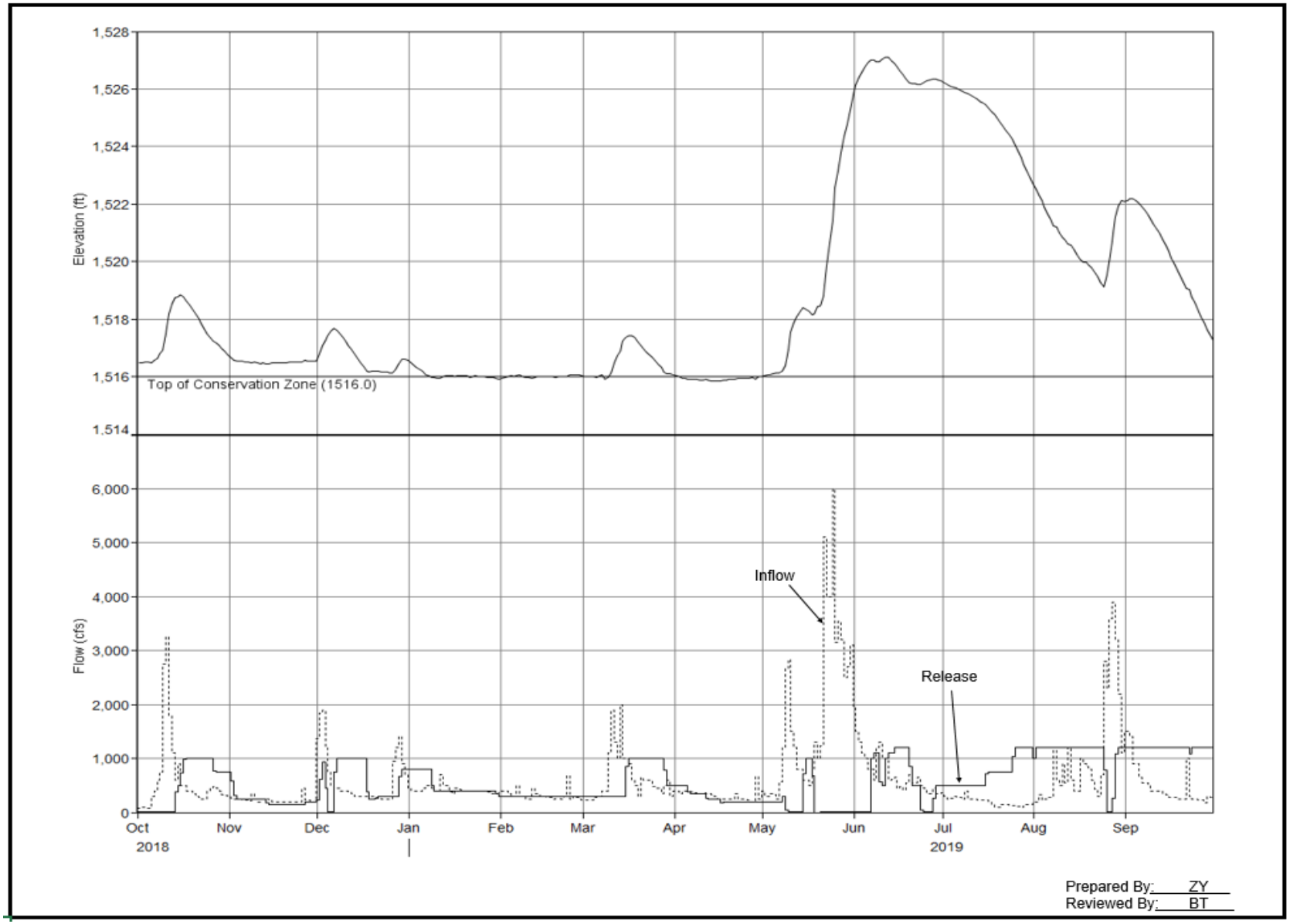


FIGURE A-70. WILSON DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE A-18. WILSON HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:

	Daily Inflow - Date	
Highest	49300 cfs	22-Jul-93
2nd	12100 cfs	15-Apr-87
3rd	12000 cfs	24-May-95
	Daily Outflow - Date	
Highest	2775 cfs	15-Apr-73
2nd	2100 cfs	02-Sep-64
3rd	1700 cfs	04-Dec-93
	Pool - Date	
Highest	1548.2 ft	13-Aug-93
2nd	1530.7 ft	12-Jun-95
3rd	1528.1 ft	27-Apr-87

b. Minimums of Record (since initial fill)

	Pool - Date	
Lowest	1505.5 ft	15-Apr-16
2nd	1508.8 ft	18-Dec-06
3rd	1509.6 ft	26-May-92

c. Report Period

Total Inflow		**Total Outflow**	
456,954 ac-ft	461% of norm	410,437 ac-ft	678% of norm
Peak Daily Inflow		**Peak Daily Outflow**	
6000 cfs	25-May-19	1200 cfs	15-Jun-19
Peak Pool Elev		**Min Pool Elev**	
1527.1 ft	11-Jun-19	1515.8 ft	13-Apr-19

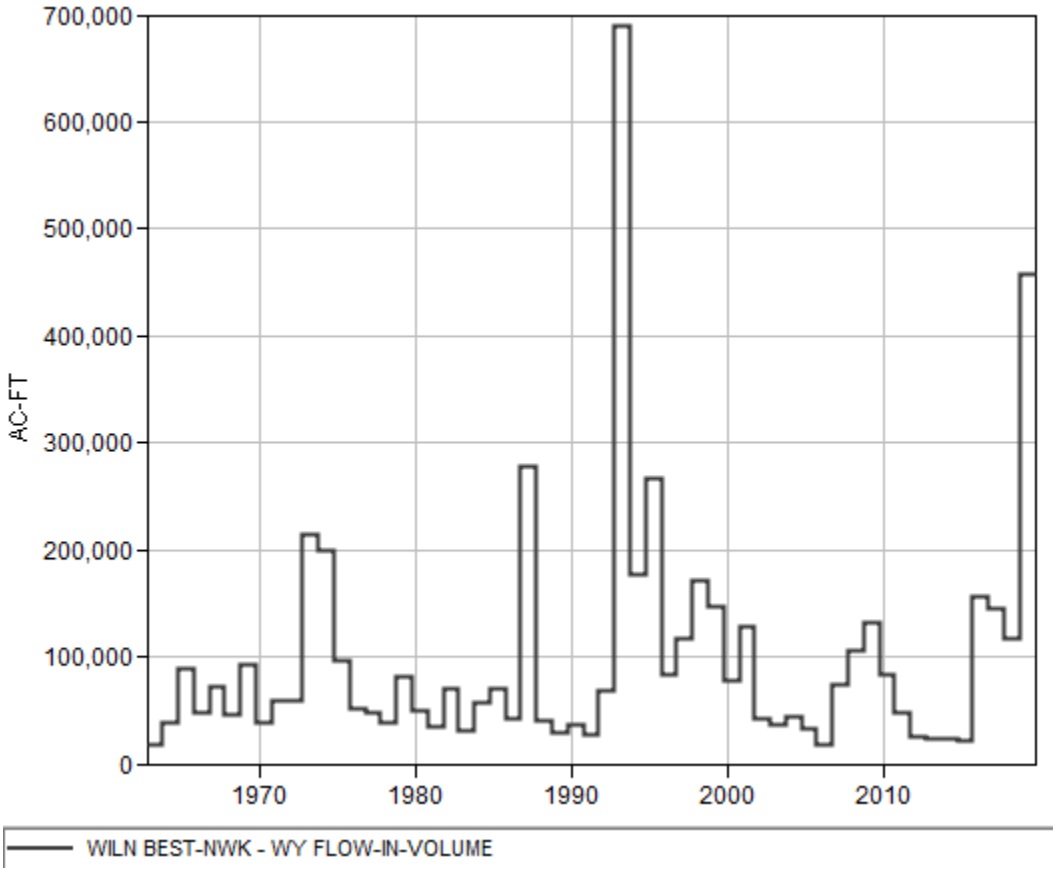


FIGURE A-71. WILSON PERIOD OF RECORD ANNUAL INFLOWS

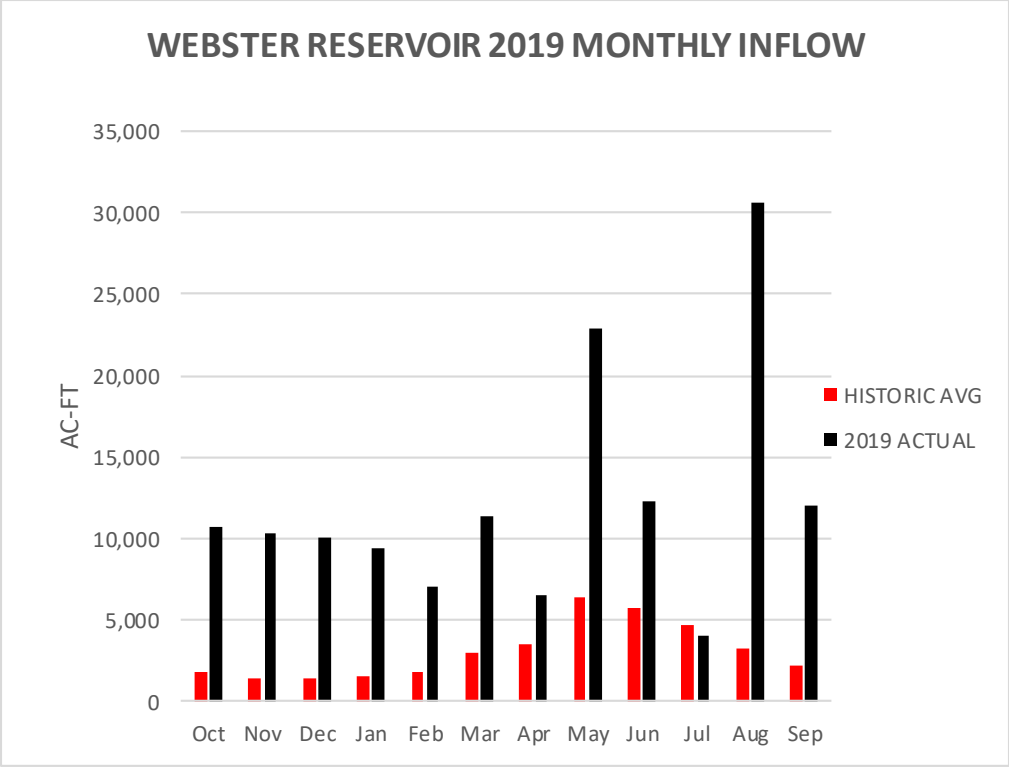


FIGURE A-72. WEBSTER 2019 MONTHLY INFLOWS

APPENDIX B
BUREAU OF RECLAMATION PROJECTS

BONNY RESERVOIR

CEDAR BLUFF RESERVOIR

ENDERS RESERVOIR

HARRY STRUNK LAKE
(Medicine Creek Dam)

HUGH BUTLER LAKE
(Red Willow Dam)

KEITH SEBELIUS LAKE
(Norton Dam)

KIRWIN RESERVOIR

LOVEWELL RESERVOIR

SWANSON LAKE
(Trenton Dam)

WACONDA LAKE
(Glen Elder Dam)

WEBSTER RESERVOIR

BONNY RESERVOIR
2019 REGULATION

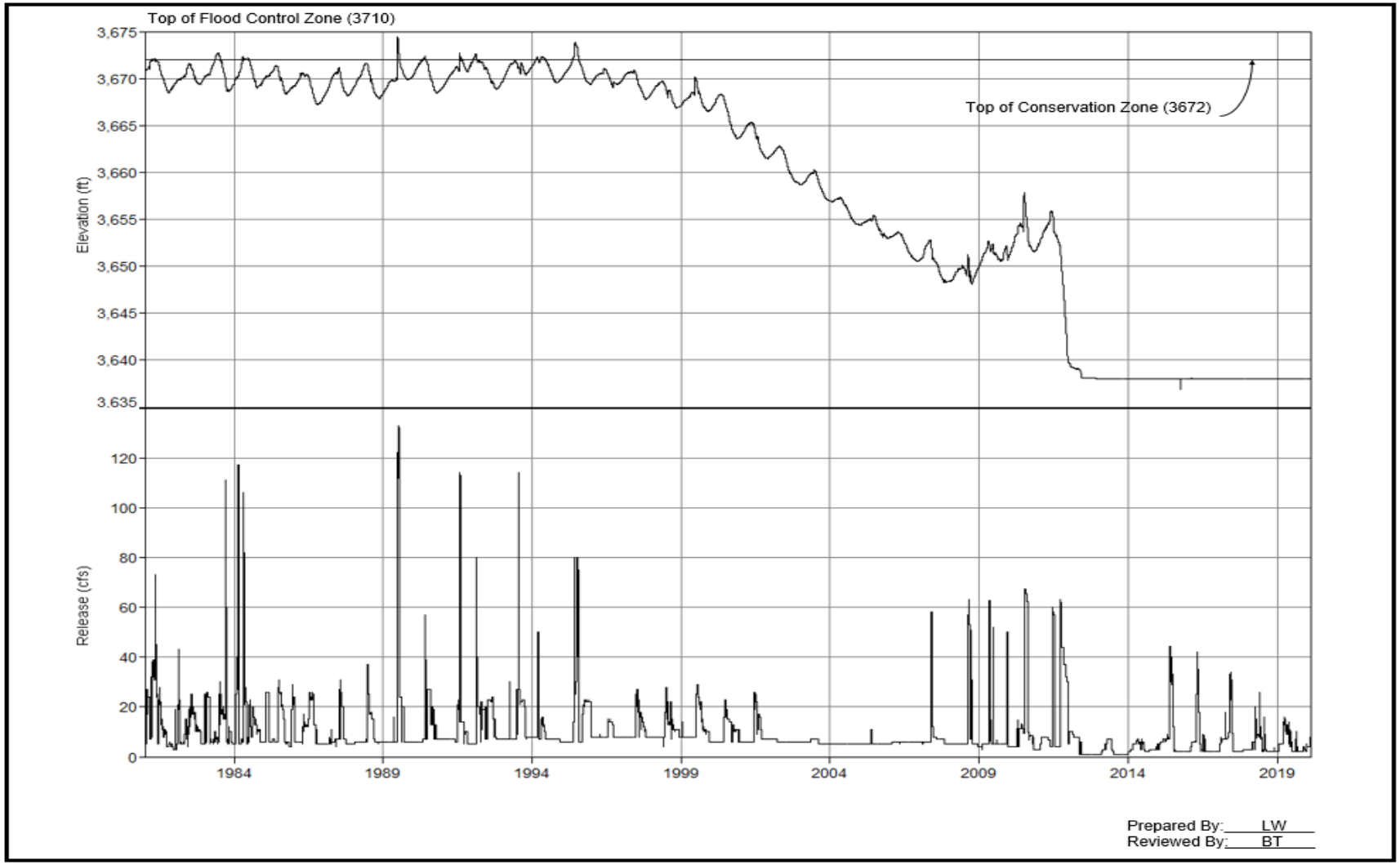


FIGURE B-1. BONNY DAM HISTORICAL POOL ELEVATIONS AND RELEASES

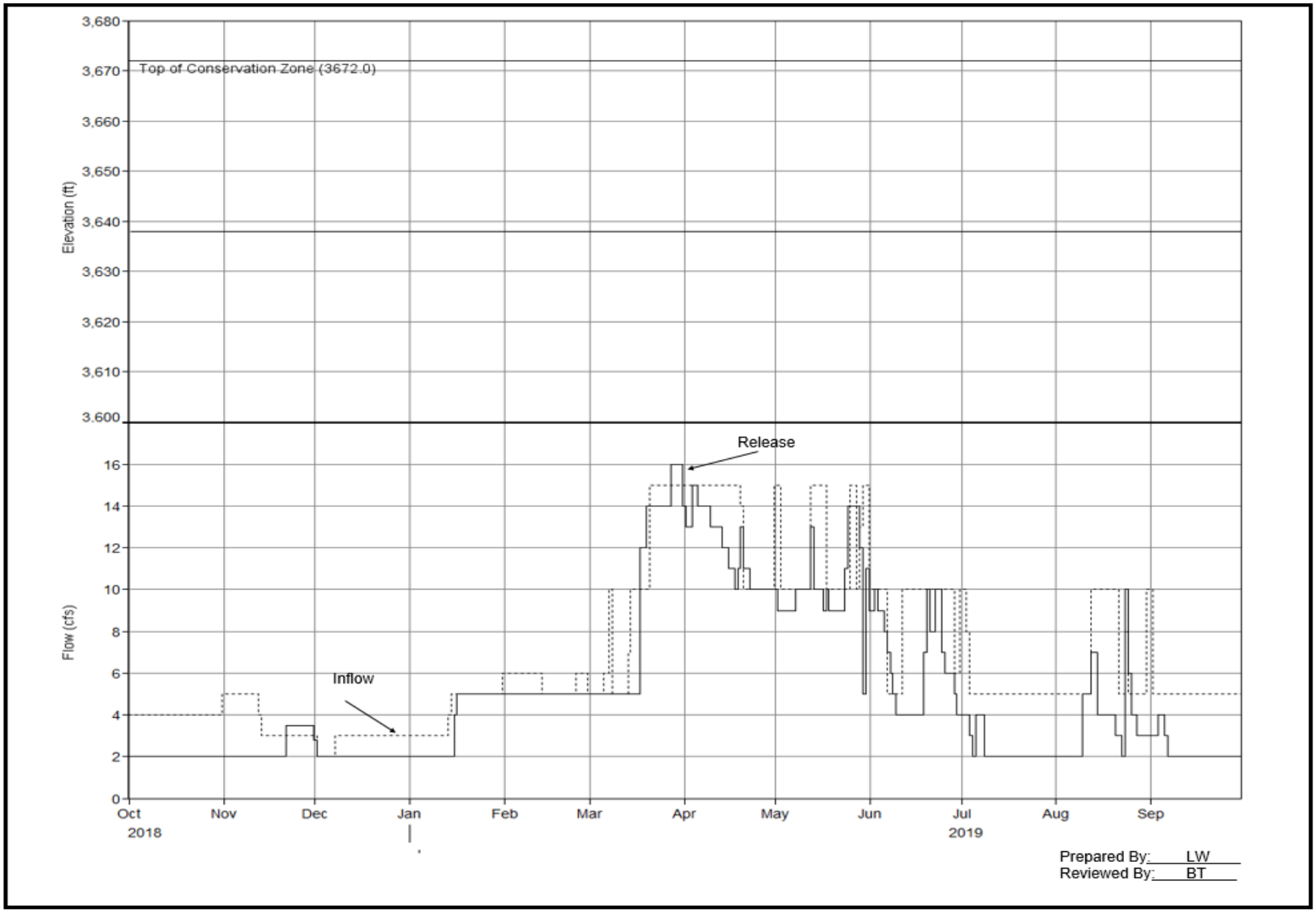


FIGURE B-2. BONNY DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE B-1. BONNY HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:			b. Minimums of Record (since initial fill)			
	Daily Inflow - Date		**Pool - Date**			
Highest	4342 cfs	25-Jun-89	Pool drawn down to 3638 ft since 01-Jan-2013			
2nd	1100 cfs	03-Jul-10				
3rd	1006 cfs	24-Jul-91				
	Daily Outflow - Date					
Highest	133 cfs	08-Jul-89	**c. Report Period**			
2nd	117 cfs	22-Feb-84	**Total Inflow**		**Total Outflow**	
3rd	114 cfs	01-Aug-91	4,919 ac-ft	40% of norm	3,692 ac-ft	52% of norm
	Pool - Date		**Peak Daily Inflow**		**Peak Daily Outflow**	
Highest	3674.4 ft	26-Jun-89	15 cfs	21-Mar-19	16 cfs	28-Mar-19
2nd	3673.8 ft	14-Jun-95	**Peak Pool Elev**		**Min Pool Elev**	
3rd	3672.8 ft	17-Jun-83	3638.0 ft	01-Oct-18	3638.0 ft	01-Oct-18

Note: Bonny statistics are based on daily data from 1980 through 2019.

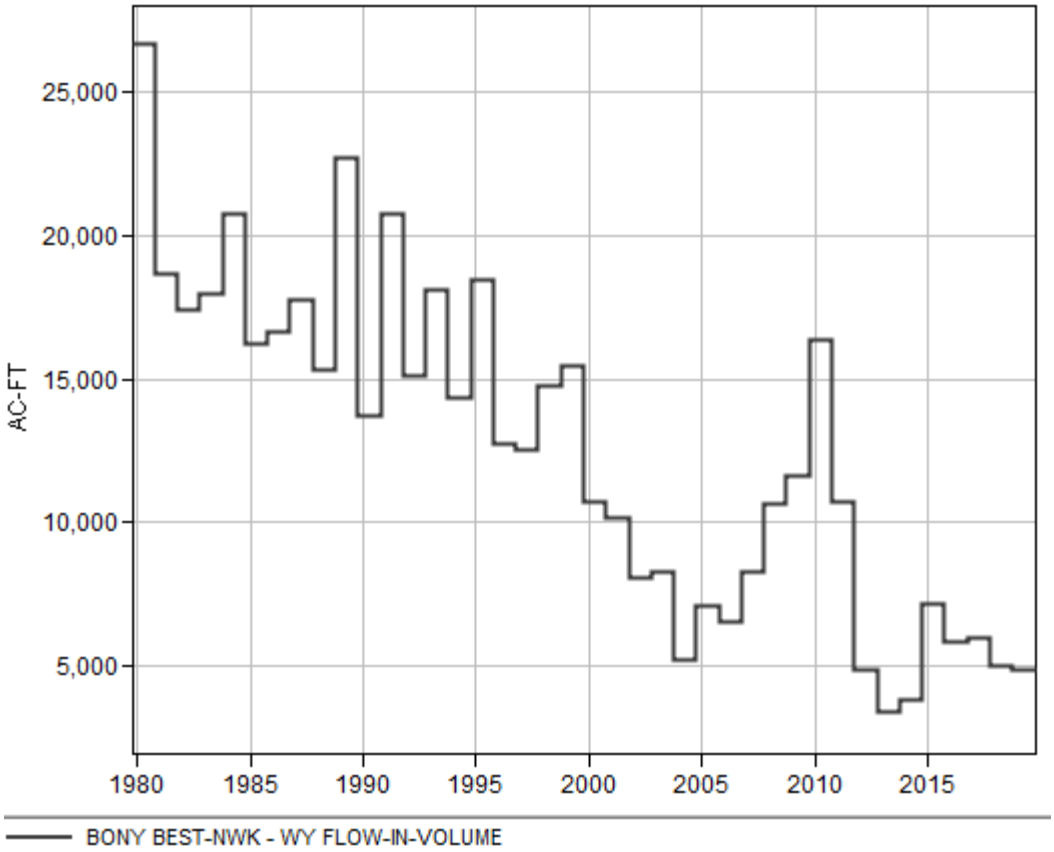


FIGURE B-3. BONNY PERIOD OF RECORD ANNUAL INFLOWS

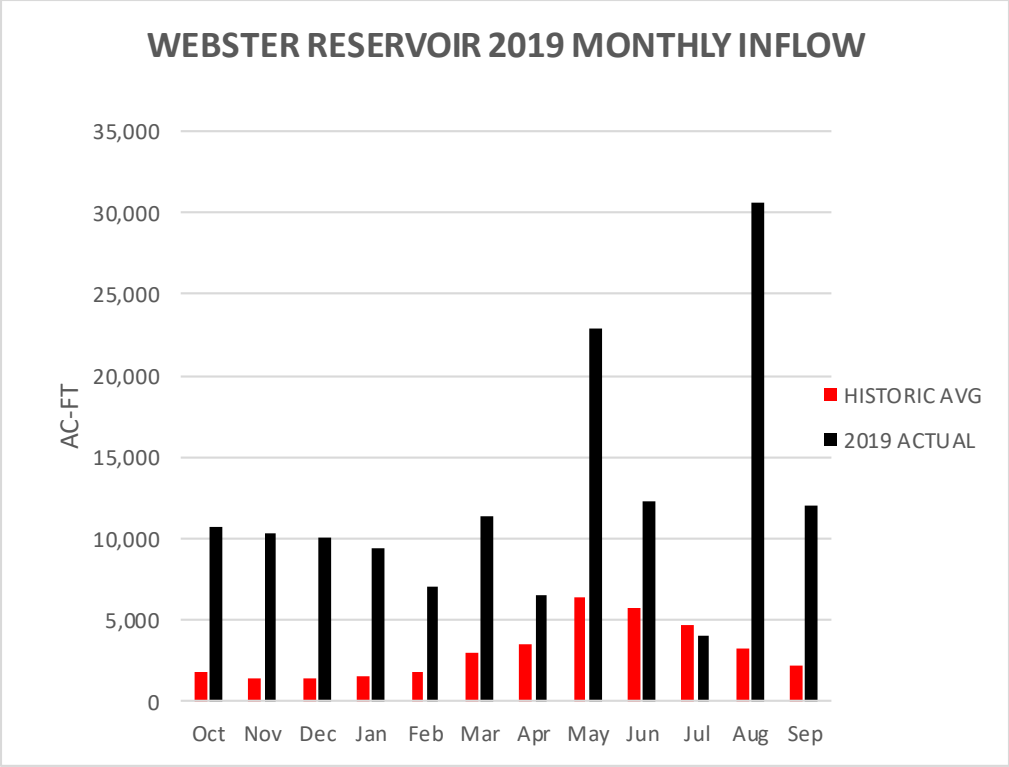


FIGURE B-4. BONNY 2019 MONTHLY INFLOWS

CEDAR BLUFF RESERVOIR
2019 REGULATION

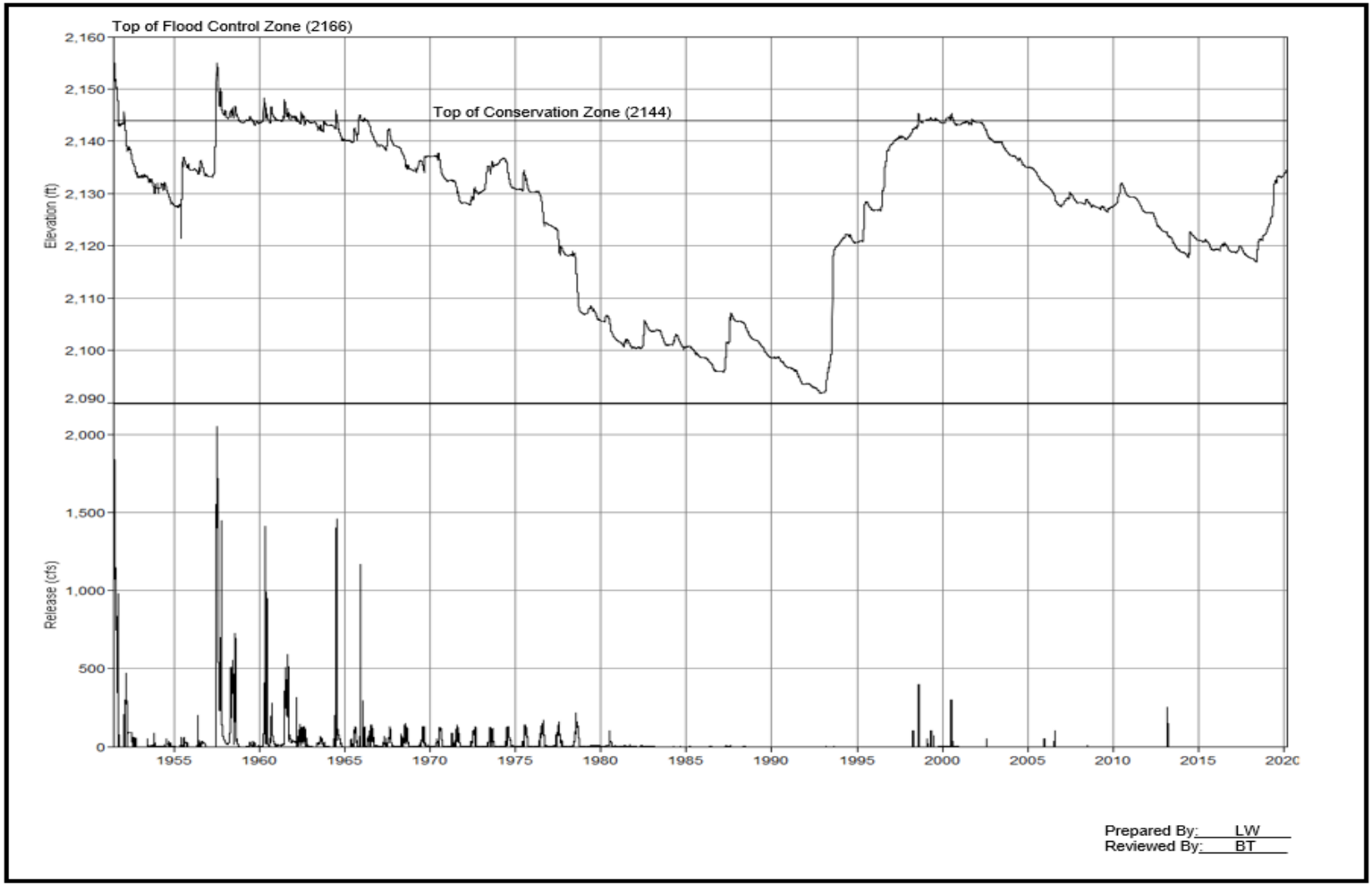


FIGURE B-5. CEDAR BLUFF DAM HISTORICAL POOL ELEVATIONS AND RELEASES

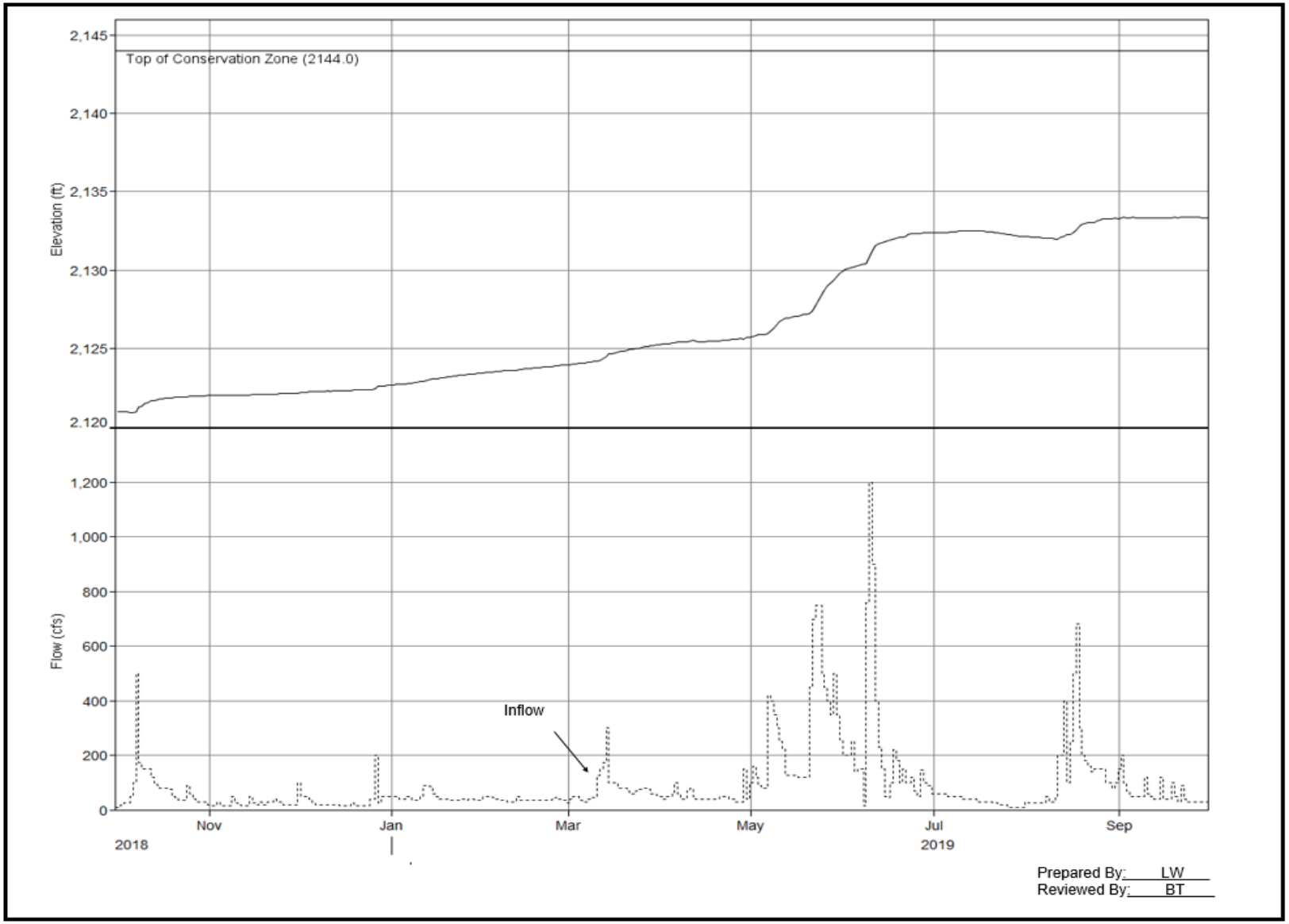


FIGURE B-6. CEDAR BLUFF DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE B-2. CEDAR BLUFF HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:

	Daily Inflow - Date	
Highest	22560 cfs	16-Jun-57
2nd	14000 cfs	12-Jun-51
3rd	7880 cfs	18-Jun-55
	Daily Outflow - Date	
Highest	2050 cfs	05-Jul-57
2nd	1840 cfs	02-Jul-51
3rd	1460 cfs	28-Jun-51
	Pool - Date	
Highest	2154.9 ft	01-Jul-51
2nd	2154.9 ft	04-Jul-57
3rd	2148.3 ft	27-Mar-60

b. Minimums of Record (since initial fill)

	Pool - Date	
Lowest	2091.8 ft	09-Nov-92
2nd	2095.8 ft	16-Mar-87
3rd	2100.3 ft	24-Apr-82

c. Report Period

Total Inflow		**Total Outflow**	
69,566 ac-ft	114% of norm	0 ac-ft	0% of norm
Peak Daily Inflow		**Peak Daily Outflow**	
1175 cfs	09-Jun-19	0 cfs	All WY19
Peak Pool Elev		**Min Pool Elev**	
2133.4 ft	22-Sep-19	2120.9 ft	05-Oct-18

Note: 3rd highest outflow occurs 28Jun51 and 01Jul64

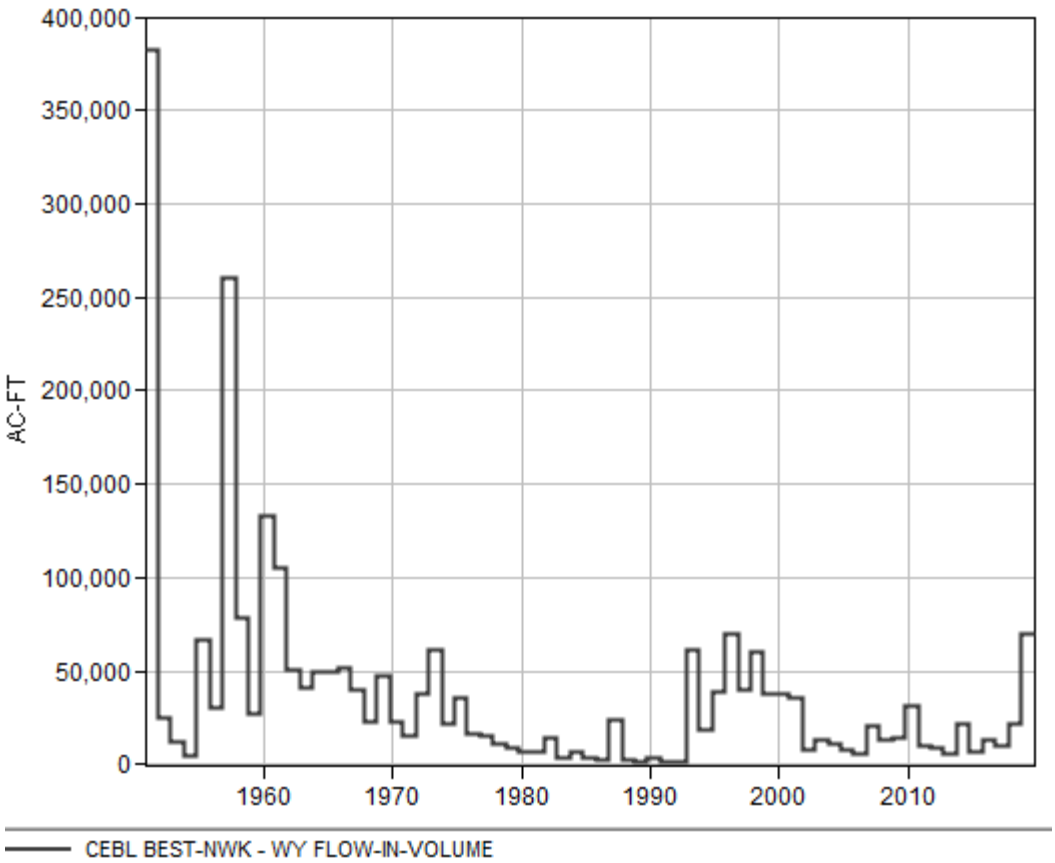


FIGURE B-7. CEDAR BLUFF PERIOD OF RECORD ANNUAL INFLOWS

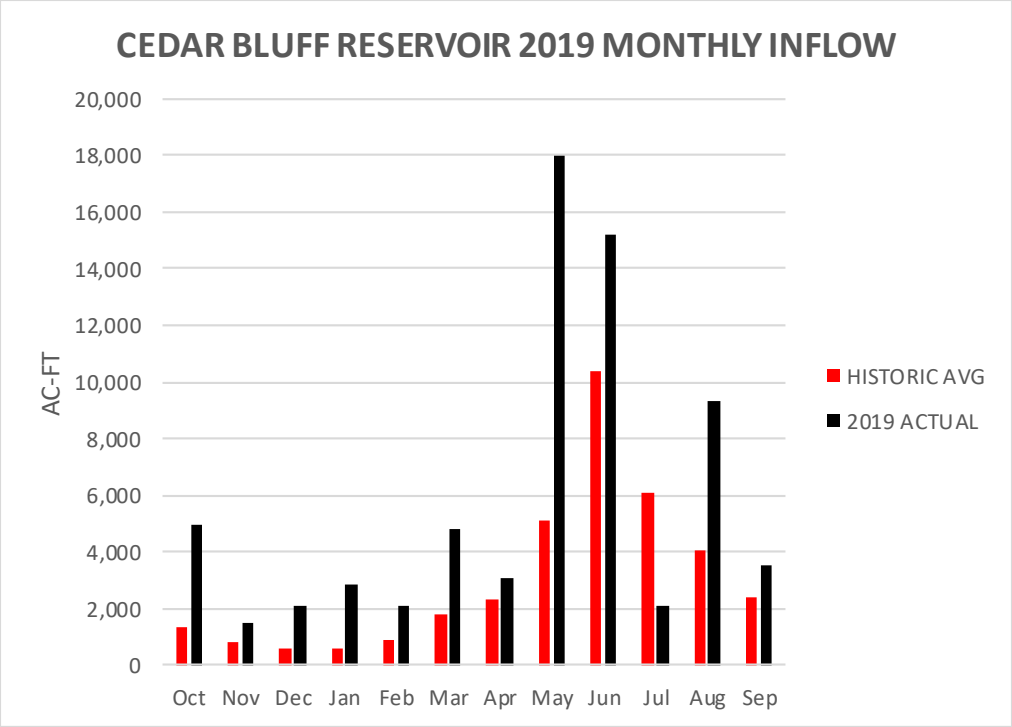


FIGURE B-8. CEDAR BLUFF 2019 MONTHLY INFLOWS

ENDERS RESERVOIR
2013 REGULATION

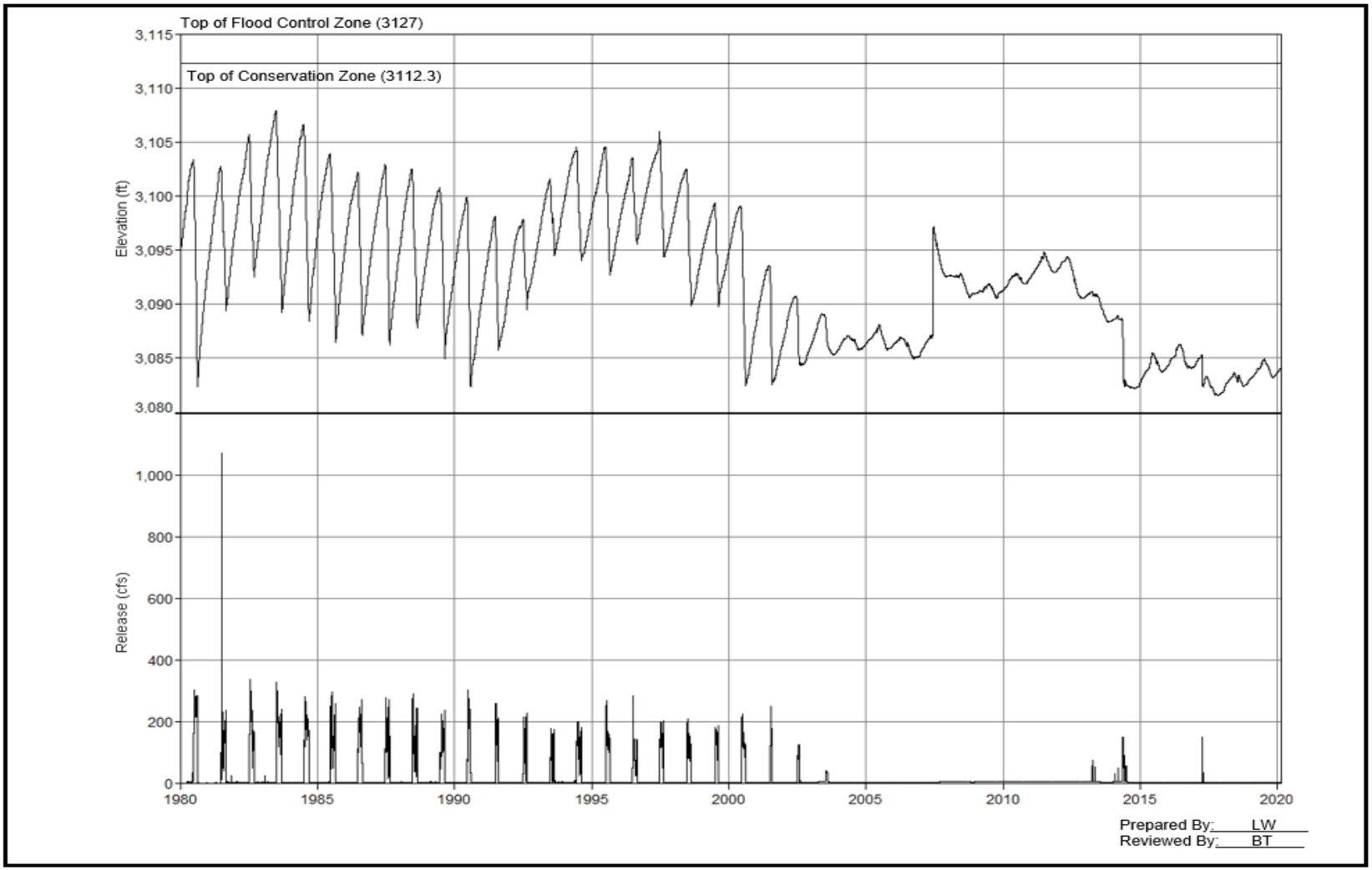


FIGURE B-9. ENDERS DAM HISTORICAL POOL ELEVATIONS AND RELEASES

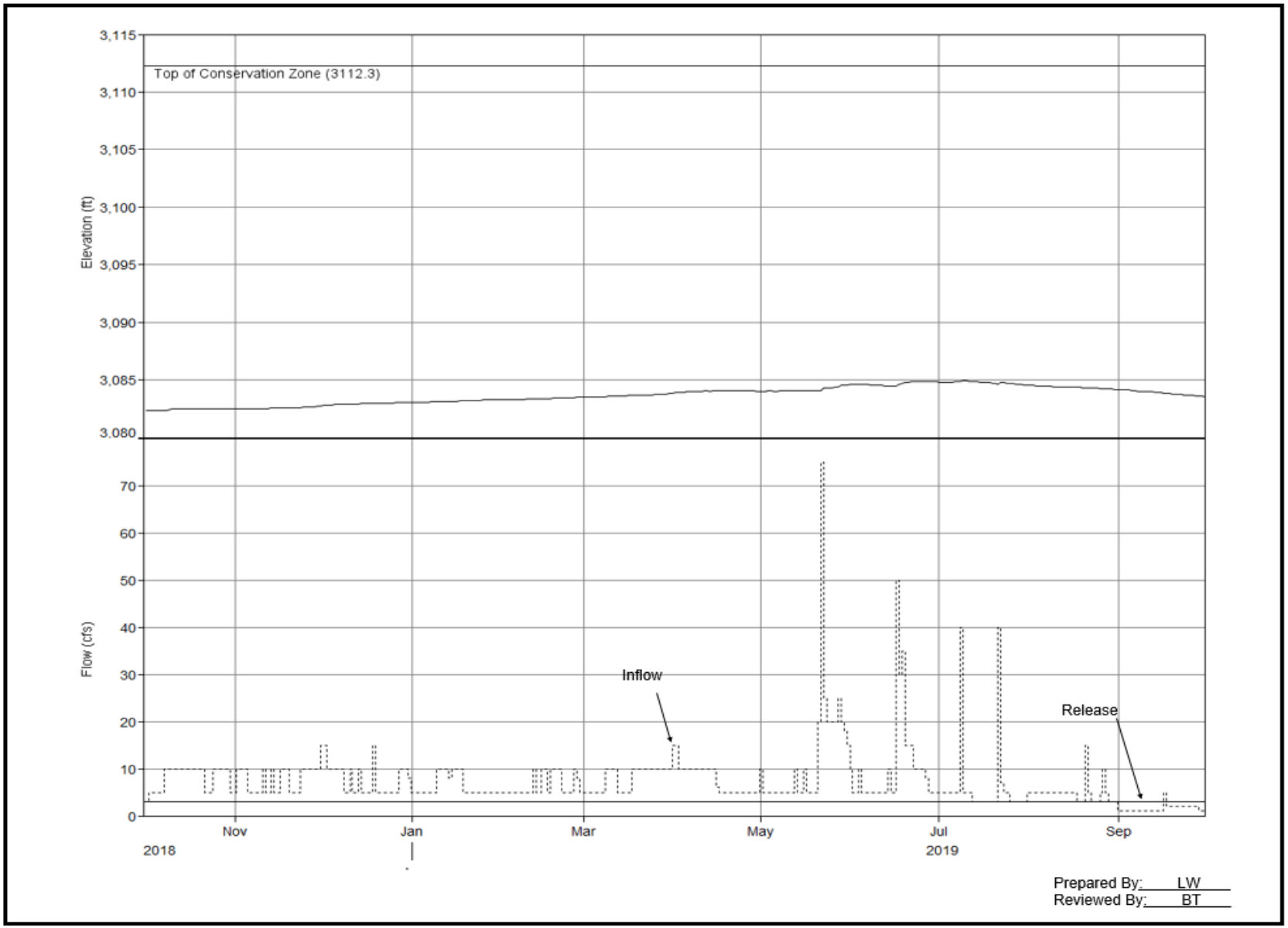


FIGURE B-10. ENDERS DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE B-3. ENDERS HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:			b. Minimums of Record (since initial fill)			
	Daily Inflow - Date			**Pool - Date**		
Highest	2500 cfs	14-Jun-07	Lowest	3081.5 ft	21-Sep-17	
2nd	954 cfs	08-Jul-81	2nd	3082.2 ft	16-Oct-14	
3rd	460 cfs	18-Jun-97	3rd	3082.3 ft	04-Oct-18	
	Daily Outflow - Date					
Highest	1070 cfs	08-Jul-81	**c. Report Period**			
2nd	335 cfs	22-Jul-82	**Total Inflow**		**Total Outflow**	
3rd	327 cfs	11-Jul-83	5,338 ac-ft	11% of norm	2,172 ac-ft	5% of norm
	Pool - Date		**Peak Daily Inflow**		**Peak Daily Outflow**	
Highest	3107.9 ft	01-Jul-83	75 cfs	22-May-19	3 cfs	01-Oct-18
2nd	3106.6 ft	26-Jun-84	**Peak Pool Elev**		**Min Pool Elev**	
3rd	3106.0 ft	21-Jun-97	3084.9 ft	09-Jul-19	3082.3 ft	04-Oct-18

Note: Enders statistics are based on daily data from 1980 through 2019.

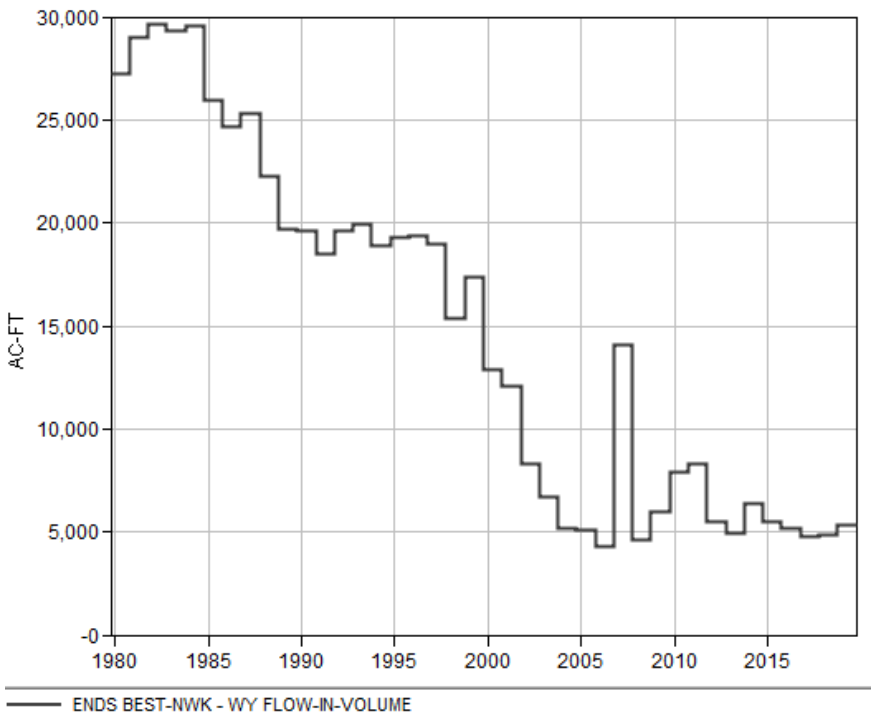


FIGURE B-11. ENDERS PERIOD OF RECORD ANNUAL INFLOWS

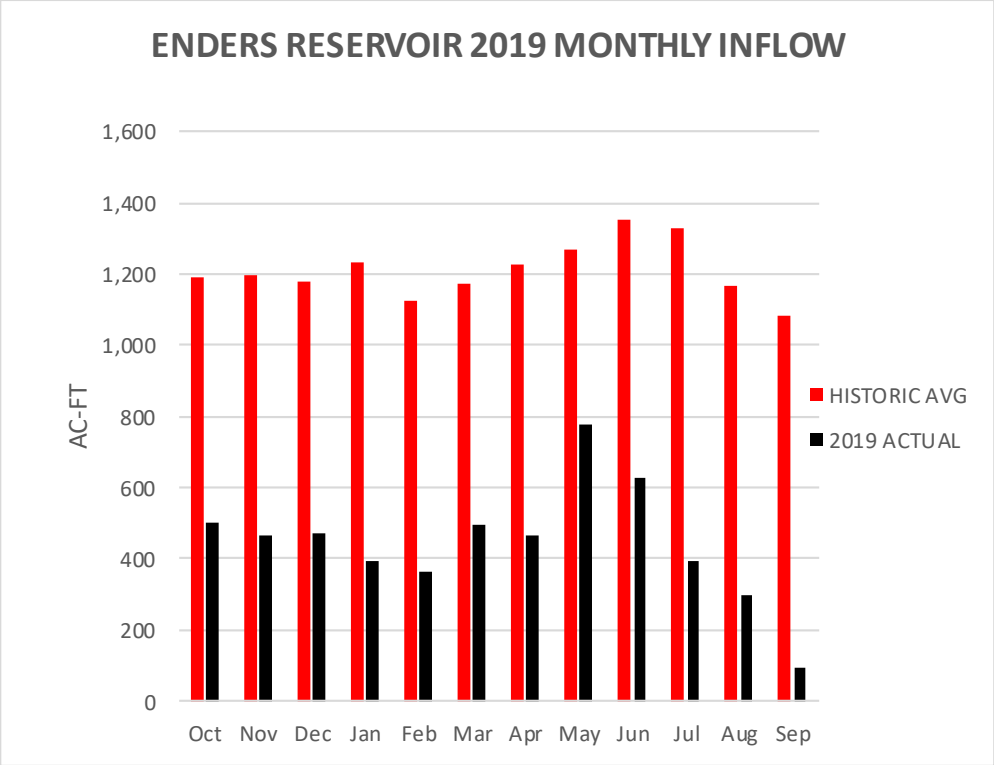


FIGURE B-12. ENDERS 2019 MONTHLY INFLOWS

HARRY STRUNK LAKE
2019 REGULATION

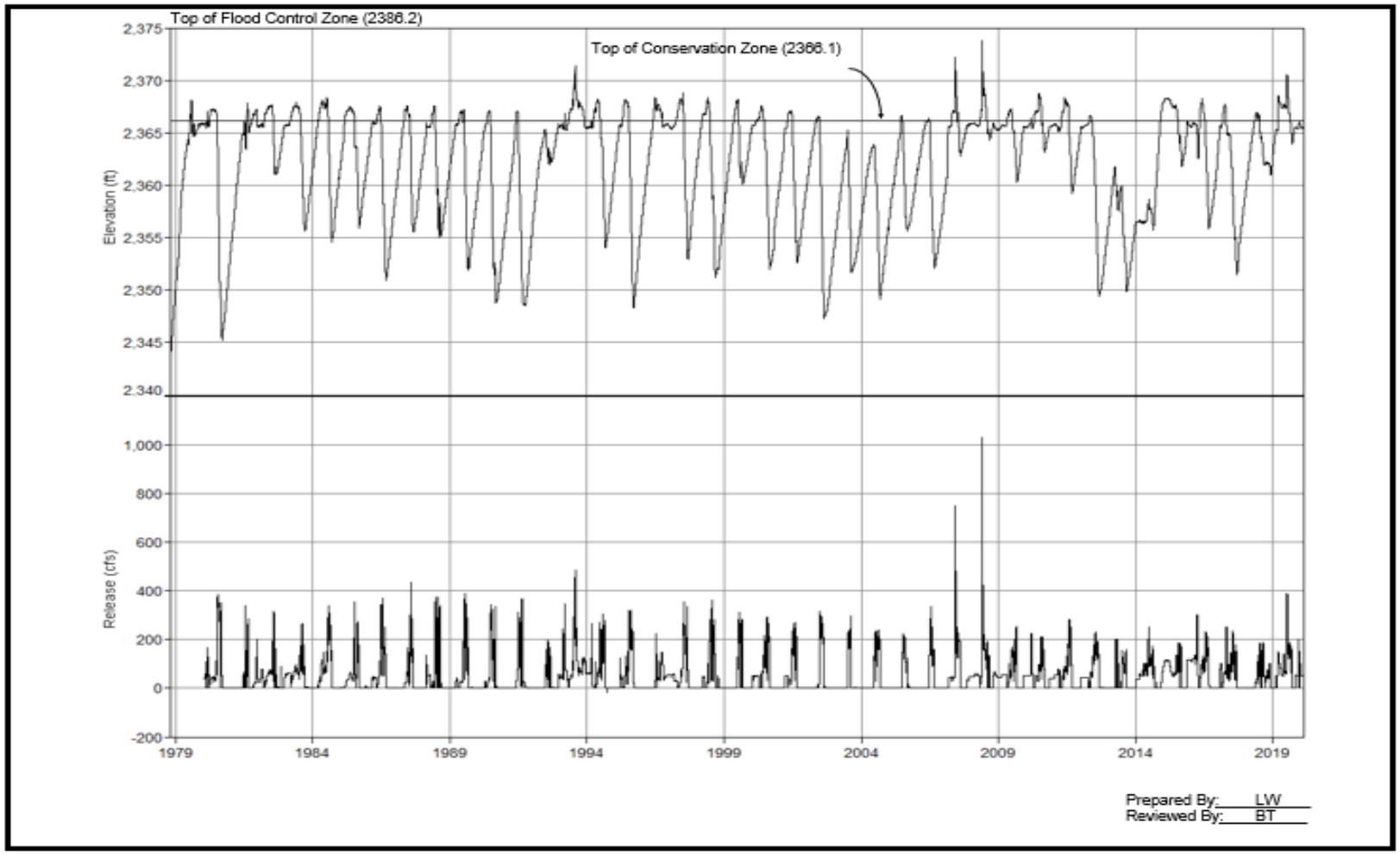


FIGURE B-13. HARRY STRUNK DAM HISTORICAL POOL ELEVATIONS AND RELEASES

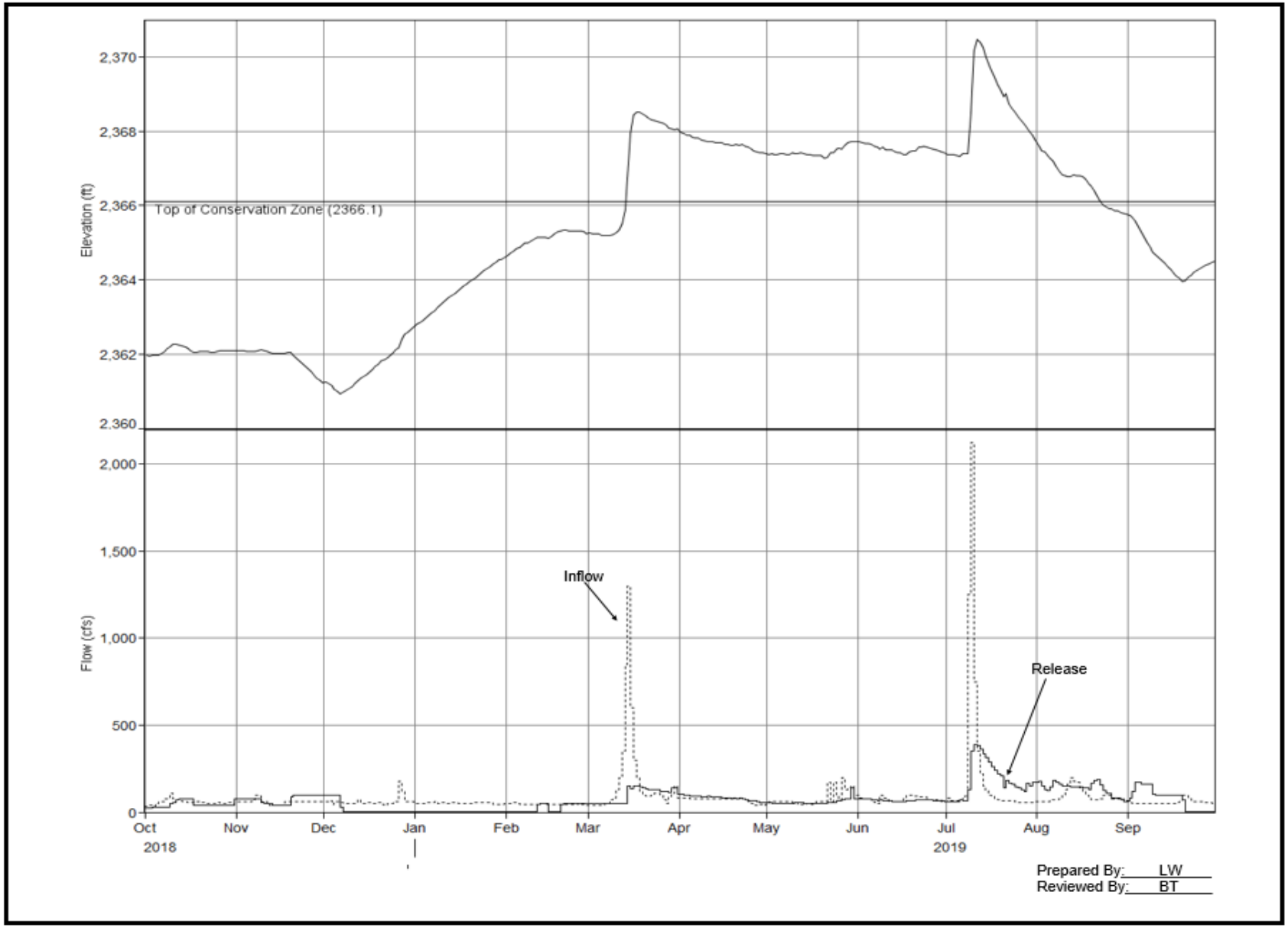


FIGURE B-14. HARRY STRUNK DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE B-4. HARRY STRUNK HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:			b. Minimums of Record (since initial fill)			
	Daily Inflow - Date			**Pool - Date**		
Highest	5108 cfs	31-May-07	Lowest	2340.4 ft	07-Sep-78	
2nd	4340 cfs	25-May-08	2nd	2345.3 ft	09-Sep-80	
3rd	2125 cfs	10-Jul-19	3rd	2347.2 ft	20-Aug-02	
	Daily Outflow - Date					
Highest	1030 cfs	25-May-08	**c. Report Period**			
2nd	750 cfs	03-Jun-07	**Total Inflow**		**Total Outflow**	
3rd	486 cfs	28-Jul-93	63,550 ac-ft	152% of norm	52,537 ac-ft	150% of norm
	Pool - Date		**Peak Daily Inflow**		**Peak Daily Outflow**	
Highest	2373.8 ft	25-May-08	2125 cfs	10-Jul-19	390 cfs	11-Jul-19
2nd	2372.2 ft	03-Jun-07	**Peak Pool Elev**		**Min Pool Elev**	
3rd	2371.4 ft	28-Jul-93	2370.5 ft	11-Jul-19	2360.9 ft	06-Dec-18

Note: Harry Strunk statistics are based on daily data from 1978 through 2019.

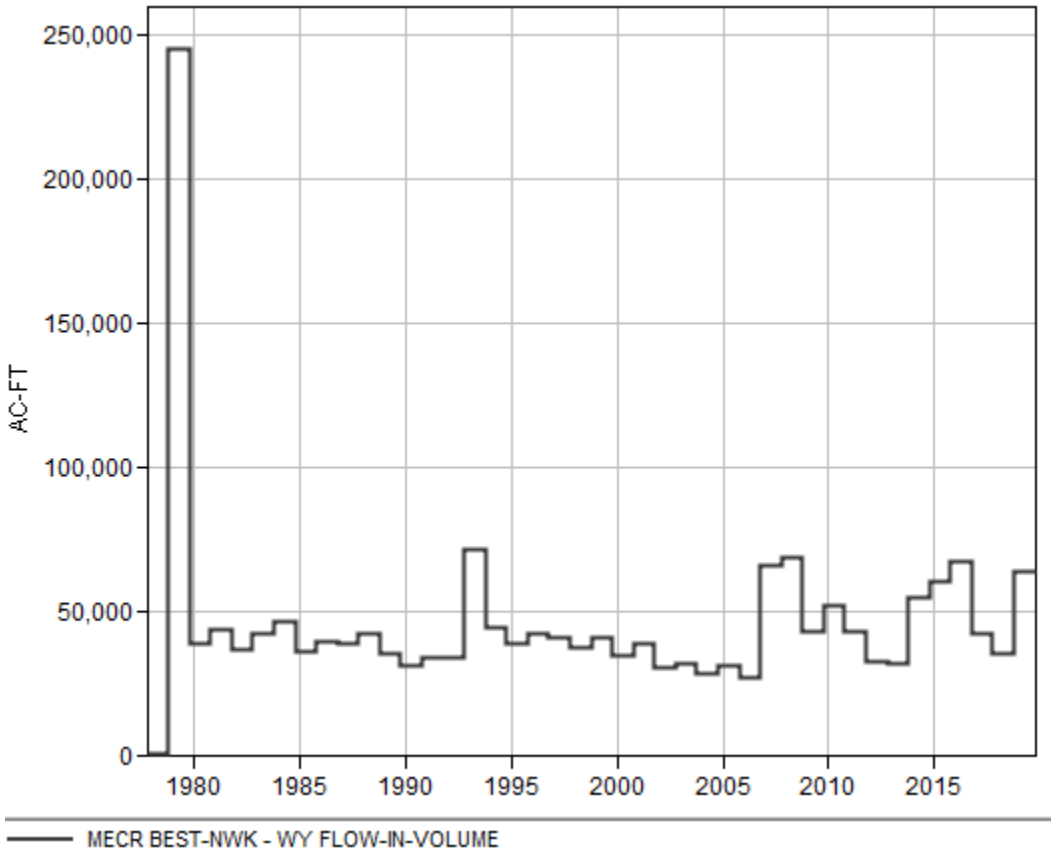


FIGURE B-15. HARRY STRUNK PERIOD OF RECORD ANNUAL INFLOWS

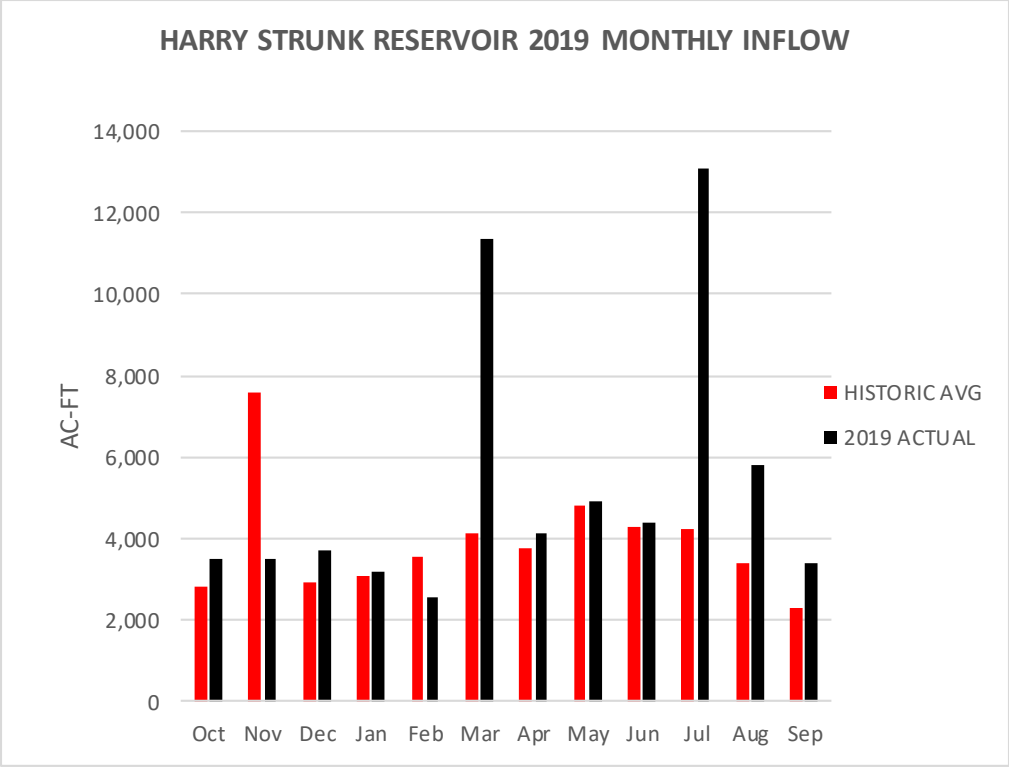


FIGURE B-16. HARRY STRUNK 2019 MONTHLY INFLOWS

HUGH BUTLER LAKE
2019 REGULATION

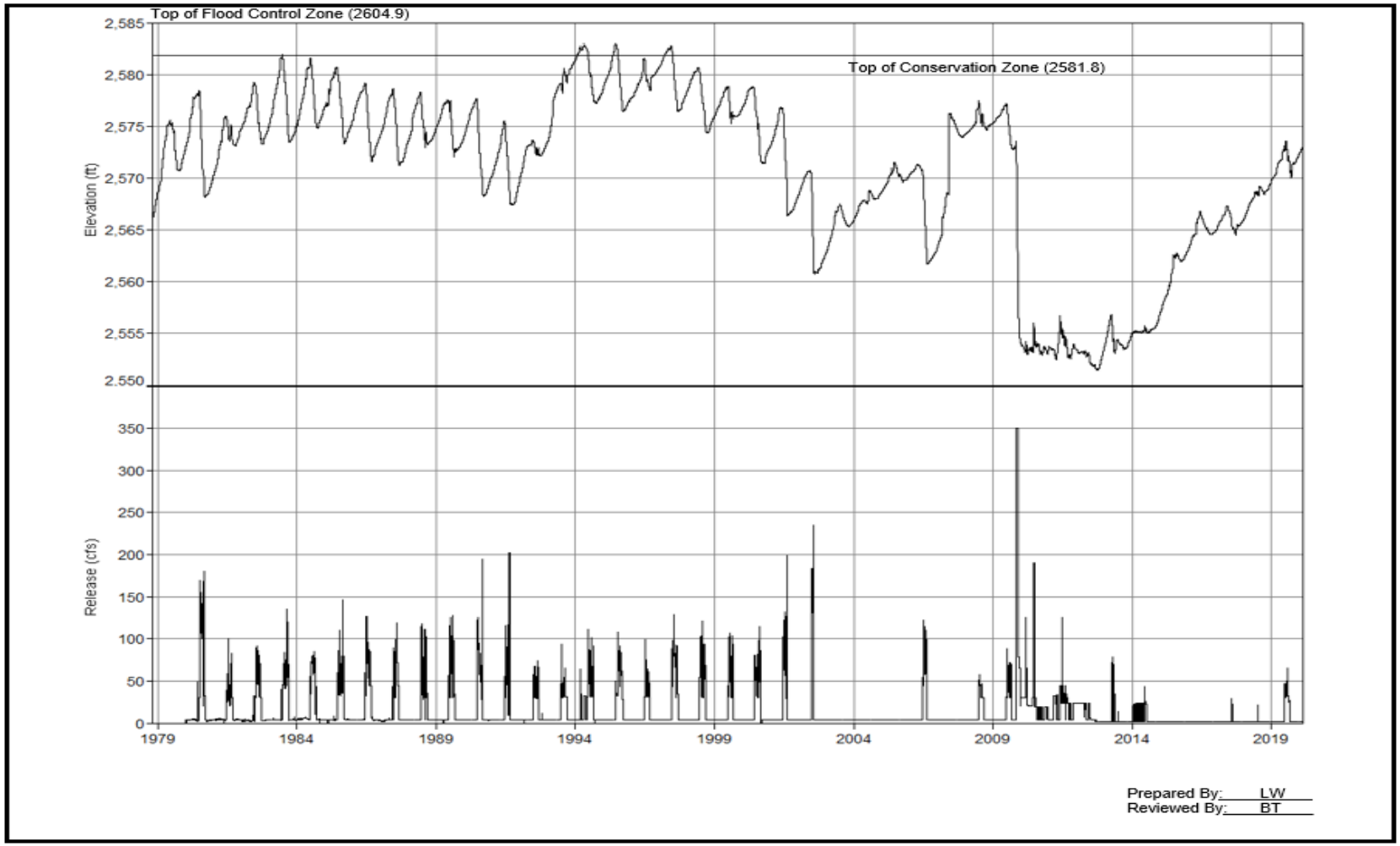


FIGURE B-17 . HUGH BUTLER DAM HISTORICAL POOL ELEVATIONS AND RELEASES

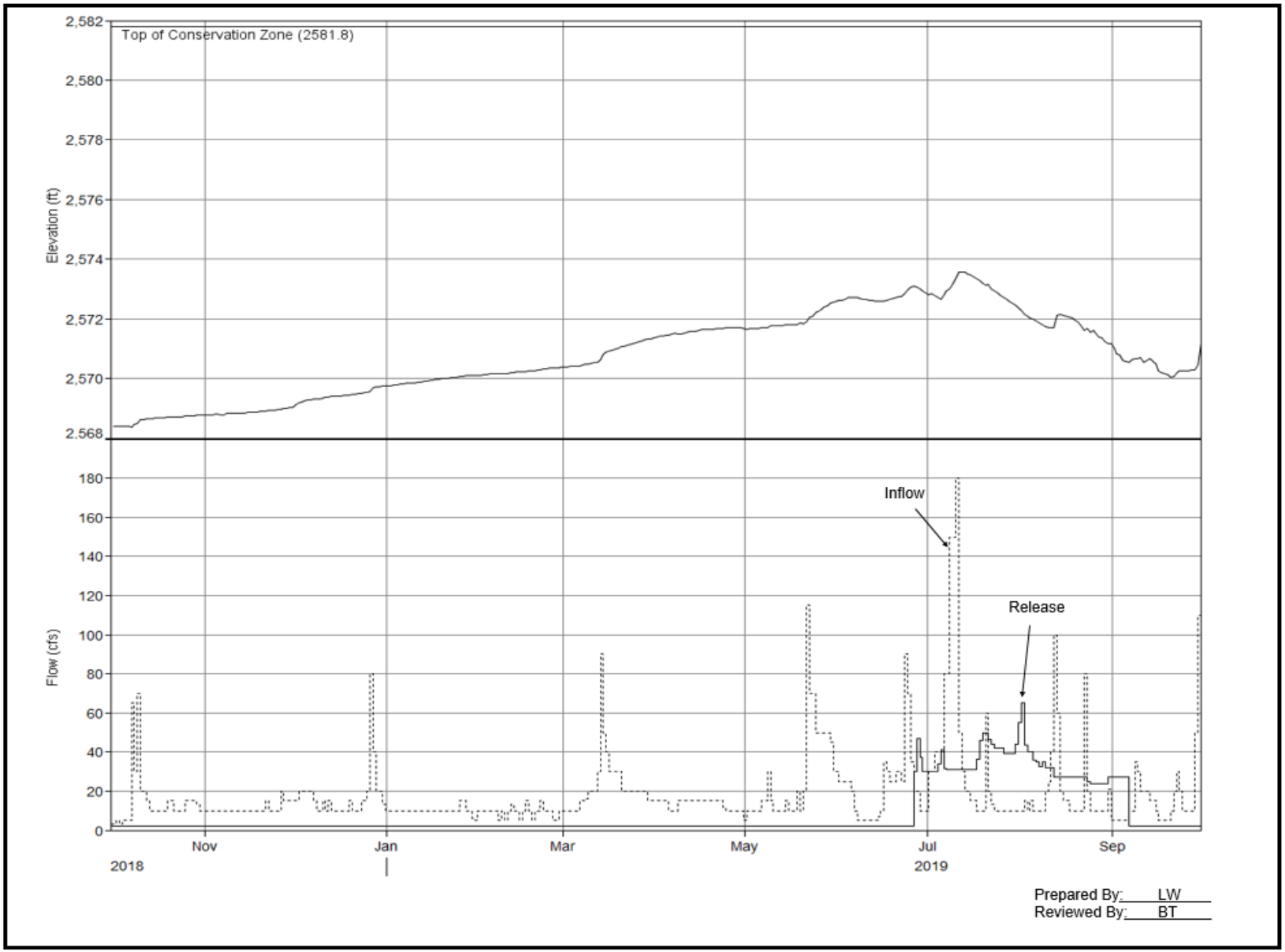


FIGURE B-18 . HUGH BUTLER DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE B-5. HUGH BUTLER HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:			b. Minimums of Record (since initial fill)			
	Daily Inflow - Date			**Pool - Date**		
Highest	3000 cfs	30-May-07	Lowest	2551.5 ft	29-Sep-12	
2nd	600 cfs	11-Aug-99	2nd	2552.5 ft	14-Apr-11	
3rd	574 cfs	25-Jun-89	3rd	2552.9 ft	29-Mar-10	
	Daily Outflow - Date					
Highest	350 cfs	06-Nov-09	**c. Report Period**			
2nd	235 cfs	23-Jul-02	**Total Inflow**		**Total Outflow**	
3rd	202 cfs	20-Aug-91	13,573 ac-ft	93% of norm	5,946 ac-ft	61% of norm
	Pool - Date		**Peak Daily Inflow**		**Peak Daily Outflow**	
Highest	2583.0 ft	15-Jun-95	180 cfs	11-Jul-19	65 cfs	02-Aug-19
2nd	2583.0 ft	25-Apr-94	**Peak Pool Elev**		**Min Pool Elev**	
3rd	2582.7 ft	15-Jun-97	2573.6 ft	12-Jul-19	2568.4 ft	07-Oct-18

Note: Hugh Butler statistics are based on daily data from 1978 through 2019.

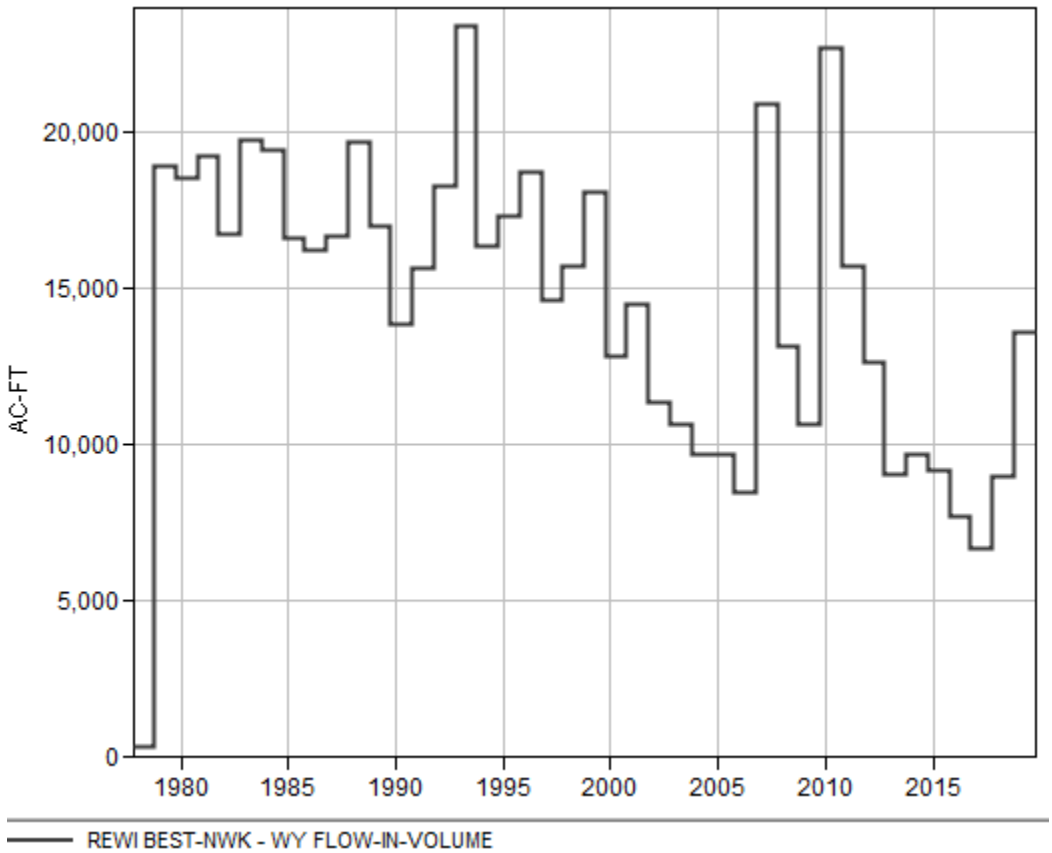


FIGURE B-19. HUGH BUTLER PERIOD OF RECORD ANNUAL INFLOWS

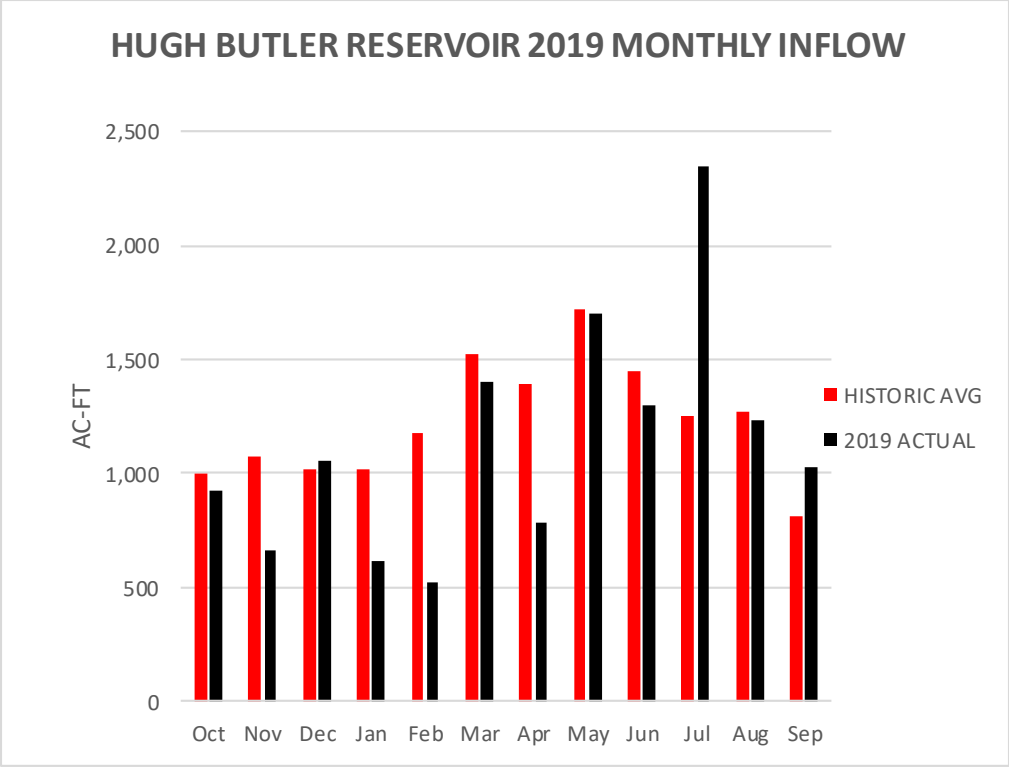


FIGURE B-20. HUGH BUTLER 2019 MONTHLY INFLOWS

KEITH SEBELIUS LAKE
2019 REGULATION

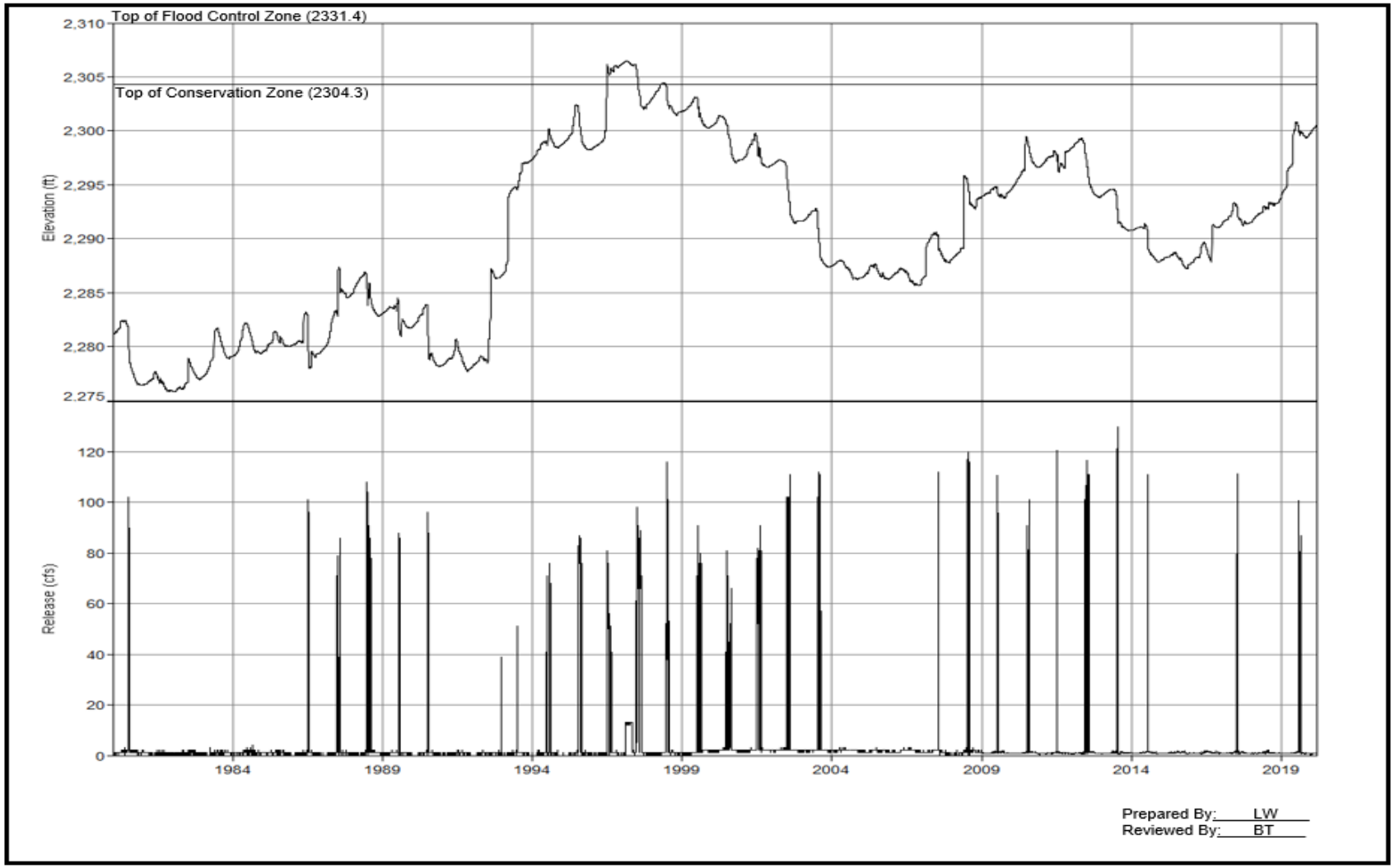


FIGURE B-21. KEITH SEBELIUS DAM HISTORICAL POOL ELEVATIONS AND RELEASES

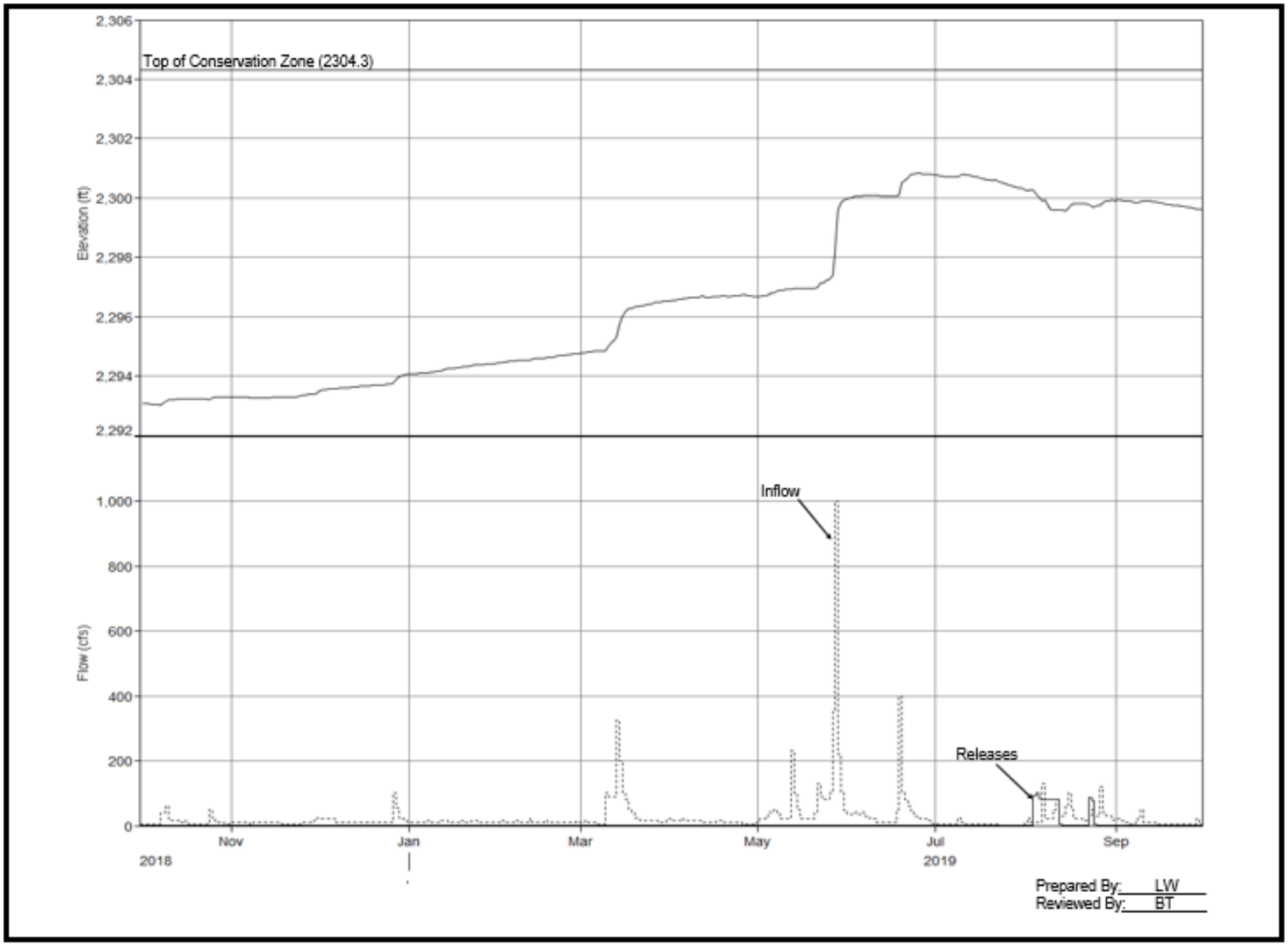


FIGURE B-22. KEITH SEBELIUS DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE B-6. KEITH SEBELIUS HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:			b. Minimums of Record (since initial fill)			
	Daily Inflow - Date			**Pool - Date**		
Highest	2300 cfs	24-May-08	Lowest	2275.8 ft	28-Nov-81	
2nd	1605 cfs	25-Jun-96	2nd	2276.4 ft	19-Dec-80	
3rd	1009 cfs	08-Aug-92	3rd	2276.9 ft	27-Nov-82	
	Daily Outflow - Date					
Highest	130 cfs	19-Jul-13	**c. Report Period**			
2nd	121 cfs	06-Jul-11	**Total Inflow**		**Total Outflow**	
3rd	120 cfs	16-Jul-08	18,815 ac-ft	233% of norm	2,470 ac-ft	90% of norm
	Pool - Date		**Peak Daily Inflow**		**Peak Daily Outflow**	
Highest	2306.5 ft	15-Feb-97	1000 cfs	28-May-19	101 cfs	05-Aug-19
2nd	2304.5 ft	25-May-98	**Peak Pool Elev**		**Min Pool Elev**	
3rd	2303.2 ft	22-Jun-99	2300.8 ft	24-Jun-19	2293.0 ft	07-Oct-18

Note: Keith Sebelius statistics are based on daily data from 1980 through 2019.

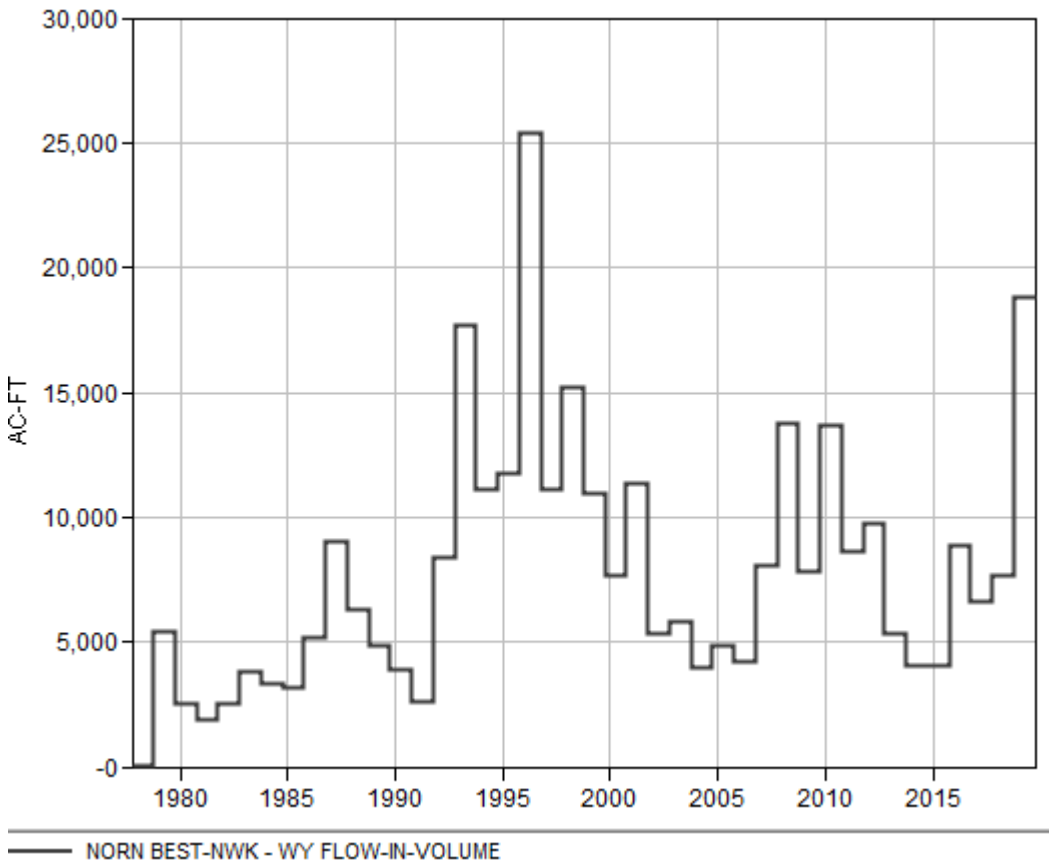


FIGURE B-23. KEITH SEBELIUS PERIOD OF RECORD ANNUAL INFLOWS

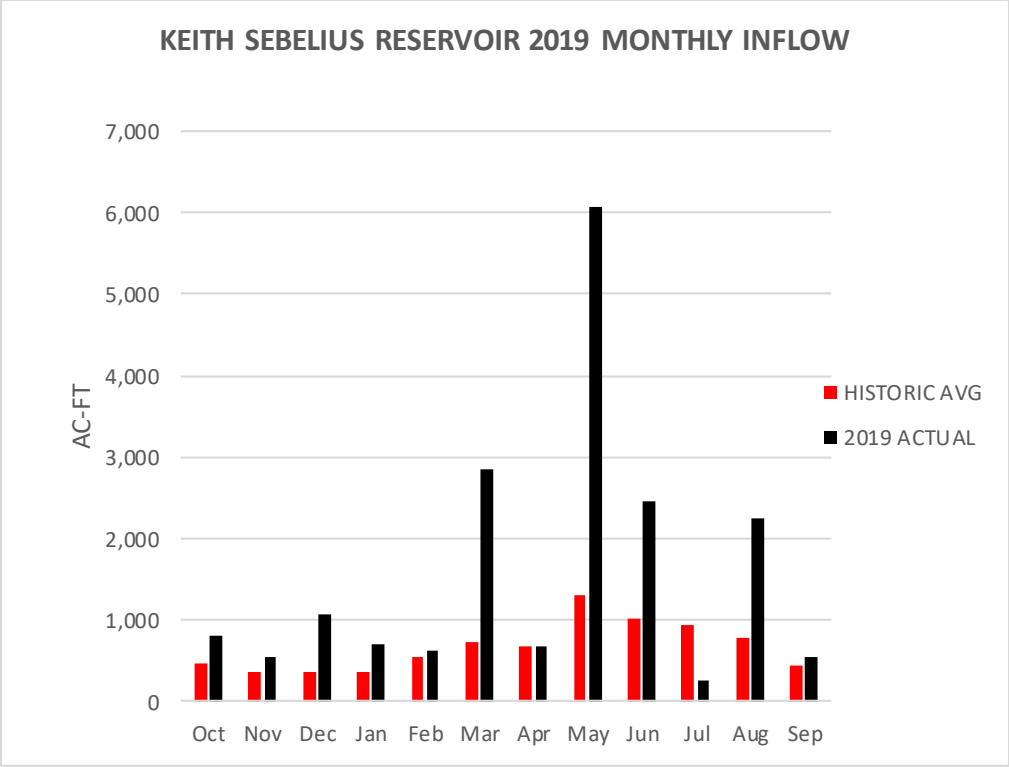


FIGURE B-24. KEITH SEBELIUS 2019 MONTHLY INFLOWS

KIRWIN RESERVOIR
2019 REGULATION

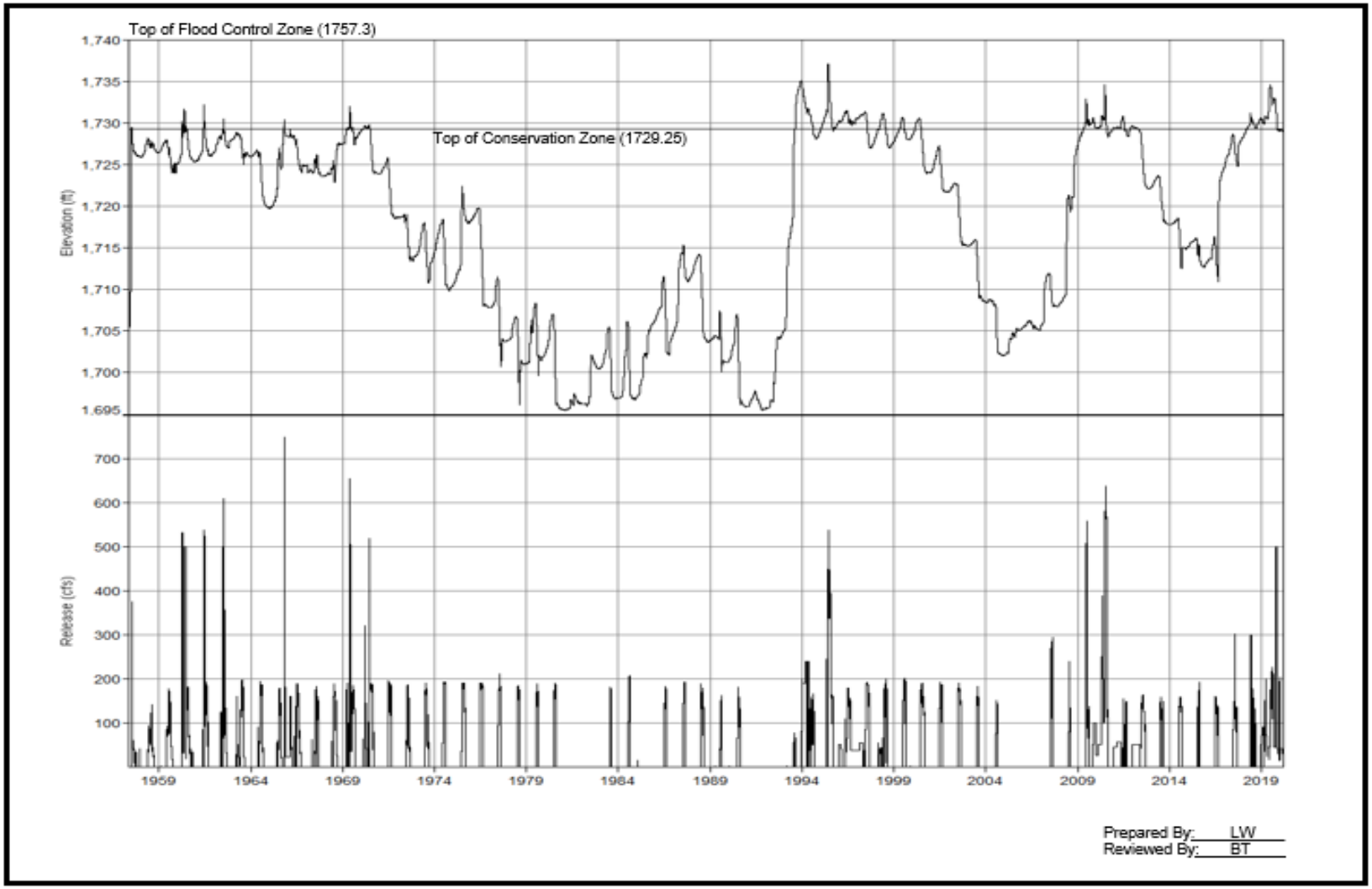


FIGURE B-25. KIRWIN DAM HISTORICAL POOL ELEVATIONS AND RELEASES

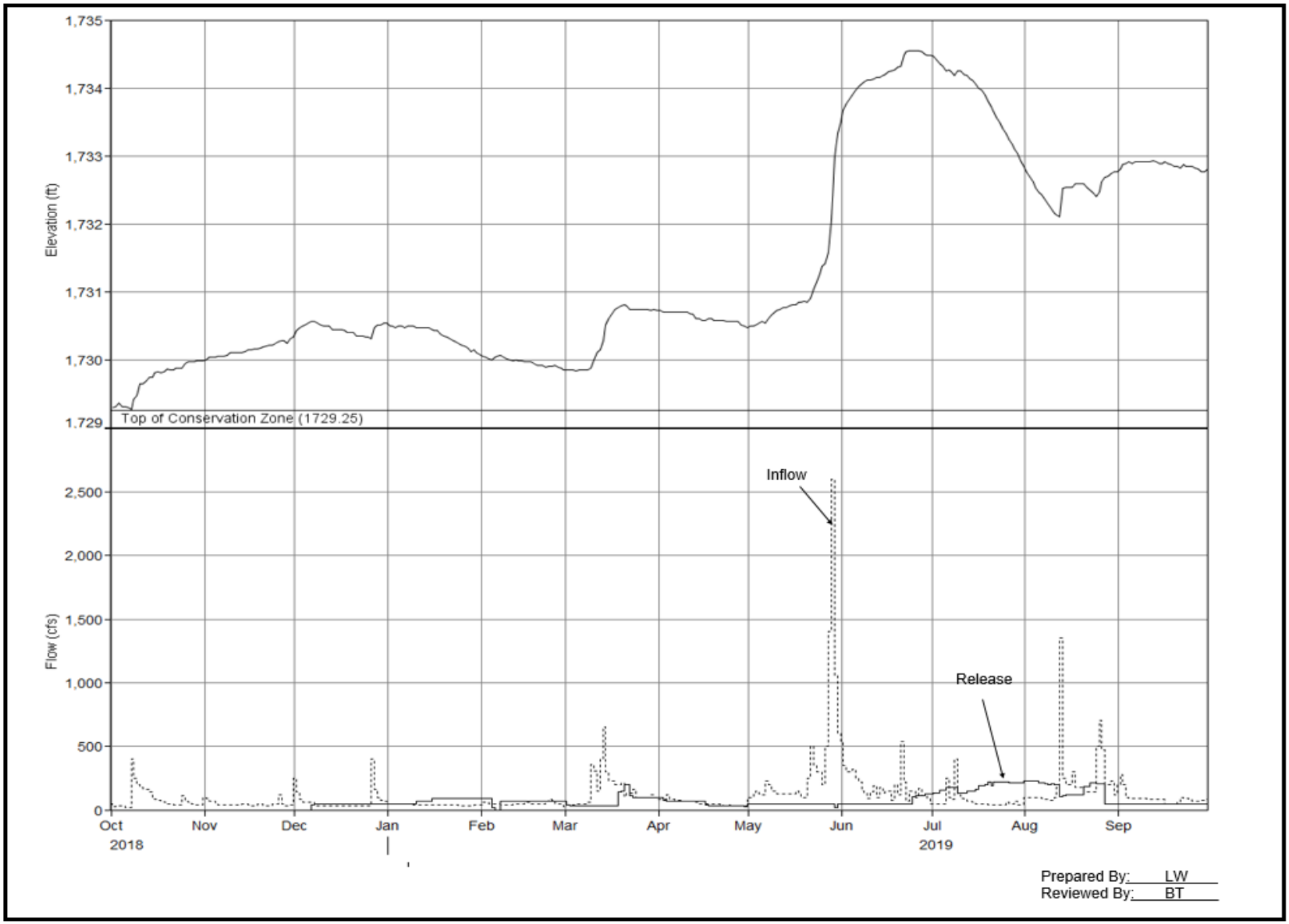


FIGURE B-26. KIRWIN DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE B-7. KIRWIN HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:

	Daily Inflow - Date	
Highest	11190 cfs	16-Jun-57
2nd	8900 cfs	06-Sep-16
3rd	8207 cfs	28-May-95
	Daily Outflow - Date	
Highest	750 cfs	23-Oct-65
2nd	655 cfs	22-May-69
3rd	637 cfs	17-Jul-10
	Pool - Date	
Highest	1737.1 ft	02-Jun-95
2nd	1735.1 ft	06-Dec-93
3rd	1734.7 ft	01-Jan-94

b. Minimums of Record (since initial fill)

	Pool - Date	
Lowest	1695.5 ft	11-Feb-81
2nd	1695.5 ft	31-Oct-91
3rd	1695.8 ft	17-Dec-90

c. Report Period

Total Inflow		**Total Outflow**	
88,032 ac-ft	158% of norm	48,358 ac-ft	145% of norm
Peak Daily Inflow		**Peak Daily Outflow**	
2600 cfs	29-May-19	226 cfs	01-Aug-19
Peak Pool Elev		**Min Pool Elev**	
1734.6 ft	23-Jun-19	1729.3 ft	07-Oct-18

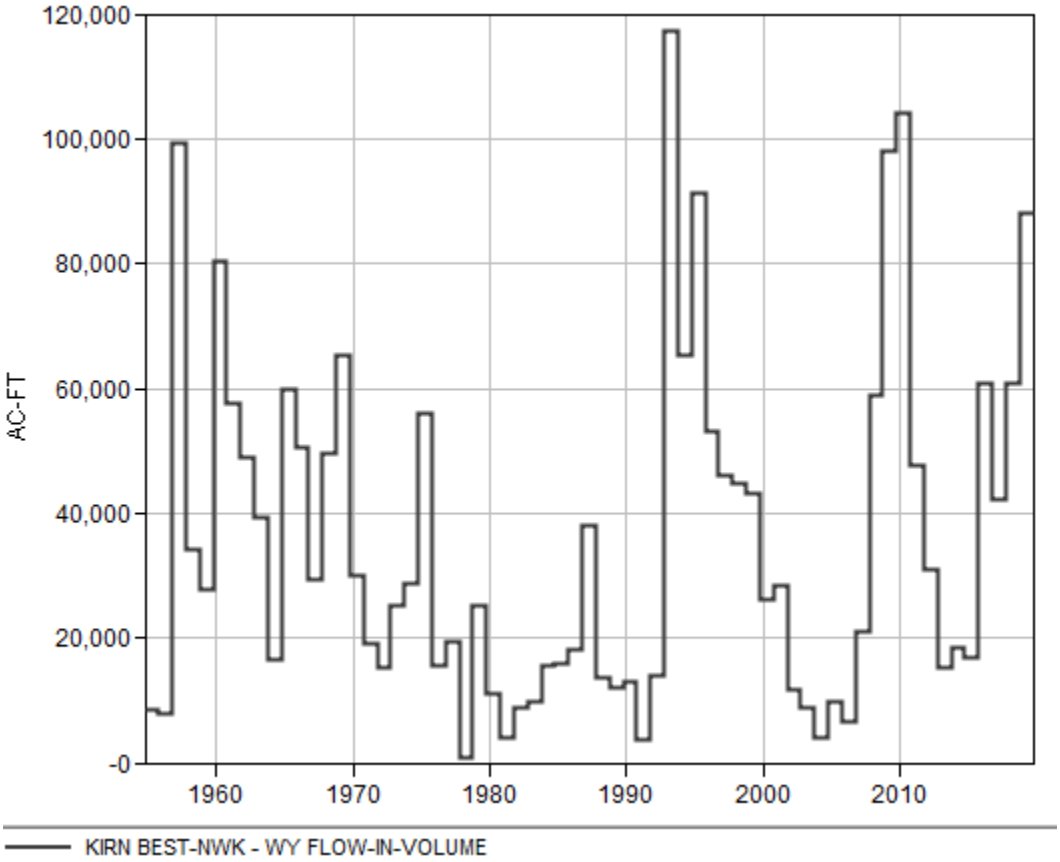


FIGURE B-27. KIRWIN PERIOD OF RECORD ANNUAL INFLOWS

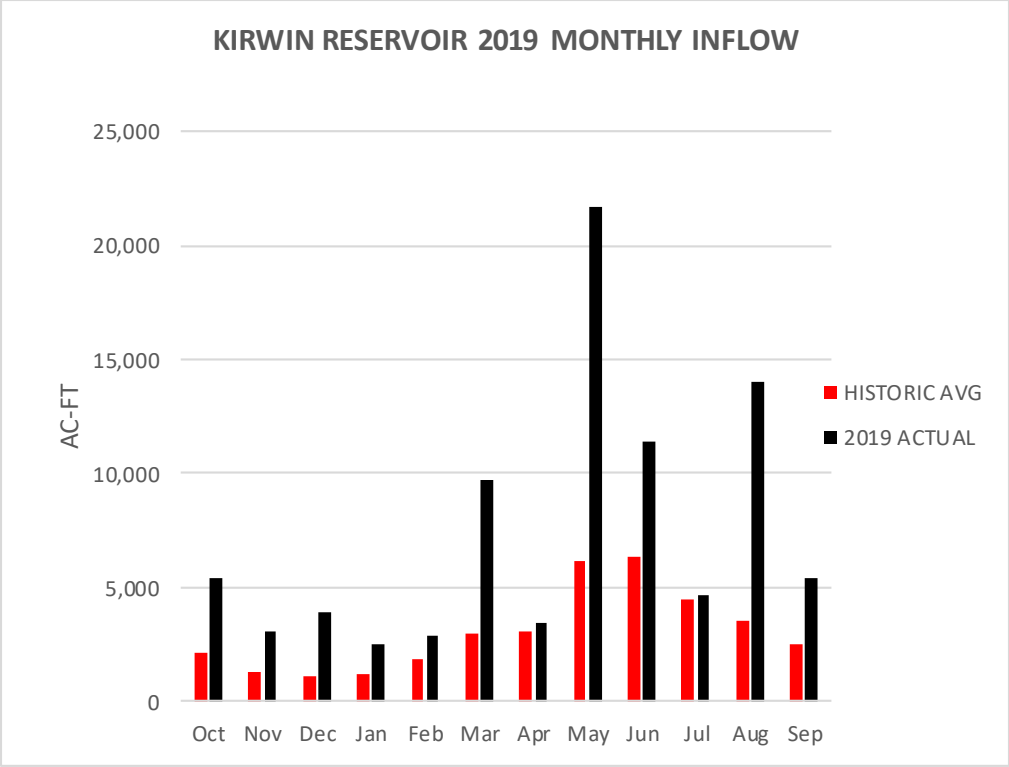


FIGURE B-28. KIRWIN 2019 MONTHLY INFLOWS

LOVEWELL RESERVOIR
2019 REGULATION

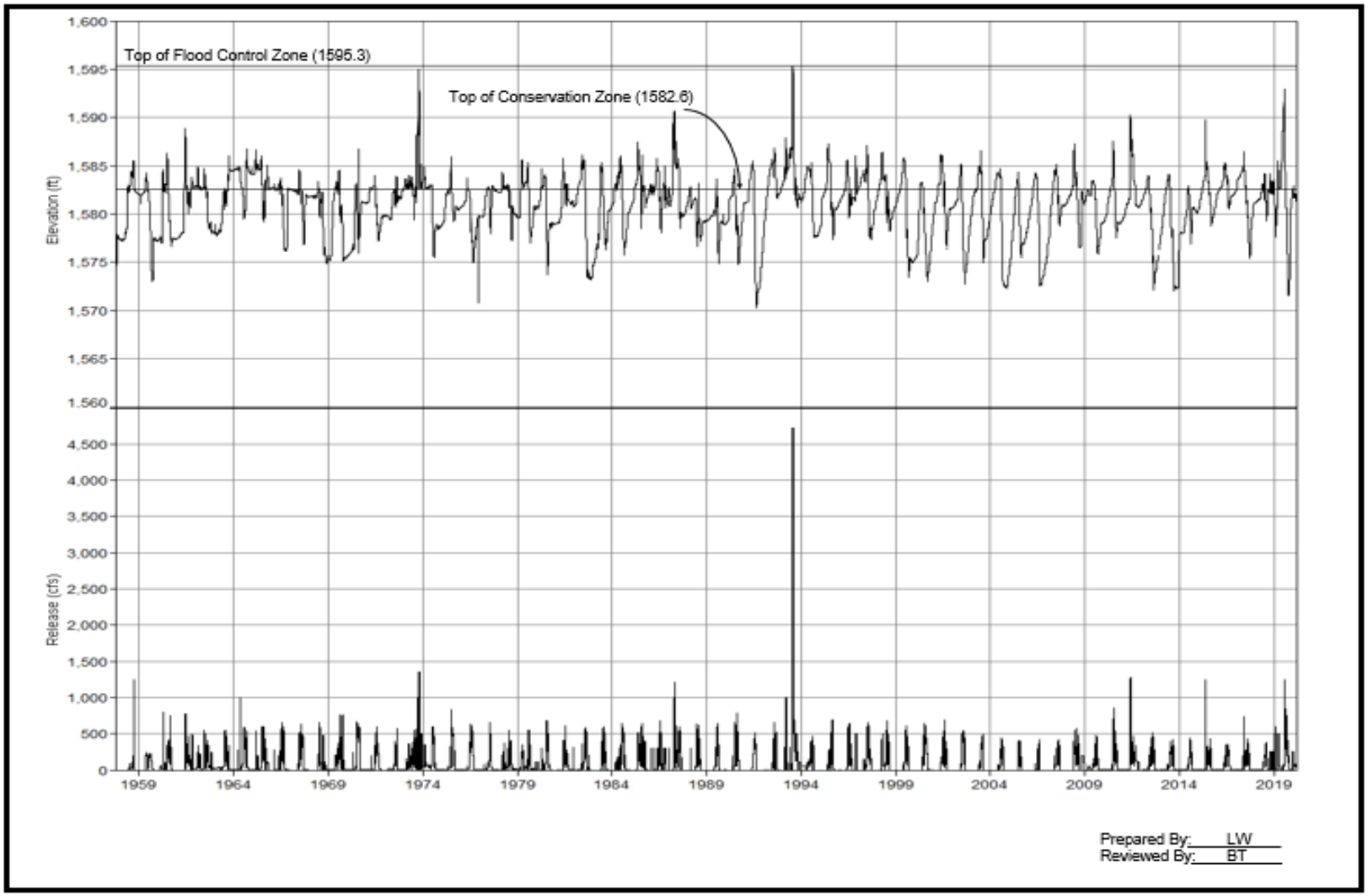


FIGURE B-29. LOVEWELL DAM HISTORICAL POOL ELEVATIONS AND RELEASES

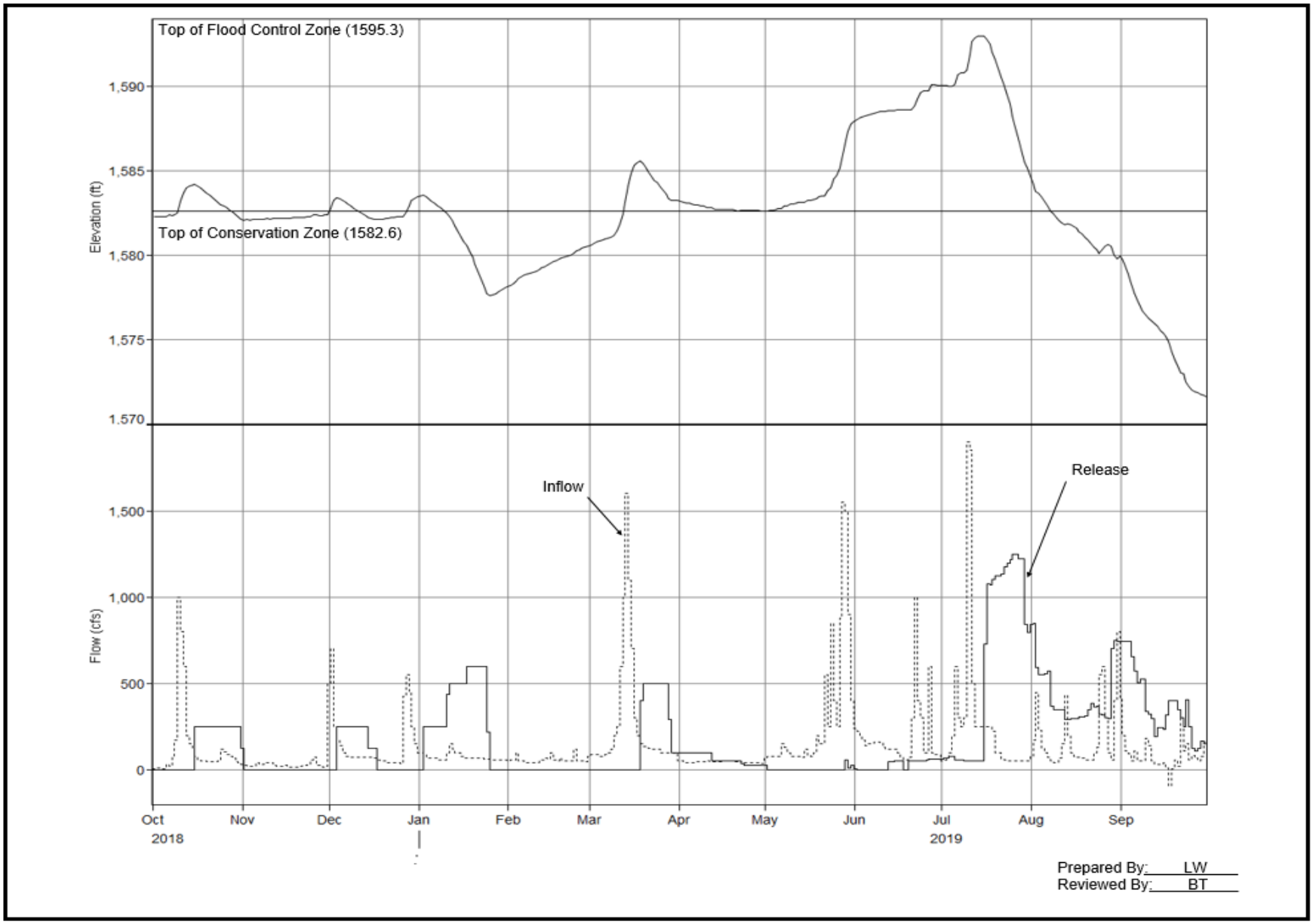


FIGURE B-30. LOVEWELL DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE B-8. LOVEWELL HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:

	Daily Inflow - Date	
Highest	7000 cfs	18-Jun-57
2nd	6800 cfs	07-May-15
3rd	6368 cfs	22-Jul-93
	Daily Outflow - Date	
Highest	4717 cfs	23-Jul-93
2nd	1350 cfs	20-Oct-73
3rd	1281 cfs	01-Jun-11
	Pool - Date	
Highest	1595.3 ft	22-Jul-93
2nd	1595.0 ft	13-Oct-73
3rd	1593.0 ft	15-Jul-19

b. Minimums of Record (since initial fill)

	Pool - Date	
Lowest	1570.2 ft	21-Aug-91
2nd	1570.8 ft	03-Dec-76
3rd	1571.6 ft	01-Oct-19

c. Report Period

Total Inflow		**Total Outflow**	
111,416 ac-ft	147% of norm	136,405 ac-ft	157% of norm
Peak Daily Inflow		**Peak Daily Outflow**	
1900 cfs	10-Jul-19	1248 cfs	27-Jul-19
Peak Pool Elev		**Min Pool Elev**	
1593.0 ft	15-Jul-19	1571.6 ft	30-Sep-19

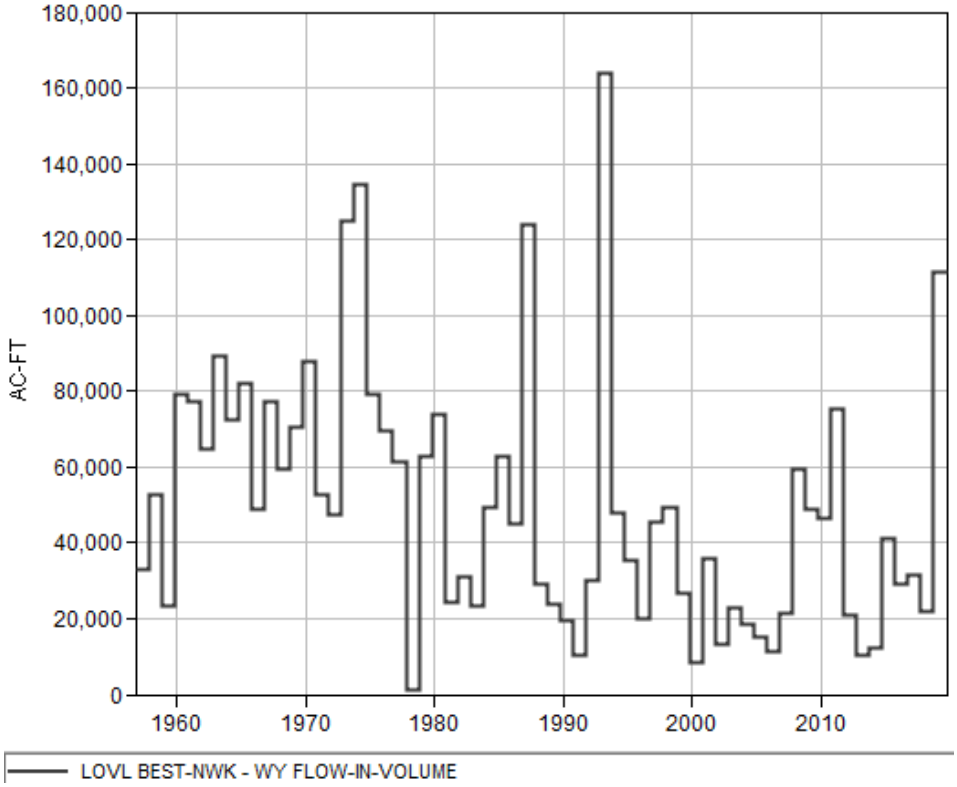


FIGURE B-31. LOVEWELL PERIOD OF RECORD ANNUAL INFLOWS

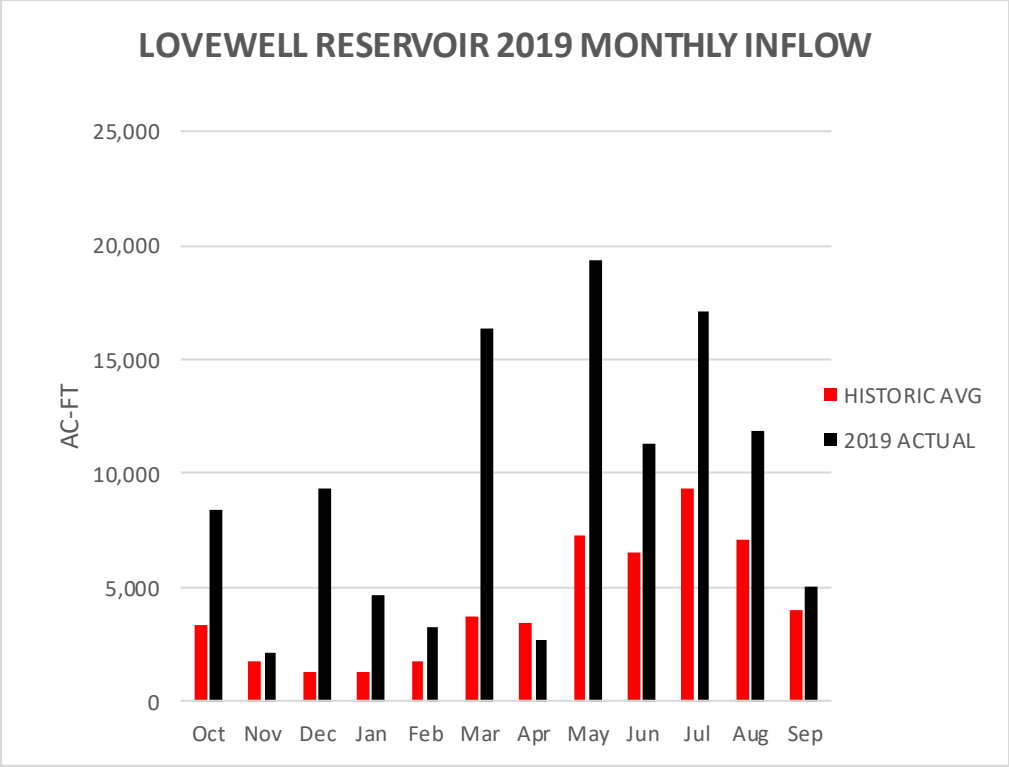


FIGURE B-32. LOVEWELL 2019 MONTHLY INFLOWS

SWANSON LAKE
2019 REGULATION

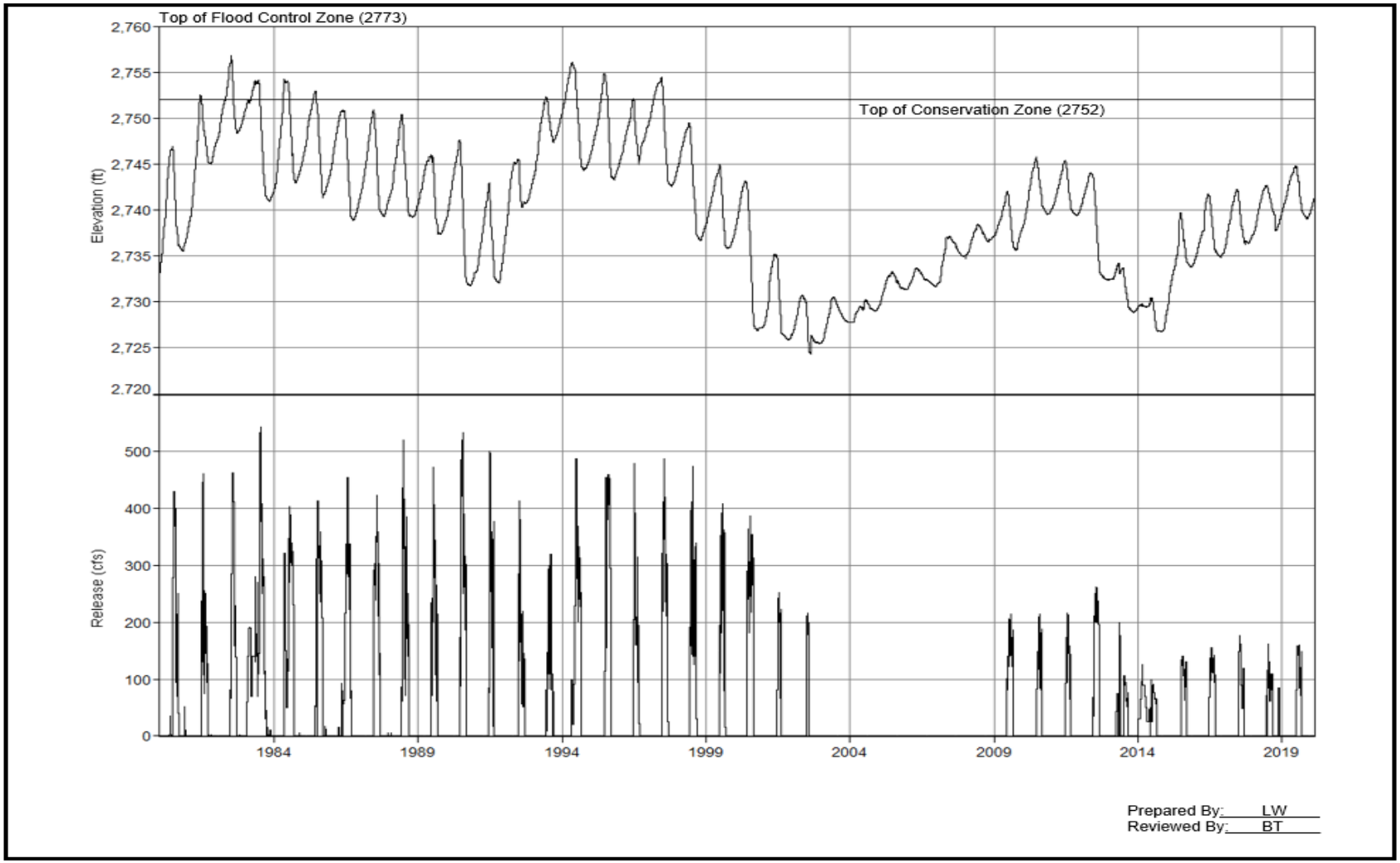


FIGURE B-33. SWANSON DAM HISTORICAL POOL ELEVATIONS AND RELEASES

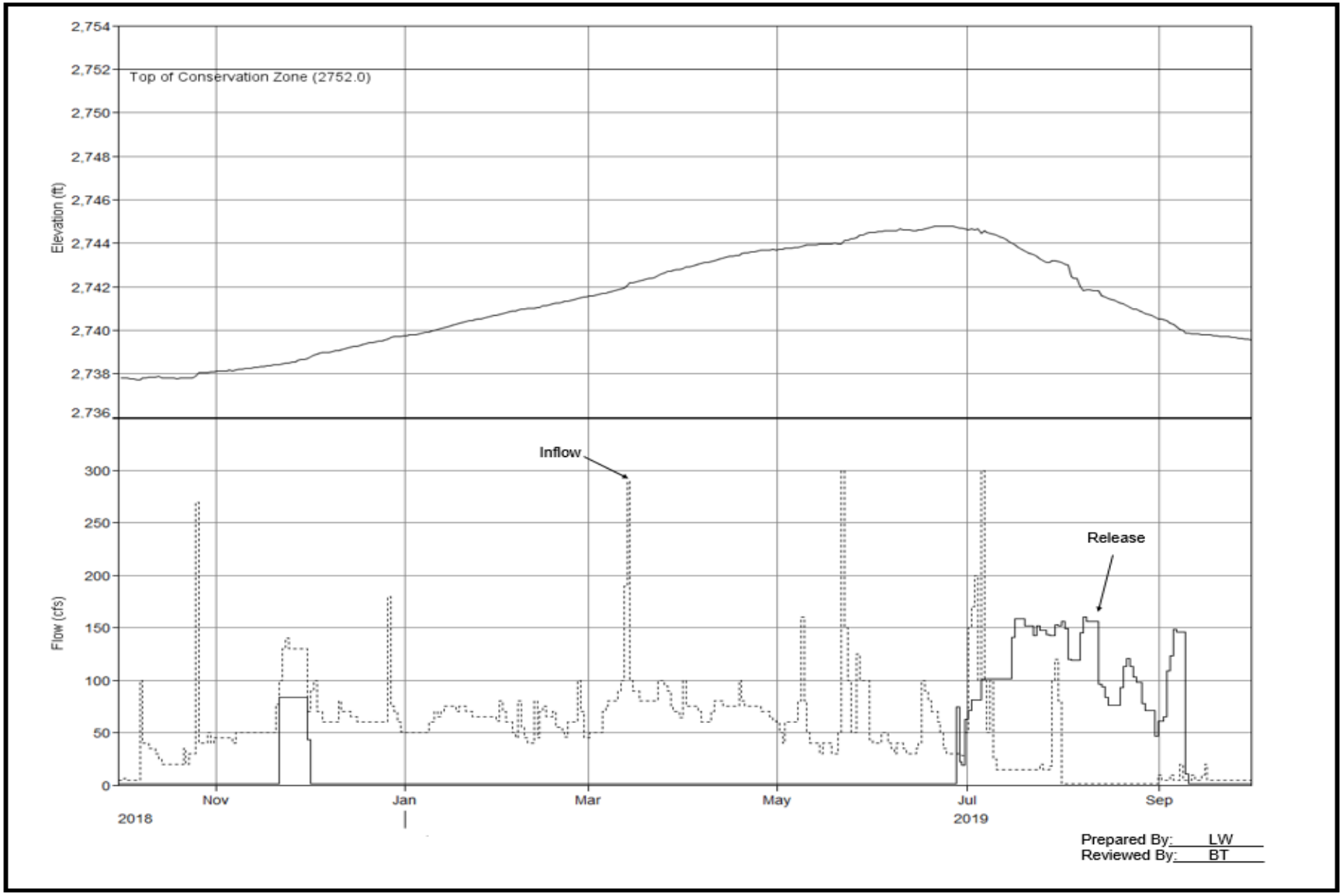


FIGURE B-34. SWANSON DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE B-9. SWANSON HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:			b. Minimums of Record (since initial fill)			
	Daily Inflow - Date			**Pool - Date**		
Highest	1333 cfs	18-Jul-81	Lowest	2724.3 ft	25-Aug-02	
2nd	1300 cfs	27-Aug-02	2nd	2725.9 ft	07-Nov-01	
3rd	1050 cfs	29-May-15	3rd	2726.8 ft	15-Oct-14	
	Daily Outflow - Date					
Highest	544 cfs	13-Jul-83	**c. Report Period**			
2nd	533 cfs	20-Jul-90	**Total Inflow**		**Total Outflow**	
3rd	521 cfs	29-Jun-88	39,039 ac-ft	87% of norm	18,573 ac-ft	59% of norm
	Pool - Date		**Peak Daily Inflow**		**Peak Daily Outflow**	
Highest	2756.8 ft	06-Jul-82	300 cfs	22-May-19	161 cfs	08-Aug-19
2nd	2756.0 ft	07-May-94	**Peak Pool Elev**		**Min Pool Elev**	
3rd	2754.9 ft	20-Jun-95	2744.8 ft	21-Jun-19	2737.7 ft	07-Oct-18

Note: Swanson statistics are based on daily data from 1980 through 2019.

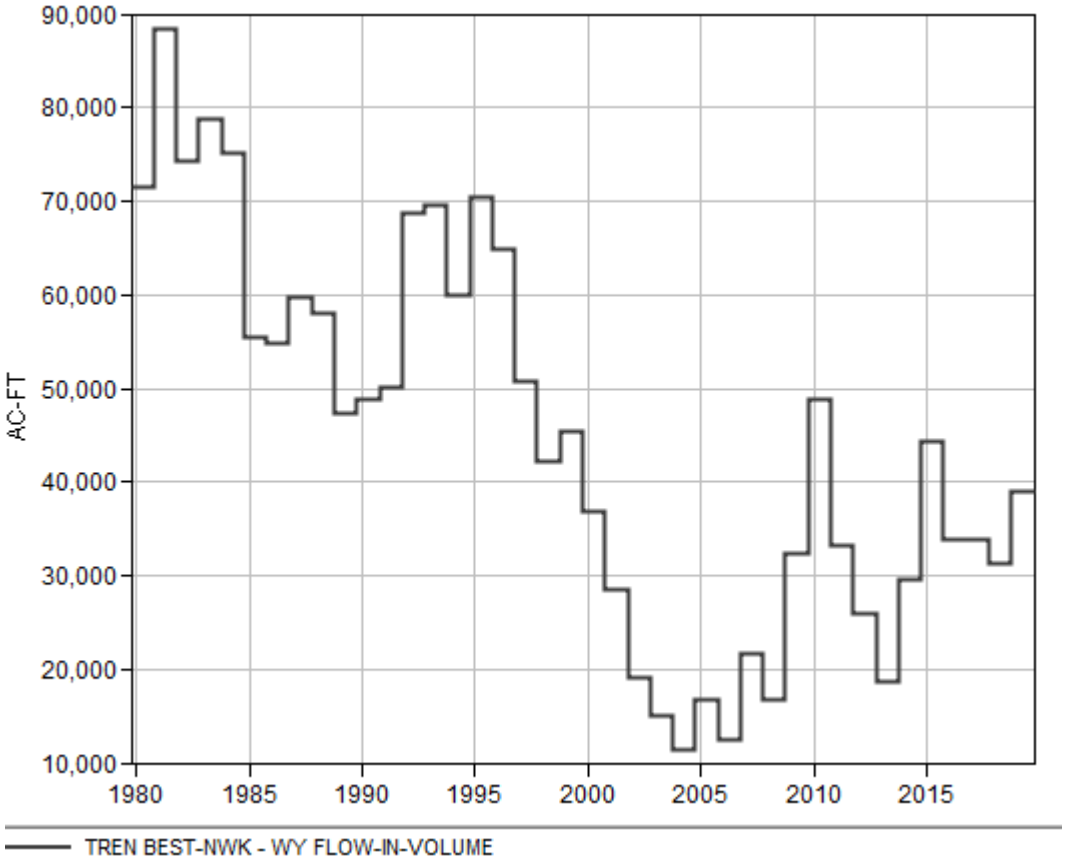


FIGURE B-35. SWANSON PERIOD OF RECORD ANNUAL INFLOWS

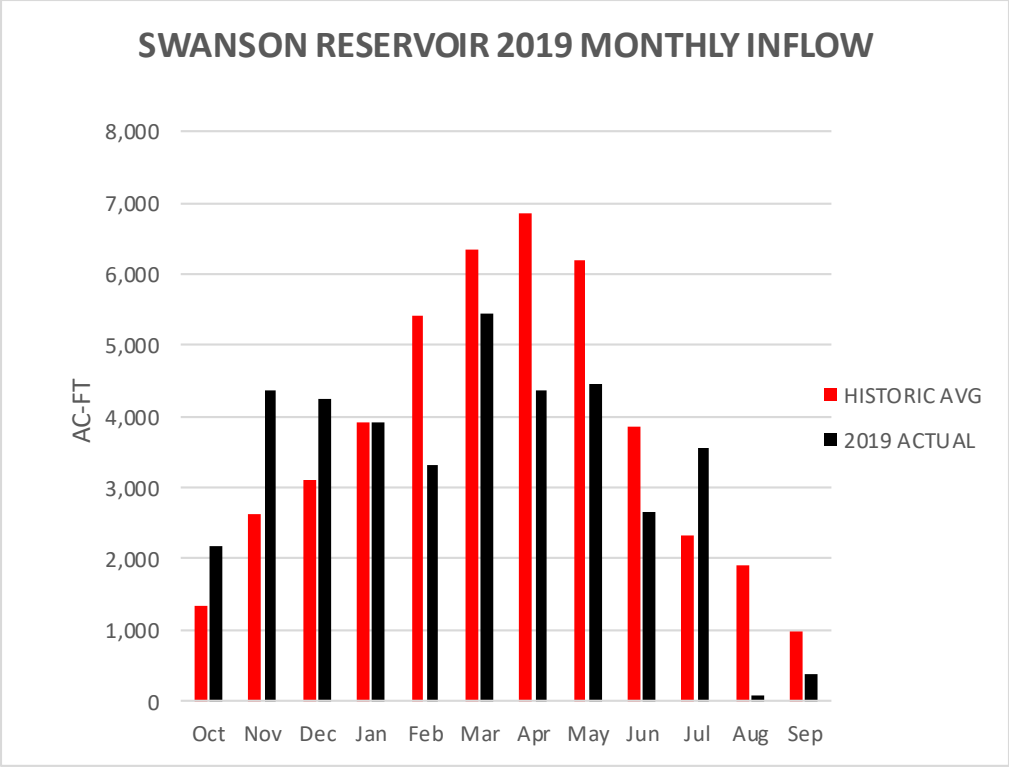


FIGURE B-36. SWANSON 2019 MONTHLY INFLOWS

WACONDA LAKE
2019 REGULATION

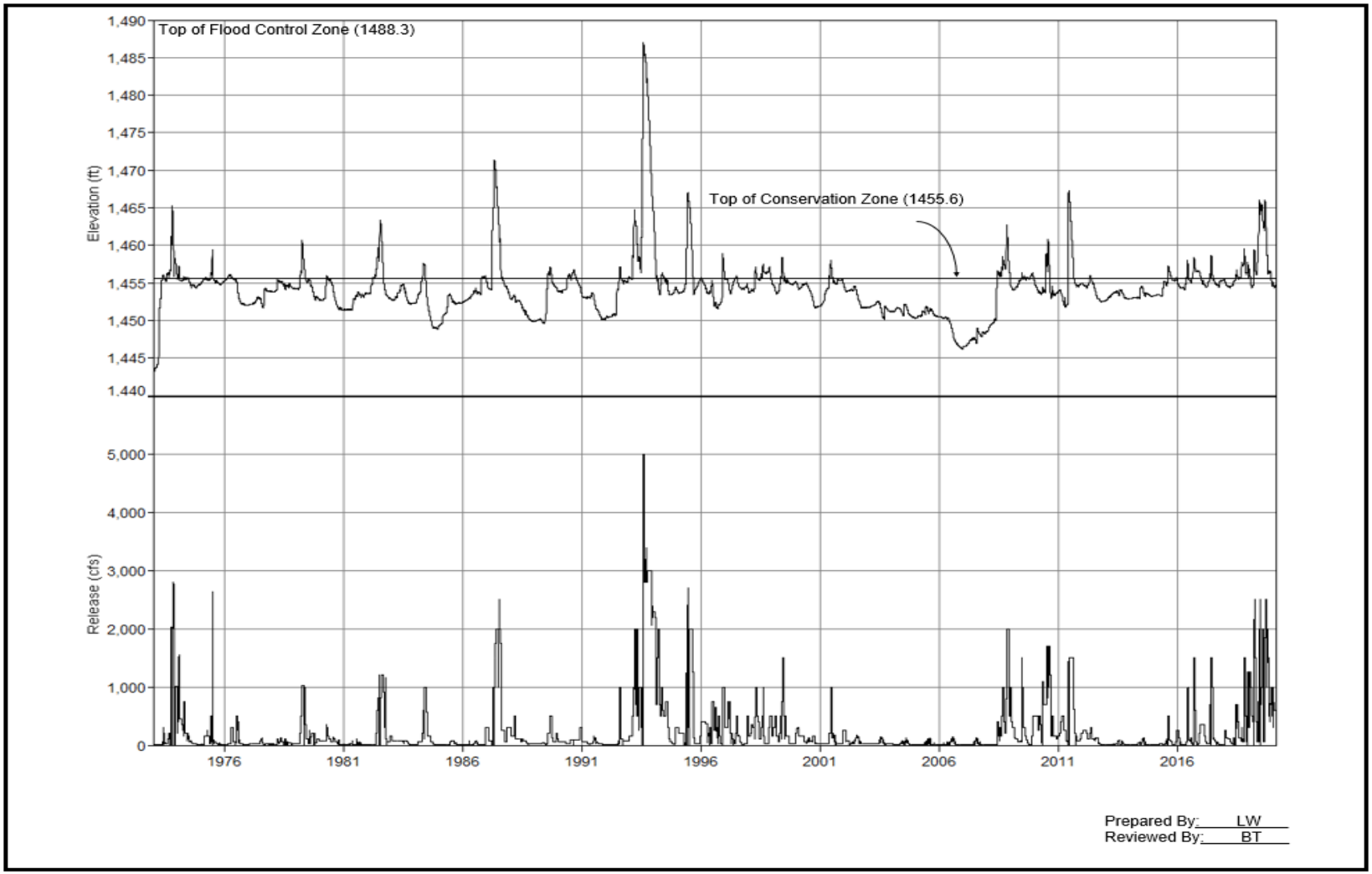


FIGURE B-37. WACONDA DAM HISTORICAL POOL ELEVATIONS AND RELEASES

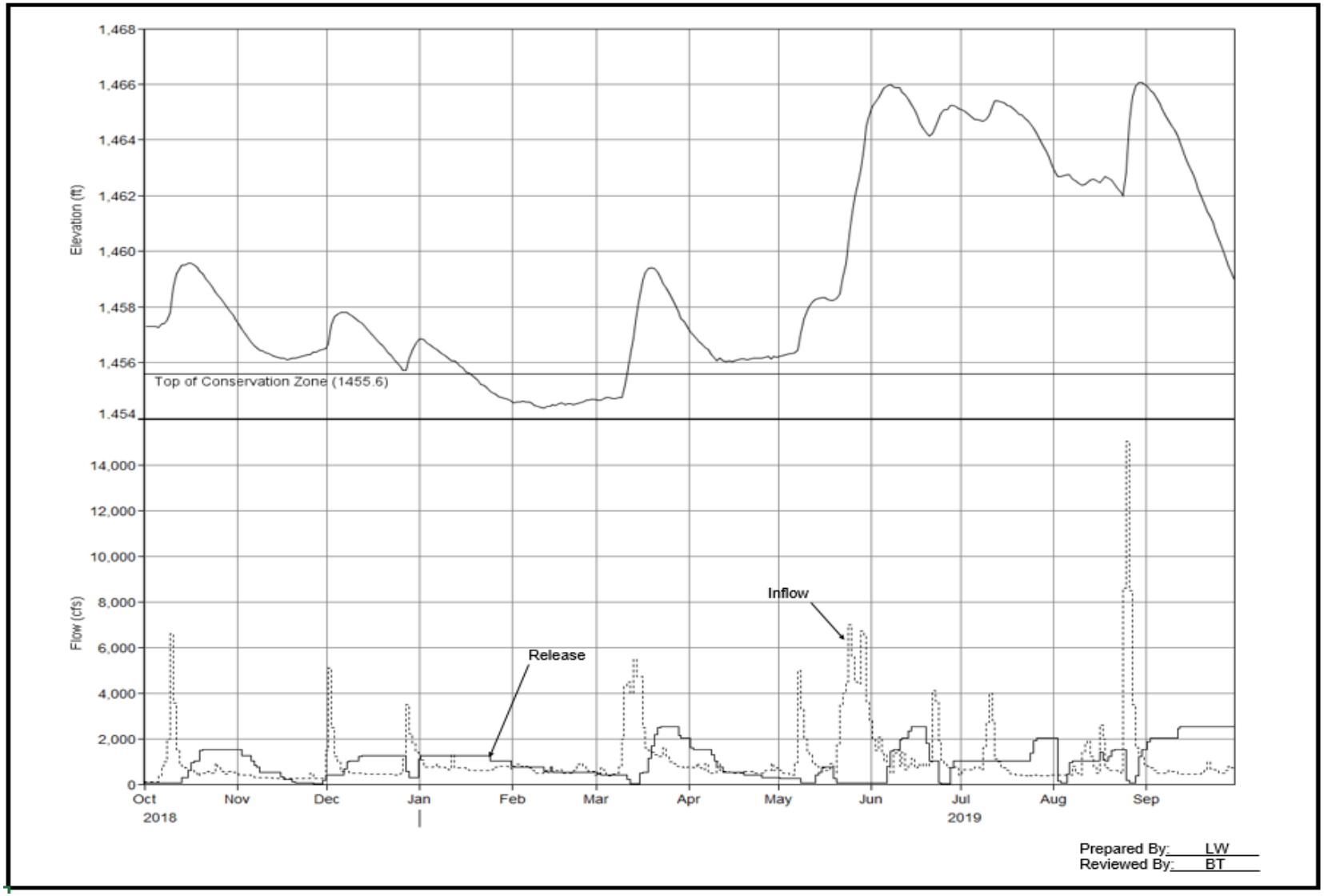


FIGURE B-38. WACONDA DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE B-10. WACONDA HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:			b. Minimums of Record (since initial fill)			
	Daily Inflow - Date			**Pool - Date**		
Highest	48728 cfs	22-Jul-93	Lowest	1446.2 ft	19-Dec-06	
2nd	30000 cfs	03-Jun-11	2nd	1448.9 ft	06-Dec-84	
3rd	21500 cfs	24-Mar-87	3rd	1449.6 ft	09-Jun-89	
	Daily Outflow - Date					
Highest	5001 cfs	01-Aug-93	**c. Report Period**			
2nd	2795 cfs	25-Oct-73	**Total Inflow**		**Total Outflow**	
3rd	2701 cfs	15-Jun-95	789,749 ac-ft	375% of norm	705,359 ac-ft	440% of norm
	Pool - Date		**Peak Daily Inflow**		**Peak Daily Outflow**	
Highest	1487.0 ft	29-Jul-93	15000 cfs	26-Aug-19	2502 cfs	15-Jun-19
2nd	1471.3 ft	27-Apr-87	**Peak Pool Elev**		**Min Pool Elev**	
3rd	1467.3 ft	06-Jun-11	1466.1 ft	29-Aug-19	1454.4 ft	11-Feb-19

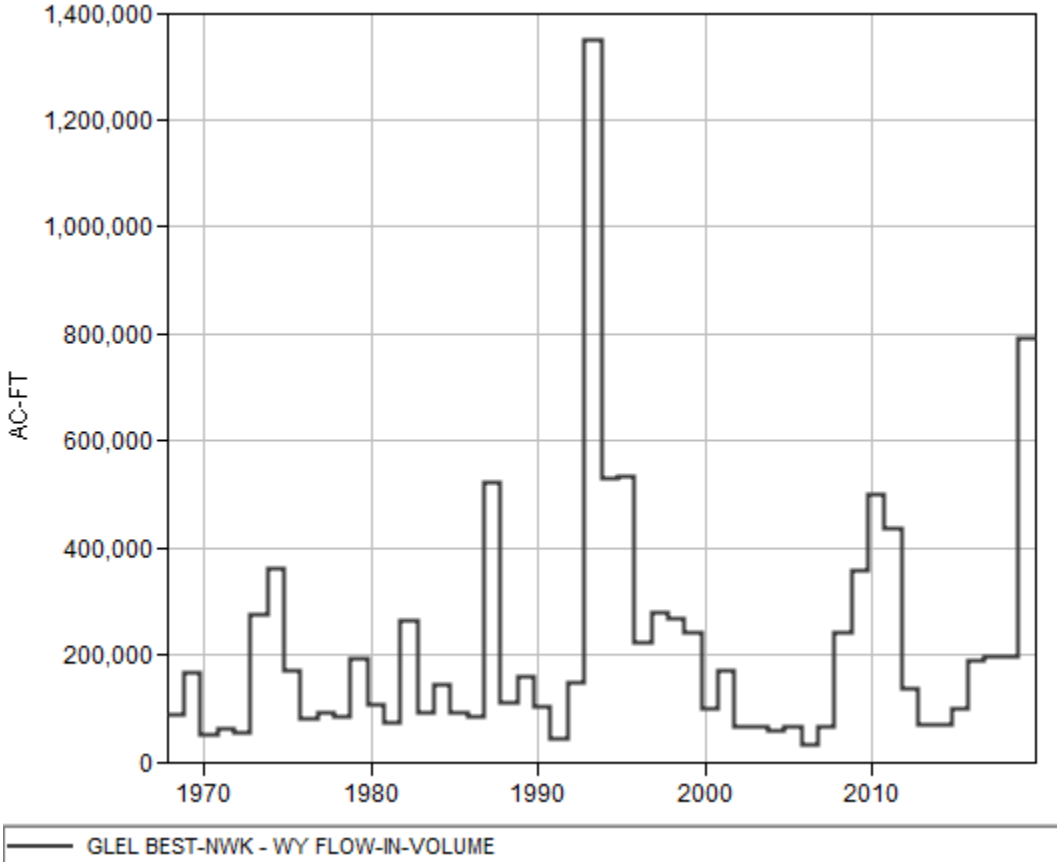


FIGURE B-39. WACONDA PERIOD OF RECORD ANNUAL INFLOWS

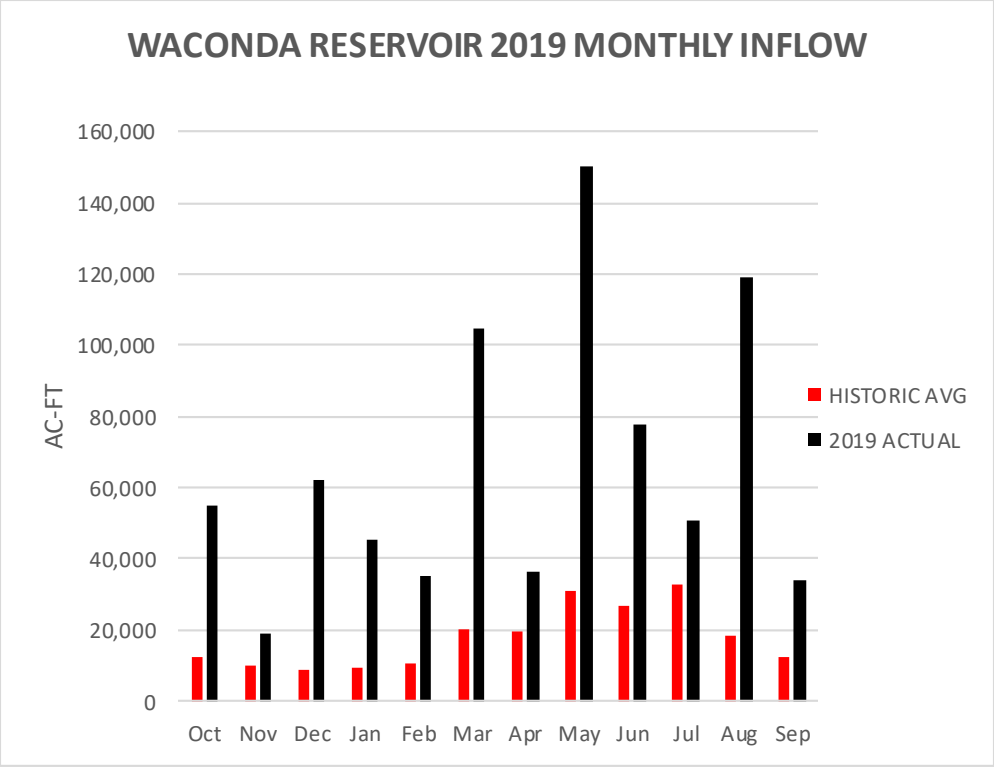


FIGURE B-40 . WACONDA 2019 MONTHLY INFLOWS

WEBSTER RESERVOIR
2019 REGULATION

FIGURE B-41. WEBSTER DAM HISTORICAL POOL ELEVATIONS AND RELEASES

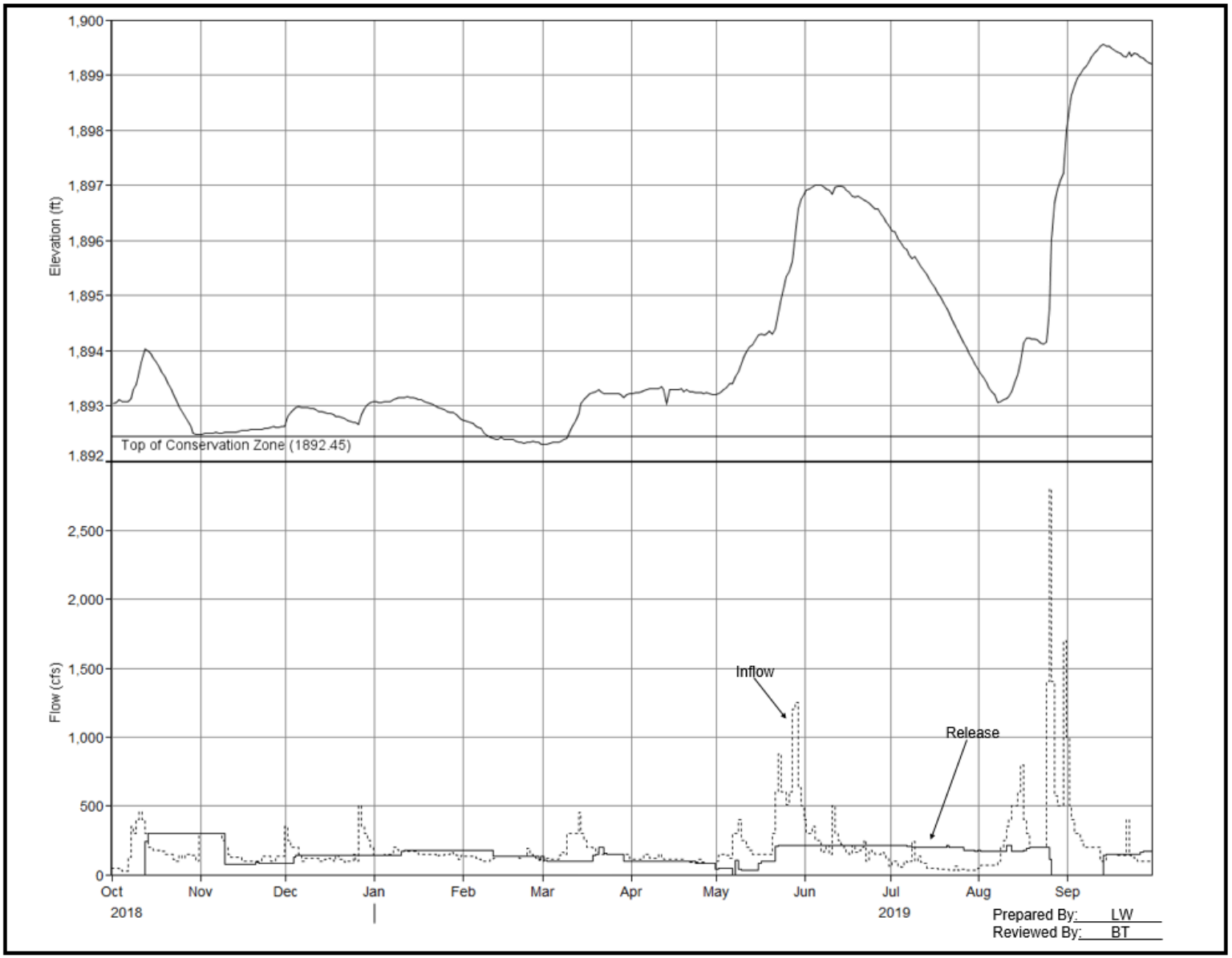


FIGURE B-42. WEBSTER DAM POOL ELEVATIONS, INFLOWS, AND RELEASES FOR REPORT PERIOD

TABLE B-11. WEBSTER HISTORIC ELEVATION AND FLOW RECORDS

a. Maximums of Record:			b. Minimums of Record (since initial fill)			
	Daily Inflow - Date			**Pool - Date**		
Highest	10430 cfs	17-Jun-57	Lowest	1857.4 ft	22-Oct-71	
2nd	10137 cfs	28-May-95	2nd	1858.7 ft	30-Oct-91	
3rd	9500 cfs	30-May-18	3rd	1860.8 ft	04-Jan-84	
	Daily Outflow - Date					
Highest	2500 cfs	24-Jul-57	**c. Report Period**			
2nd	2000 cfs	08-Jul-62	**Total Inflow**		**Total Outflow**	
3rd	1000 cfs	14-Jun-95	146,918 ac-ft	254% of norm	105,882 ac-ft	261% of norm
	Pool - Date		**Peak Daily Inflow**		**Peak Daily Outflow**	
Highest	1907.0 ft	05-Jun-95	2800 cfs	26-Aug-19	300 cfs	14-Oct-18
2nd	1904.3 ft	17-Oct-93	**Peak Pool Elev**		**Min Pool Elev**	
3rd	1899.7 ft	09-Jun-61	1899.6 ft	13-Sep-19	1892.3 ft	01-Mar-19

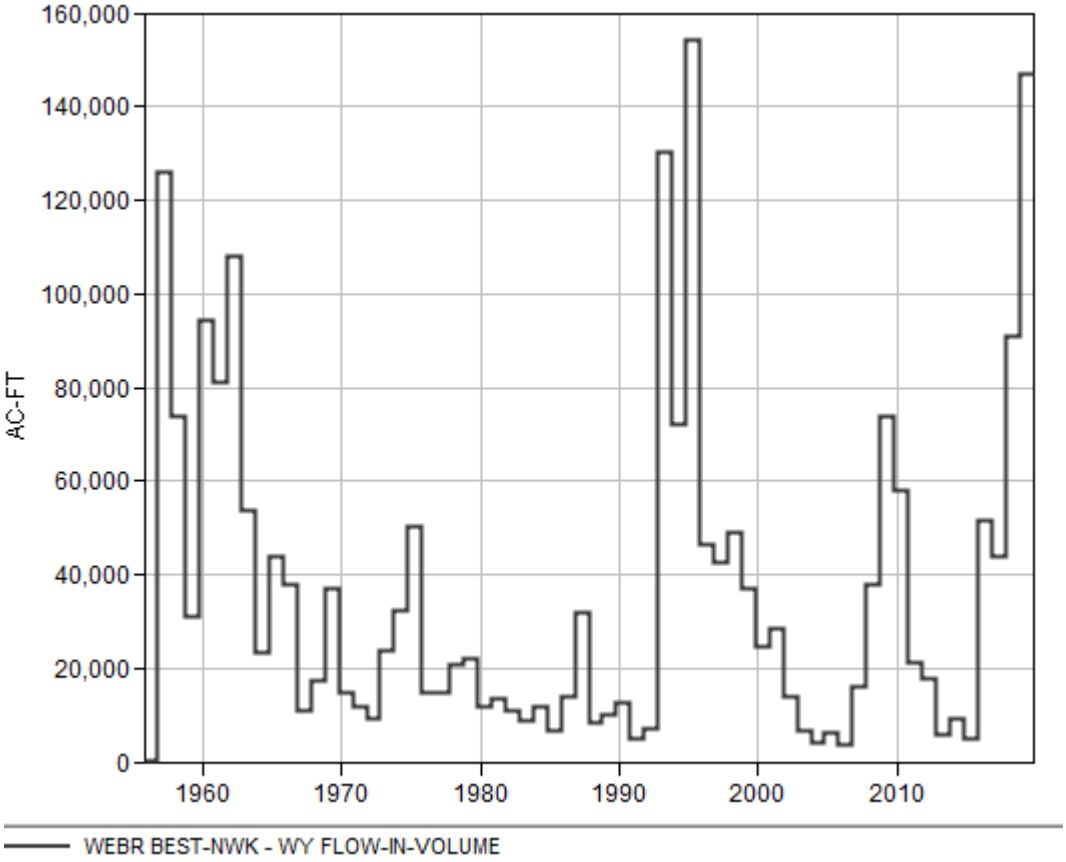


FIGURE B-43. WEBSTER PERIOD OF RECORD ANNUAL INFLOWS

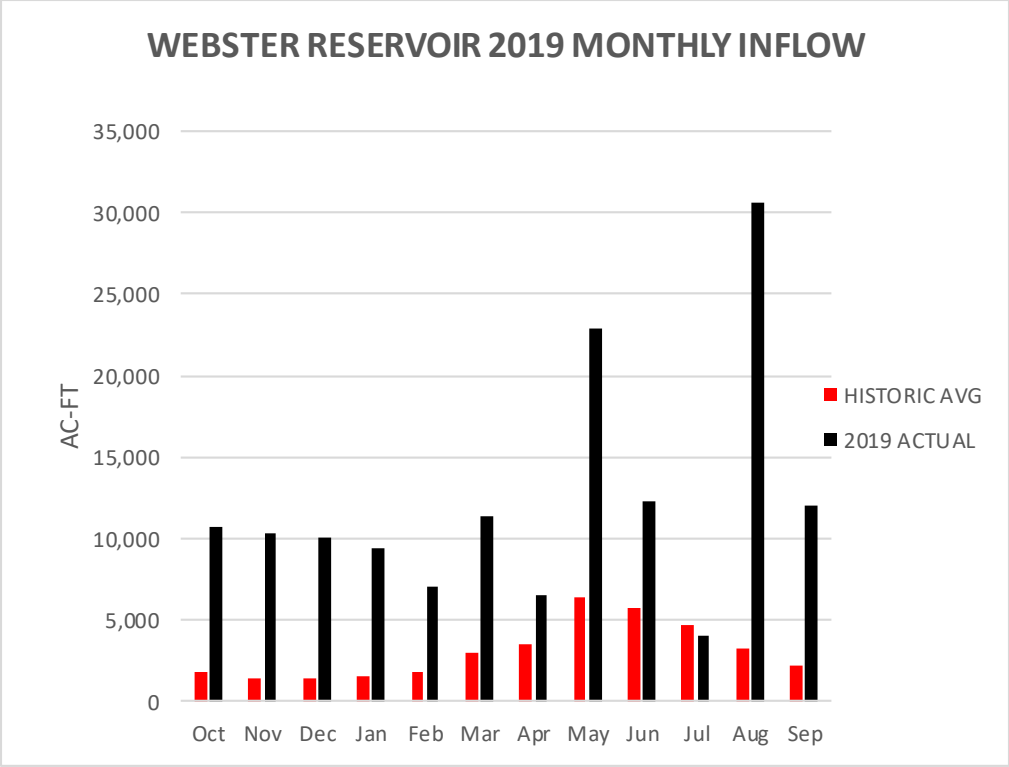


FIGURE B-44. WEBSTER 2019 MONTHLY INFLOWS

Appendix C
Deviation Enclosures

1. Kansas River Flood Control
2. Kansas River Surcharge Releases
3. Kansas River Flood Control
4. Phase I Waverly, MO
5. Stockton Flood Control

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, NORTHWESTERN DIVISION
1616 CAPITOL AVENUE, STE 365
OMAHA NE 68102

REPLY TO
ATTENTION OF

CENWD-PDR

24 May 2019

MEMORANDUM FOR Commander, Kansas City District (CENWK-ED)

SUBJECT: Kansas River Flood Control Operations Deviation Request, Waverly Control Point, Missouri River

1. Reference memorandum dated 17 May 2019, CENWK-ED, subject as above.

2. The request for a deviation to increase the flow criteria for flood control releases on the Missouri River at Waverly, MO is approved. The deviation increases the Phase I flow criteria at Waverly from 90,000 cfs to 110,000 cfs and increases the Phase II flow criteria from 130,000 cfs to 160,000 cfs. This deviation is in effect through 15 December 2019.

3. The increased Phase I and Phase II flow criteria at Waverly are necessary to reduce the likelihood of exceeding designated flood control storage in the four lower Kansas River Basin reservoirs -- Clinton, Perry, Tuttle Creek and Mildford. Exceeding the designated flood control storage at these projects would result in potentially damaging surcharge releases through the remainder of the historically high-runoff months of May, June and July. Since 11 March 2019, Missouri River flows at Waverly, due to basin wide flooding have prohibited the evacuation of stored flood water in the four lower Kansas River Basin reservoirs. All four reservoirs have risen into their Phase II zones of their flood control zones. Occupied flood control storage exceeds 65 percent at Tuttle Creek and 60 percent at Perry. Increasing the Phase I and Phase II criteria is needed to evacuate stored flood waters from the reservoirs during the summer and fall.

4. Increasing the Phase I and Phase II flow criterion will result in higher sustained flows in the Missouri River below Kansas City. The Missouri River stage for the increased Phase I criteria of 130,000 cfs is slightly below the flood stages at Napoleon and Waverly and well below flood stage at locations downstream of Waverly. However, the increased Phase II flow criteria of 160,000 cfs will result in Missouri River stages substantially above flood stage at Napoleon and Waverly and near flood stage at Glasgow and Boonville. In addition, the increased Phase I and Phase II criteria will impact the functionality of a number of interior drainage structures from Kansas City to Jefferson City.

5. The Kansas City District Public Affairs Office is developing a communications strategy to inform state agencies, Congressional delegations and stakeholders of the deviation, its limitations, and potential consequences.

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6. If you have any questions concerning this reply, please contact me at (402) 996-3840, or Kevin Grode of my staff at (402) 996-3870.

FOR THE COMMANDER:

JOHN I. REMUS II, P.E.
Chief, Missouri River Basin Water
Management Division

ENCLOSURE C-1. KANSAS RIVER FLOOD CONTROL OPERATIONS DEVIATION

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, NORTHWESTERN DIVISION
1616 CAPITOL AVENUE, STE 365
OMAHA NE 68102

REPLY TO
ATTENTION OF

CENWD-PDR

31 May 2019

MEMORANDUM FOR Commander, Kansas City District (CENWK-ED)

SUBJECT: Deviation Request to Temporarily Remove Lower Kansas River Basin Control Targets

1. Reference memorandum dated 31 May 2019, CENWK-ED, subject as above.

2. The request for a deviation to temporarily remove Lower Kansas River Basin flood control targets for Tuttle Creek, Perry, Milford and Clinton is approved. This deviation is in effect when storage in any of the four projects exceeds 80 percent of their respective designated flood control storage. This deviation is effective until the storage levels have declined below 80 percent with no short-term forecasts indicating that the storage level will increase above 80 percent, or 31 August 2019, whichever comes first.

3. As noted in your deviation request, the four projects are either in surcharge operations or expected to be nearing surcharge operations. Soil conditions in Kansas are extremely wet in Kansas due to record May precipitation. Any future rains during the historically high-runoff months of June, July and August will likely lead to significant runoff into the reservoirs.

4. This deviation will allow the Kansas City District to prudently evacuate a portion of the stored flood waters from these projects while providing some flood control capability over the next several months.

5. The Kansas City District Public Affairs Office is integrating this deviation into its current flood-related communications strategy to inform state agencies, Congressional delegations and stakeholders of the deviation, its limitations, and potential consequences. In addition, the deviation will be explained and discussed at ongoing and future public meetings that are being held across the region.

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CENWD-PDR
SUBJECT: Deviation Request to Temporarily Remove Lower Kansas River Basin Control Targets

6. If you have any questions concerning this reply, please contact me at (402) 996-3840, or Kevin Grode of my staff at (402) 996-3870.

FOR THE COMMANDER:

JOHN I. REMUS II, P.E.
Chief, Missouri River Basin Water Management Division

ENCLOSURE C-2. KANSAS RIVER SURCHARGE RELEASES DEVIATION

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, NORTHWESTERN DIVISION
1616 CAPITOL AVENUE, STE 366
OMAHA NE 68102

REPLY TO
ATTENTION OF

CENWD-PDR

24 May 2019

MEMORANDUM FOR Commander, Kansas City District (CENWK-ED)

SUBJECT: Kansas River Flood Control Operations Deviation Request, Waverly Control Point, Missouri River

1. Reference memorandum dated 17 May 2019, CENWK-ED, subject as above.

2. The request for a deviation to increase the flow criteria for flood control releases on the Missouri River at Waverly, MO is approved. The deviation increases the Phase I flow criteria at Waverly from 90,000 cfs to 110,000 cfs and increases the Phase II flow criteria from 130,000 cfs to ~~160,000~~ cfs. This deviation is in effect through 15 December 2019. 180,000 DR 19 Jun 19

3. The increased Phase I and Phase II flow criteria at Waverly are necessary to reduce the likelihood of exceeding designated flood control storage in the four lower Kansas River Basin reservoirs -- Clinton, Perry, Tuttle Creek and Mildford. Exceeding the designated flood control storage at these projects would result in potentially damaging surcharge releases through the remainder of the historically high-runoff months of May, June and July. Since 11 March 2019, Missouri River flows at Waverly, due to basin wide flooding have prohibited the evacuation of stored flood water in the four lower Kansas River Basin reservoirs. All four reservoirs have risen into their Phase II zones of their flood control zones. Occupied flood control storage exceeds 65 percent at Tuttle Creek and 60 percent at Perry. Increasing the Phase I and Phase II criteria is needed to evacuate stored flood waters from the reservoirs during the summer and fall.

4. Increasing the Phase I and Phase II flow criterion will result in higher sustained flows in the Missouri River below Kansas City. The Missouri River stage for the increased Phase I criteria of 130,000 cfs is slightly below the flood stages at Napoleon and Waverly and well below flood stage at locations downstream of Waverly. However, the increased Phase II flow criteria of ~~160,000~~ cfs will result in Missouri River stages substantially above flood stage at Napoleon and Waverly and near flood stage at Glasgow and Boonville. In addition, the increased Phase I and Phase II criteria will impact the functionality of a number of interior drainage structures from Kansas City to Jefferson City. 180,000 DR 19 Jun 19

5. The Kansas City District Public Affairs Office is developing a communications strategy to inform state agencies, Congressional delegations and stakeholders of the deviation, its limitations, and potential consequences.

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6. If you have any questions concerning this reply, please contact me at (402) 996-3840, or Kevin Grode of my staff at (402) 996-3870.

FOR THE COMMANDER:

JOHN I. REMUS II, P.E.
Chief, Missouri River Basin Water
Management Division

ENCLOSURE C-3. KANSAS RIVER FLOOD CONTROL OPERATIONS DEVIATION

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, NORTHWESTERN DIVISION
1616 CAPITOL AVENUE, STE 365
OMAHA NE 68102

REPLY TO
ATTENTION OF

CENWD-PDR

3 September 2019

MEMORANDUM FOR Commander, Kansas City District (CENWK-ED)

SUBJECT: Deviation Request to Increase Phase I Waverly Criterion to 140,000 cfs

1. Reference memorandum dated 30 August 2019, CENWK-EDH-C, subject as above.

2. The request for a deviation to increase the Missouri River at Waverly, Missouri Phase I criterion to 140,000 cfs until 15 December 2019 is approved.

3. As noted in your deviation request, the Kansas City District needs to evacuate approximately 2 million acre-feet of stored flood waters from the Clinton, Perry, Tuttle Creek, Milford and Harlan County reservoirs prior to the start of the 2020 runoff season.

4. As detailed in your deviation enclosure, the Kansas City District has completed a thorough impacts analysis that addresses the impacts of not evacuating all the stored flood waters in the NWK reservoir projects. This analysis includes current and forecasted mainstem releases and incremental inflows, as well as Kansas City District levee assessments and repairs.

5. The Kansas City District Public Affairs Office is integrating this deviation into its current flood-related communications strategy to inform state agencies, Congressional delegations and stakeholders of the deviation, its limitations, and potential consequences.

6. If you have any questions concerning this reply, please contact me at (402) 996-3840, or Kevin Grode of my staff at (402) 996-3870.

FOR THE COMMANDER:

JOHN I. REMUS II, P.E.
Chief, Missouri River Basin Water
Management Division

ENCLOSURE C-4. PHASE I WAVERLY DEVIATION

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, NORTHWESTERN DIVISION
1616 CAPITOL AVENUE, STE 365
OMAHA NE 68102

REPLY TO
ATTENTION OF

CENWD-PDR

7 June 2019

MEMORANDUM FOR Commander, Kansas City District (CENWK-ED)

SUBJECT: Deviation Request to Temporarily Suspend Water Control Manual Guidance for Osage River Projects

1. Reference memorandum dated 06 June 2019, CENWK-ED, subject as above.

2. The request for a deviation to temporarily suspend water control manual guidance for the Stockton and Truman projects to make emergency spillway tainter gate repairs at Stockton is approved. This deviation is in effect until the gate has been repaired and Stockton repairs have returned back to normal operations, or 30 June 2019, whichever comes first.

3. As noted in your deviation request, this deviation is necessary to stabilize the Stockton Reservoir elevation to facilitate construction activities that will re-attached control linkages to an inoperable tainter gate. As noted in your request, the present state of the tainter gate is an immediate dam safety concern and this request has been coordinated with the NWK Dam Safety Officer and the NWD Dam Safety Program Manager.

4. The Kansas City District Public Affairs Office is integrating this deviation into its current flood-related communications strategy to inform state agencies, Congressional delegations and stakeholders of the deviation, its limitations, and potential consequences.

5. If you have any questions concerning this reply, please contact me at (402) 996-3840, or Kevin Grode of my staff at (402) 996-3870.

FOR THE COMMANDER:

JOHN I. REMUS II, P.E.
Chief, Missouri River Basin Water
Management Division

CF:
CENWD-RBT (Berre)

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ENCLOSURE C-5. STOCKTON FLOOD CONTROL OPERATION DEVIATION