US Army Corps
of Engineers
Kansas City District

Engineering Division
Hydrologic Engineering Branch
Water Management Section

Annual Report of Reservoir Regulation Activities

Summary for 2010 - 2011

November 2011

NORTHWESTERN DIVISION, KANSAS CITY DISTRICT
SUMMARY OF LAKE REGULATION ACTIVITIES
AUGUST 1, 2010 TO JULY 31, 2011

List of Tables

List of Plates

Appendices

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 August 1, 2010, through July 31, 2011, with additional discussion on proposed operations and studies programmed through calendar year 2012. Preparation of this report is in conformance with paragraph 13b of ER 1110-2-240, dated October 8, 1982.

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***.

PROJECT FUNCTIONS AND GENERAL PLAN.

Functions served by storage facilities in the Kansas City District include: flood control, irrigation, water supply, low flow and navigation supplementation, water quality, 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 with an aim toward 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.

CLIMATOLOGIC AND HYDROLOGIC CONDITIONS.

August 1, 2010 through July 31, 2011

August 2010

Northern and western parts of the District experienced numerous thunderstorms during the month of August with total monthly accumulations of 2-4 inches in western Kansas. Eastern and southern parts of the District, including the Ozarks were hot and dry. Up to 5 inches of precipitation was recorded in the Blue basin in Nebraska from the 23rd to 25th of the month. Minor flooding was reported in the Blue basin. In Missouri monthly rainfall totals were 1-5 inches.

September 2010

September was 2-3 degrees warmer than usual for most of the District. Rainfall was sparse in eastern Colorado, western Kansas, and western Nebraska. Central parts of Kansas received 2-5 inches of precipitation for the month. On the 9th and 10th remnants of Tropical Storm Hermine brought locally heavy rainfall over eastern Kansas and most of Missouri. Rainfall totals ranged from 4 inches in southeast Nebraska to 12 inches in the Missouri Ozarks. Minor flooding was reported in southeast Nebraska, eastern Kansas, and central Missouri.

October 2010

It was abnormally dry across the entire District during the month of October. Rainfall was less than half of normal and temperatures averaged 2-4 degrees above normal. No flooding was reported.

November 2010

Precipitation across the basin was slightly below normal during the month of November. There was little thunderstorm activity and temperatures were 1-2 degrees above normal. The one exception was a stalled cold front on the 12th which dumped 1-2 inches of rain along the I-44 corridor in Missouri. A few flash flood statements were issued, but no flooding was reported.

December 2010

December was exceptionally dry over the entire District. Rolla, MO recorded the most, with 1.56 inches of liquid precipitation. Temperatures were average for December. An outbreak of tornadoes occurred in central Missouri during the overnight hours of December 30th and into the morning hours of New Years Eve. Little precipitation came with the tornadoes.

January 2010

Precipitation ranged from slightly below normal in eastern Colorado to slightly above normal in eastern Kansas and western Missouri. Eastern Missouri and the Ozarks were abnormally dry. Temperatures were as much as 20 degrees below normal, and nearly all the precipitation came as snow. Ice jams were a problem along the Platte River in Nebraska.

February 2011

February was exceptionally cold and snowy over the Kansas City District. Strong winter storms dumped 18 inches of snow in central Missouri, and up to 34 inches in central and western Kansas. Temperatures averaged 3 degrees to 10 degrees below normal for the month. Ice jamming continued to be a problem in Nebraska. No river flooding was reported elsewhere.

March 2011

Early spring showers varied greatly across the District. Western parts of the basin received about 25% of normal precipitation. Rainfall in eastern parts of the basin was near-normal. Temperatures were also normal. Minor low-land flooding was reported at isolated locations across Missouri.

April 2011

Temperatures were 2-4 degrees above normal throughout the District. The first three weeks of the month saw normal precipitation patterns. Streamflow was near-normal for most of the District. A cold front stalled out across the southeast third of the basin from the 22nd to the 27th producing large amounts of precipitation. Rainfall amounts of 7-10 inches were not uncommon across south-central Missouri. Rivers rose above flood stage at many locations in central and south-central Missouri.

May 2011

May was a cool month, averaging about 2 degrees below normal. Rainfall amounts varied widely. Parts of central Kansas received up to 300% of normal rainfall while eastern Kansas and western Missouri only got 50% of normal. The Ozarks region had several severe weather episodes which resulted in numerous flood warnings. Flooding was light in Missouri. The Chariton River basin, in Iowa, received heavy rains during the last week of the month.

June 2011

More heavy rains were reported over the Chariton River basin in Iowa. Rainfall was also above-normal in western parts of the Kansas City District, although no flooding was reported. Rainfall was sparse across eastern sections of the District. Temperatures averaged 1-2 degrees above normal across the District.

July 2011

July will be remembered for the Excessive Heat Warnings. Many parts of the District recorded their hottest July on record, with multiple days above 100 degrees. Rainfall was average in eastern Colorado, and below average in the rest of the District. No flood warnings were issued.

PROJECT ACCOMPLISHMENTS.

Operating purposes at storage projects in the Kansas City District include flood control, irrigation, water supply, low flow and navigation supplementation, water quality, hydropower, recreation, and fish and wildlife. Project accomplishments in each of these functional areas, for the period covered by this report, are described briefly in the following subparagraphs.

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,

Table 1: Flood Reduction Benefits
(Thousand Dollars)

Project	Fiscal Year 2011	Cumulative
Clinton Lake, KS	$2.3	$1,209,539.7
Harlan County Lake, NE	$10,447.2	$228,574.7
Harry S Truman Resv., MO	$466.3	$1,870,150.9
Hillsdale Lake, KS	$75.6	$33,409.5
Kanopolis Lake, KS	$375.7	$1,647,012.8
Little Blue River Lakes, MO	$0	$50,813.0
Long Branch Lake, MO	$144.6	$50,229.0
Melvern Lake, KS	$328.3	$220,441.6
Milford Lake, KS	$39,786.3	$1,316,824.9
Perry Lake, KS	$12,665.4	$5,438,812.2
Pomme De Terre Lake, MO	$90.5	$69,169.6
Pomona Lake, KS	$95.4	$210,026.4
Rathbun Lake, IA	$855.0	$158,985.8
Smithville Lake, MO	$3,358.8	$970,223.6
Stockton Lake, MO	$143.8	$206,831.2
Tuttle Creek Lake, KS	$133,886.2	$6,553,329.5
Wilson Lake, KS	$2,270.8	$1,573,237.9
TOTALS	**$204,992.2**	**$21,807,612.3**

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, all of the District lakes stored water in the flood control pools. Flood reduction benefits during Fiscal Year (FY) 2011 credited to all Corps lake projects in the District were $204,992,200. During the same period, benefits credited to Section 7 Bureau of Reclamation projects within the District totaled $40,254,000. The accumulated total of flood control benefits for Bureau projects within the District totaled $1,837,831,400. The upstream main-stem projects are responsible for additional flood damage reductions along the Missouri River within the Kansas City District reach. A compilation of flood reduction benefits at Corps Lakes in the District is shown in ***Table 1*** above. The majority of the period flood reduction benefits were incurred in the Kansas River basin during May and June, 2011.

Irrigation.

The 2010 crop yields on lands receiving project water in the Nebraska-Kansas Projects were lower than 2009. The average corn yield, the principal crop of all reporting districts, was 163 bushels per acre. This was approximately 35 bushels per acre less than in 2009. The start of irrigation releases from project reservoirs varied considerably but was generally later than normal due to abundant rainfall in June. Below normal rainfall was experienced during much of the growing season with a few exceptions. Temperatures were near normal during the season. Crop maturity progressed near normal during the growing season. Most irrigation districts had finished making irrigation releases by early September and all irrigation districts had finished delivering water by the end of September. Corn harvest generally commenced in late October and concluded in November. Only two canals did not divert water in 2010 as a result of short water supplies.

The State of Colorado makes Bonny Reservoir storage water available to Hale Ditch and other natural flow appropriators under short-term water service contracts. Most of the 700 acres served by Hale Ditch are now owned and operated by the Division of Wildlife. During the reporting period, the Colorado Water Commissioner did not direct that reservoir inflows from the South Fork of the Republican River and Landsman Creek be passed through Bonny Reservoir into Hale Ditch. Likewise, the Colorado Department of Natural Resources did not request storage releases for irrigation purposes into Hale Ditch. A total of 2,422 AF was released into Hale Ditch during 2010.

Municipal and Industrial Water Supply and Water Quality Control.

Three municipalities and one rural water district have executed water service contracts for full or supplemental water supplies from three Reclamation reservoirs. A contract with the city of Norton, Kansas, provides for a maximum annual usage of 1,600 AF from Keith Sebelius Lake (Norton Dam). A contract with Beloit, Kansas, provides for a maximum annual usage of 2,000 AF from Waconda Lake. Waconda Lake also provides up to 1,009 AF of water for a contract with the Mitchell County Rural Water District No. 2. Based on the current State of Kansas Certificate of Appropriation, water usage is not to exceed 737 AF per calendar year. A

contract with the City of Russell, Kansas, provides for a maximum annual usage of 2,000 AF from Cedar Bluff Reservoir.

During calendar year 2010, the City of Norton used 347 AF of storage from Keith Sebelius Lake for municipal purposes. Storage releases made from Waconda Lake for the city of Beloit totaled 0 AF, with 0 AF bypassed for downstream water quality control as directed by the State Water Commissioner. Releases of 714 AF were made to the Mitchell County Rural Water District No. 2 from Waconda Lake. No water was released from Cedar Bluff Reservoir during 2009 for the City of Russell. The State of Kansas took 20 AF of water for the fish hatchery downstream of Cedar Bluff Dam.

Twenty three water supply contracts exist between the Corps of Engineers and the State Agencies at 14 lakes, for lake storage space, annual withdrawals, or surplus water. Contracts exist with eleven other municipalities and rural water districts within Kansas, Missouri, and Iowa. The State of Kansas in turn contracts with a large number of municipalities and industrial sites to supply water from the State's contracted storage space through the water assurance and water marketing programs. To date, assurance districts have been formed for users along the lower Smoky Hill River, lower Kansas River and the State of Kansas portion of the Marais des Cygnes River.

Water is supplied within the limits of each contract through designated lake releases or from intakes located on the lake at the following projects: Kanopolis, Milford, Tuttle Creek, Perry, Clinton, Melvern, Pomona, Hillsdale, Smithville, Longview, Rathbun, Long Branch, Stockton, and Harry S Truman.

Recommendations for minimum stream flows to benefit stream sanitation and for the maintenance of desirable water quality standards were originally established by the U.S. Public Health Service for many river reaches below proposed dams in the District. These recommendations were then utilized to establish minimum release requirements for many of the District lake projects. The minimum release standards set by the Corps water control plans are usually less than the minimum desirable stream flows set by state water authorities. The latter are intended to satisfy water right holders and fish and wildlife flow standards. In some cases, specific water quality storage allocations were included in the project planning to increase the reliability of the minimum flow releases. Depending on the project, the minimum release quantities may be constant through the year, or they may vary seasonally or vary depending on the amount of current lake storage. Minimum releases for the purposes of downstream quality control and stream sanitation range from 3 cfs during the winter months at Hillsdale Lake to 100 cfs at Tuttle Creek Lake. Seepage is generally considered sufficient to meet minimum flow requirements downstream of the Reclamation dams. Additional releases are made from Tuttle Creek, Milford, and Perry Lakes for water quality and water supply purposes during periods of low flow on the Kansas River. Releases from any lake may be reduced below minimum requirements for brief periods due to construction, periodic inspections, or emergencies.

Navigation.

Releases from the Missouri River main stem reservoir system are designed to provide equitable service to navigation and other project purposes, while at the same time recognizing the important flood control functions of the system. Navigation on the Missouri is limited to the ice-free season, with a full season normally extending from April 1 to December 1 at the mouth. Operating experience plus numerous studies have indicated that flows of 35,000 cfs at Kansas City are the minimum that will permit navigation. Groundings can occur with flows of that magnitude, and dredging may be needed to alleviate local problems. Therefore, an additional flow of 6,000 cfs above the minimum service target has been set as the "full service" level for the navigation function. Thus, a full-service target flow of 41,000 cfs at Kansas City is considered adequate to maintain the designed 9-foot by 300-foot channel with little or no dredging. Milford, Tuttle Creek and Perry lakes are at times called upon to supplement Missouri River flows below Kansas City in order to meet the navigation requirement and to conserve water in the main stem lakes.

The Reservoir Control Center did not request supplemental releases for navigation support during this reporting period. The navigation season ended at the Kansas City reach on December 15, 2010.

Hydropower.

Hydropower is generated at two Kansas City District projects. Stockton Dam has one unit with a nameplate rated capacity of 45 megawatts (MW), and an overload generation rate of 52 MW. Harry S Truman Dam has six units with a total nameplate rated capacity of 160 MW, and an overload generation rate of 180 MW. The Southwestern Power Administration markets power from Stockton and Harry S Truman projects.

On February 5, 2009, the Stockton turbine experienced a catastrophic failure in the form of a broken blade. In September 2010, temporary repairs were completed and the unit was returned to service. Under a contract funded by ARRA, the Stockton power plant is receiving a total rehabilitation. Stockton's power operation continues to be restricted by downstream channel capacities that limit tailwater elevations to 777.0 feet above mean sea level (msl) and Highway "J" stages to a maximum reading of 17.5 feet. Generation by the Stockton plant during this report period totaled 53,389 megawatt hours (MWH).

Generation by the Harry S Truman plant totaled 256,732 MWH during the period of this report. Power generation releases at Harry S Truman are restricted to four units during the week and three units on weekends between Memorial Day and Labor Day by the Consensus Plan. During the period December 1 to March 1, five units may be operated during the weekdays (total time limited to 600 hours per year) and three units on weekends. The tailwater elevation measured at the Highway 7 Bridge in Warsaw is limited to 662.5 feet msl, Union Electric datum, during five-unit releases from the power pool. Flood control releases are made through the generation units as much as possible. When Truman pool level is above 710.0 feet msl, a minimum of one unit is operated continuously. The Consensus Plan for Truman was negotiated

and approved between the Corps, the State, and the Southwestern Power Administration, and became effective March 1990.

Fish and Wildlife.

Water level management plans, which include the fluctuation of pool levels at various times of the year for the enhancement of fish and migrating waterfowl, were in effect during the report period at the following Kansas City District lakes: Smithville, Clinton, Hillsdale, Kanopolis, Melvern, Wilson, Pomme de Terre, Perry, Pomona, Milford, Tuttle Creek, Rathbun, Stockton, and Long Branch. Truman Lake makes releases for the downstream spring fish spawn when water is available, in accordance with an agreement with Southwest Power Administration and the State of Missouri.

Recreation.

Table 2: Visitation Hours
August 1, 2010 through July 31, 2011

Project	Visitation (Visitor Hours)
Clinton Lake, KS	8,061,375
Harlan County Lake, NE	8,253,419
Harry S Truman Resv., MO	18,234,018
Hillsdale Lake, KS	1,192,382
Kanopolis Lake, KS	920,595
Long Branch Lake, MO	1,830,772
Longview/Blue Springs MO	3,873,221
Melvern Lake, KS	5,729,331
Milford Lake, KS	8,973,330
Perry Lake, KS	5,966,230
Pomme de Terre Lake, MO	13,256,982
Pomona Lake, KS	3,818,932
Rathbun Lake, IA	5,286,294
Smithville Lake, MO	7,022,258
Stockton Lake, MO	7,874,721
Tuttle Creek Lake, KS	1,817,853
Wilson Lake, KS	2,430,874
TOTALS	**104,542,587**

Recreational use of the Corps lakes is a highly visible and important function. Recreational use is enhanced when the lakes are operated close to their normal or multipurpose pool levels. During flood years when large quantities of water are stored in the flood pools and during drought years when the lake levels drop, then access to the lakes and the shoreline facilities, as well as the quality of the experience, is reduced. Park managers at the projects are also concerned about related factors such as facility maintenance and water quality. The fish and wildlife function is closely related to the recreation experience, and coordination with state and county park officials for park management is important. A list by projects of the visitation totals at Corps lakes is shown in ***Table 2***. Park visitation was down 7% over the previous year. Project park facilities at Blue Springs, Hillsdale, Long Branch, Longview, and Smithville are leased to county or state agencies.

PROJECT OPERATIONS.

Corps of Engineer Lakes - August 1, 2010 through July 31, 2011.

Pomme de Terre. In the autumn of 2010 Kansas City District lowered the Pomme De Terre pool to elevation 833.99 in preparation for replacement of the badly worn stilling basin. A temporary bulkhead was installed over the end of the outlet conduit and a 30-inch by-pass tube was hung from steel hangers. The pipe was placed into service on 25 October 2010 and a flow rate of 110 c.f.s. was established. No releases, other than the flow through the tube, were made until

Pomme De Terre – temporary bulkhead and by-pass pipe.

7 April 2011. On that date a maximum pool elevation of 855.94 was reached. The concrete was allowed to cure for one week, and a Phase II release of 3,500 c.f.s. was established on 11 April 2011. The Phase II release remained in effect until 31 May 2011. The multipurpose elevation of 839.0 feet was reached on 13 June 2011. A plot of the historic pool elevation is shown in Appendix A.

Missouri River. During the winter and spring of 2011 snowpack in the upper Missouri River basin accumulated to levels well above normal. The outlook was for higher than normal releases from upstream reservoirs including Gavins Point Dam. Intense rainfalls then fell over the upper basin in Montana and Wyoming causing extreme volumes of inflow into the mainstem reservoirs. Releases from the mainstem dams reached record levels during the summer of 2011. Gavins Point Dam reached a maximum release of 160,000 cubic feet per second (cfs) on 23 June

2011. This record rate of release was sustained through 29 July. Gavins Point releases were above 150,000 cfs for 65 days from 15 June 2011 to 18 August 2011.

These record releases from Gavins Point Dam led to high stages downstream on the lower Missouri River. The Missouri River at St. Joseph reached flood stage (17 ft.) on 12 May 2011 and reached a peak stage of 29.97 ft. on 28 June 2011. Provisional data from the USGS indicate that this stage corresponds to a flow of 277,000 cfs. Reservoir releases in the Kansas basin remained at low-flow from 19 June through 1 September 2011.

Flood Pool Storage. During the last 12-month period, prolonged flood-fighting lake regulation activities were required at Rathbun lake. A short-duration event occurred at Truman Lake in May and June. All of the District's 18 lakes stored at least a little water in their flood control pools. The maximum encroachment into exclusive flood control space was 13.73 feet above multipurpose level (13% of FCP) at Tuttle Creek Lake on 31 July 2011. All Corps lakes within the Kansas City District were regulated in accordance with normal procedures during the period covered by this report. Details regarding the regulation of all projects are included, along with pool elevation hydrographs, in Appendix A of this report.

Deviations.

In August 2010, a deviation from the Rathbun Reservoir water control manual was approved by Northwestern Division (NWD) to increase flood control releases to 3,000 cfs for the remainder of calendar year 2010. This was due to an exceptionally high pool level in the reservoir.

On March 24, 2011 a deviation from the Pomme de Terre lake water control manual was approved by NWD to continue limiting releases to allow for stilling basin construction until April 7, 2011 or until the pool elevation entered the Phase III zone (862.7 feet).

In April 2011, a deviation from the Truman Master Manual was approved by NWD to hold water at Truman Reservoir to assist with reducing Mississippi River stages. HST releases were restricted to a maximum of firm power from May 3rd to May 10th.

In early May 2011, a deviation from the Kansas River Basin Master Manual was requested from NWD to increase the Phase I criteria to 130,000 cfs at the Waverly control point on the Missouri River. The request was to maintain Tuttle Creek and Milford releases, and was requested due to anticipated high Gavins Point releases. The deviation was not used and rescinded at the end of the month due to even higher anticipated Gavins Point releases. On May 29th a deviation was approved through email to remove any Missouri River restrictions from any KCD projects. The deviation was necessary due to sustained high Gavins Point releases. The deviation was approved to allow releasing onto the leading edge of the Missouri River hydrograph without increasing any peak stages from the event.

On June 6, 2011 a deviation from the Waconda lake water control manual was approved by NWD to release 1,500 cfs so that major maintenance and repair of the spillway could be performed, while avoiding a potential spillway release.

In July 2011, a deviation from the Rathbun Reservoir water control manual was approved by NWD to increase the permitted seasonal release from 1,200 cfs to 1,500 cfs due to high pool

levels. The deviation also removed any restriction due to the Boonville gage on the Missouri River.

Bureau of Reclamation Projects – August 1, 2010 through July 31, 2011.

1. Conservation Operations. The 2010 inflow was above the dry-year forecast at all 11 of the project reservoirs. Enders and Lovewell Reservoirs had inflows between the dry- and normal-year forecasts. Bonny, Webster, and Cedar Bluff Reservoirs along with Swanson, Harry Strunk, Keith Sebelius, Waconda, and Harlan County Lakes had inflows between the normal- and wet-year forecasts. Kirwin Reservoir along with Hugh Butler Lake had inflows above the wet-year forecast. Half of the project reservoirs had below average carryover storage from the 2009 water year. Reservoir releases were made from Medicine Creek, Harlan County, Kirwin, Webster, and Glen Elder Dams to maintain or reduce reservoir levels prior to the 2010 irrigation season. Just prior to the irrigation season, Enders, Keith Sebelius, Swanson, and Hugh Butler Lakes, did not have sufficient storage to provide water users with a full water supply. Harry Strunk, Harlan County, and Waconda Lakes and Lovewell, Kirwin, and Webster Reservoirs had some flood storage occupied prior to the irrigation season. The irrigation demand months of July and August did little to reduce storage in those project reservoirs that had storage available for full irrigation as inflows maintained reservoir pools. Precipitation during June also helped in reducing the demands on project reservoirs. Reservoir storage was below normal at nine project reservoirs at the end of 2010.

2. Flood Control Operations. Harry Strunk, Harlan County, Waconda Lakes, Lovewell, Kirwin, and Webster Reservoirs utilized flood pool storage and made flood releases in 2010. The water year 2010 flood damages prevented by the operation of Reclamation's Nebraska-Kansas Projects facilities was $42,127,300 as determined by the Corps of Engineers. An additional benefit of $27,035,400 was credited to Harlan County Lake.

The regulation of flood control storage in Reclamation reservoirs in the Kansas River basin is the responsibility of the Kansas City District Water Management Section. When project inflows are sufficient to produce an encroachment into the flood pool, coordination is immediate between the two Federal agencies, and decisions are made regarding the regulation desired. Water Management staff issues regulation orders to the Reclamation's Water Operations Group at the McCook Field Office in Nebraska. The McCook Field Office is responsible for issuing orders for both flood control and conservation releases to the Reservoir Superintendent.

Operations – August 1, 2011.

Corps and Reclamation storage lakes in the District contained a total of 6,408,803 AF of storage on August 1, 2011. Of the total volume in storage, 754,655 AF (12 percent) were contained in the Reclamation lakes and 5,654,148 AF (88 percent) were contained in the Corps projects.

Nine of eighteen Corps lakes and two of the eleven Reclamation lakes in the District contained storage in their flood control pools on August 1, 2011. The occupied flood control storage amounted to 638,501 AF. This volume compares to 1,331,449 AF of flood control storage space occupied on August 1, 2010.

New record low pool levels were established for Pomme de Terre and Hugh Butler Lakes.

MAJOR REGULATION PROBLEMS AND PROPOSED SOLUTIONS.

Water Level Management Plans

Paragraph 8-5 of the Osage River Basin Master Manual, Volume 1, December 1968, reads as follows: "Fish and Wildlife. Control and manipulation of water levels, both in the multipurpose pool and in the lower 2 or 3 feet of the flood pool, can be very beneficial to fish and wildlife when properly timed and executed. The level of the reservoir, degree of fluctuation, and timing of these conditions will have an extremely important effect on fish spawning. The possibility of achieving some control of production of rough fish species is also a factor favoring close control and manipulation of water levels."

In February 2008 this paragraph was reviewed by Kansas City District counsel and the Reservoir Control Center. A consensus was reached with the following conclusions:

a. Paragraph 8-5 applies to each Corps of Engineers reservoir in the Osage basin, and
b. Paragraph 8-5 gives the Kansas City District Hydraulic Engineering Branch the authority to approve Water Level Management Plans.

District Council has determined that it is no longer necessary to seek deviations for Water Level Management Plans at Kanopolis, Long Branch, Perry, Pomona, Stockton, Tuttle Creek, Wilson, or Truman reservoirs. The Chief of the Hydraulic Engineering Branch now has the authority to approve Water Level Management Plans at these lakes. Public hearings are now planned to change the language in the Reservoir Regulation Manuals for Clinton, Hillsdale, Melvern, Milford, Pomme de Terre, Rathbun, Smithville, Keith Sebelius, Kirwin, Lovewell, Waconda, and Webster reservoirs.

Endangered Species Act.

Releases at Milford and Tuttle Creek Lakes are typically affected each summer by special operations required by the Endangered Species Act (ESA). Two listed bird species, the Piping Plover and the Least Tern, were first reported nesting on sandbars in the Kansas River during the mid-1990's. These birds have also affected operations along the Missouri River upstream of Omaha since they were first listed under ESA in 1985. The Terns and Plovers nesting season typically lasts from May through August. During that period, the Corps monitors the bird nests and when possible restricts releases from upstream lakes to protect them to the extent practical

from local uncontrolled runoff. The lakes can only control a portion of the basin runoff from spring and summer storms, and many times the runoff from storms closer to the nests are sufficient to destroy them. Since the major nesting areas to date have been in the Manhattan to Topeka reach of the river, these operations have mainly affected Milford and Tuttle Creek Lakes. In previous years, as much as 17 percent of the flood pool at Tuttle Creek Lake has been forced into storage by ESA concerns.

In accordance with a U.S. Fish and Wildlife Service Missouri River Biological Opinion, the District has developed a plan of operation to monitor the nesting areas and coordinate lake releases. However, in 2011, least tern and piping plover surveys were not conducted in late May and early June due to high river stages. All four reaches of the Kansas River were surveyed during late June and early July. No least terns or piping plovers were observed during any of the nest surveys. There was no requirement for deviation from the reservoir regulation manuals to satisfy ESA considerations.

WATER CONTROL MANUALS.

Manual Status.

This section serves to provide the information requested in paragraph 13c of ER 1110-2-240, dated October 8, 1982, regarding the status of water control manuals.

Water control plans prepared for specific projects and basins within the Kansas City District have been documented in appropriate manuals as directed by paragraph 6c of the above referenced ER. Paragraph 6c also directs that water control plans be revised as necessary to conform with changing requirements resulting from developments in the basin, improvements in technology, new legislation, or other relevant factors, provided such revisions comply with existing Federal regulations and established Corps of Engineers policy.

No water control manuals were submitted to Division for approval during the current reporting period. The schedule and status of manuals for all projects is shown on ***Table 3***.

Table 3: Project Manual Status and Revision Schedule

Reservoir/Lake	Stream/River	Owner	Report Status	Submission Schedule
Nebraska				
Master Manual	Republican	CE	Updated final submitted to NWD for review July 28, 1977	
Harlan County	Republican	CE	Revision approved by NWD May 10, 2001	
Harry Strunk	Medicine Creek	BR	Approved by NWD July 12, 1974	
Enders	Frenchman Creek	BR	Approved by NWD March 26, 1973	
Swanson	Republican	BR	Flood Control Plan approved by HQUSACE October 6, 1969	
Hugh Butler	Red Willow Creek	BR	Flood Control Plan approved by HQUSACE November 21,1969	
Colorado				
Bonny	S. Fork Republican	BR	Approved by HQUSACE October 6, 1969	
Kansas				
Lovewell	White Rock Creek	BR	Approved by HQUSACE April 9, 1969 subject to comments	
Milford	Republican	CE	Approved December 1984. Minor revision approved Jan 1995	
Norton	Prairie Dog Creek	BR	Approved August 28, 1974	
Master Manual	Smoky Hill	CE	Approved March 28, 1975	
Kanopolis	Smoky Hill	CE	Revision submitted to NWD October 30, 1984	
Cedar Bluff	Smoky Hill	BR	Approved by NWD September 25, 1975	
Kirwin	N. Fork Solomon	BR	Approved by NWD February 6, 1974	
Webster	S. Fork Solomon	BR	Approved by NWD July 16, 1975	
Wilson	Saline	CE	Revision submitted to NWD June 13, 1997	
Waconda	Solomon River	BR	Approved by NWD July 12, 1972	
Master Manual	Kansas	CE	Approved by HQUSACE March 22, 1967 subject to comments	
Tuttle Creek	Big Blue	CE	Approved April 16, 1974. Minor revision approved January 1995	
Perry	Delaware	CE	Approved July 1973. Minor revision approved January 1995	
Clinton	Wakarusa	CE	Approved February 12, 1980	
Master Manual	Osage River	CE	Approved by HQUSACE Sep 21, 1970 subject to comments	
Pomona	110 Mile Creek	CE	Approved February 1973	
Melvern	Marais Des Cygnes	CE	Approved June 27, 1985	
Hillsdale	Big Bull Creek	CE	Submitted to CENWD-PDM for approval on May 20, 2005.	
Missouri				
Pomme De Terre	Pomme De Terre	CE	Submitted to CENWD-PDM for final approval on Sep 11, 2006.	
Harry S Truman	Osage	CE	Interim manual approved by NWD May 12, 1981. Minor revision approved April 1996	
Hillsdale	Big Bull Creek	CE	Submitted to CENWD-PDM for final approval on Sep 11, 2006.	
Stockton	Sac	CE	Approved August 21, 1975	
Smithville	Little Platte	CE	Approved August 12, 1979	
Long Branch	E. Fk Ltl. Chariton	CE	Interim manual approved November 21, 1978	
Longview	Little Blue	CE	Approved February 15, 1994	
Blue Springs	E. Fork Little Blue	CE	Approved January 27, 1994, minor revisions submitted Dec 1994	
Iowa				
Rathbun	Chariton	CE	Submitted to CENWD-PDM for final approval on Apr 20, 2006	

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.

As indicated in Engineering Manual 1110-2-3600, it is essential that project operators (dam tenders, operations managers, power plant superintendents) at the various flood control and multiple-purpose reservoirs be supplied with regulation schedules to be followed in case of communication failure. These regulation schedules should be followed in case of communication failure with the headquarters from which instructions are normally issued during flood situations. Standing Instructions have not yet been issued for Harry S Truman Reservoir, Clinton, Hillsdale, Long Branch, Smithville, Longview, and Blue Springs Lakes.

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 the various types of data collection now being utilized are presented in the following paragraphs.

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 includes both FTP and 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/watermanagement/.

The Water Management Section is using a Unix/Linux system. Hardware is available in Omaha for a backup server if needed.

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 sophisticated 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. For Fiscal Year 2012, the District will support 86 permanent DCP's, a 9% cut from the previous year. A breakdown of the total number of DCP's, by states, shows 39 units in Missouri, 33 in Kansas, 8 in Nebraska, and 6 in Iowa.

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). A similar network of reporting stations has been operated by the National Weather Service (NWS) for their river forecasting services. 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. A summary of funds expended for data collection purposes during the report period is included in the Personnel and Funding section at the end of this report.

Water Quality Investigations and Monitoring Activities.

Lake Projects - All 18 District reservoirs were sampled from April through September for nutrients, pesticides, metals, chlorophyll a and in-situ water column profiles. Sampling season had little influence from flood and runoff events. Environmental staff and Lake Project personnel worked to complete all monthly sampling with one missed sample month at Rathbun Lake. Record floods in the Dakotas and northern states in the Missouri River watershed produced record Missouri River releases from Gavins Point Dam through the most of the summer of 2011. A hot dry summer resulted in minimal inflow in most lakes and downstream releases were reduced or negligible to minimize downstream flooding in the Missouri River. These environmental variables and reduced flow through the lakes resulted in stagnant conditions and reduced water quality compared to typical years. Swim beaches and blue green algae blooms are sampled by district staff, state health departments, and/or contract labs for E. coli bacteria, and harmful algae populations/toxins for public safety alerts/closures. Significant bluegreen algal blooms occurred at Perry and Milford Lakes resulting in a public health warning

with some or all beaches closed and full body contact with water prohibited. Moderate algal blooms occurred at Hillsdale and Clinton Lakes resulting in public health advisories discouraging contact with lake water for people and pets. District swim beaches at Rathbun Lake were closed for a short duration due to high bacteria counts. Beaches at Truman, Rathbun, and Milford were closed due to high water levels and public safety concerns. Zebra mussel surveys were completed at nine un-infested NWK lakes. Three seasons of samples at Pomme de Terre Lake failed to produce zebra mussel veligers analyzed by two independent labs. As a result, Pomme de Terre was removed from the infested list. Smithville Lake had adult zebra mussels discovered in a marina cove and a treatment was attempted in 2010. Recent samples have not indicated reproducing populations in Smithville. New populations were discovered at Melvern Lake by Kansas Division of Wildlife and Parks. This population will eventually flow downstream to Truman Lake in Missouri via the Osage River. District lakes with documented populations of zebra mussels include Perry, Wilson, Milford, Rathbun, and Melvern Lakes. The WQ Program continues to participate with watershed groups for the following lakes: Kanopolis (Smoky Hill), Clinton (Upper Wakarusa), Tuttle Creek, Perry (Delaware River), Pomona, Melvern, Milford, Hillsdale, and Rathbun (Chariton).

Missouri River - NWK staff sampled 7 Missouri River mainstem sites and 11Missouri River tributary sites in support of the Missouri River Recovery Program (MRRP) in 2011. In conjunction with samples collected by NWO staff, this data will be used to facilitate the application of a CEQUAL-W2 hydrodynamic and water quality model on the lower Missouri River. This sampling was completed on a monthly basis. High water and flooding conditions provided challenges to the sampling in 2011. Many boat ramps were unusable so crews were forced to launch from unique places. Additionally, given the out- of-bank flows some of the data collected in 2011 will not be used for the model, but will provide a unique opportunity to better understand water quality parameters during a flood of this type. Samples collected in the past have been taken from flood waters that were the result of high flows from tributaries. Conversely, the origin of the floodwaters in 2011 was derived from releases from mainstem reservoirs. This provided the unique opportunity to compare and contrast the differences in water quality parameters during two different types of high water events. In addition to sampling mainstem and tributary sites in 2011, the high water event provided opportunities to better understand the chemical and biological responses that take place on the floodplain during these types of events. Samples (water quality, zooplankton, phytoplankton, etc.) were collected from Dalbey Bottoms (Corps mitigation site), Overton Bottoms (Corps mitigation site), and Baltimore Bend (US Fish and Wildlife Service – Big Muddy Refuge System) twice a month while the river was at flood stage (June through September). These sites were also sampled by Habitat Assessment and Monitoring Program (HAMP) and Pallid Sturgeon Population Assessment Program (PSPAP) crews as well. Information gained from these efforts will ultimately help the Corps design, build, and adaptively manage USACE projects as we better understand the physical, chemical, and biological responses to floodplain inundation and lateral connectivity. In 2011, Corps staff continued to monitor for estrogen compounds in the Missouri River. Again, the flooding added challenges to this sampling but it should provide insight as to the presence of these compounds in the system during these types of events.

Sediment Observations.

Hydrographic surveys of all 18 District lakes have been completed. Area-Capacity tables will be available in 2012.

Three outlet channels were inspected during the report period:

Tuttle Creek Lake - Periodic General Inspection #10A was conducted 6-7 October 2010. The outlet channel was walked and visually inspected from the outlet works to the rocky Ford Recreation Area. The riprap is generally in good repair. In the unprotected portion of the outlet channel, bank sloughing and erosion is still a concern after the high release in 1993. Surveyed records of this area show the bank eroded from approximately 4 to 20 feet during the 1993 event. The bank loss has continued adjacent to the public parking fence. Head cutting in the Wolf Creek channel and deposition of this material in the outlet channel continues to occur. At the confluence of the outlet channel to the natural channel, minor bank cutting and erosion is visible along the left bank. At Range A, the bed has degraded approximately 14 feet since 1961, but appears to have stabilized. At Range B the bank has widened 2 feet, but also appears to have stabilized. Likewise, Ranges C-G appear to be stable. The outlet channel is hydrologically adequate and is operating as designed.

Rocky Ford Dam.

Rathbun Lake - Periodic General Inspection #13A was conducted 21-23 March 2011. The outlet channel was walked and visually inspected from the stilling basin to the confluence with the Rural Water District Intake Structure. During the 2010 high water event, a maximum release of

3,000 c.f.s. was released for 64 consecutive days. After the event, the grouted riprap nearest the stilling basin walls was replaced with a concrete apron. During to the 2010 event, most of the surveyed cross sections experienced a widening and lateral movement. At Range D, the left bank has widened 25 feet since 2006. Other Ranges have less dramatic widening. The 2010 event did not result in any bed degradation. In general, there has been minimal change to the thalwag and channel bed since 1972. Hydraulic adequacy may be impacted, to a small degree, due to several trees and root balls in the channel. The outlet and river channels should continue to function as designed.

Milford Lake – Periodic General Inspection #13 was conducted on 4-5 May 2011. There have been no Phase II releases (greater than 15,000 cfs) since the last periodic inspection, and the outlet channel and river appear to be in excellent condition. No significant streambed changes have occurred since the 2005 survey.

Milford Outlet Channel.

Through an interagency cooperative agreement with the USGS, the District collects point, depth integrated, and bed sediment samples at five Missouri River stations and two inflow points to Truman Lake. The Missouri River data at St. Joseph, Kansas City, and Boonville include point velocities. Laboratory analyses are performed at the USGS facility at Rolla, Missouri, and the results are stored in their database. The USGS publishes the suspended sediment load data for the Schell City and Clinton stations.

RESEARCH AND STUDIES.

.

Kanopolis Release Rates - Kanopolis Lake provides minimum releases to support the downstream water quality requirements for sanitary purposes at Salina, Kansas, based on a 1949 U.S. Public Health Service study. The State of Kansas believes that the lake's beneficial purposes would be better served by reducing the monthly releases from the Kanopolis project. The Kansas Water Office proposed a reduced table of Kanopolis release rates, and the Water Management section created a Kanopolis operation model to evaluate the affect of the reduced releases on the pool elevation.

The report was complete on January 28, 2011 with the conclusion that a reduced release would improve the Kanopolis Lake beneficial purposes during periods of drought. The report further concluded that flood control benefits would not be adversely affected. The State of Kansas needs to perform additional analysis to insure that downstream water quality does not become a concern with the reduced Kanopolis Lake releases.

Lake Bathymetry Reports - In 2009 and 2010, the District contracted with Eisenbraun and Associates to complete total lake bathymetric surveys of 11 District lake projects. The surveys were conducted with single side band sonar using GPS horizontal control. Eisenbraun then used a CADD methodology to evaluate areas and capacities for the multipurpose pools at eight of the lakes in Missouri, Iowa, and Nebraska. Kansas Biological Survey used a similar field methodology in 2007-09 to complete bathymetric surveys of six additional lake projects in Kansas. Their data files were submitted to NWK as part of the State's contribution to the Kansas River PAS studies. For the nine Kansas lakes within NWK, the District contracted with Surdex Corporation to combine the bathymetric data from KBS and Eisenbraun with LiDAR and DEM data to develop complete area and capacity tables to the top of the dam using GIS methods. Water Management has compiled the Surdex results into tables and background reports, and the review of those reports should be finalized in FY 12. Water Management will then begin using the revised area and capacity tables for the nine Kansas lakes operationally. Only Long Branch Lake was not included in the recent bathymetric surveys.

One of the primary purposes for the bathymetric surveys was to evaluate sedimentation trends. Most lakes have not had a sediment survey since the early 1990's, and in some cases even earlier. For the Kansas lakes, the results indicate that sedimentation trends are in line with previous projections. Sedimentation is not a near term concern at any lake with water supply contracts. The results for the Missouri, Iowa, and Nebraska lakes have not yet been compiled.

TRAINING AND METHODS.

Table 4: Staff Training

Employee	Course or Training
#1	None
#2	None
#3	ResSim
#4	CWMS Modeling for Water Mgmt
#5	None
#6	None
#7	None
#8	Water and Watershed
#9	CWMS Modeling for Water Mgmt

Training of Water Management Section staff progresses as time and scheduling permit. Technical abilities are enhanced as individuals continue to pursue courses on their own initiative. During the period of this report, Section employees participated in the training courses listed in ***Table 4***. All staff members attended in-house training of Personally Identifiable Information, Combat Trafficking in Persons (CTIP), ACE-IT IA, Violence in the Workplace, Suicide Prevention for DA Civilians, TARP, SAEDA & OPSEC Training, Sexual Harassment Sexual Response and Prevention (SHARP), and Individual Development Plan Status.

PERSONNEL AND FUNDING.

Personnel.

Authorized positions of the Water Management Section at the close of the fiscal year (September 30, 2011) consisted of one Supervisory Hydraulic Engineer, four Hydraulic Engineers, and four Hydrologic Technicians. At the end of this reporting period, the Section had no 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 5: Water Management Section Personnel

Employee	Grade
(1)	GS-13
(2)	GS-12
(4)	GS-11
(4)	GS-8
(4)	GS-11
(4)	GS-11
(2)	GS-12
(2)	GS-12
(2)	GS-12

Job Title
(1) Supervisory Hydraulic Engineer
(2) Hydraulic Engineer
(3) Hydrologist
(4) Hydrologic Technician

Funding.

Activities of the Water Management Section are funded from the following sources:

Planning

Part of the funds appropriated for survey reports, flood plain information studies, and project planning studies are assigned to the Water Management Section for special studies if water control is included in connection with the planning and design.

Operations and Maintenance

Operation of the existing lakes and reservoirs in the Kansas City District requires stream flow forecasting, water control planning, stream gauging, and other related activities for each authorized function at Corps of Engineers projects, and for the flood control function at Bureau of Reclamation projects. Operation and maintenance funds are used for these purposes.

Technical Services and Flood Emergency

Technical services provided to non-Federal interests, flood emergency operations, post flood reports, and the annual flood report are tasks assigned to the Water Management Section. These activities vary from year to year. Special accounts are provided for these services. Individuals in the Section may also receive special funding from other sources when they participate as a technical resource on Project Development Teams.

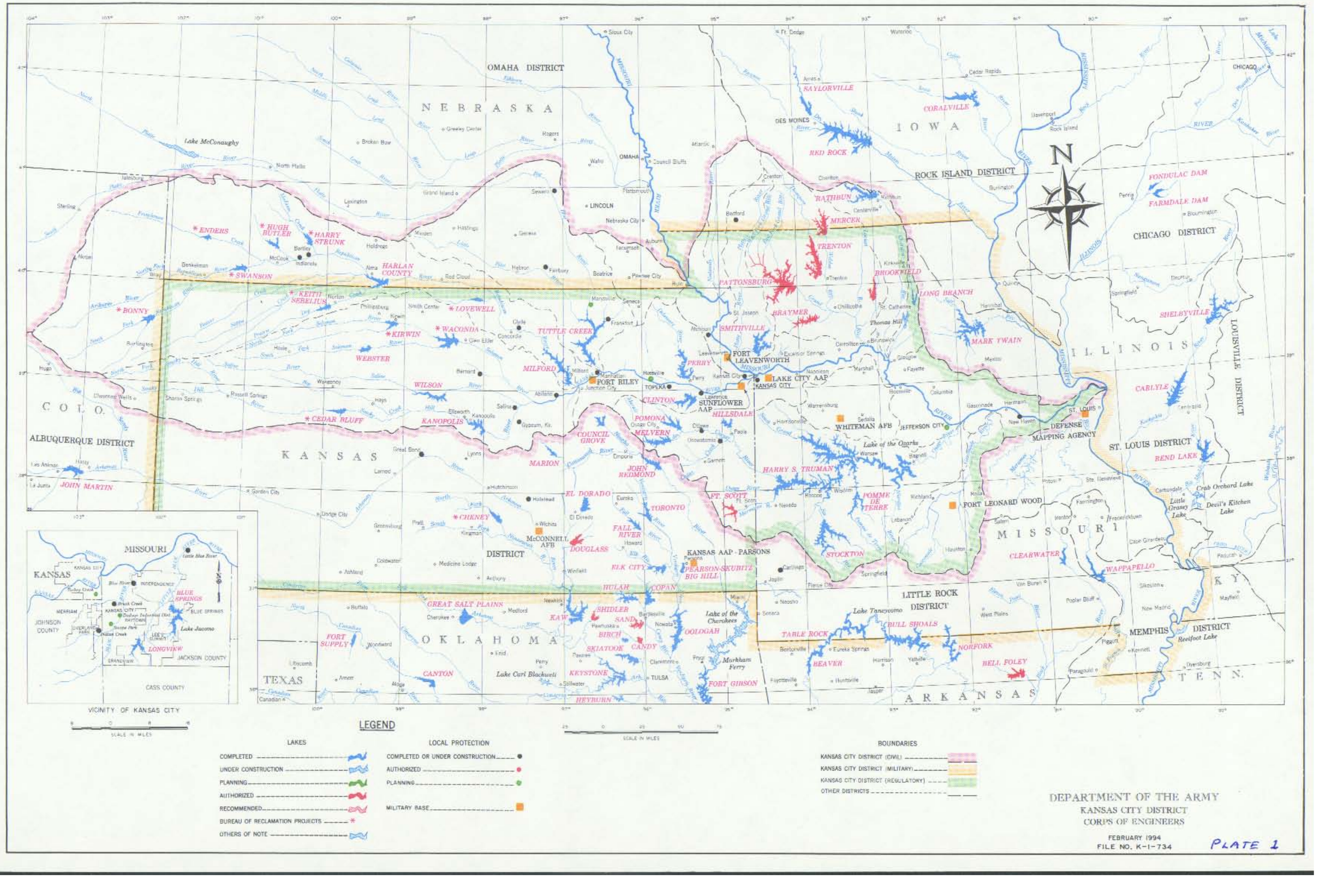
Data Collection Programs

The Cooperative Stream Gauging Program with the four U.S. Geological Survey districts (Kansas, Nebraska, Iowa, and Missouri) includes 86 stations. Kansas City District funding for this program during FY 2012 is $1,096,138, an 11% drop from the FY 2011 program.

Fiscal year expenses for data collected in FY 2010 and FY 2011, and the programmed expenses for FY 2012 are shown in ***Table 6*** below.

Table 6: Data Collection Expenditures

Program	FY 2010	FY 2011	FY 2012
U.S.G.S	$1,227,720	$1,229,235	$1,096,138
Independent Stations	$0	$0	$0
TOTAL	$1,227,720	$1,229,235	$1,096,138


OMAHA DISTRICT
NEBRASKA
IOWA
ROCK ISLAND DISTRICT
CHICAGO DISTRICT
ILLINOIS
LOUISVILLE DISTRICT
ST. LOUIS DISTRICT
ALBUQUERQUE DISTRICT
COLO.
KANSAS
OKLAHOMA
TEXAS
MISSOURI
KY.
TENN.
ARKANSAS
LITTLE ROCK DISTRICT
MEMPHIS DISTRICT
KANSAS AAP - PARSONS
FORT LEAVENWORTH
FORT RILEY
LAKE CITY AAP
KANSAS CITY
SUNFLOWER AAP
WHITEMAN AFB
DEFENSE MAPPING AGENCY
McCONNELL AFB
FORT LEONARD WOOD
Lake McConaughy
Lake of the Ozarks
Lake of the Cherokees
Lake Tanycomo
Markham Ferry
Lake Carl Blackwell
Reelfoot Lake
Crab Orchard Lake
Little Grassy Lake
Devil's Kitchen Lake
ENDERS
HUGH BUTLER
HARRY STRUNK
SWANSON
HARLAN COUNTY
KEITH SEBELIUS
BONNY
KIRWIN
WEBSTER
WACONDA
LOVEWELL
TUTTLE CREEK
MILFORD
WILSON
CLINTON
CEDAR BLUFF
KANOPOLIS
COUNCIL GROVE
MARION
JOHN REDMOND
EL DORADO
CHENEY
FALL RIVER
DOUGLASS
TORONTO
ELK CITY
PEARSON-SKUBITZ BIG HILL
HULAH
COPAN
GREAT SALT PLAINS
KAW
SHIDLER
SAND
BIRCH
SKIATOOK
CANDY
KEYSTONE
OOLOGAH
FORT SUPPLY
CANTON
FORT GIBSON
HEYBURN
TABLE ROCK
BULL SHOALS
NORFORK
BEAVER
BELL FOLEY
STOCKTON
CLEARWATER
WAPPAPELLO
POMME DE TERRE
HARRY S. TRUMAN
JOHN MARTIN
KAYLORVILLE
RED ROCK
RATHBUN
MERCER
TRENTON
PATTONSBURG
BRAYMER
SMITHVILLE
PERRY
POMONA
MELVERN
HILLSDALE
BROOKFIELD
LONG BRANCH
MARK TWAIN
FONDULAC DAM
FARMDALE DAM
SHELBYVILLE
CABLYLE
BEND LAKE
VICINITY OF KANSAS CITY
MISSOURI
KANSAS
INDEPENDENCE
BLUE SPRINGS
LONGVIEW
JOHNSON COUNTY
JACKSON COUNTY
CASS COUNTY
SCALE IN MILES
LEGEND
LAKES
COMPLETED
UNDER CONSTRUCTION
PLANNING
AUTHORIZED
RECOMMENDED
BUREAU OF RECLAMATION PROJECTS
OTHERS OF NOTE
LOCAL PROTECTION
COMPLETED OR UNDER CONSTRUCTION
AUTHORIZED
PLANNING
MILITARY BASE
BOUNDARIES
KANSAS CITY DISTRICT (CIVIL)
KANSAS CITY DISTRICT (MILITARY)
KANSAS CITY DISTRICT (REGULATORY)
OTHER DISTRICTS
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	REMARKS
GENERAL							(1) With pool at multipurpose level.
Location of Dam	Near Melvern, KS	Near Pomona, KS	Near Paola, KS	Near Stockton, MO	Near Hermitage MO	Near Warsaw, MO	(2) Damming height is from the original riverbed to the top of the flood control pool.
Stream / River	Marais des Cygnes River	110 Mile Creek	Big Bull Creek	Sac River	Pomme de Terre River	Osage River	(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:
Miles above Mouth	175.4	8.3	18.2	51.4	45.6	175.1	Melvern, February 1986 (effective March 1, 1986)
Contributing Drainage Area, square miles	349	322	144	1,160	611	8,914 (4)	Pomona, March 1990 (effective April 1, 1990)
Approximate Length of Full Reservoir, miles	22	12	15	24	28	122	Hillsdale, 1969 (initial)
Shoreline, miles (1)	101	52	51	298	113	958	Stockton, February 1988 (effective May 1, 1988)
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)	Pomme de Terre, February 1985 (effective Mar 85)
Date of Closure	October 2, 1970	July 19, 1962	June 15, 1980	September 23, 1968	June 28, 1960	July 21, 1977	Harry S. Truman, April 1993 (effective Mar 94)
Date Storage Began	August 1, 1972	October 18, 1963	September 19, 1981	December 12, 1969	October 29, 1961	February 7, 1979	(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.
Date Multipurpose Level Reached	April 4, 1975	June 5, 1965	February 23, 1985	December 18, 1971	June 15, 1963	November 29, 1979	(5) In 1994, 1000 AF of flood control storage at Truman Reservoir was reallocated to water supply.
Operating Agency	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	Corps of Engineers	The top of the multipurpose pool was adjusted from 706.0 to 706.018
DAM AND EMBANKMENT				911.0 for concrete section			
Top of Dam Elevation, feet msl	1,078.0	1,031.0	952.2	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)							**TOTALS**
Surcharge Pool Elevation and Area	1,073.0 ft msl 22,673 ac	1,025.4 ft msl 14,584 ac	948.0 ft msl 10,983 ac	906.2 ft msl 48,053 ac	900.2 ft msl 25,456 ac	751.1 ft msl 295,870 ac	417,619 ac
Flood Control Pool Elevation and Area	1,057.0 ft msl 13,935 ac	1,003.0 ft msl 8,522 ac	931.0 ft msl 7,413 ac	892.0 ft msl 38,281 ac	874.0 ft msl 15,999 ac	739.6 ft msl 209,048 ac	293,198 ac
Multipurpose Pool Elevation and Area	1,036.0 ft msl 6,912 ac	974.0 ft msl 3,865 ac	917.0 ft msl 4,575 ac	867.0 ft msl 24,632 ac	839.0 ft msl 7,790 ac	706.02 ft msl (5) 55,406 ac	103,180 ac
Surcharge Storage, AF	1,073.0 - 1,057.0 289,410	1,025.4 - 1,003.0 255,327	948.0 - 931.0 155,799	906.2 - 892.0 608,708	900.2 - 874.0 535,724	751.1 - 739.6 2,910,768	4,755,736 AF
Flood Control Storage, AF	1,057.0 - 1,036.0 208,207	1,003.0 - 974.0 176,123	931.0 - 917.0 83,570	892.0 - 867.0 776,066	874.0 - 839.0 406,821	739.6 - 706.02 4,005,392	5,656,179 AF
Multipurpose Storage, AF	1,036.0 - 965.0 152,051	974.0 - 930.0 64,208	917.0 - 852.5 76,270	867.0 - 765.0 874,887	839.0 - 750.0 237,356	706.02 - 631.0 1,181,640	2,586,412 AF
Gross Storage, AF	1,057.0 - 965.0 360,258	1,003.0 - 930.0 240,331	931.0 - 852.5 159,840	892.0 - 765.0 1,650,953	874.0 - 750.0 644,177	739.6 - 631.0 5,187,032	8,242,591 AF
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		ac = acres
River Outlet Type	Gated Horseshoe Conduit	Gated Horseshoe Conduit	Gated Oblong Conduit	None	Gated Tunnel	None	AF = acre-feet
Number and Size of Conduit	1 - 11.5’	1 - 13.5’	1 - 15.92’x11.67’		1 - 14’		ft = feet
Length of Conduit, feet	754	720.5	685		560		msl = elevation above mean sea level
Entrance Invert Elevation	962.0 ft msl	925.0 ft msl	868.0 ft msl		750.0 ft msl		cfs = cubic feet per second
Discharge Capacity, Top of Surcharge Pool	6,700 cfs	9,200 cfs	8,200 cfs		12,750 cfs		kw = kilowatts
Discharge Cap, Top of Flood Control Pool	6,235 cfs	8,170 cfs	7,400 cfs		11,500 cfs		hp = horsepower
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	

SUMMARY OF ENGINEERING DATA
OSAGE RIVER BASIN PROJECTS

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

Plate 2A

SUBJECT	SMITHVILLE LAKE	LONGVIEW LAKE	BLUE SPRINGS LAKE	RATHBUN LAKE	LONG BRANCH LAKE	REMARKS
GENERAL						(1) With pool at multipurpose level.
Location of Dam	Near Smithville, MO	Kansas City, MO	Kansas City, MO	Near Rathbun, IA	Near Macon, MO	(2) Damming height is from original riverbed to top of flood pool.
Stream / River	Little Platte River	Little Blue River	East Fork Little Blue River	Chariton River	East Fork Little Chariton River	(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:
Miles above Mouth	13.6	42.9	28.8	142.3	78	Smithville Lake, February 1990 (effective March 1, 1990)
Contributing Drainage Area, square miles	213	50.3	32.8	549	109	Longview Lake, May 1970 (initial)
Approximate Length of Full Reservoir, miles	18	3.5	2.5	14	9	Blue Springs Lake, September 1974 (initial)
Shoreline, miles (1)	175	24	12	155	24.2	Rathbun Lake, January 2000 (effective December 1, 2000)
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)	Long Branch Lake, January 1989 (effective October 1, 1989)
Date of Closure	July 13, 1976	June 16, 1983	August 12, 1986	September 29, 1967	September 3, 1976	(4) Spillway flood routing at Long Branch Lake revised for Emergency Action Plan, dated 1981.
Date Storage Began	October 19, 1979	September 16, 1985	September 27, 1988	November 21, 1969	August 2, 1978	(5) Flows above 1,800 cfs result in overtopping of the outlet stilling basin walls
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)						**TOTALS**
Surcharge Pool Elevation and Area	891.1 ft msl 14,611 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 6,608 ac (4)	56,761 ac
Flood Control Pool Elevation and Area	876.2 ft msl 9,990 ac	909.0 ft msl 1,964 ac	820.3 ft msl 982 ac	926.0 ft msl 22,452 ac	801.0 ft msl 3,663 ac	39,051 ac
Multipurpose Pool Elevation and Area	864.2 ft msl 7,115 ac	891.0 ft msl 927 ac	802.0 ft msl 722 ac	904.0 ft msl 10,329 ac	791.0 ft msl 2,429 ac	21,522 ac
Recreation Pool Elevation and Area		870.0 ft msl 432 ac				432 ac
Surcharge Storage	891.1 - 876.2 182,198 AF	922.9 - 909.0 35,370 AF	837.7 - 820.3 19,039 AF	940.0 - 926.0 368,859 AF	821.2 - 801.0 101,880 AF (4)	707,346 AF
Flood Control Storage	876.2 - 864.2 101,777 AF	909.0 - 891.0 24,810 AF	820.3 - 802.0 15,715 AF	926.0 - 904.0 349,173 AF	801.0 - 791.0 30,327 AF	521,802 AF
Multipurpose Storage	864.2 - 810.0 141,666 AF	891.0 - 870.0 13,579 AF	802.0 - 760.0 10,842 AF	904.0 - 857.0 221,360 AF	791.0 - 750.0 34,189 AF	421,636 AF
Recreation Storage		870.0 - 810.0 8,555 AF				8,555 AF
Gross Storage	876.2 - 810.0 243,443 AF	909.0 - 810.0 46,944 AF	820.3 - 760.0 26,557 AF	926.0 - 857.0 570,533 AF	801.0 - 750.0 64,516 AF	951,993 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.	

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 Distict
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 59,886 ac	1,151.4 ft msl 70,030 ac	941.2 ft msl 42,656 ac	921.4 ft msl 18,336 ac	190,908 ac
Flood Control Pool Elevation and Area	1,176.2 ft msl 32,979 ac	1,136.0 ft msl 53,050 ac	920.6 ft msl 25,363 ac	903.4 ft msl 12,890 ac	124,282 ac
Multipurpose Pool Elevation and Area	1,144.4 ft msl 15,709 ac	1,075.0 ft msl 12,617 ac	891.5 ft msl 11,146 ac	875.5 ft msl 7,120 ac	46,592 ac
Surcharge Storage	1,208.2 - 1,176.2 1,442,049 AF	1,151.4 - 1,136.0 939,272 AF	941.2 - 920.6 692,375 AF	921.4 - 903.4 285,809 AF	3,359,505 AF
Flood Control Storage	1,176.2 - 1,144.4 756,669 AF	1,136.0 - 1,075.0 1,870,735 AF	920.6 - 891.5 515,795 AF	903.4 - 875.5 268,783 AF	3,411,982 AF
Multipurpose Storage	1,144.4 - 1,080.0 388,816 AF	1,075.0 - 1,020.0 280,137 AF	891.5 - 835.0 209,513 AF	875.5 - 828.0 125,334 AF	1,003,800 AF
Gross Storage	1,176.2 - 1,080.0 1,145,485 AF	1,136.0 - 1,020.0 2,150,872 AF	920.6 - 835.0 725,308 AF	903.4 - 828.0 394,117 AF	4,415,782 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 2,557 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	69,721 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 4,922 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 2,987 ac	30,605 ac
Inactive Pool Elev (ft msl), Area	3,638.0 331 ac	2,720.0 1,411 ac	3,082.4 ft msl 627 ac	2,558.0 ft msl 715 ac	2,343.0 ft msl 701 ac	2,280.4 ft msl 575 ac	1,932.5 ft msl 9,282 ac	1,571.7 ft msl 1,495 ac	15,137 ac
Dead Stor Pool Elev (ft msl), Area	3,635.5 242 ac	2,710.0 488 ac	3,080.0 ft msl 567 ac	2,552.0 ft msl 536 ac	2,335.0 ft msl 481 ac	2,275.0 ft msl 317 ac	1,885.0 ft msl 0 ac	1,562.07 ft msl 494 ac	3,125 ac
Surcharge Storage, AF	3,736.2 - 3,710 178,230	2,785 - 2,773 107,610	3,129.5 - 3,127 6,203	2,628.0 - 2,604.9 76,829	2,408.9 - 2,386.2 105660	2,341.0 - 2,331.4 58,287	1,975.5 - 1,973.5 47,767	1,610.3 - 1,595.3 94,145	674,731 AF
Flood Control Storage, AF	3,710.0 - 3,672 128,820	2,773 - 2,752 134,077	3,127.0 - 3,112.3 30,048	2,604.9 - 2,581.8 48,846	2,386.2-2,366.1 52,715	2,331.4 - 2,304.3 99,230	1,973.5 - 45.73 500,000	1,595.3 - 1,582.6 50,465	1,044,201 AF
MP, or Active Conserv Storage, AF	3,672.0 - 3,638 39,206	2,752 - 2,720 99,784	3,112.3 - 3,082.4 33,962	2,581.8 - 2,558 27,303	2,366.1 - 2,343 26,846	2,304.3 - 2,280.4 30,517	1,945.73 - 32.5 150,000	1,582.6 - 1,571.7 24,022	431,640 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 4,699	2,280.4 - 2,275 2,357	1,932.5 - 1,890 164,111	1,571.7 - 1,562.07 9,985	197,348 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 4,160	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 85,070	2,386.2 - 2,318.5 88,420	2,331.4 - 2,262 133,740	1,973.5 - 1,890 814,111	1,595.3 - 1,550.0 86,131	1,696,881 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 16.5'x21.5' sluice, with 1 - 16.5' x 10.75'gate, crest elev 3,672.0. The 56" gated outlet conduit feeds all three gated sub outlets. Capacity of irrig pipe outlet limited to 34.5 cfs by canal cap.	Notes: Irrigation outlet in right abutment.	Notes: Spillway has an uncontrolled notch w/ crest elevation at 3112.3. Concrete ogee weir diversion dam 52 miles d/s, w/ 2-14' x 9.5' gates plus 30" gated condut to river, and 2- 10'x6' gates to canal (cap 400 cfs).	Note: Concrete ogee weir diversion dam 13 miles downstream, w/ 1-6'x18' radial gate to river, and 2 - 5'x4' regulating gates to canal (max cap 90 cfs) Bartley Diversion Dam located below Rep. R. confluence. See note (4)	Notes: Spillway also has an uncontrolled notch w/ crest elevation at 2366.1. Concrete ogee weir div-ersion dam at mile 301.6 on Rep. R. blw Med Ck. 2-10'x14'gates to river and 4-10'x14' gates to canal (max cap 325 cfs).	Notes: Concrete ogee weir diversion dam 17.6 miles downstream, with 1 – 6'x18' radial gate to river, 2 – 6'x5' gates to Main Canal (cap 100 cfs) and 2 – 5'x4' gates to South Canal (capacity 36 cfs).	Franklin Canal conduit to 2-36" gates, cap 520 cfs. Naponee Canal conduit to 1-24" valve, cap 40 cfs. See also note (4)	Courtland Canal outlet.	msl = elev abv mean sea lvl

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	REMARKS
GENERAL							(1) With pool at multipurpose or full conservation level.
Location of Dam	Near Glen Elder, KS	Near Kirwin, KS	Near Stockton, KS	Near Wilson, KS	Near Ellsworth, KS	Near Ellis, KS	(2) Damming height is height from original river bed to top of flood control pool.
Stream / River	Solomon River	North Fork Solomon River	South Fork Solomon River	Saline River	Smoky Hill River	Smoky Hill River	(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:
Miles above Mouth	172.4	67.8	92.4	153.9	183.7	333.4	Waconda, July 2001 (effective January 1, 2003)
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	Kirwin, May 1996 (effective January 1, 1998)
Approx Length of Full Reservoir, miles (1)	24	9	7	24	12	9	Webster, May 1996 (effective January 1, 1998)
Shoreline, miles (1)	100	37	27	100	41	50	Wilson, December 1984 (effective January 1, 1985)
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)	Kanopolis, February 1983 (effective March 1, 1983)
Date of Closure	October 18, 1967	March 7, 1955	May 3, 1956	September 3, 1963	July 26, 1946	November 13, 1950	Cedar Bluff, March 2001 (effective January 1, 2002)
Date Storage Began	July 24, 1968	October 5, 1955	May 3, 1956	December 29, 1964	February 17, 1948	November 13, 1950	(4) Total DA with Kirwin and Webster = 5,076 sq miles
Date Multipurpose Level Reached	May 16, 1973	July 2, 1957	June 18, 1957	March 12, 1973	July 19, 1948	June 21, 1951	(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.
Operating Agency	Bureau of Reclamation	Bureau of Reclamation	Bureau of Reclamation	Corps of Engineers	Corps of Engineers	Bureau of Reclamation	(6) Total contrib. DA with Cedar Bluff = 7,695 sq miles
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)							**TOTALS**
Surcharge Pool Elevation (ft msl), Area	1,492.9 ft msl 38,178 ac	1,773.0 ft msl 14,660 ac	1,938.0 ft msl 11,270 ac	1,587.5 ft msl 33,882 ac	1,531.8 ft msl 23,408 ac	2,192.0 ft msl 16,510 ac	137,908 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 8,478 ac	1,554.0 ft msl 20,027 ac	1,508.0 ft msl 13,958 ac	2,166.0 ft msl 10,790 ac	97,574 ac
Multipurpose, or Top Cons Pool Elev, Area	1,455.6 ft msl 12,602 ac	1,729.25 ft msl 5,071 ac	1,892.45 ft msl 3,767 ac	1,516.0 ft msl 9,045 ac	1,463.0 ft msl 3,406 ac	2,144.0 ft msl 6,869 ac	40,760 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 248 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 - 1,488.3 203,798	1,773.0 - 1,757.3 198,467	1,938.0 - 1,923.7 140,912	1,587.5 - 1,554.0 894,263	1,531.8 - 1,508.0 438,655	2,192.0 - 2,166.0 353,250	2,229,345 AF
Flood Control Storage, AF	1,488.3 - 1,455.6 722,988	1,757.3 - 1,729.25 215,136	1,923.7 - 1,892.45 183,353	1,554.0 - 1,516.0 530,204	1,508.0 - 1,463.0 369,278	2,166.0 - 2,144.0 191,890	2,212,849 AF
MP, or Active Conservation Storage, AF	1,455.6 - 1,428.0 193,183	1,729.25 - 1,697.0 89,639	1,892.45-1,860.0 71,926	1,516.0 - 1,435.0 242,528	1,463.0 - 1,430.0 49,474	2,144.0 - 2,107.8 143,878	790,628 AF
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	56,682 AF
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	10,875 AF
Gross Storage, AF	1,488.3 - 1,395.0 942,408	1,757.3 - 1,680.0 313,290	1,923.7 - 1,849.0 259,510	1,554.0 - 1,435.0 772,732	1,508.0 - 1,430.0 418,752	2,166.0 - 2,078.0 364,342	3,071,034 AF
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							(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.
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	None	None	
Provision for Municipal Supply	No pipe outlets, water supply released to river	None	None	None	Provision future penstock 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

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

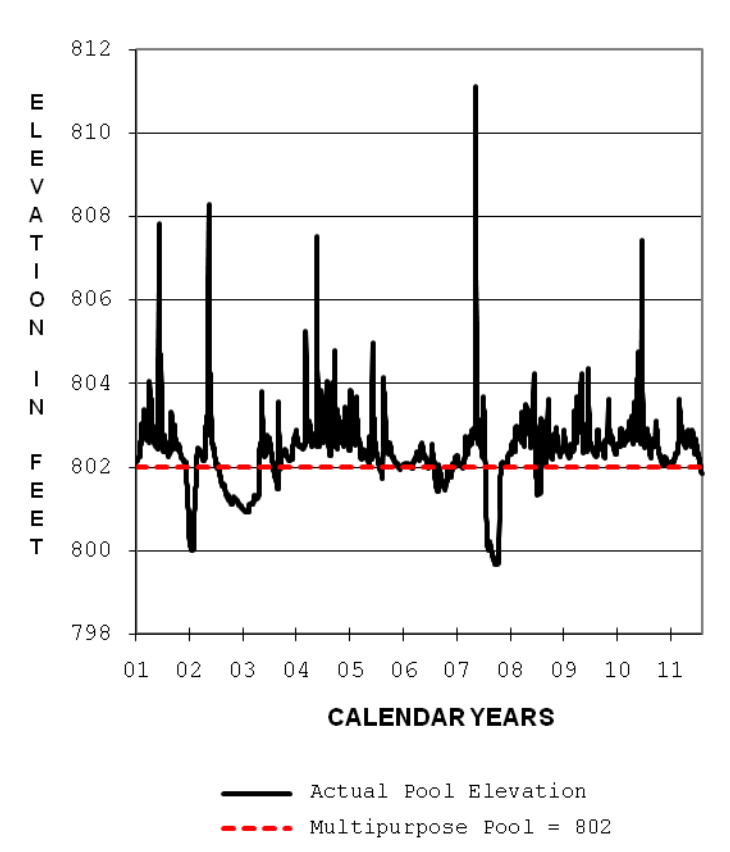
STOCKTON LAKE

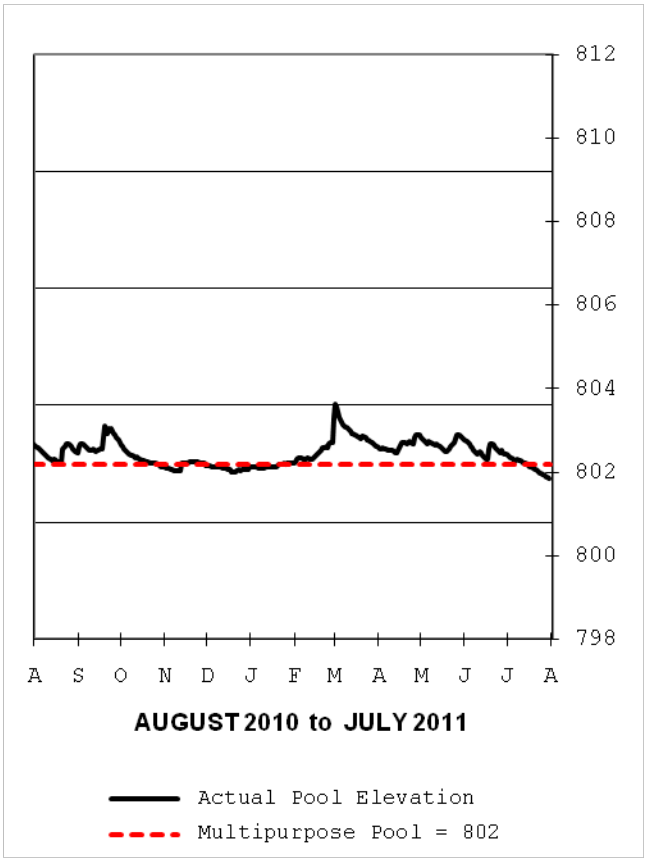
TUTTLE CREEK LAKE

WILSON LAKE

BLUE SPRINGS LAKE
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

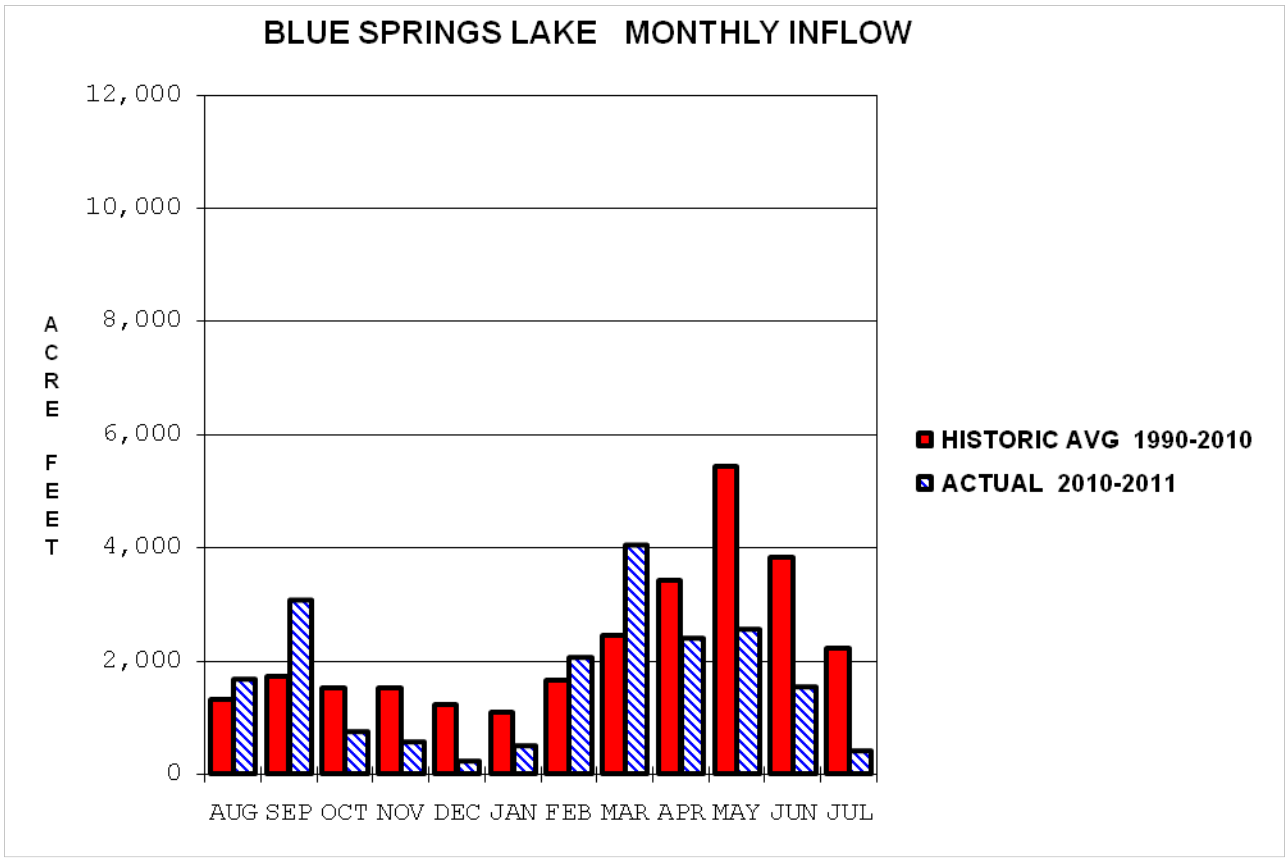


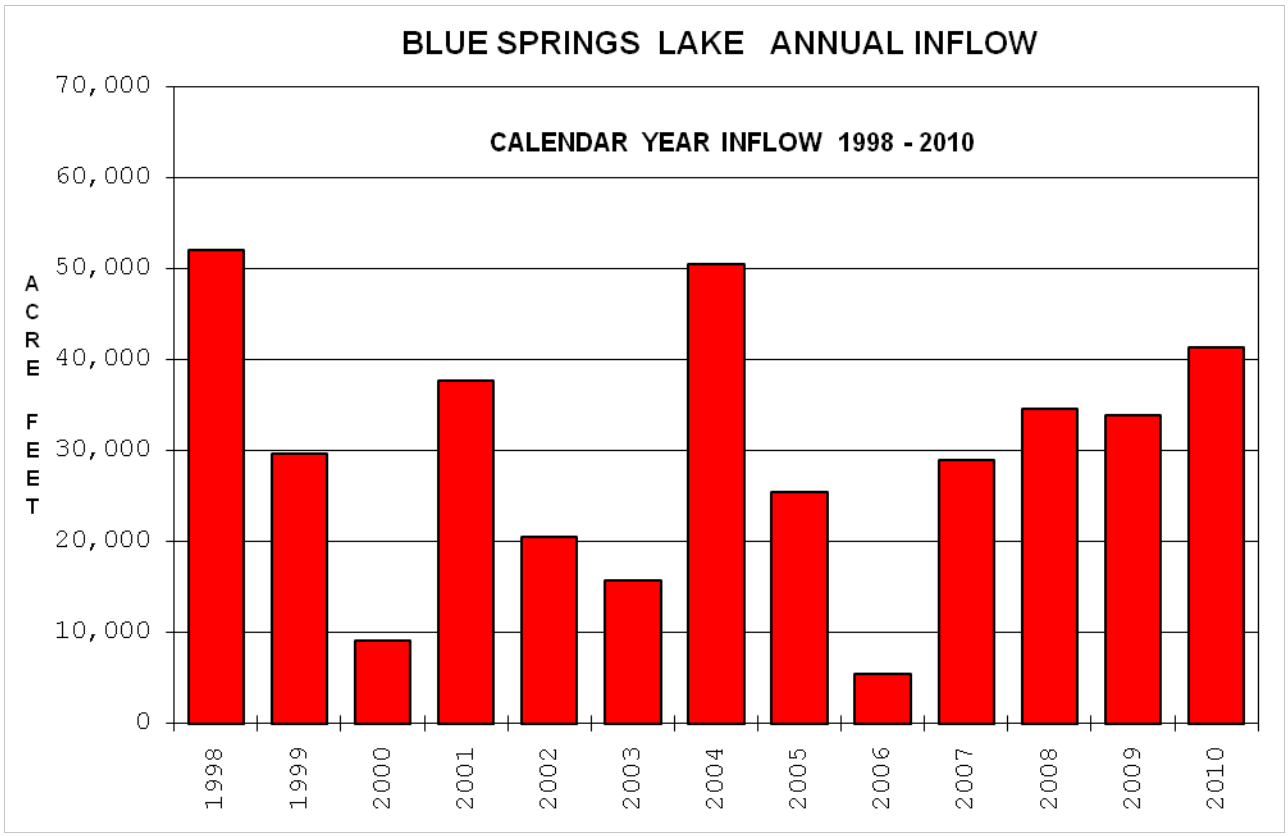


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
802.65 1 Aug 10	**801.86 31 Jul 11**	**803.64 1 Mar 11**	**801.86 31 Jul 11**	**816.37 16-17 May 90**	**799.69 7 Oct 07**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
300 28 Feb 11	**19,586**	**166 2 Mar 11**	**0 Many days**

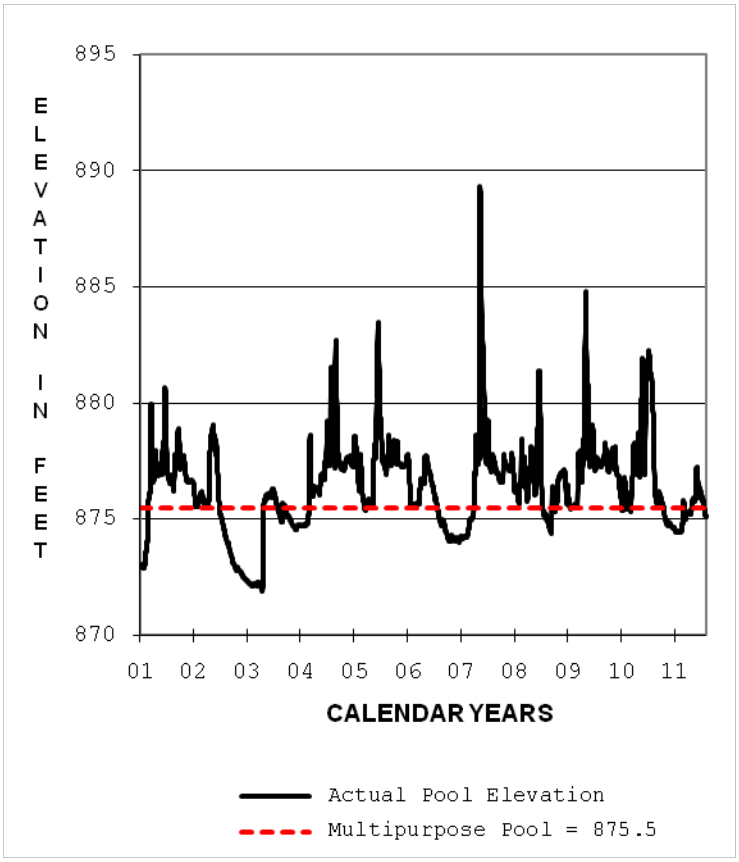
All releases are to the river. No minimum release requirement. No release when lake below notch elevation 802.0

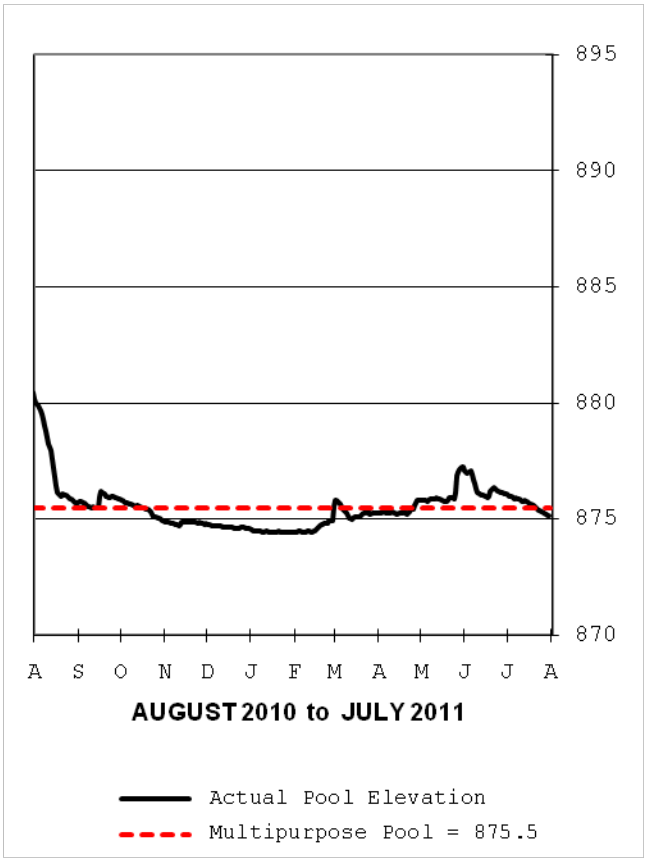

BLUE SPRINGS LAKE MONTHLY INFLOW
12,000
10,000
8,000
6,000
4,000
2,000
0
ACRE FEET
AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL
HISTORIC AVG 1990-2010
ACTUAL 2010-2011


BLUE SPRINGS LAKE ANNUAL INFLOW
CALENDAR YEAR INFLOW 1998 - 2010
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
ACRE FEET
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010

CLINTON LAKE
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



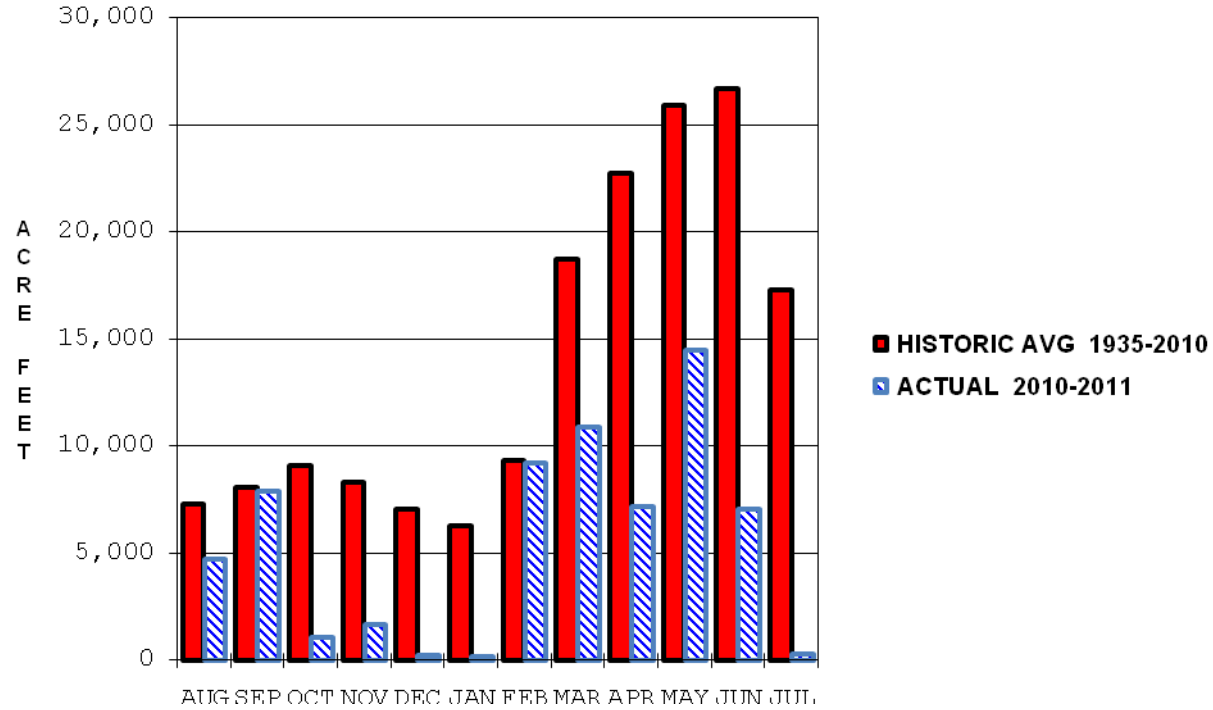


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
880.18 1 Aug 10	**875.11 31 Jul 11**	**880.18 1 Aug 10**	**874.41 19 Jan 11**	**892.48 29 May 95**	**871.60 18-19 Aug 89**

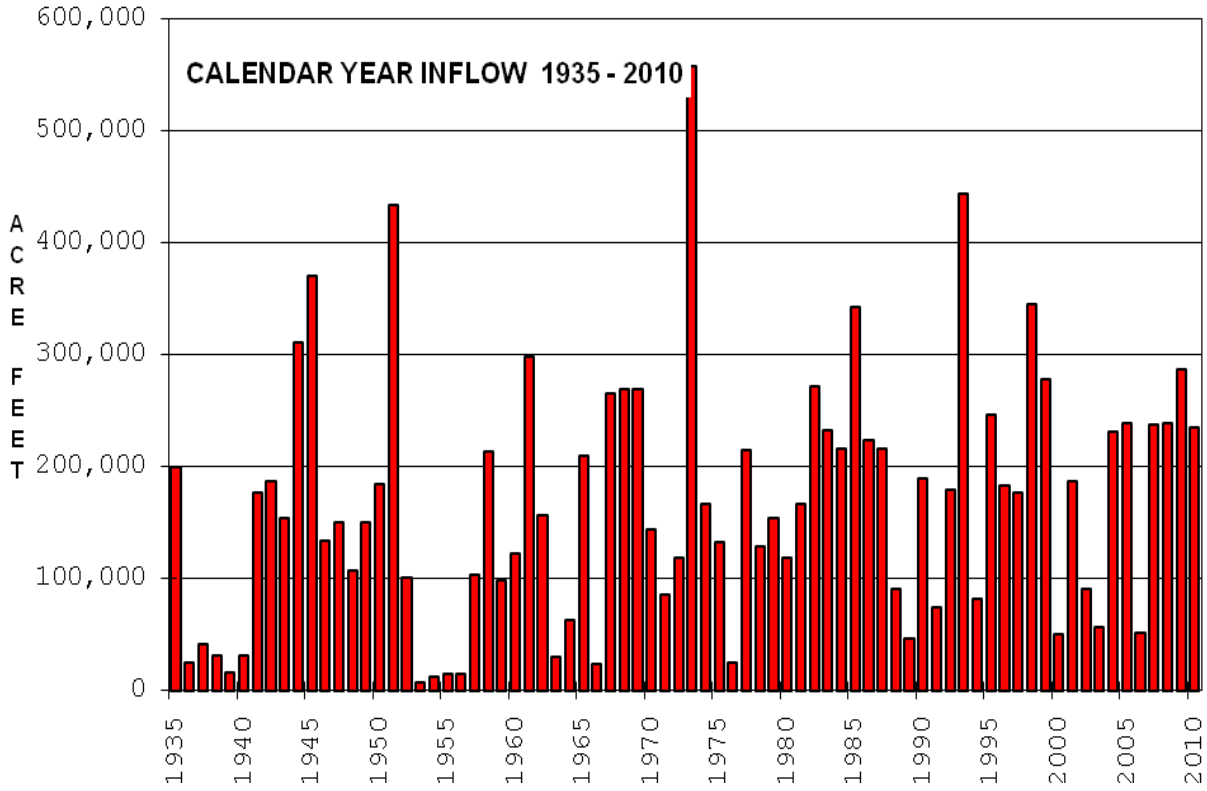
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
2,500 26 May 11	**64,506**	**1,520 14 Aug 10**	**12 27 Dec 10**

Outflows are those to river only. Minimum release is 7 to 21 cfs. Releases cut to 0 for maintenance, inspections.

CLINTON LAKE MONTHLY INFLOW

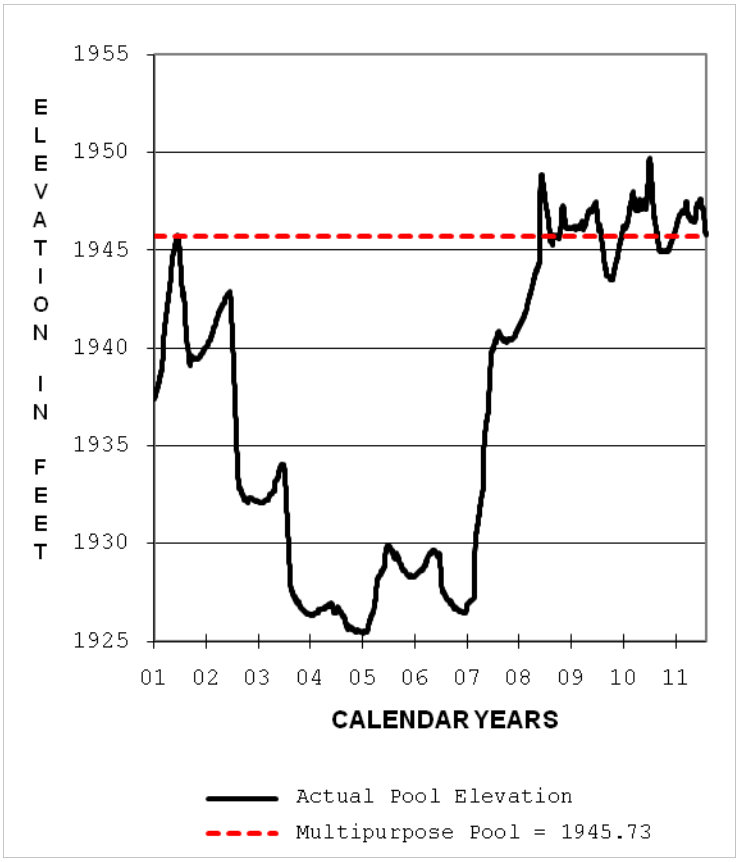


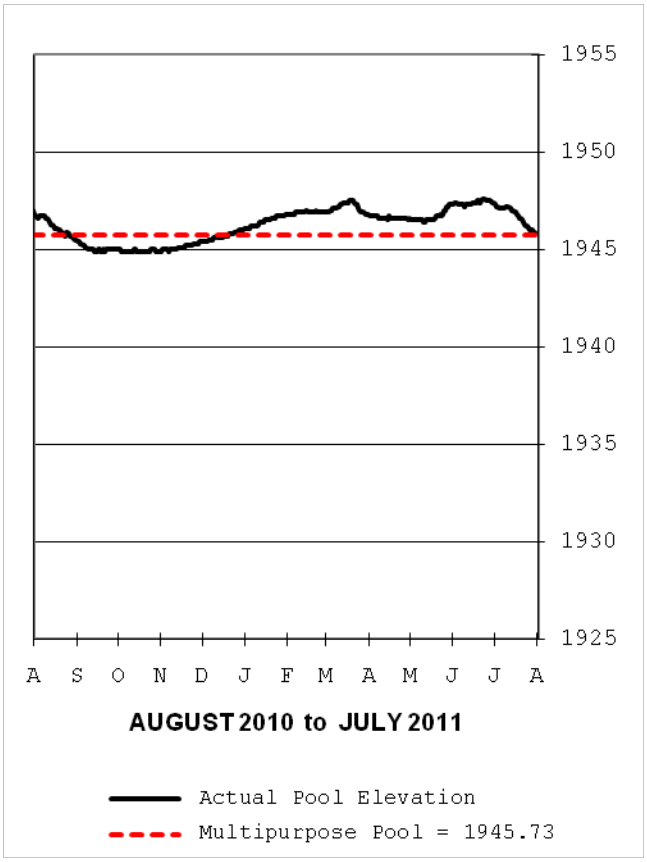
CLINTON LAKE ANNUAL INFLOW



HARLAN COUNTY LAKE
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



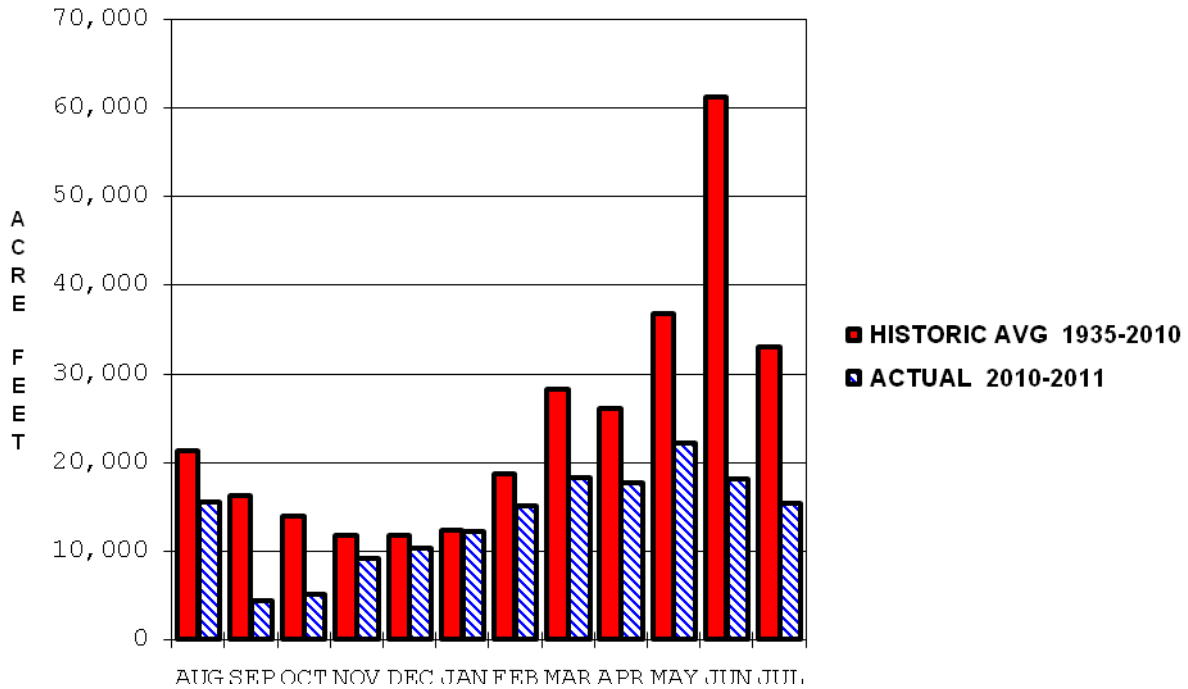


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1946.8 1 Aug 10	**1945.8 31 Jul 11**	**1947.6 23 Jun 11**	**1944.9 13 Sept 10**	**1955.66 5 Apr 60**	**1925.38 31 Dec 04**

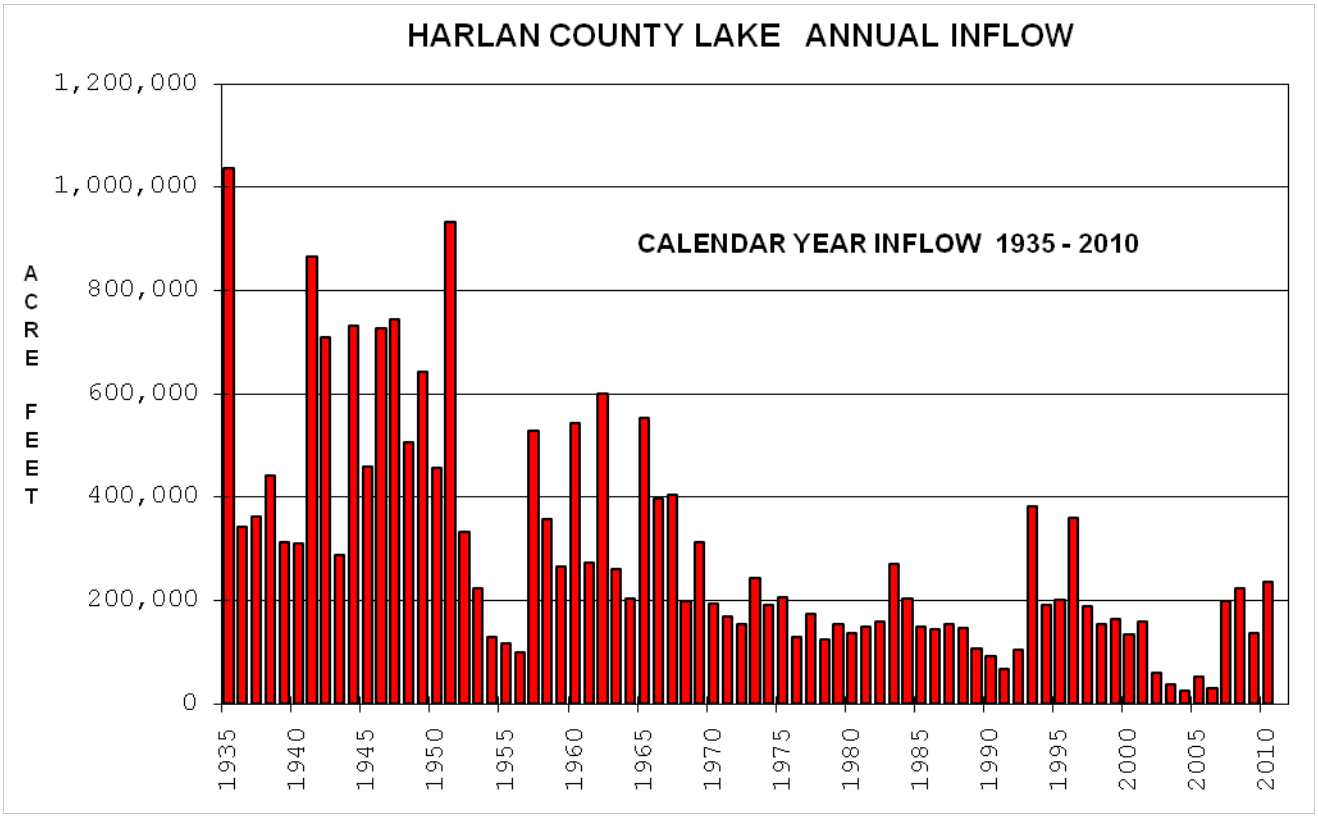
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
1,700 24 Aug 10	**164,347**	**1000 23 Mar 11**	**0 Many Days**

Max daily outflow to river normally occurs as part of normal releases for irrigation. No minimum release requirement.

HARLAN COUNTY LAKE MONTHLY INFLOW

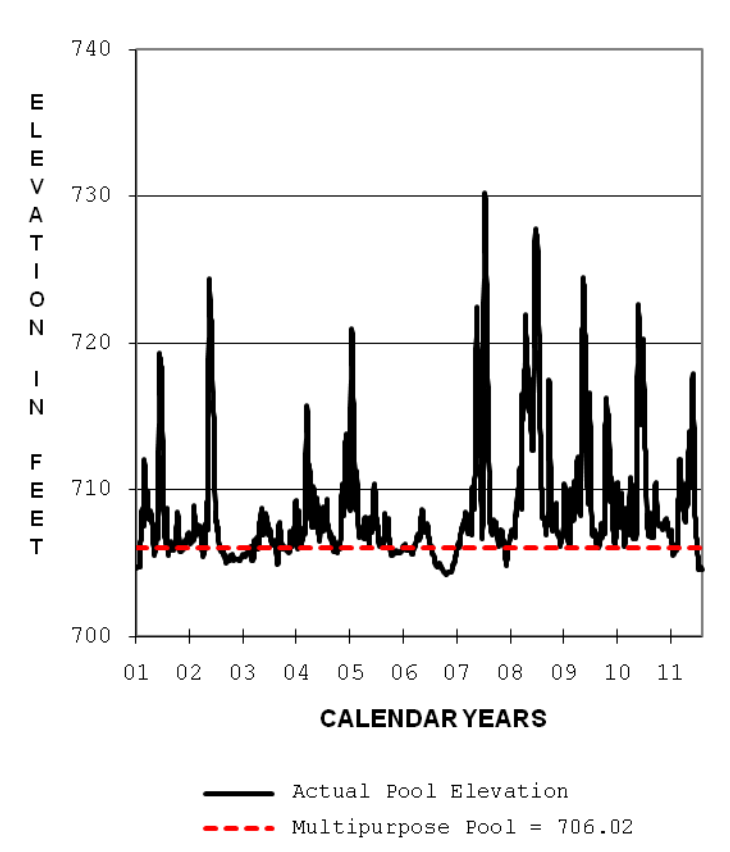


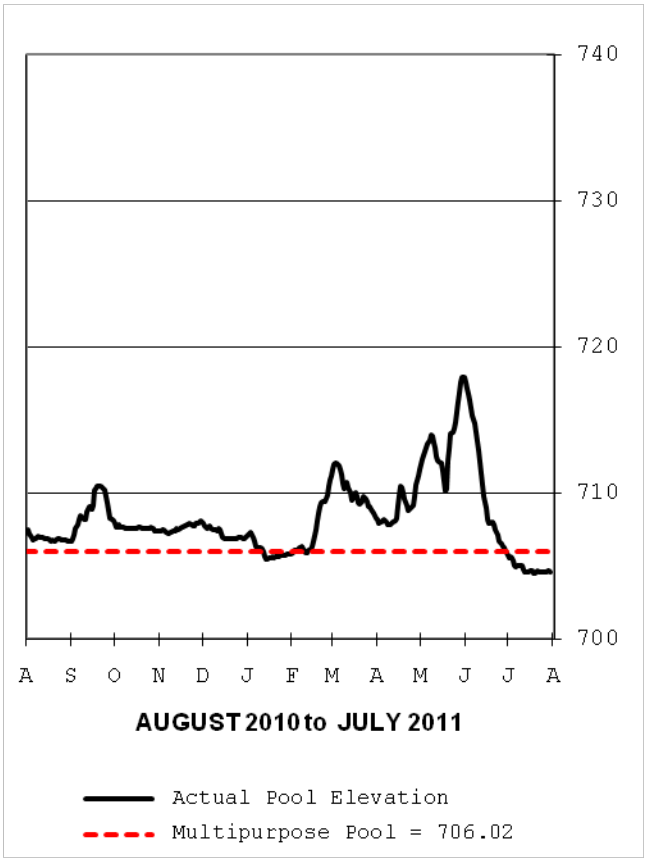
HARLAN COUNTY LAKE ANNUAL INFLOW



HARRY S TRUMAN RESERVOIR
2010 - 2011 REGULATION

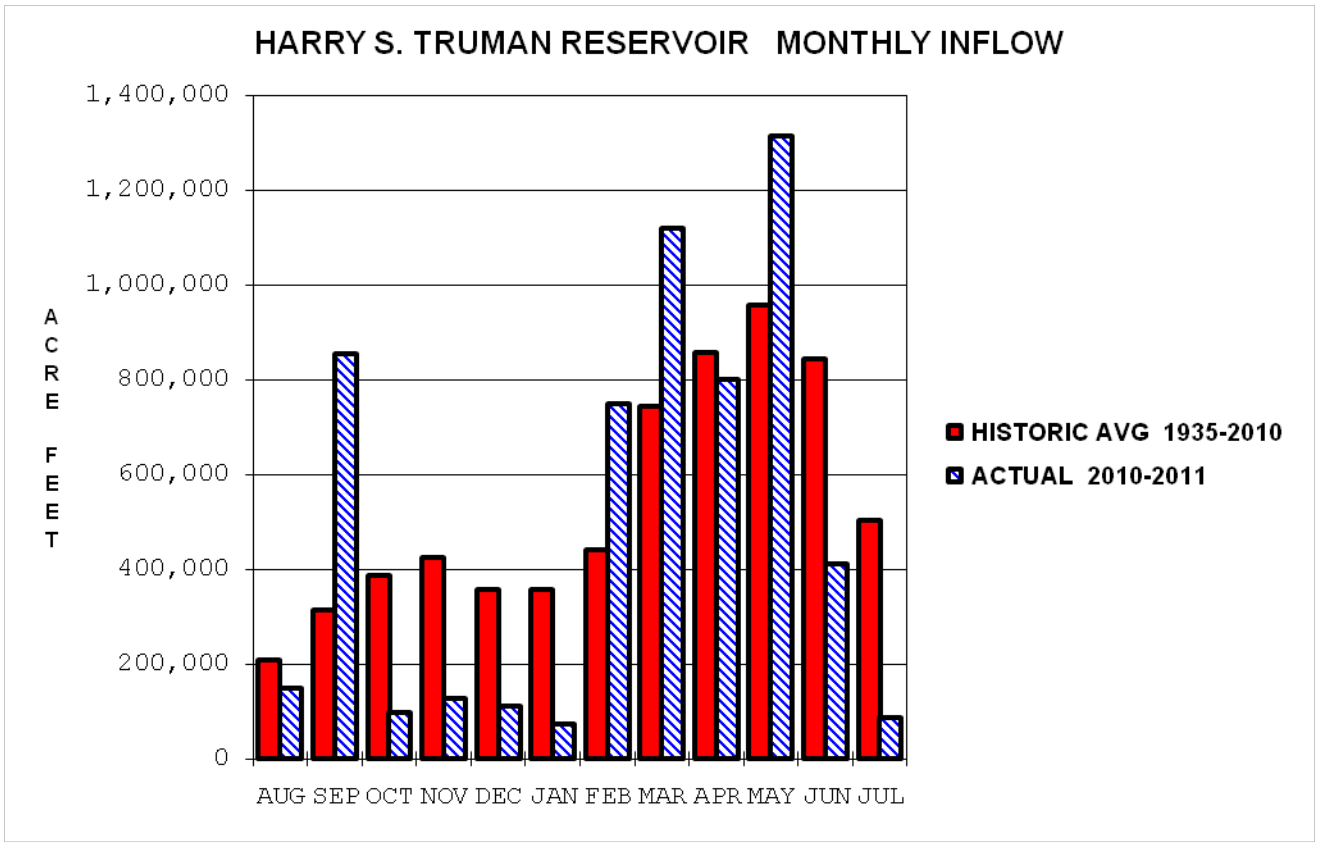
A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

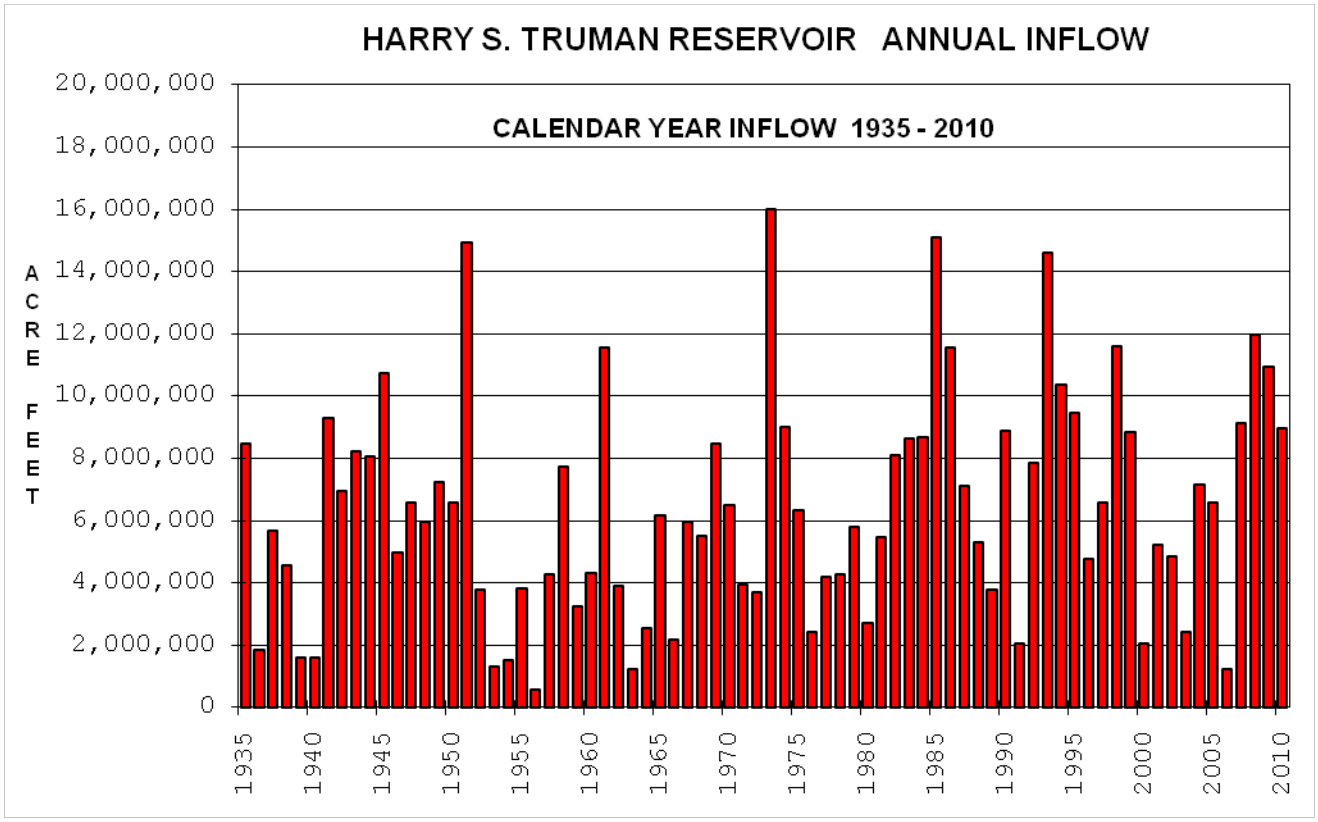




Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
707.47 1 Aug 10	**704.61 31 Jul 11**	**717.89 20 May 11**	**704.52 18 Jul 11**	**738.72 12 Oct 86**	**703.42 10 Apr 81**

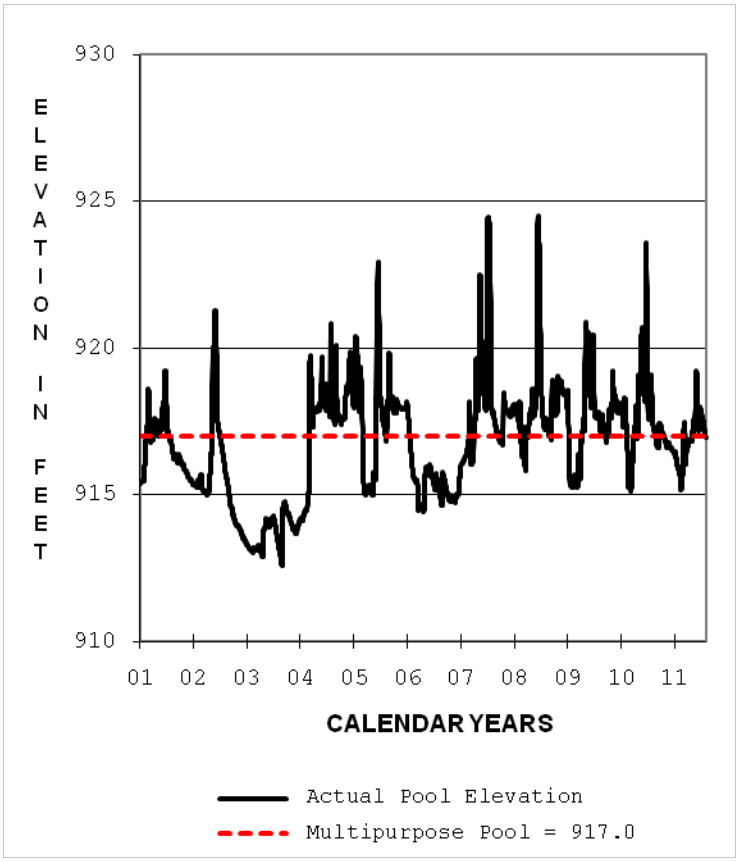
Report Period Inflow and Outflow			
Max Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
69,500 21 May 11	**5,892,559**	**33,350 9 Jun 11**	**0 Many days**
No minimum release requirement.			

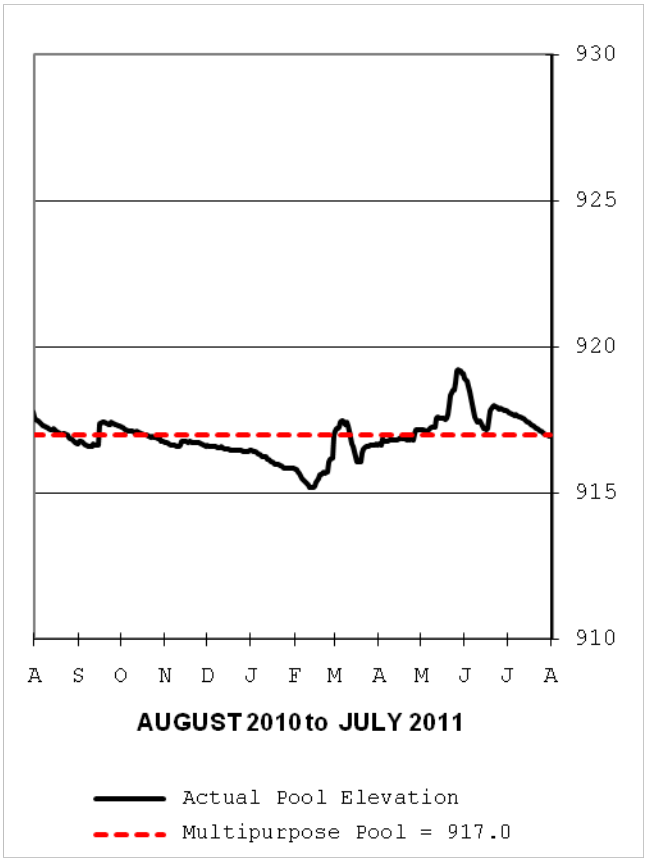

HARRY S. TRUMAN RESERVOIR MONTHLY INFLOW
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
ACRE FEET
AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL
HISTORIC AVG 1935-2010
ACTUAL 2010-2011


HARRY S. TRUMAN RESERVOIR ANNUAL INFLOW
CALENDAR YEAR INFLOW 1935 - 2010
20,000,000
18,000,000
16,000,000
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
ACRE FEET
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

HILLSDALE LAKE
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

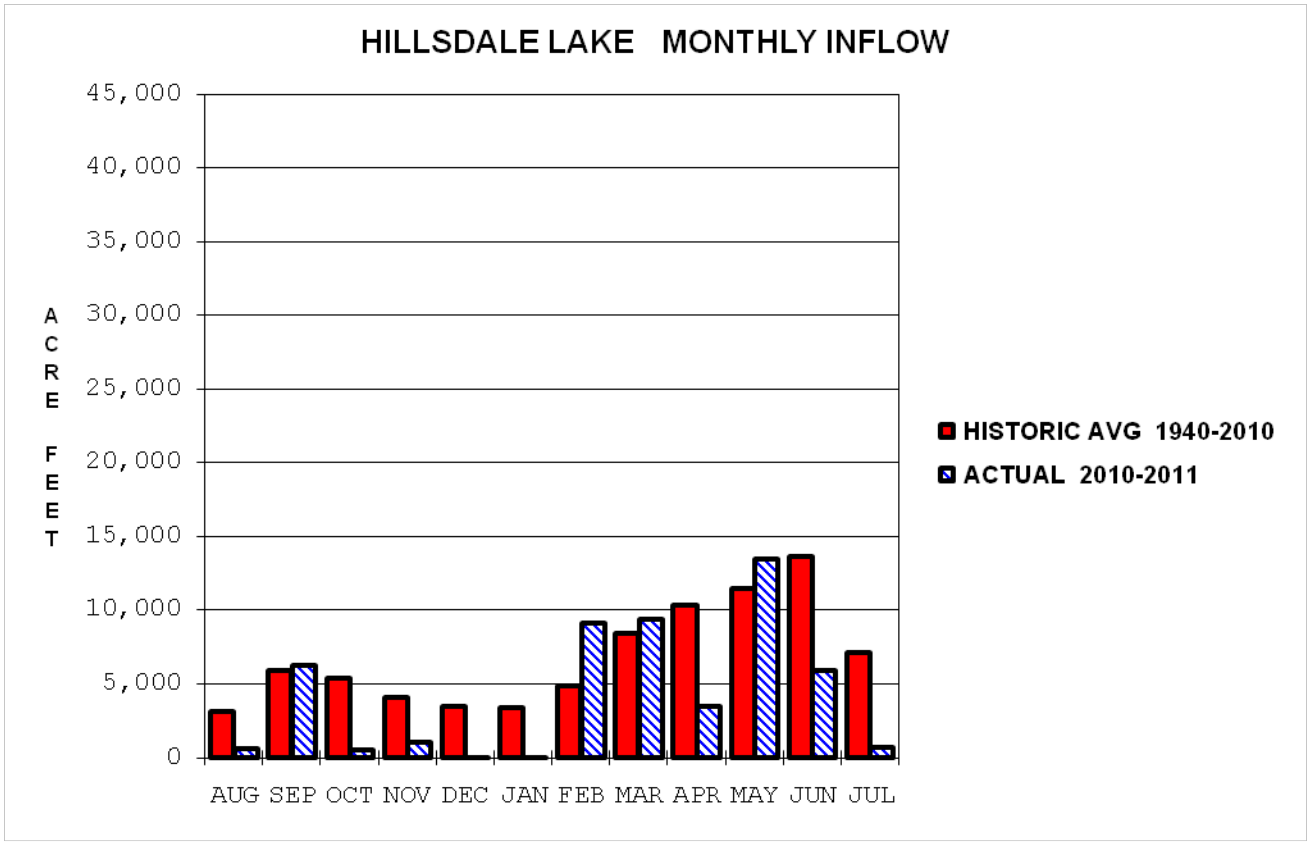


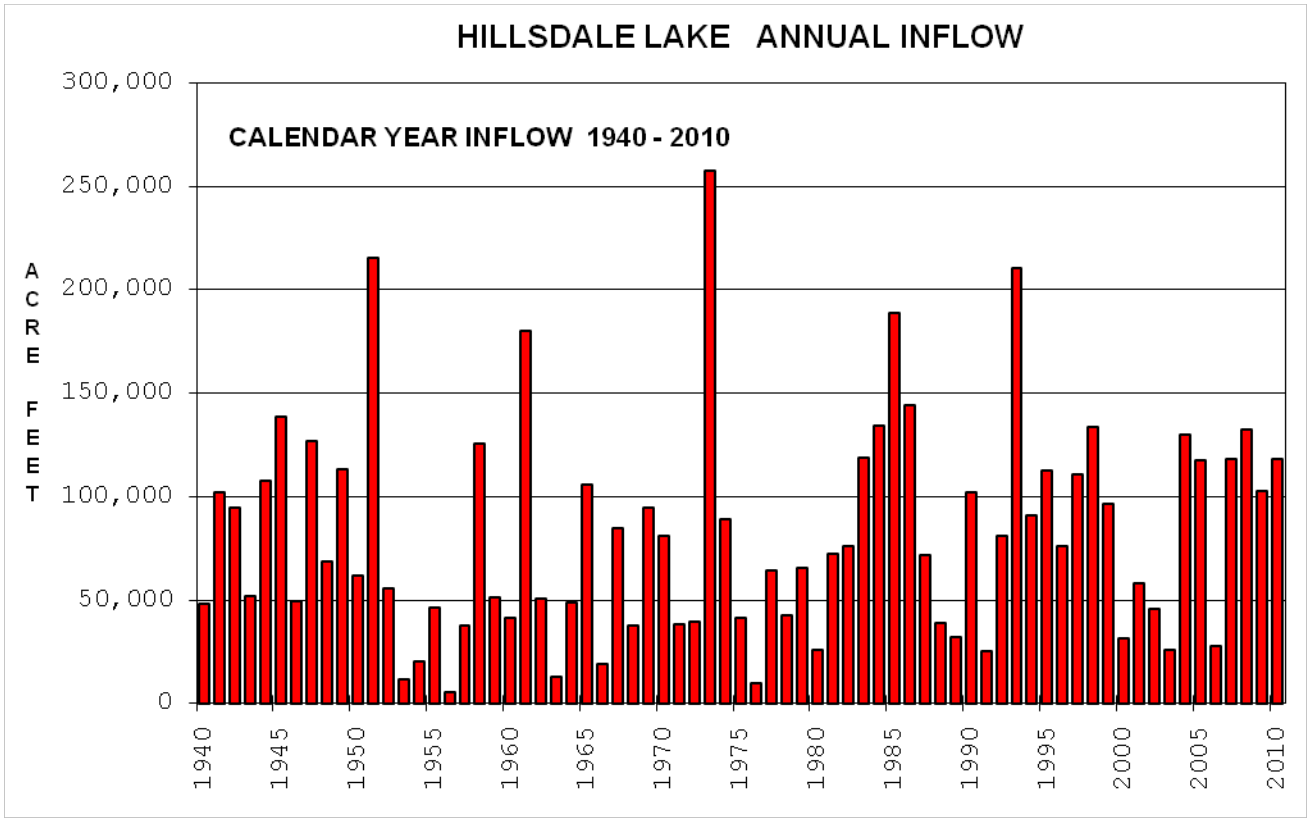


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
917.62 1 Aug 10	**916.94 31 Jul 11**	**919.21 27 May 11**	**915.17 12 Feb 11**	**928.51 21 Oct 86**	**904.97 14-15 Nov 87**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
1,700 28 Feb 11	**50,539**	**500 Many days**	**3 Many days**

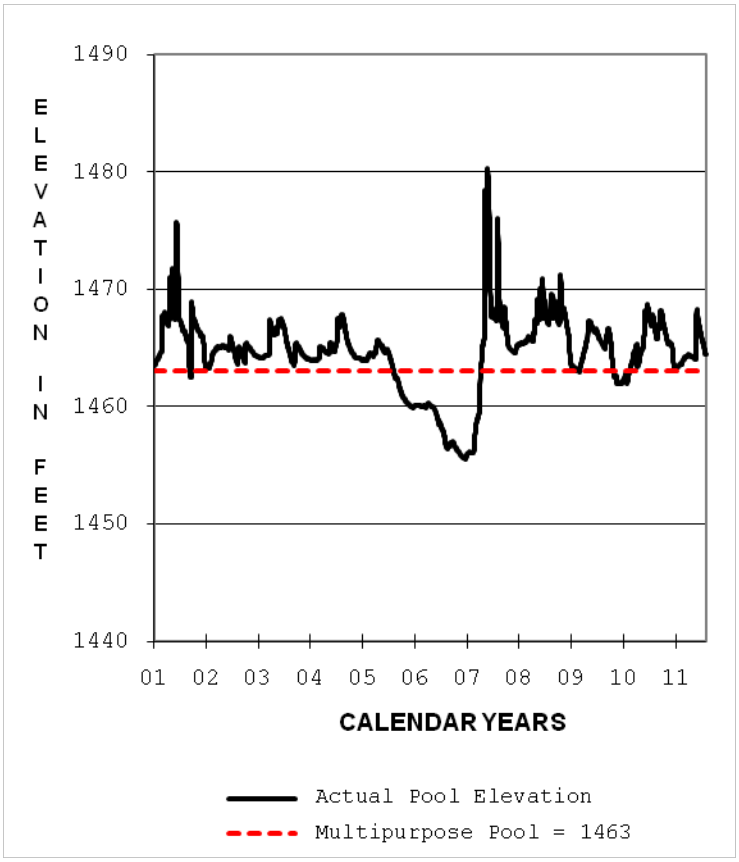
Minimum required release varies seasonally 3 to 24 cfs. Releases cut to 0 for maintenance and inspections.

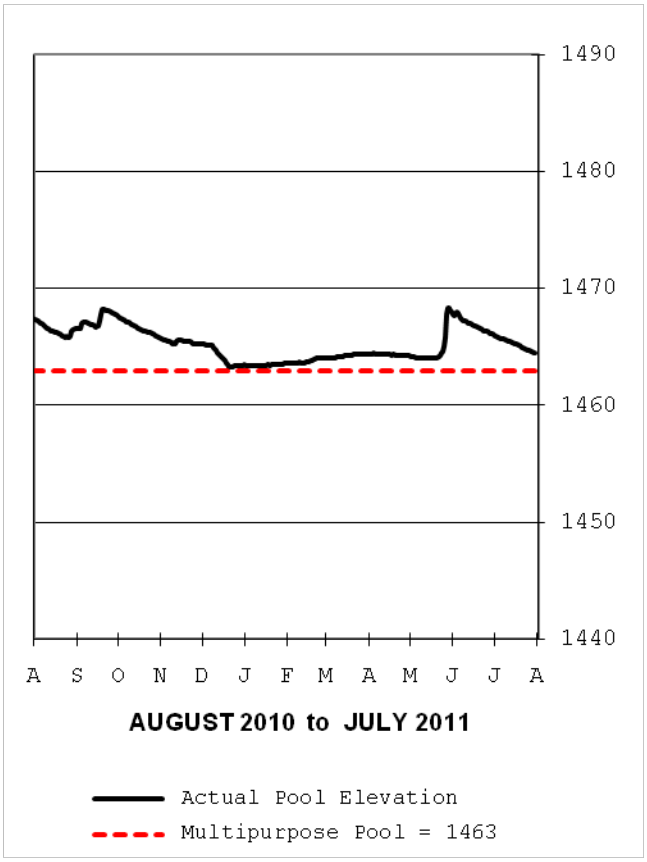

HILLSDALE LAKE MONTHLY INFLOW
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
ACRE FEET
AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL
HISTORIC AVG 1940-2010
ACTUAL 2010-2011


HILLSDALE LAKE ANNUAL INFLOW
CALENDAR YEAR INFLOW 1940 - 2010
300,000
250,000
200,000
150,000
100,000
50,000
0
ACRE FEET
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

KANOPOLIS LAKE
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

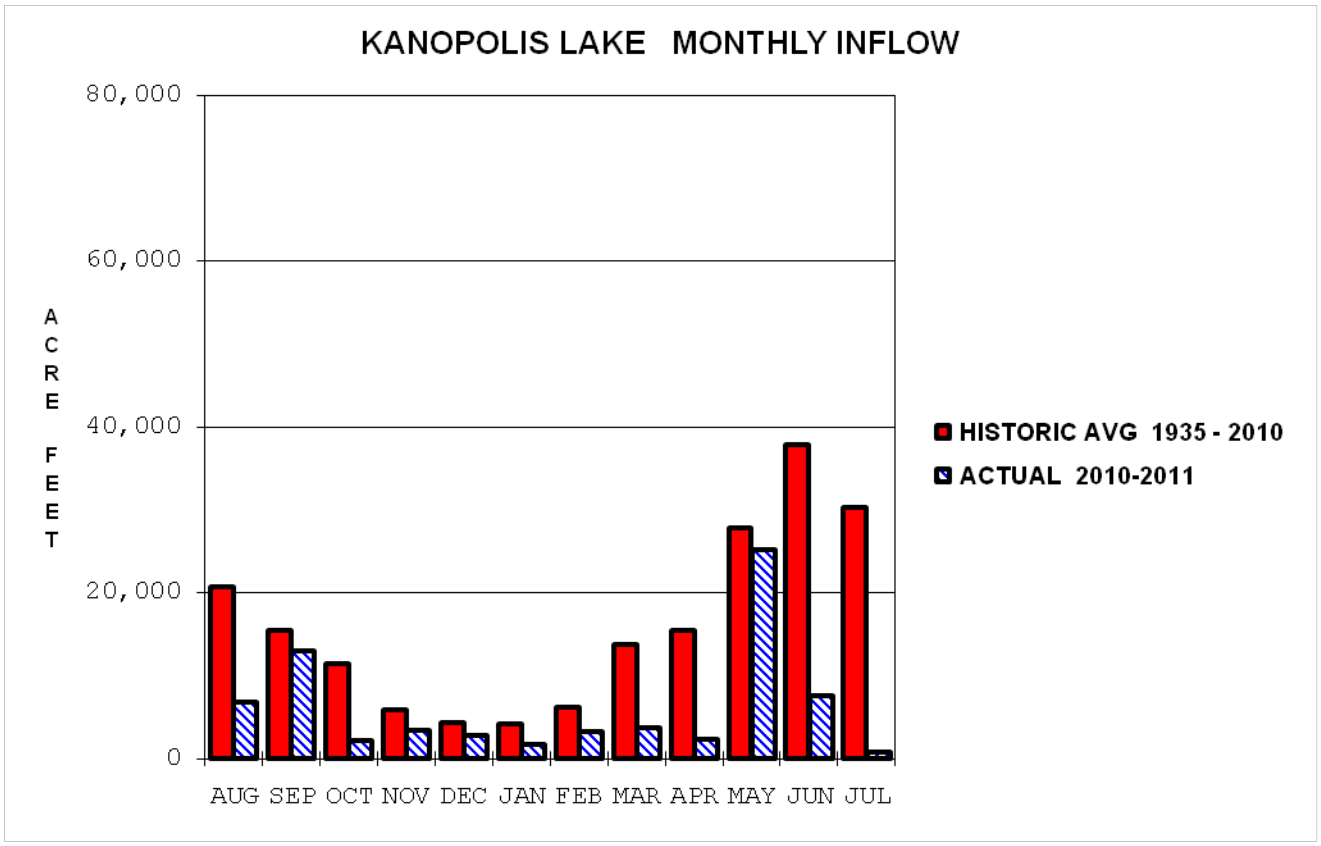


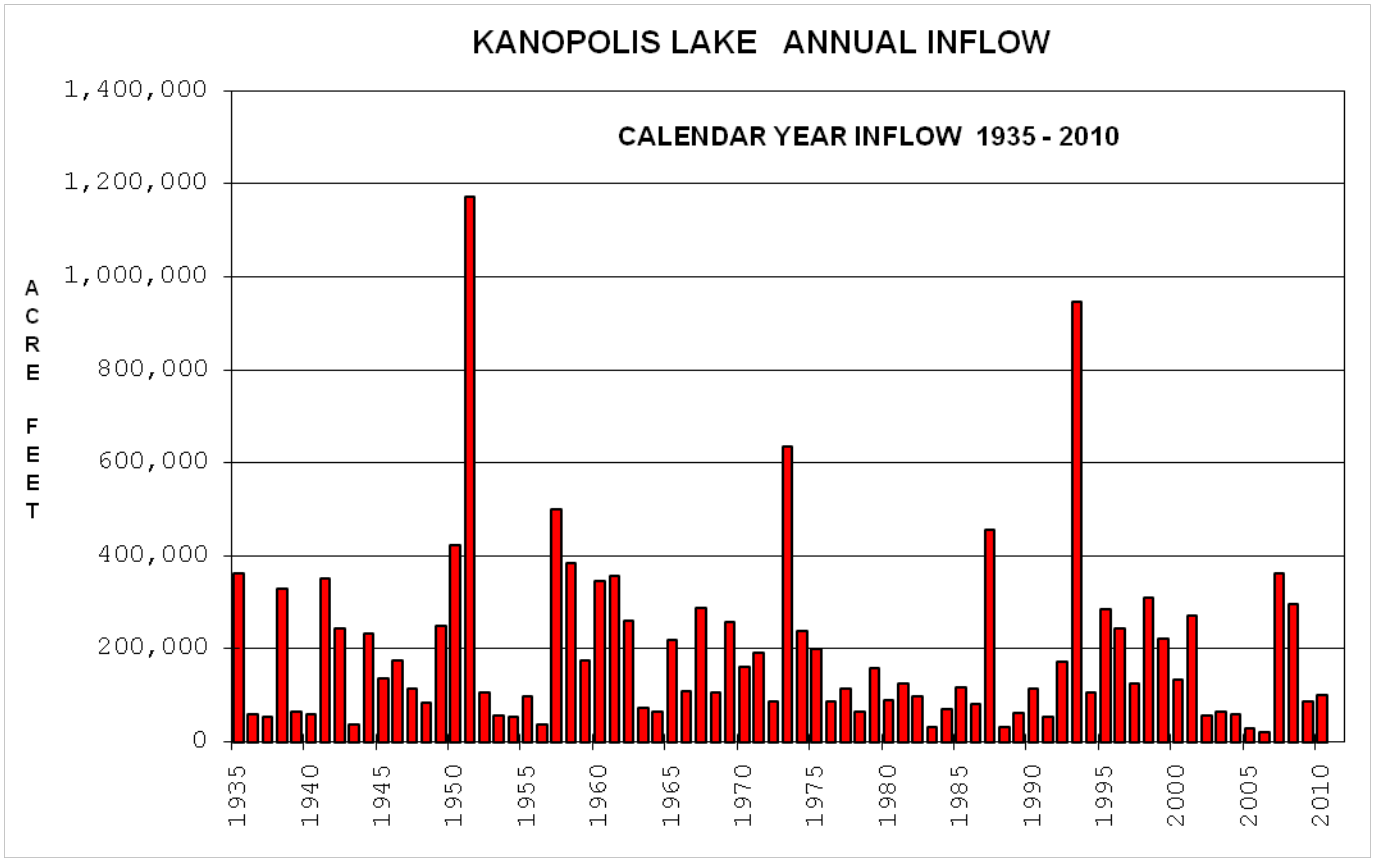


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1467.3 1 Aug 10	**1464.5 31 Jul 11**	**1468.3 28 May 11**	**1463.3 20 Dec 10**	**1506.98 14 Jul 51**	**1452.55 11 Dec 88**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
4,000 27 May 11	**76,635**	**677 29 May 11**	**0 Many days**

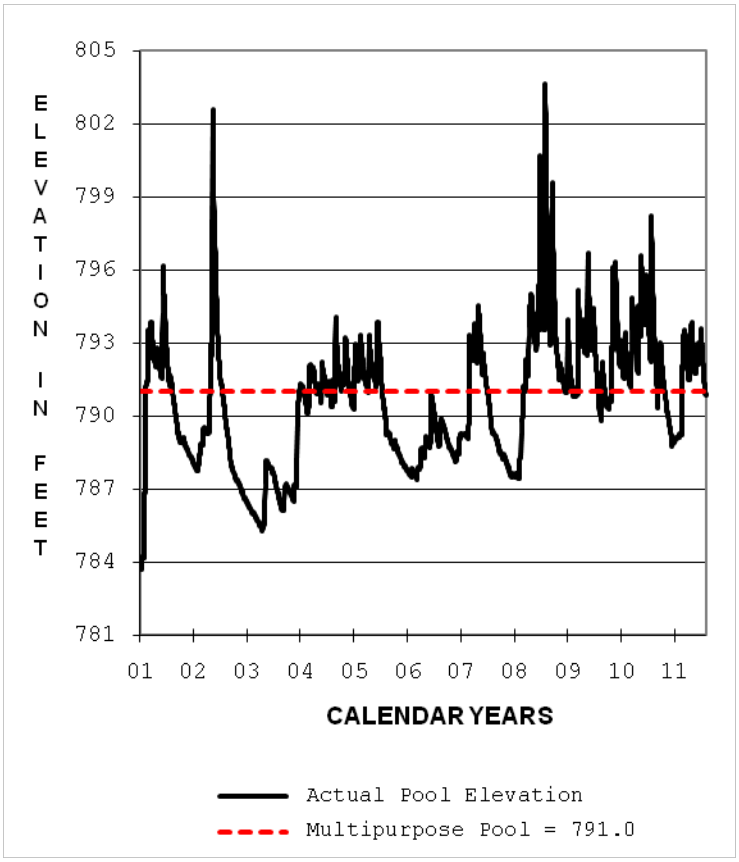
Outflows are total from the gates and the uncontrolled notch. Minimum release varies seasonally 10 to 50 cfs.

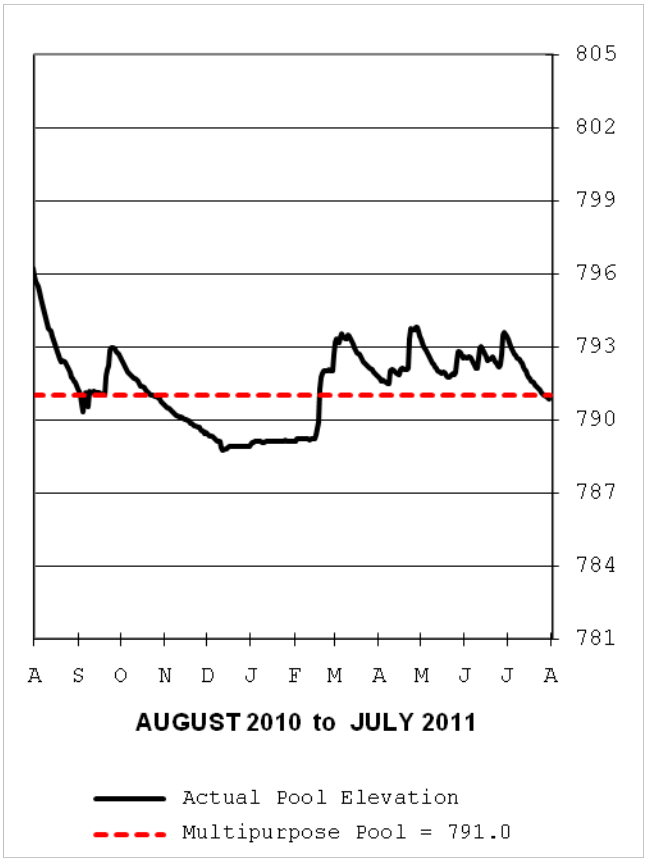

KANOPOLIS LAKE MONTHLY INFLOW
80,000
60,000
40,000
20,000
0
ACRE FEET
AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL
HISTORIC AVG 1935 - 2010
ACTUAL 2010-2011


KANOPOLIS LAKE ANNUAL INFLOW
CALENDAR YEAR INFLOW 1935 - 2010
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
ACRE FEET
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

LONG BRANCH LAKE
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

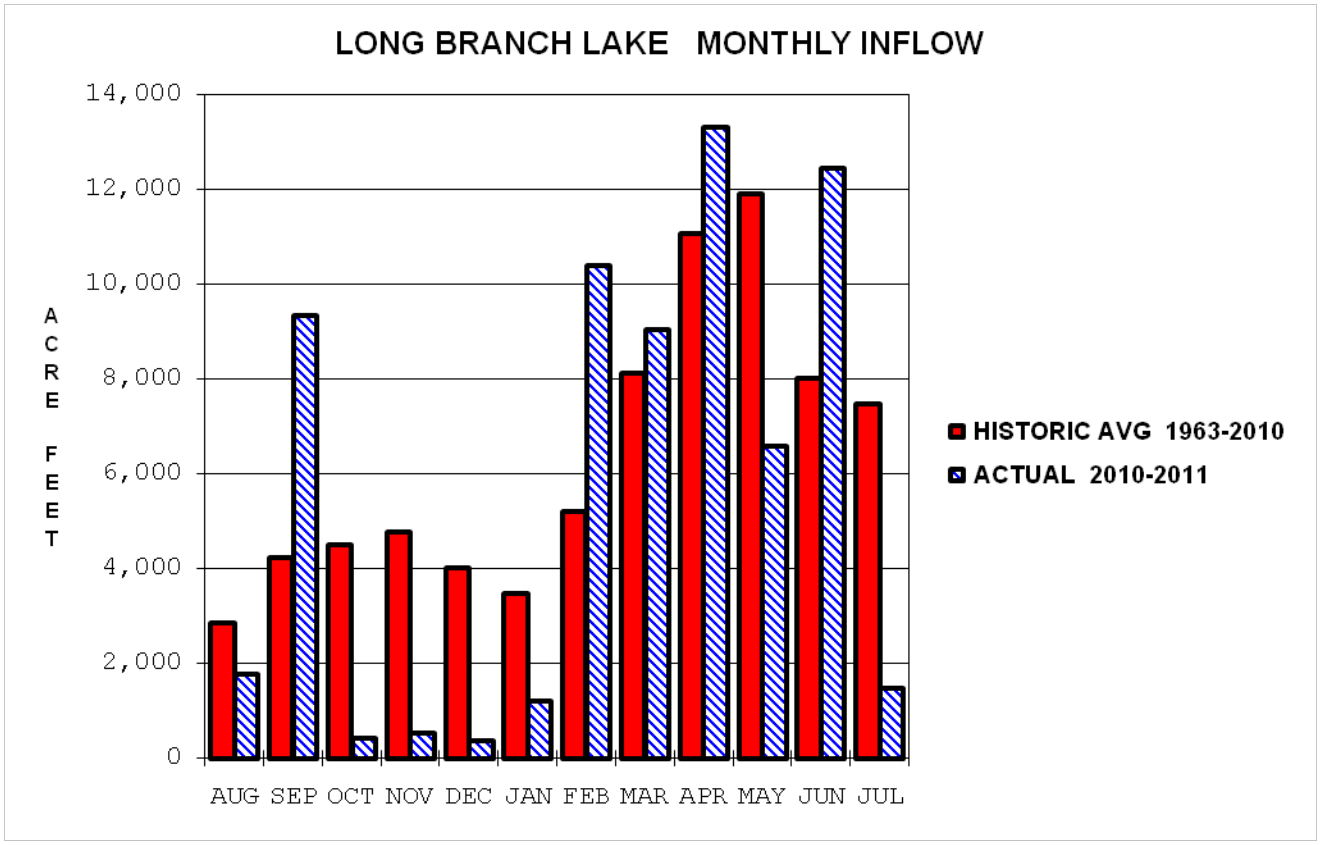


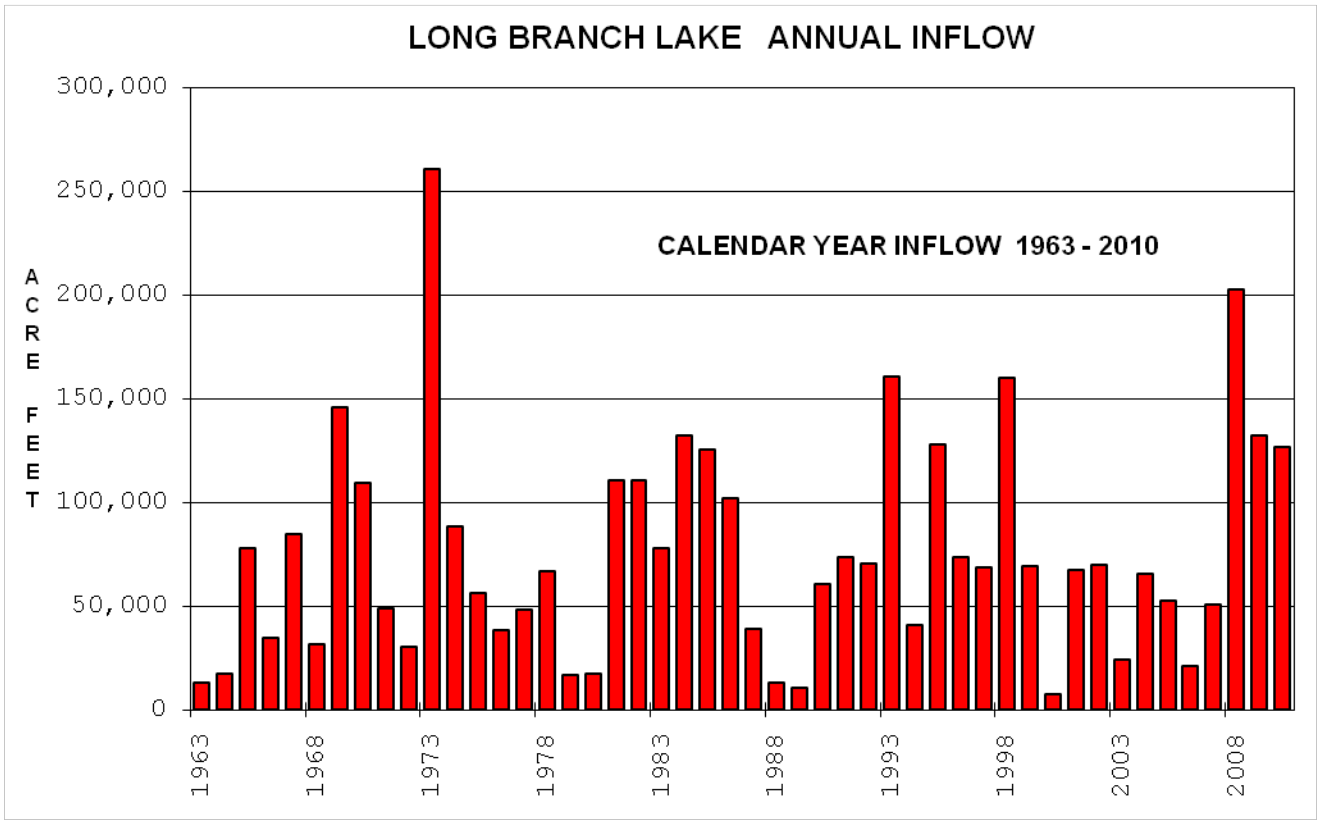


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
795.93 1 Aug 10	**790.9 31 Jul 11**	**795.93 1 Aug 10**	**782.53 15 Dec 10**	**803.64 30 Jul 08**	**783.70 12 Jan 01**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
1,800 23 Apr 11	**66,869**	**480 1 Aug 10**	**10 25 Dec 10**

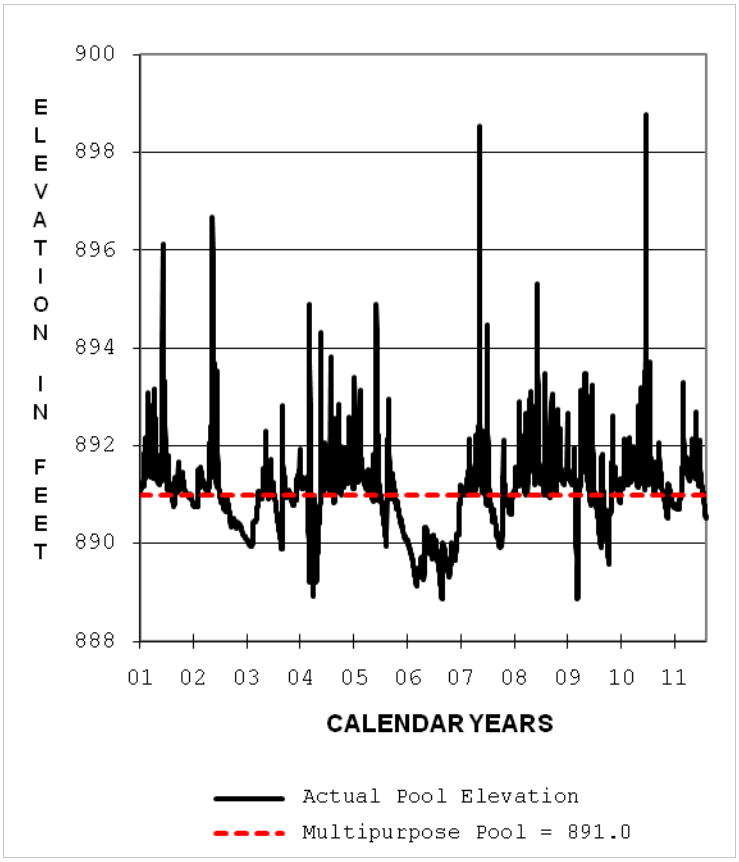
Listed outflows are total to the river from the gates and the uncontrolled notch. Min req release is normally 7 cfs.

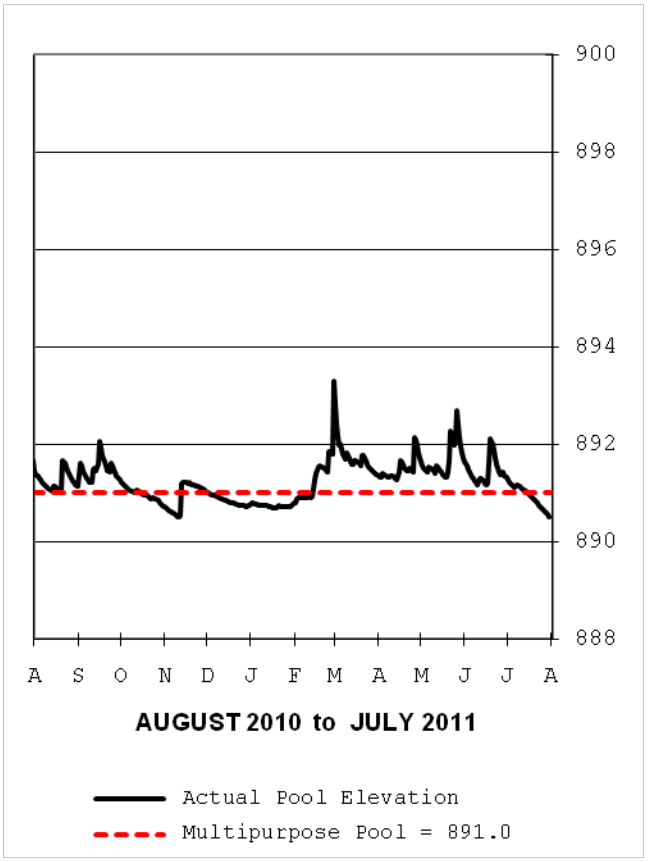

LONG BRANCH LAKE MONTHLY INFLOW
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
ACRE FEET
AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL
HISTORIC AVG 1963-2010
ACTUAL 2010-2011


LONG BRANCH LAKE ANNUAL INFLOW
300,000
250,000
200,000
150,000
100,000
50,000
0
ACRE FEET
CALENDAR YEAR INFLOW 1963 - 2010
1963
1968
1973
1978
1983
1988
1993
1998
2003
2008

LONGVIEW LAKE
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

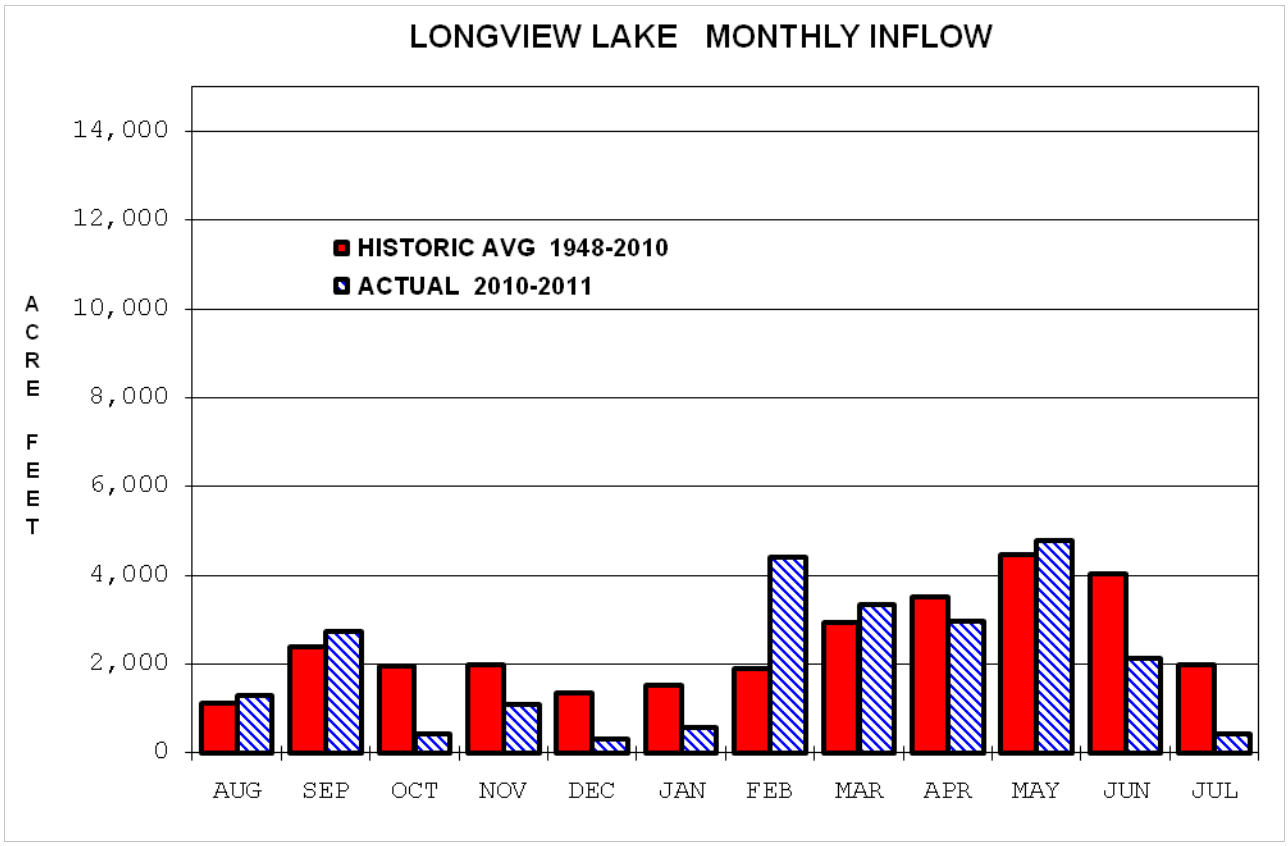


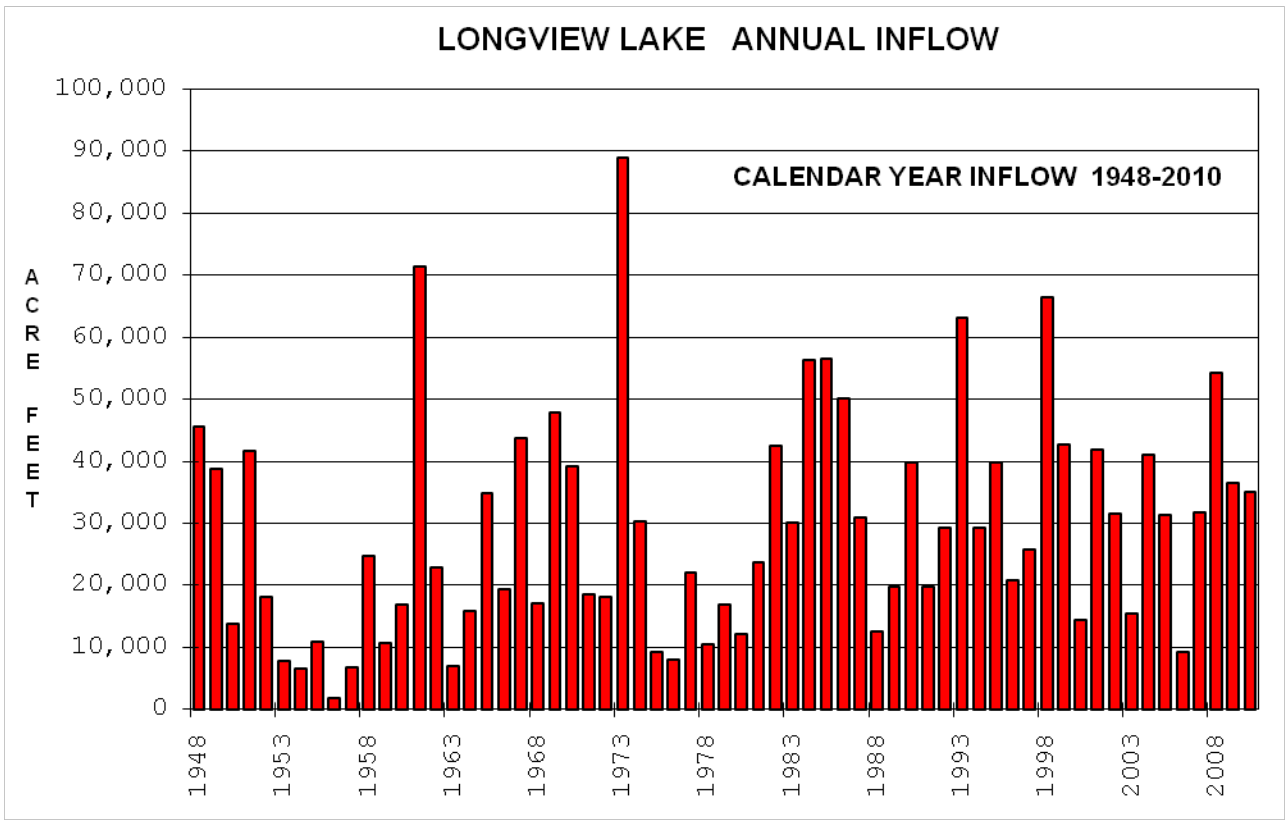


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
891.47 1 Aug 10	**890.58 31 Jul 11**	**893.3 28 Feb 11**	**890.51 11 Nov 10**	**903.37 16 May 90**	**888.08 14 Sep 88**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
1,075 28 Feb 11	**24,569**	**415 1 Mar 11**	**8 Many Days**

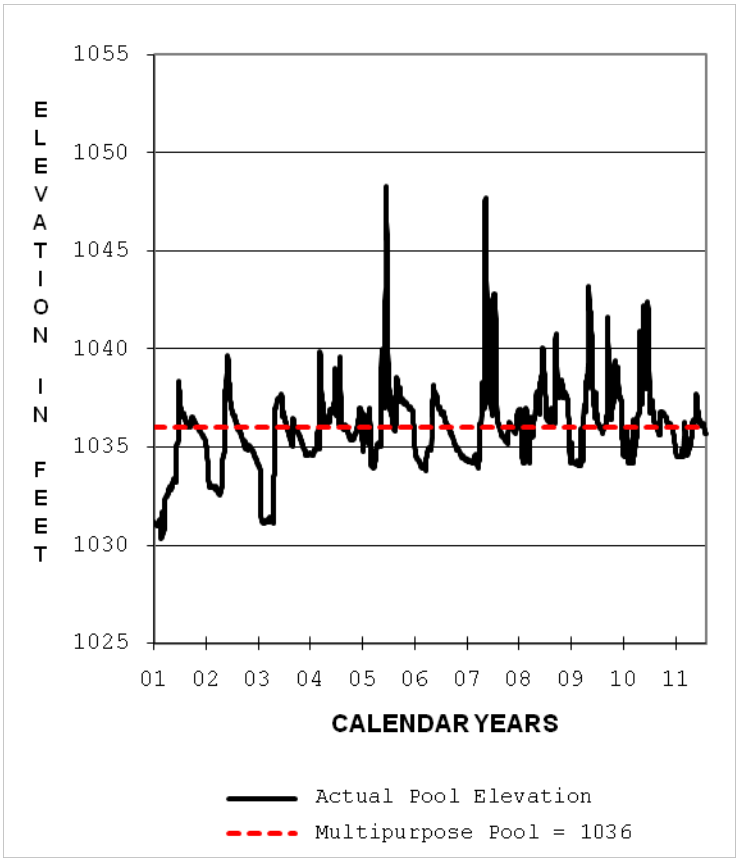
Listed outflows are total to the river from the gate and the uncontrolled notch. Minimum required release is 8 cfs.

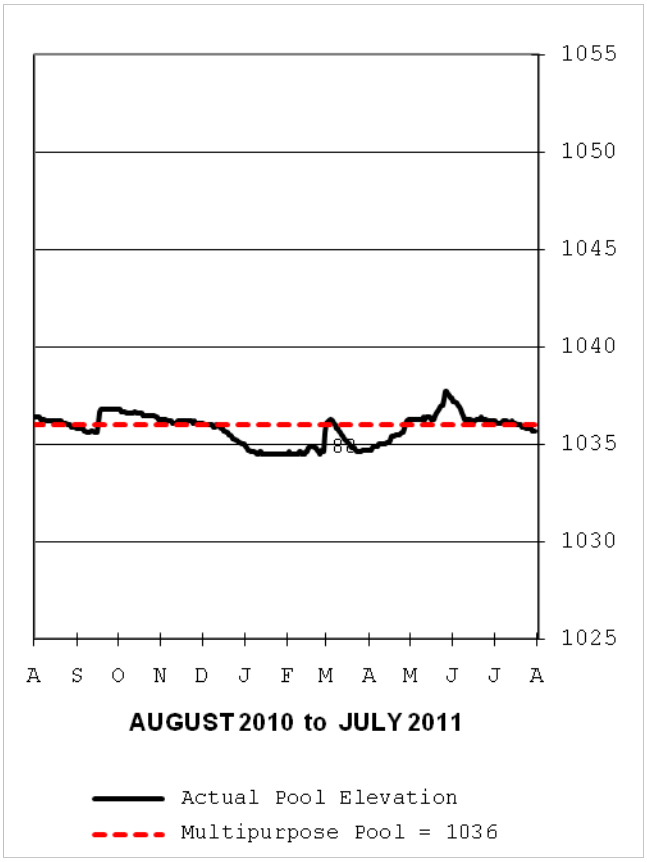

LONGVIEW LAKE MONTHLY INFLOW
ACRE FEET
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
HISTORIC AVG 1948-2010
ACTUAL 2010-2011
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL


LONGVIEW LAKE ANNUAL INFLOW
ACRE FEET
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
CALENDAR YEAR INFLOW 1948-2010
1948
1953
1958
1963
1968
1973
1978
1983
1988
1993
1998
2003
2008

MELVERN LAKE
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

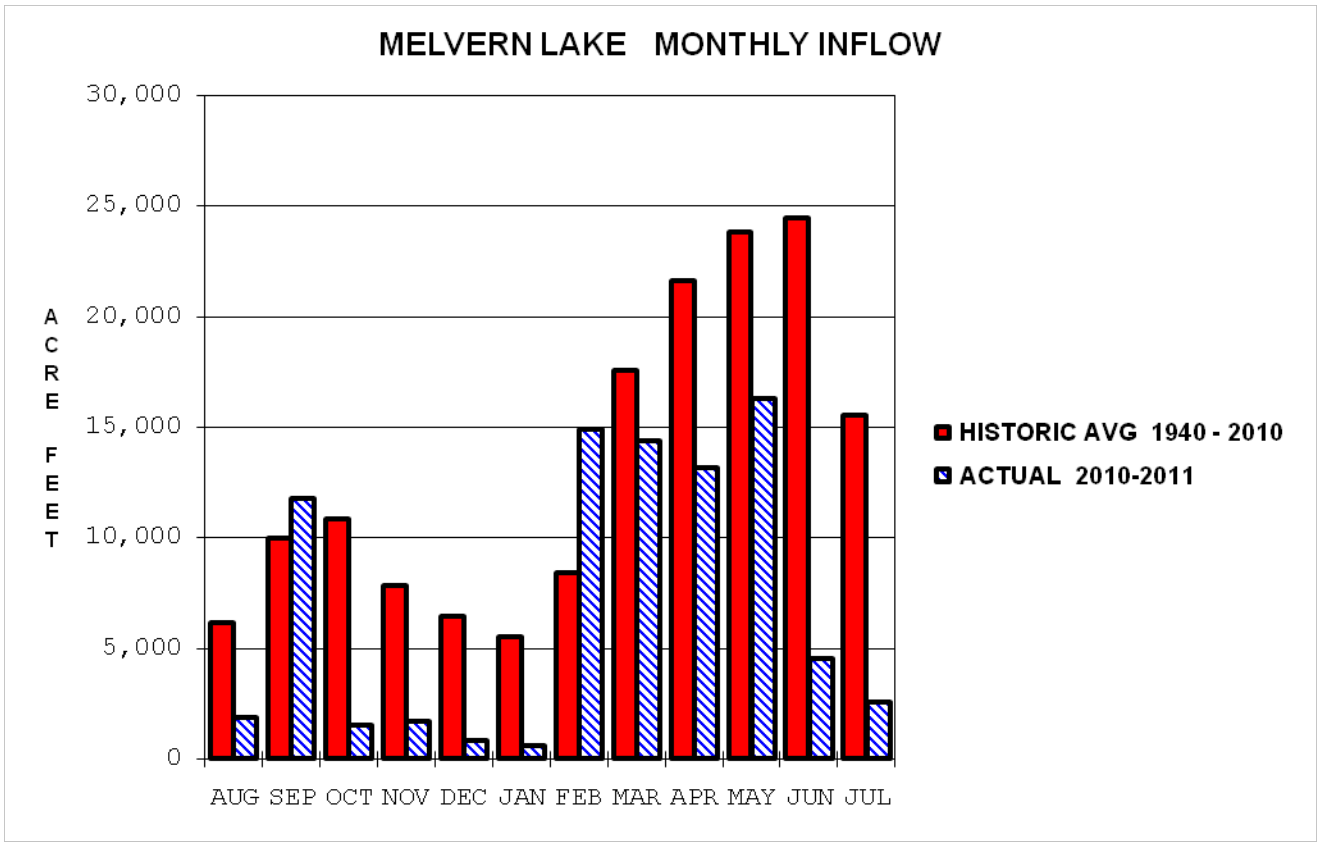


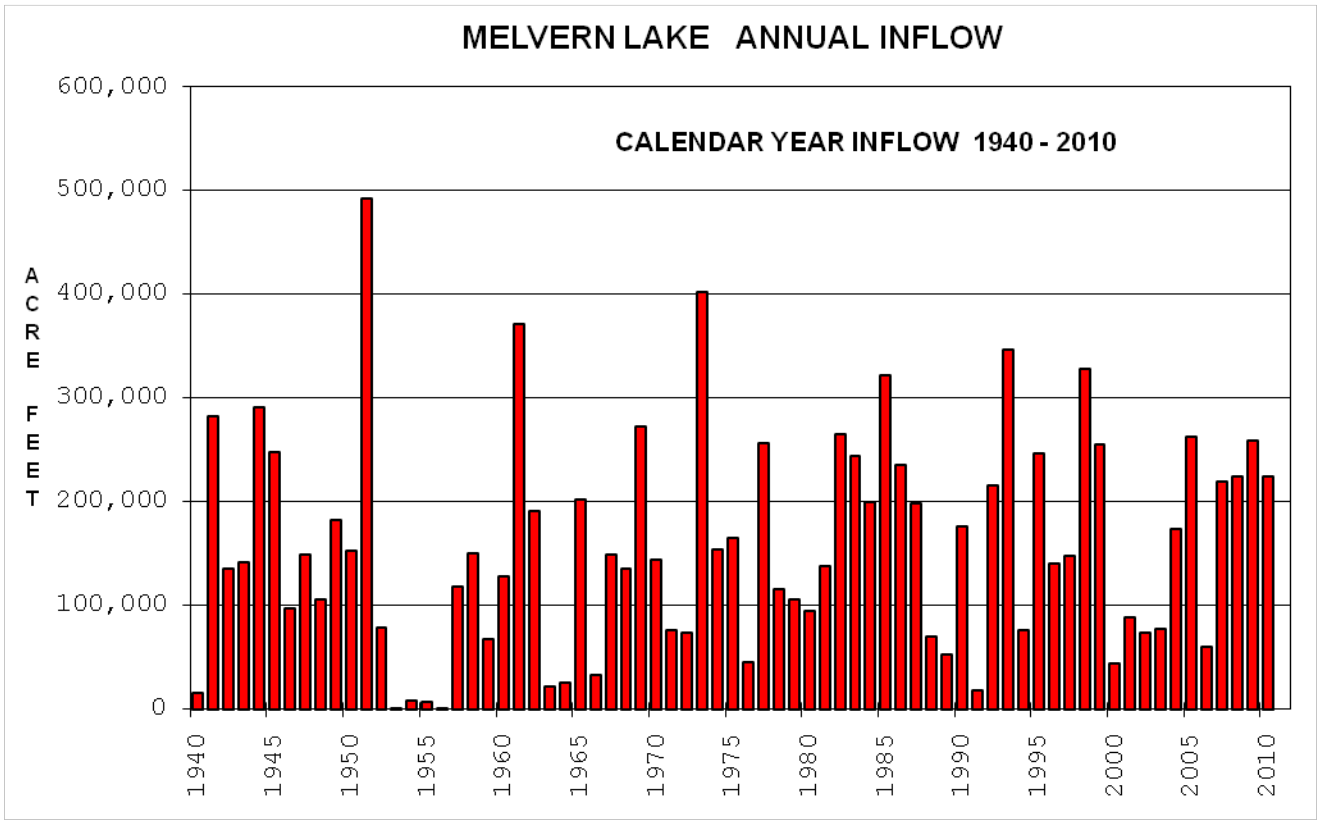


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1036.4 1 Aug 10	**1035.7 31 Jul 11**	**1037.7 26 May 11**	**1034.5 9 Jan 11**	**1053.45 13 Jun 95**	**1029.87 11 Feb 92**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
2,000 28 Feb 11	**83,600**	**500 Many days**	**20 Many days**

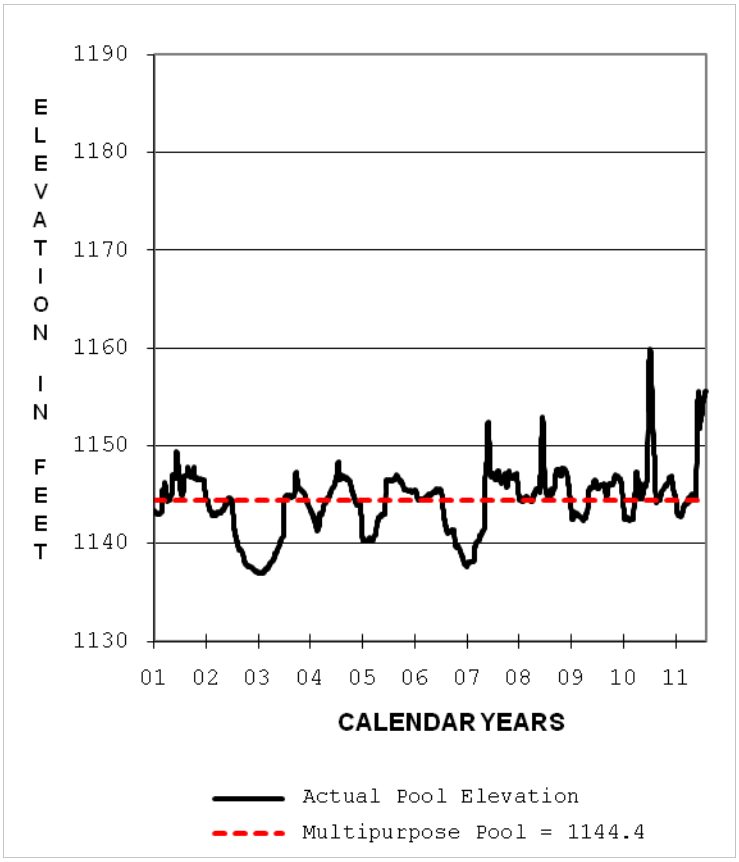
Minimum required release is 20 cfs. Releases reduced to 0 for maintenance and inspection periods.

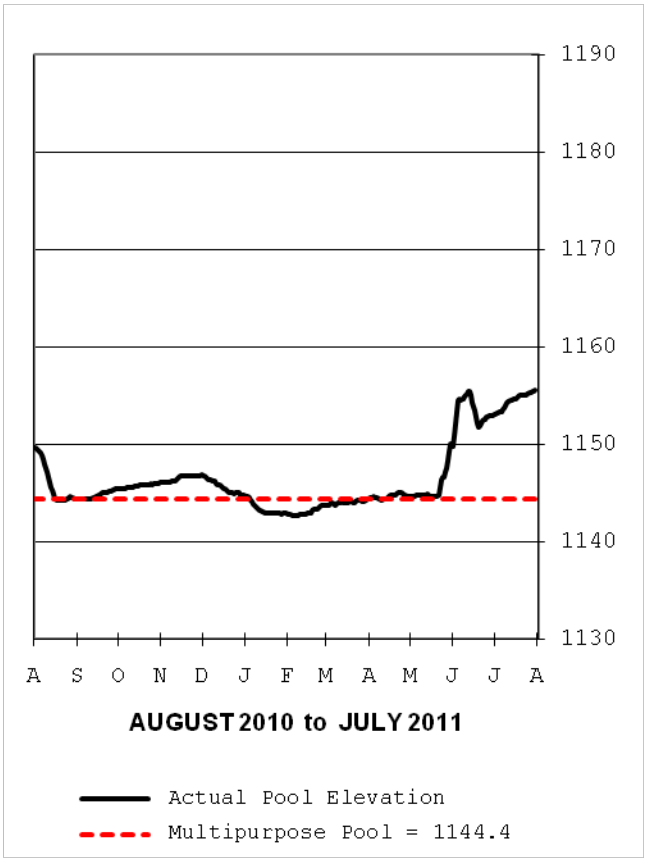

MELVERN LAKE MONTHLY INFLOW
30,000
25,000
20,000
15,000
10,000
5,000
0
ACRE FEET
AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL
HISTORIC AVG 1940 - 2010
ACTUAL 2010-2011


MELVERN LAKE ANNUAL INFLOW
CALENDAR YEAR INFLOW 1940 - 2010
600,000
500,000
400,000
300,000
200,000
100,000
0
ACRE FEET
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

MILFORD LAKE
2010 - 2011 REGULATION

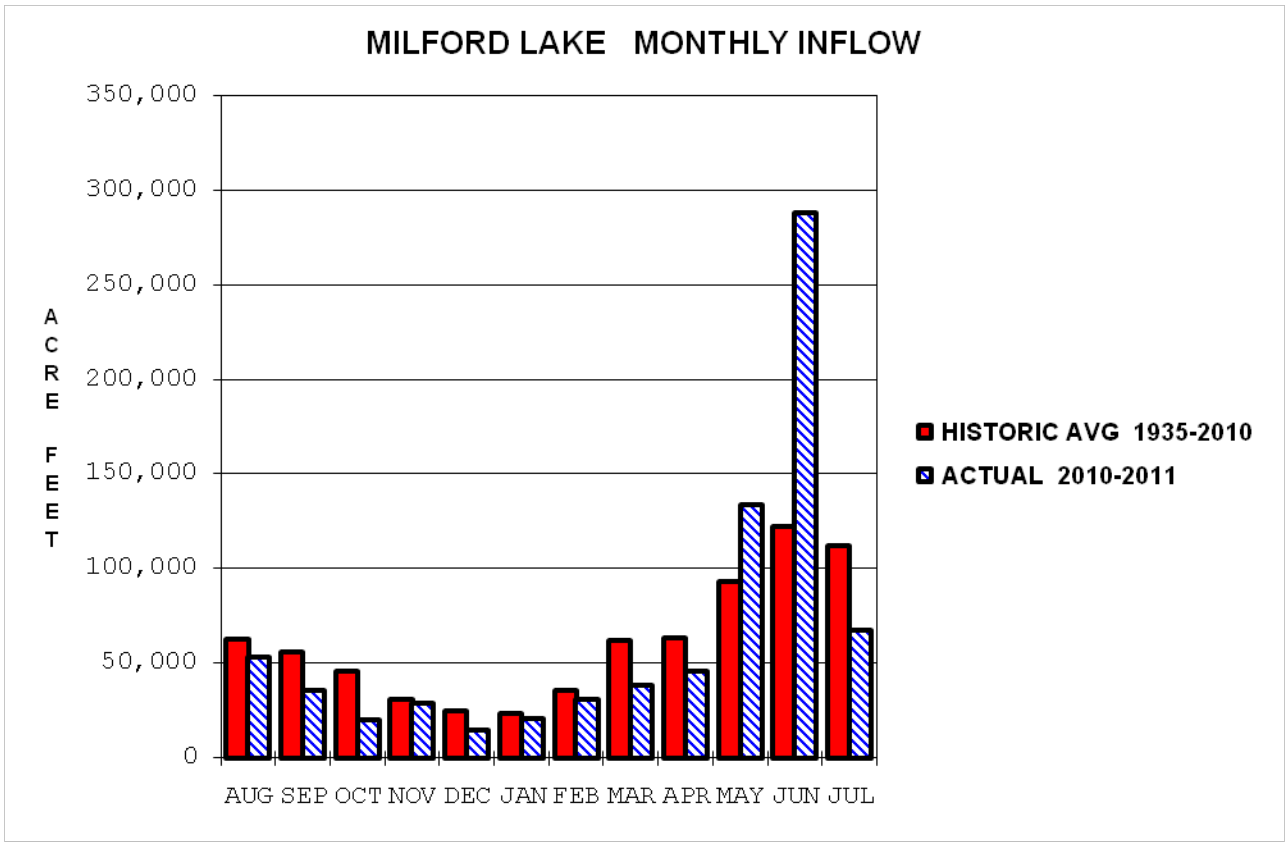
A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

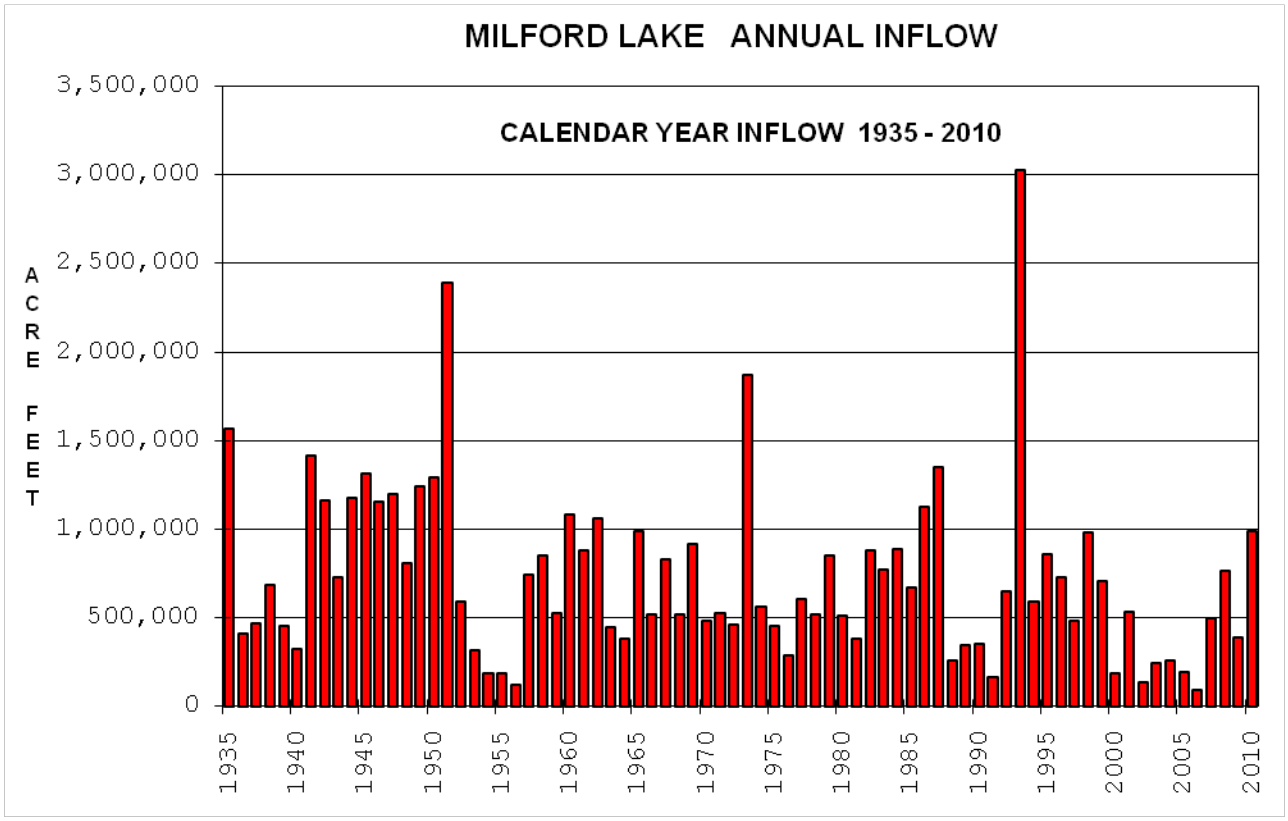




Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1149.7 1 Aug 10	**1155.6 31 Jul 11**	**1155.6 31 Jul 11**	**1142.7 4 Feb 11**	**1181.94 25 Jul 93**	**1136.89 12-13 Jan 03**

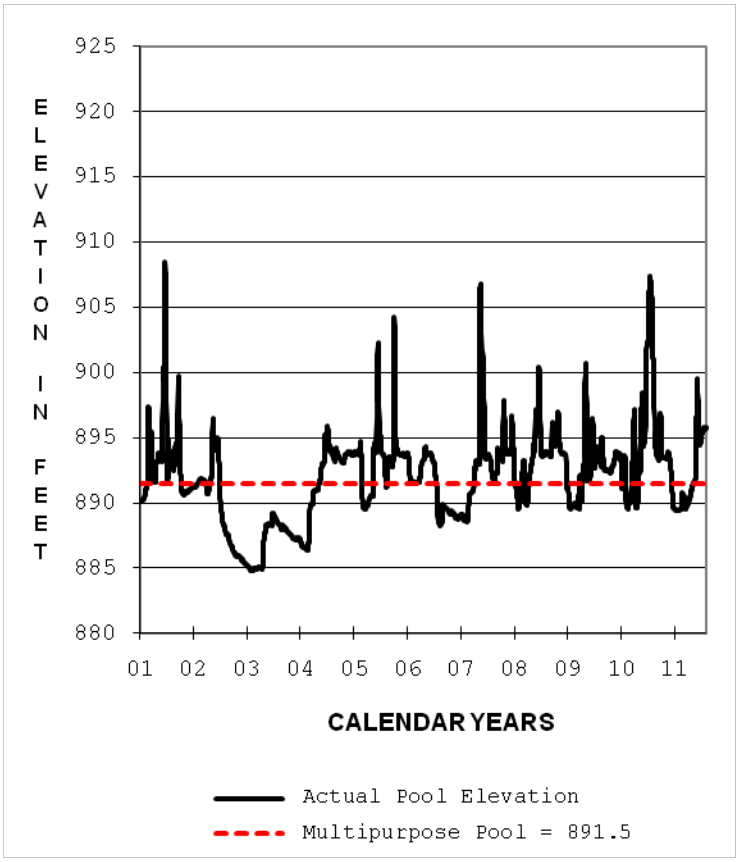
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
32,800 3 Jun 11	**778,186**	**9,000 3 Jun 11**	**25 Many days**
Minimum required release is 25 cfs.			

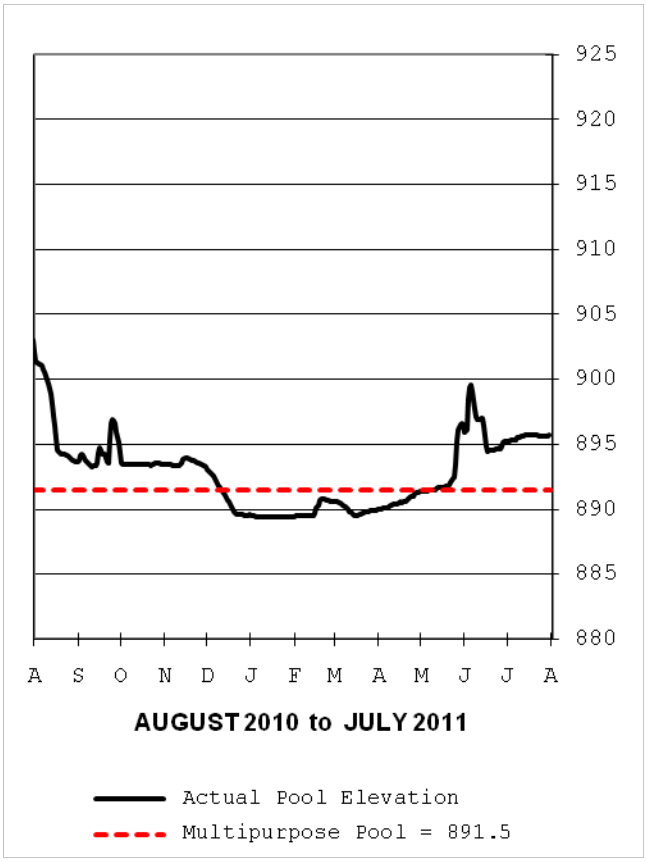

MILFORD LAKE MONTHLY INFLOW
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
ACRE FEET
AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL
HISTORIC AVG 1935-2010
ACTUAL 2010-2011


MILFORD LAKE ANNUAL INFLOW
CALENDAR YEAR INFLOW 1935 - 2010
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
ACRE FEET
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

PERRY LAKE
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

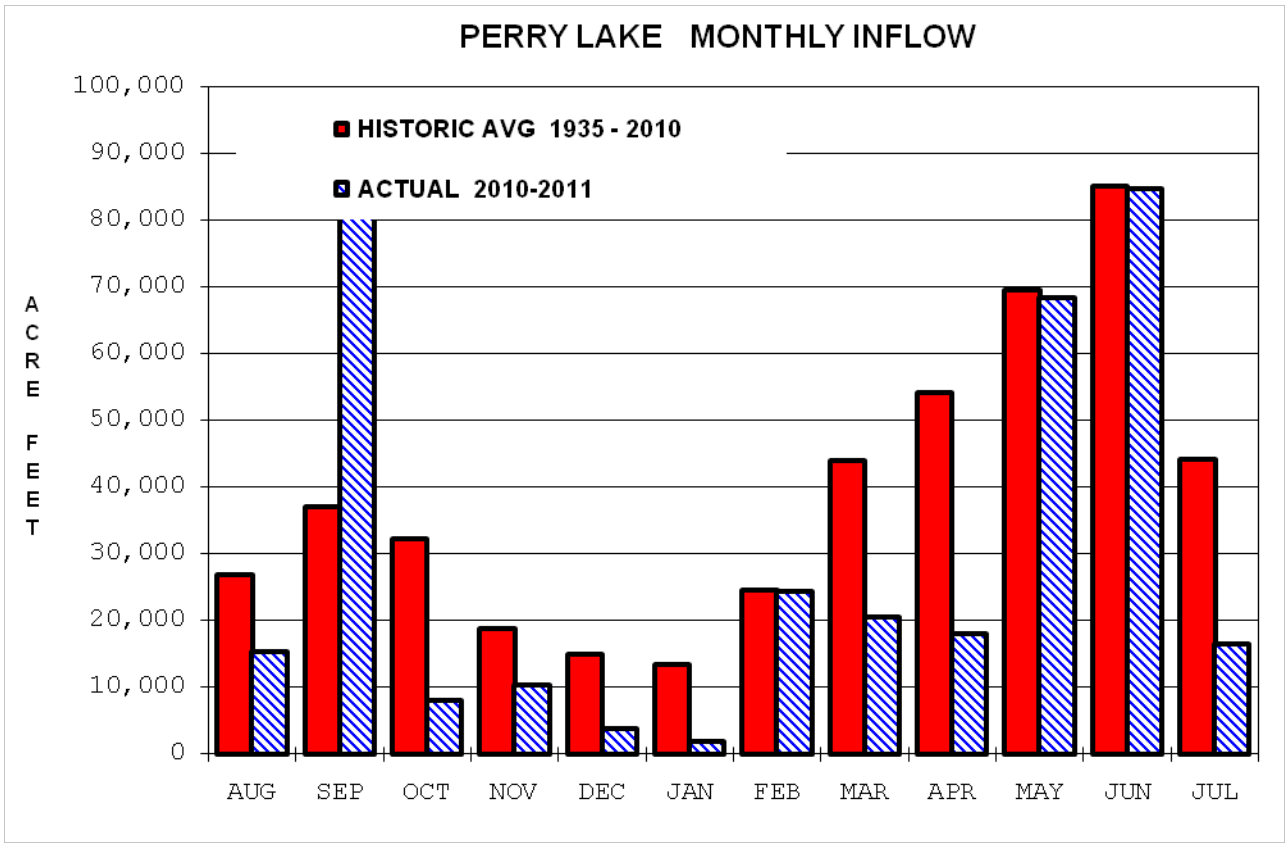


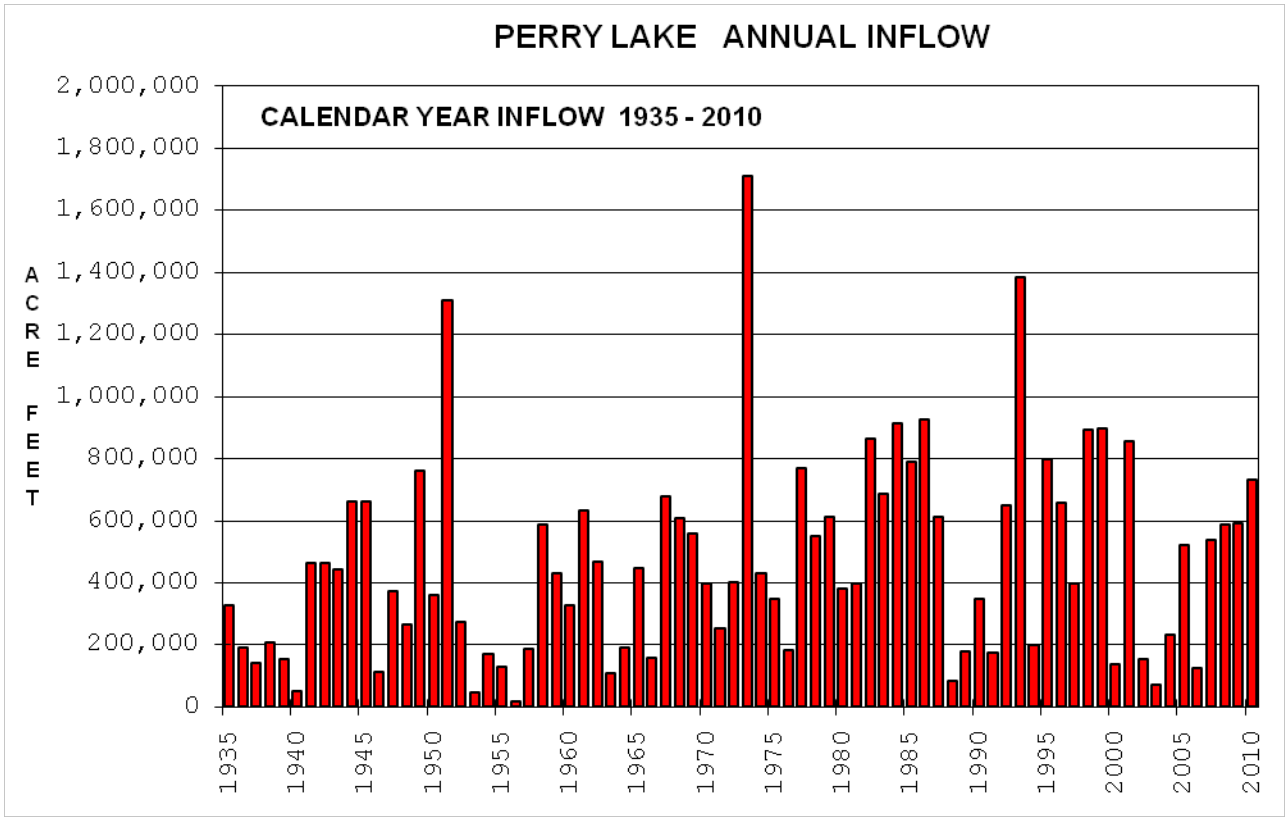


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
902.13 1 Aug 10	**895.8 31 Jul 11**	**902.13 1 Aug 10**	**889.38 17 Jan 11**	**920.85 25 Jul 93**	**884.77 30 Jan 03**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
16,400 3 Jun 11	**363,360**	**8,000 1 Aug 10**	**25 Many days**

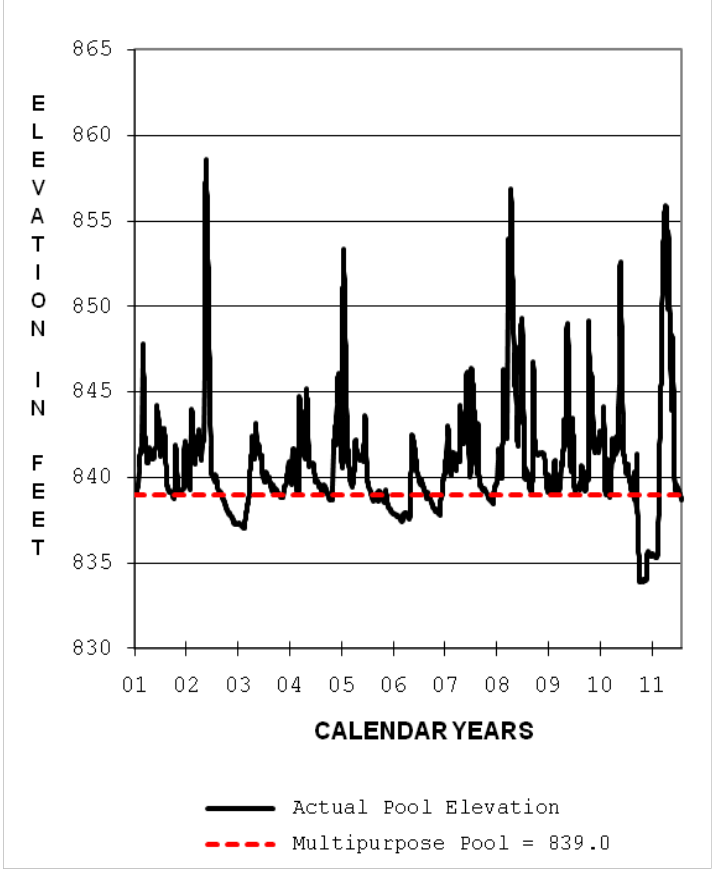
Minimum required release is 25 cfs. Releases reduced to 0 for maintenance and inspection periods.

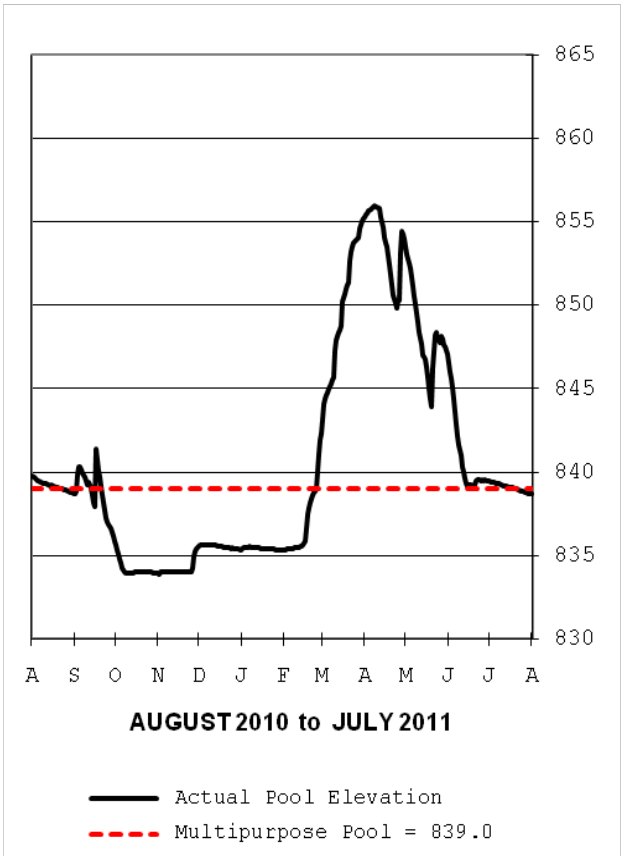

PERRY LAKE MONTHLY INFLOW
HISTORIC AVG 1935 - 2010
ACTUAL 2010-2011
ACRE FEET
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL


PERRY LAKE ANNUAL INFLOW
CALENDAR YEAR INFLOW 1935 - 2010
ACRE FEET
2,000,000
1,800,000
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

POMME DE TERRE LAKE
2010 - 2011 REGULATION

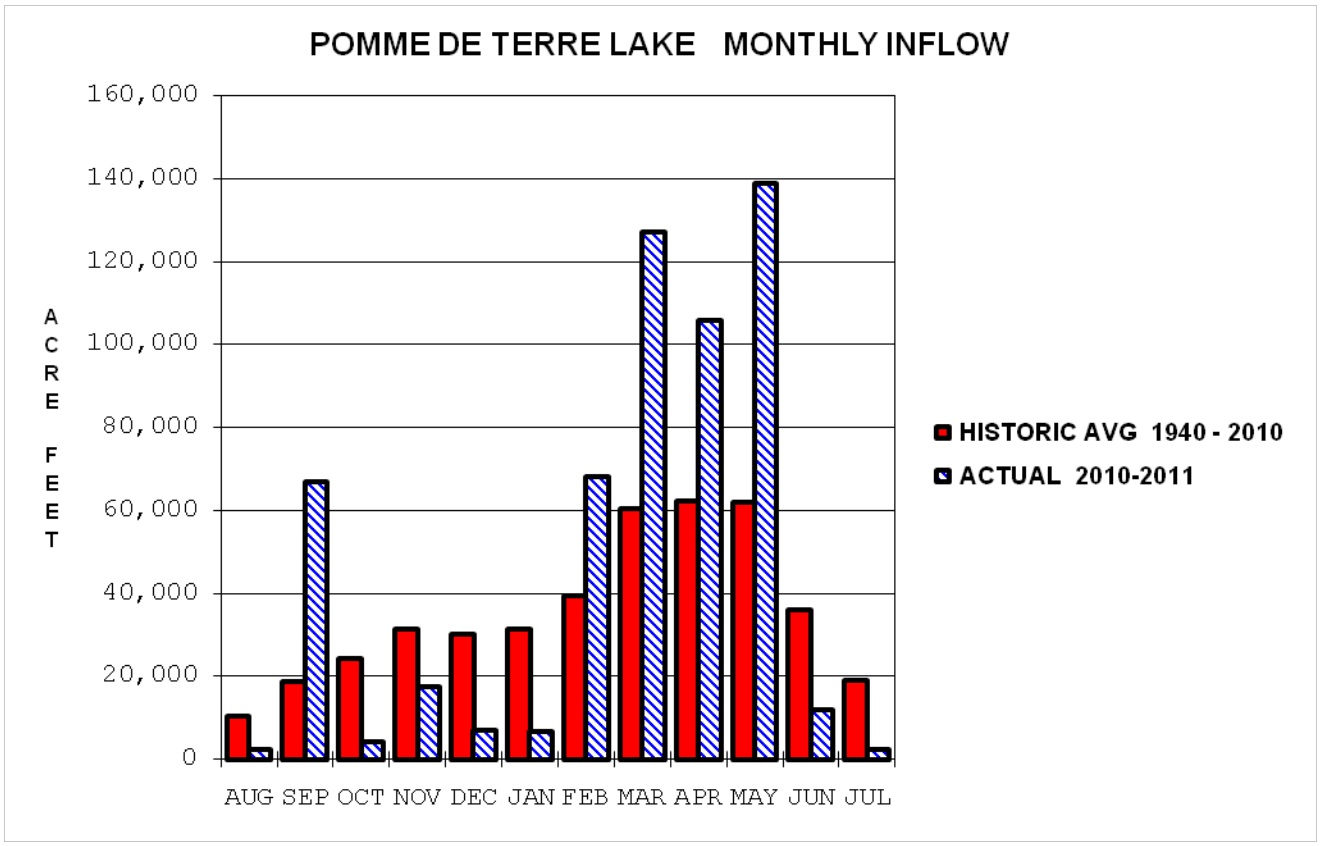
A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

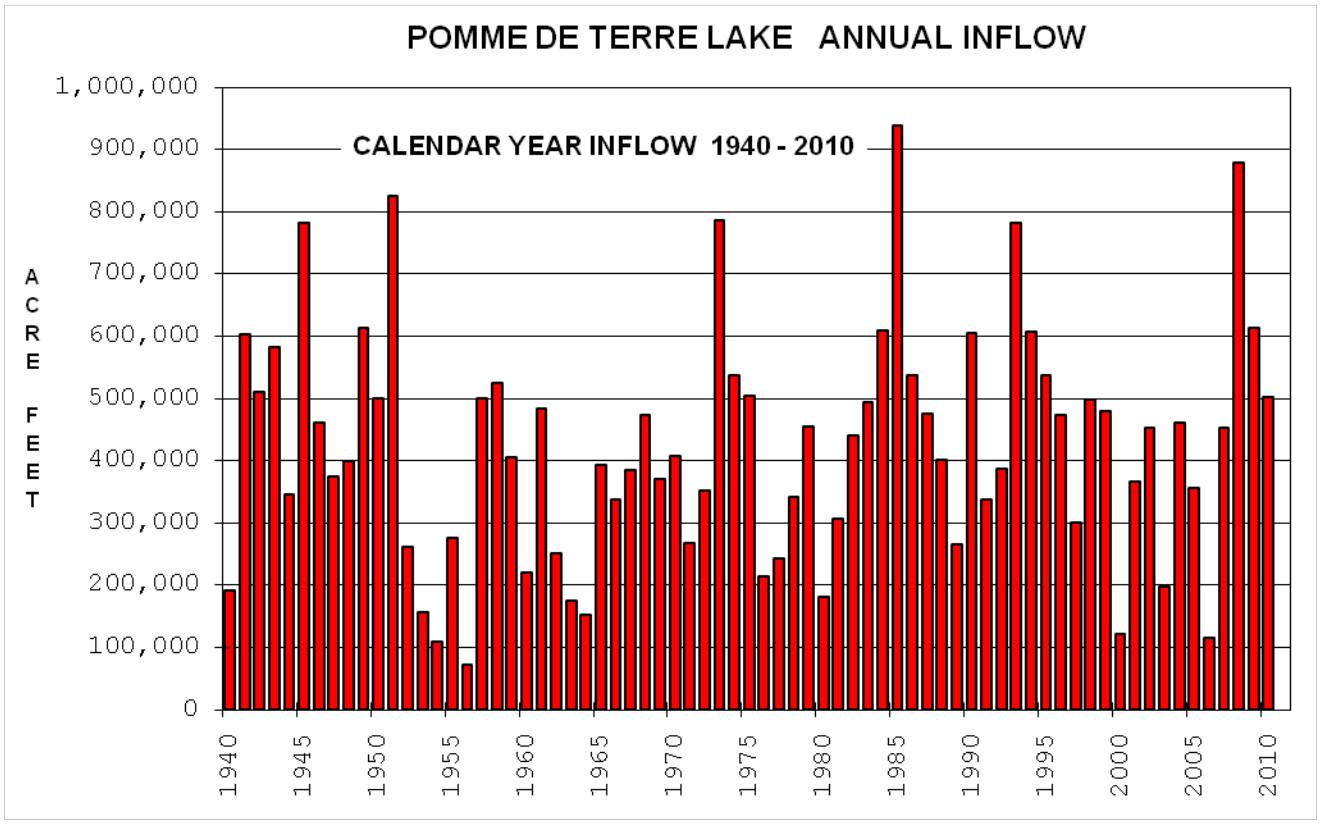




Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
839.69 1 Aug 10	**838.69 31 Jul 11**	**855.93 7 Apr 11**	**833.89 1 Nov 10**	**864.58 27 Sep 93**	**833.89 1 Nov 10**

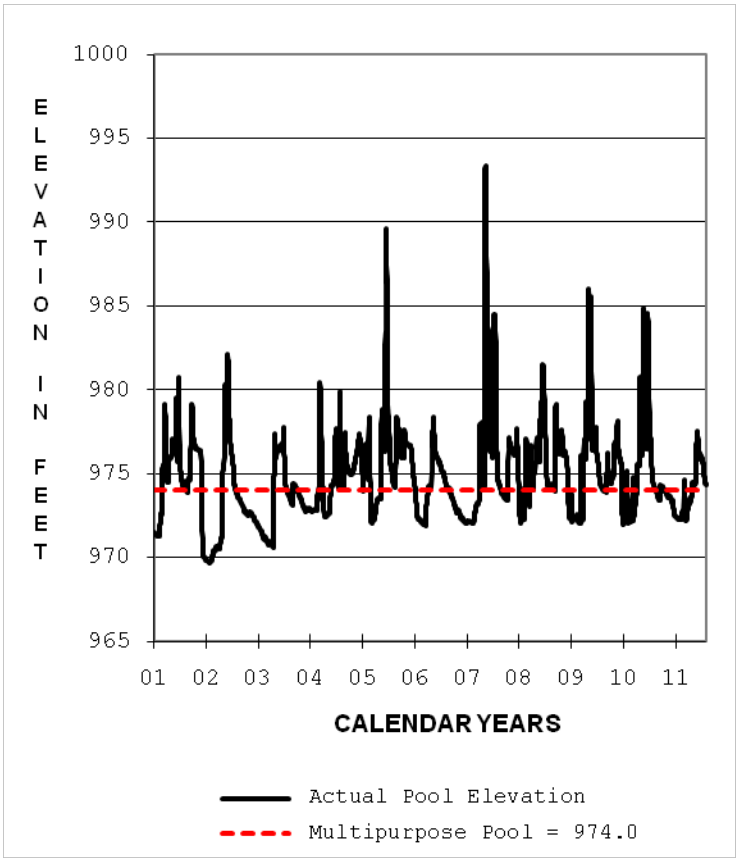
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
12,000 26 Apr 11	**559,229**	**3,500 Many days**	**0 Many days**
Minimum required release is 50 to 100 cfs, varying by season and pool level.			

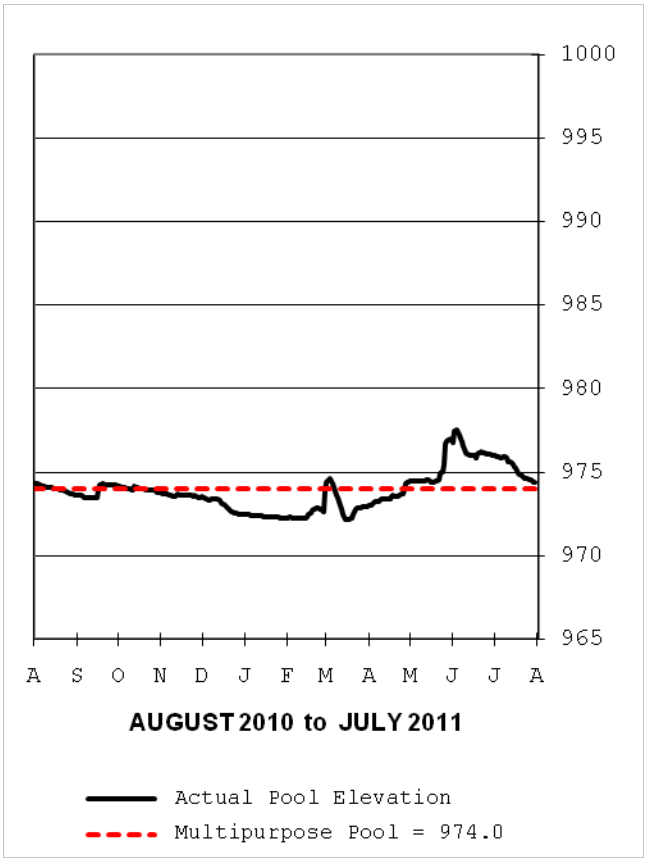

POMME DE TERRE LAKE MONTHLY INFLOW
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
ACRE FEET
AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL
HISTORIC AVG 1940 - 2010
ACTUAL 2010-2011


POMME DE TERRE LAKE ANNUAL INFLOW
1,000,000
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
ACRE FEET
CALENDAR YEAR INFLOW 1940 - 2010
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

POMONA LAKE
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW

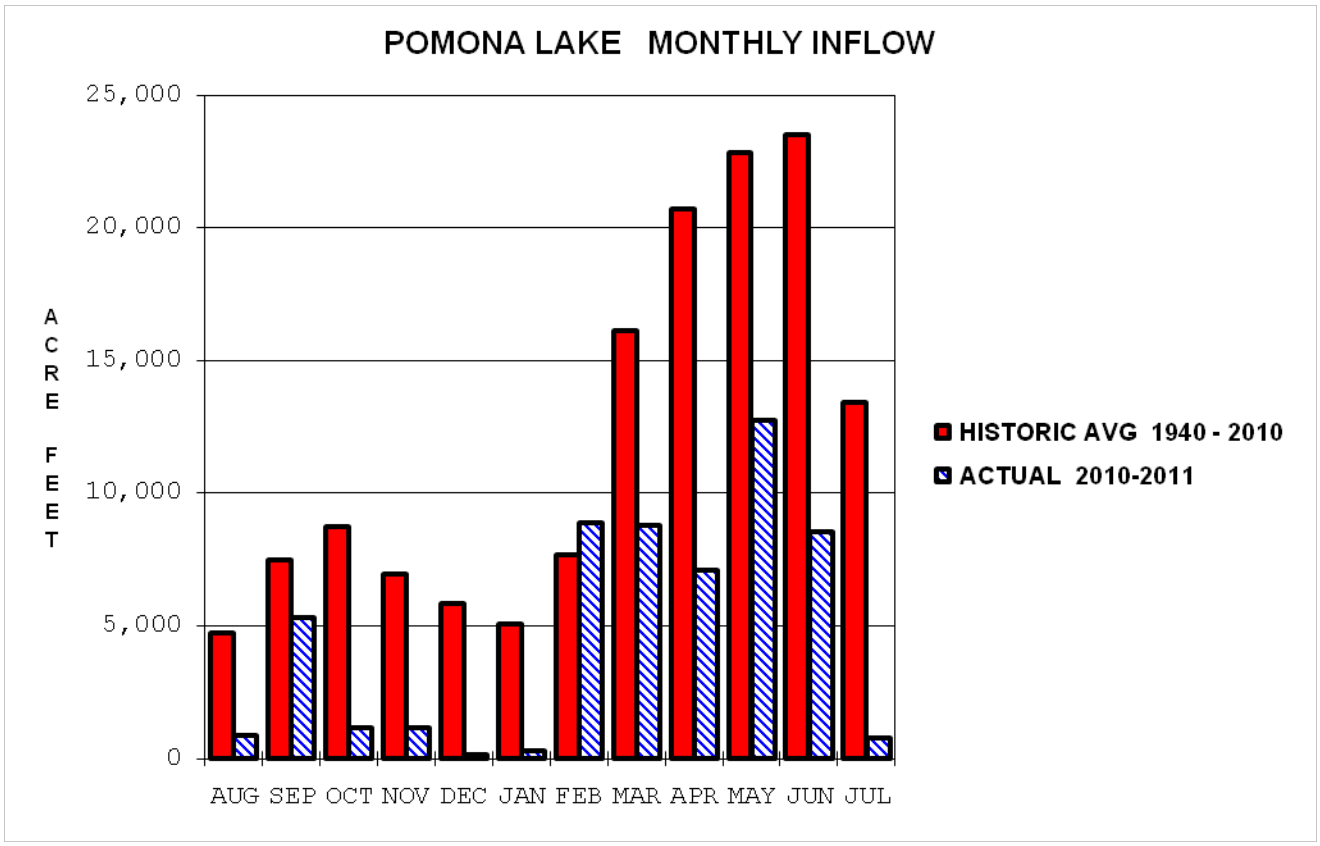


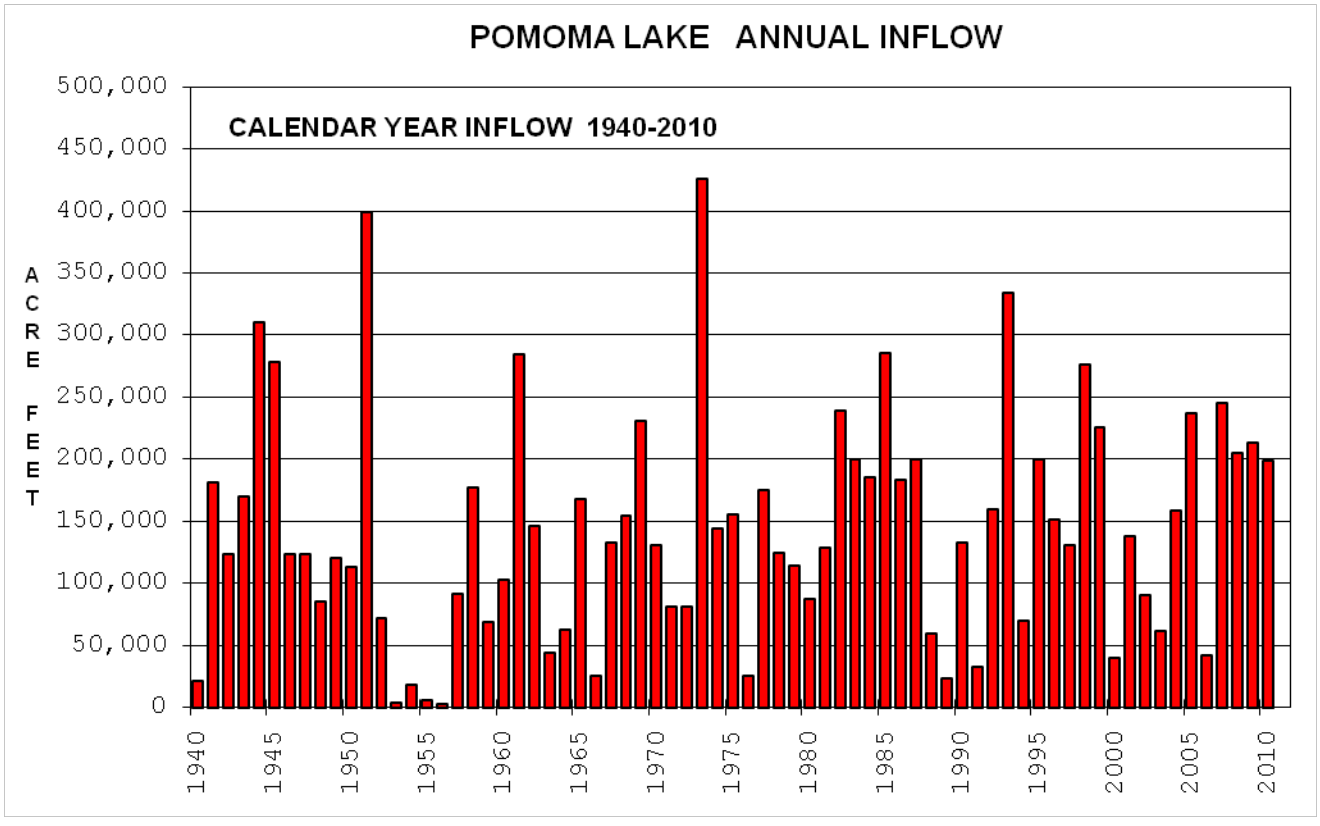


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
974.35 1 Aug 10	**974.35 31 Jul 11**	**977.51 3 Jun 11**	**972.19 15 Mar 11**	**998.40 12-13 Jun 95**	**969.62 30 Mar 67**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
2,100 28 Feb 11	**55,535**	**500 5 Mar 11**	**15 Many Days**

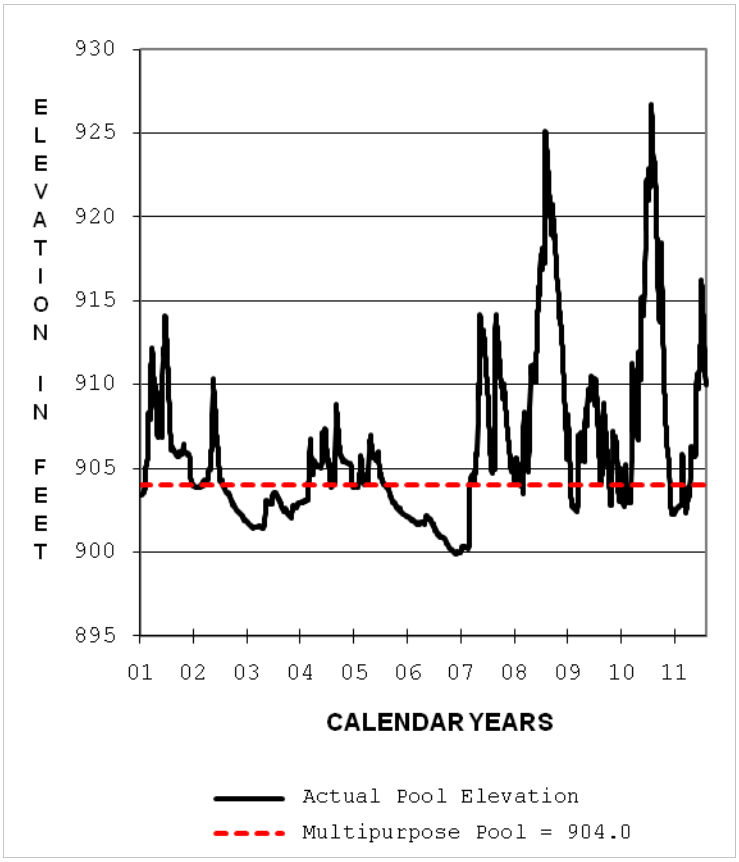
Minimum required release is 15 cfs.

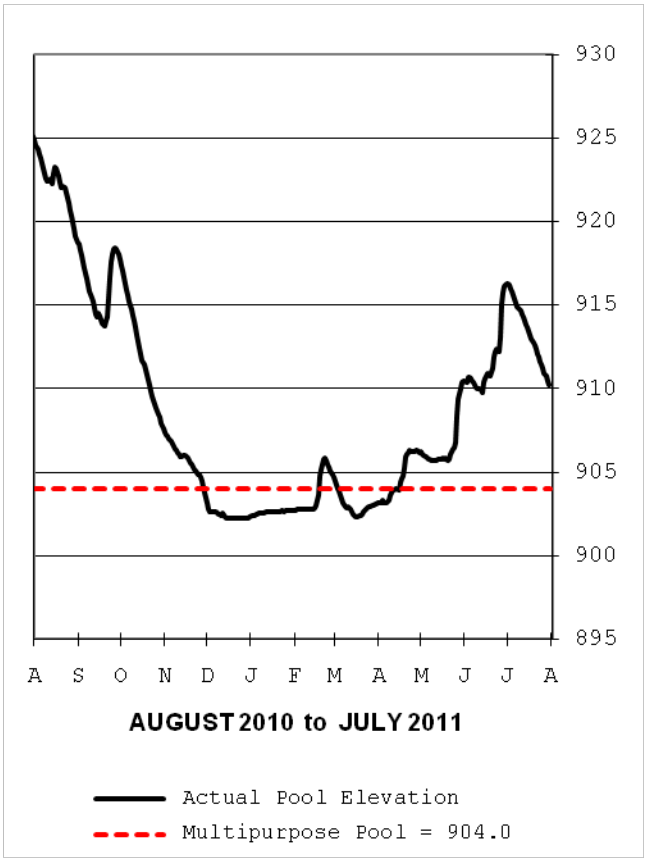

POMONA LAKE MONTHLY INFLOW
25,000
20,000
15,000
10,000
5,000
0
ACRE FEET
AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL
HISTORIC AVG 1940 - 2010
ACTUAL 2010-2011


POMOMA LAKE ANNUAL INFLOW
CALENDAR YEAR INFLOW 1940-2010
500,000
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
ACRE FEET
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

RATHBUN LAKE
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

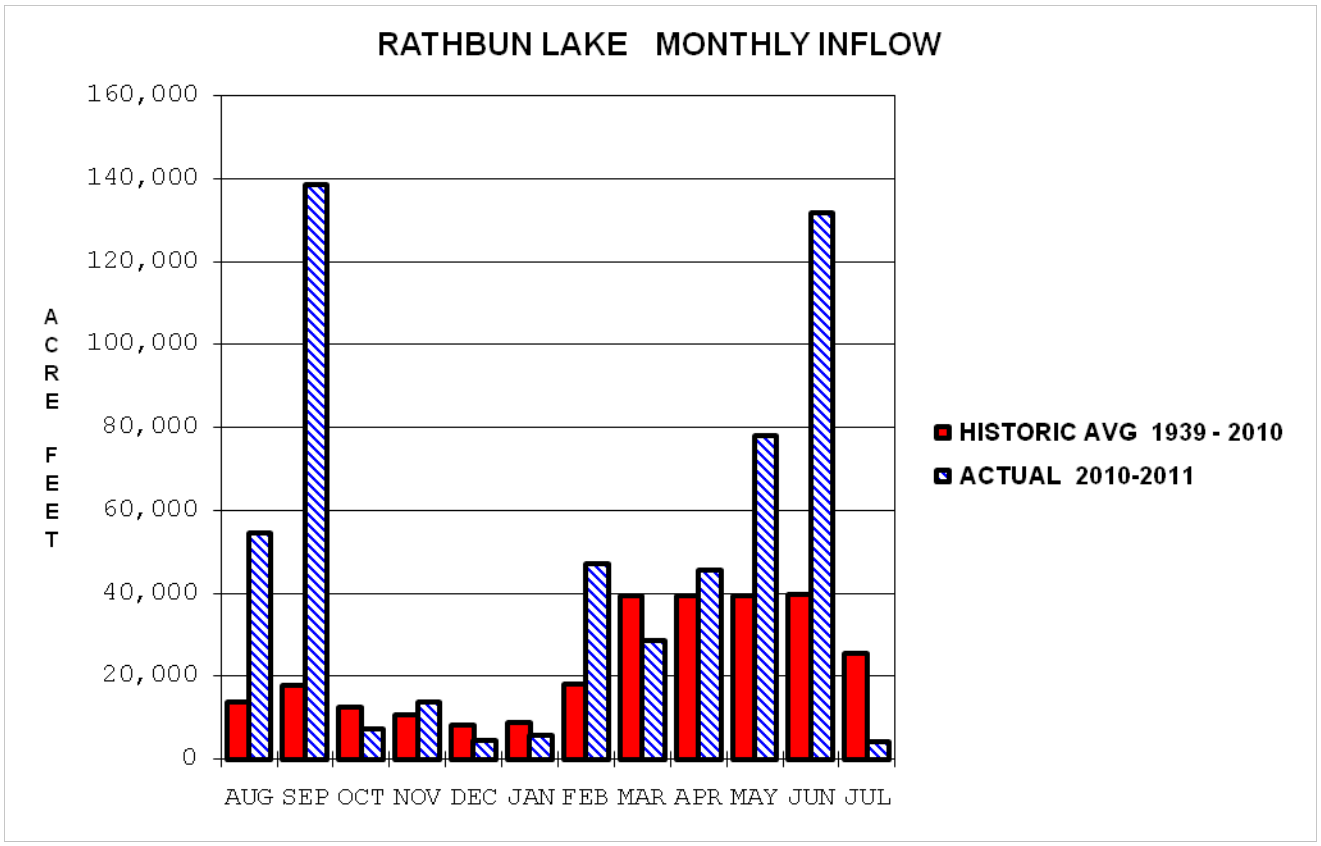


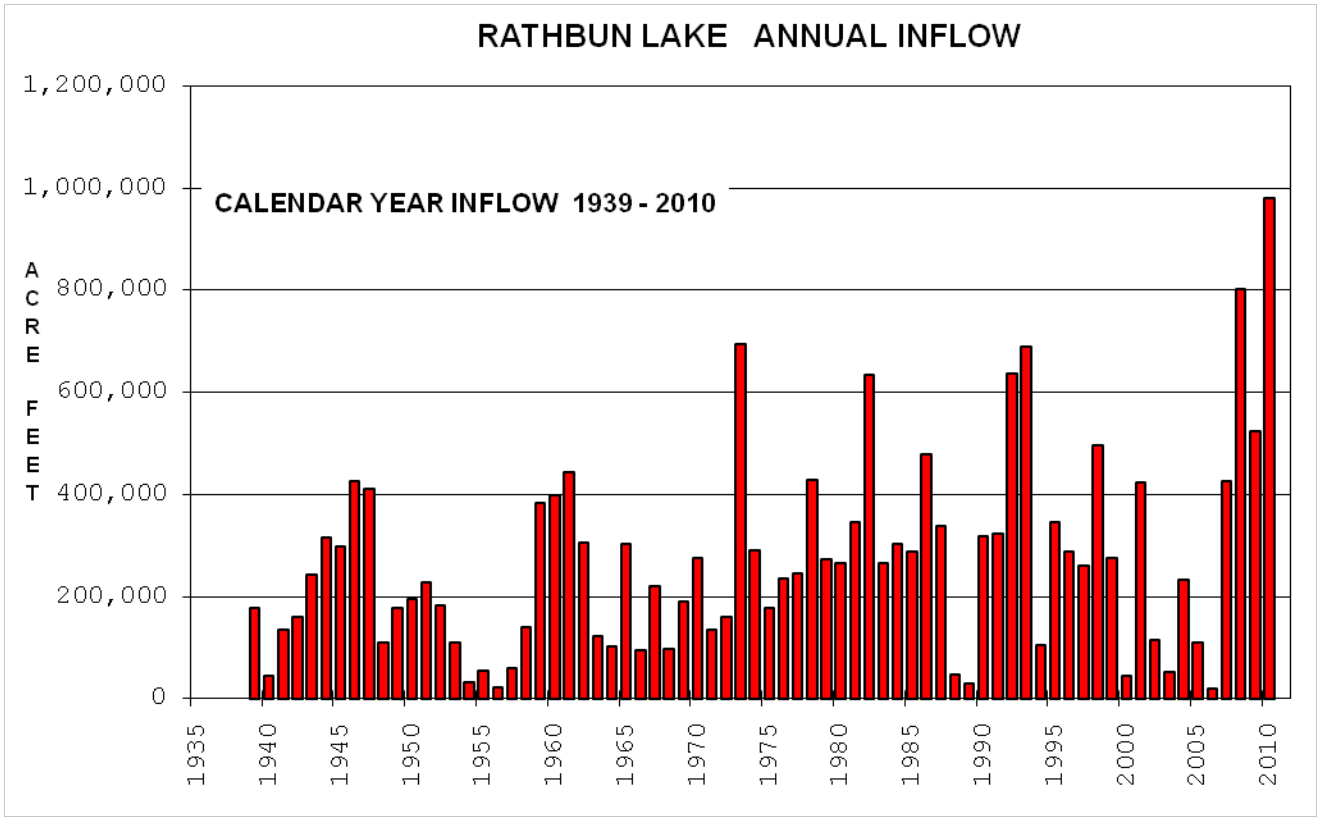


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
924.85 1 Aug 10	**909.95 31 Jul 11**	**924.85 1 Aug 10**	**902.22 19 Dec 10**	**927.16 28 Jul 93**	**898.38 26-27 Jan 95**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
11,430 23 Sep 10	**559,850**	**3006 Many Days**	**6 22 Mar 11**

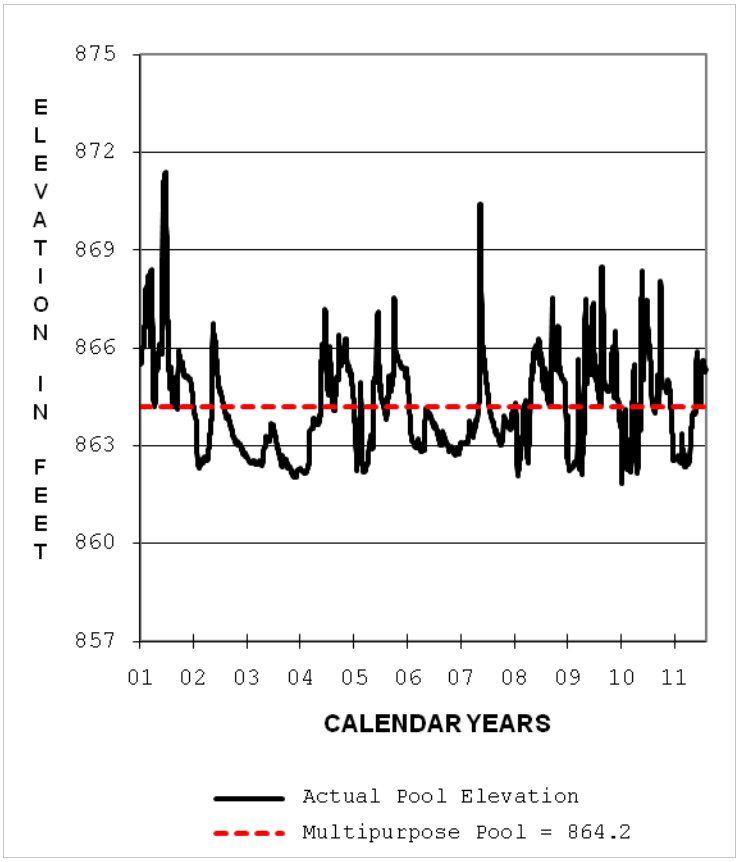
Outlets include a fish hatchery pipe and service gate. Minimum required release varies with downstream needs.

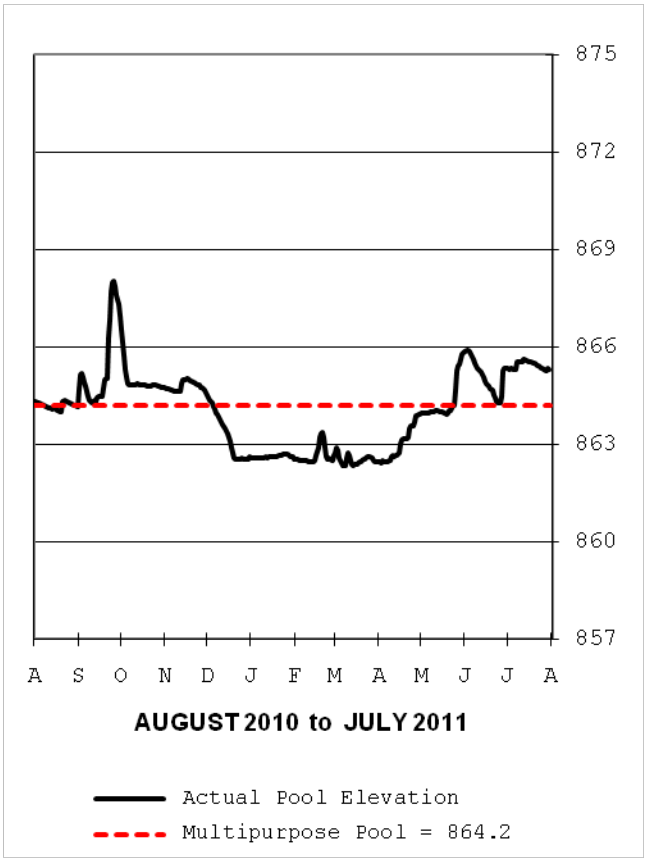

RATHBUN LAKE MONTHLY INFLOW
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
ACRE FEET
AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL
HISTORIC AVG 1939 - 2010
ACTUAL 2010-2011


RATHBUN LAKE ANNUAL INFLOW
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
ACRE FEET
CALENDAR YEAR INFLOW 1939 - 2010
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

SMITHVILLE LAKE
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

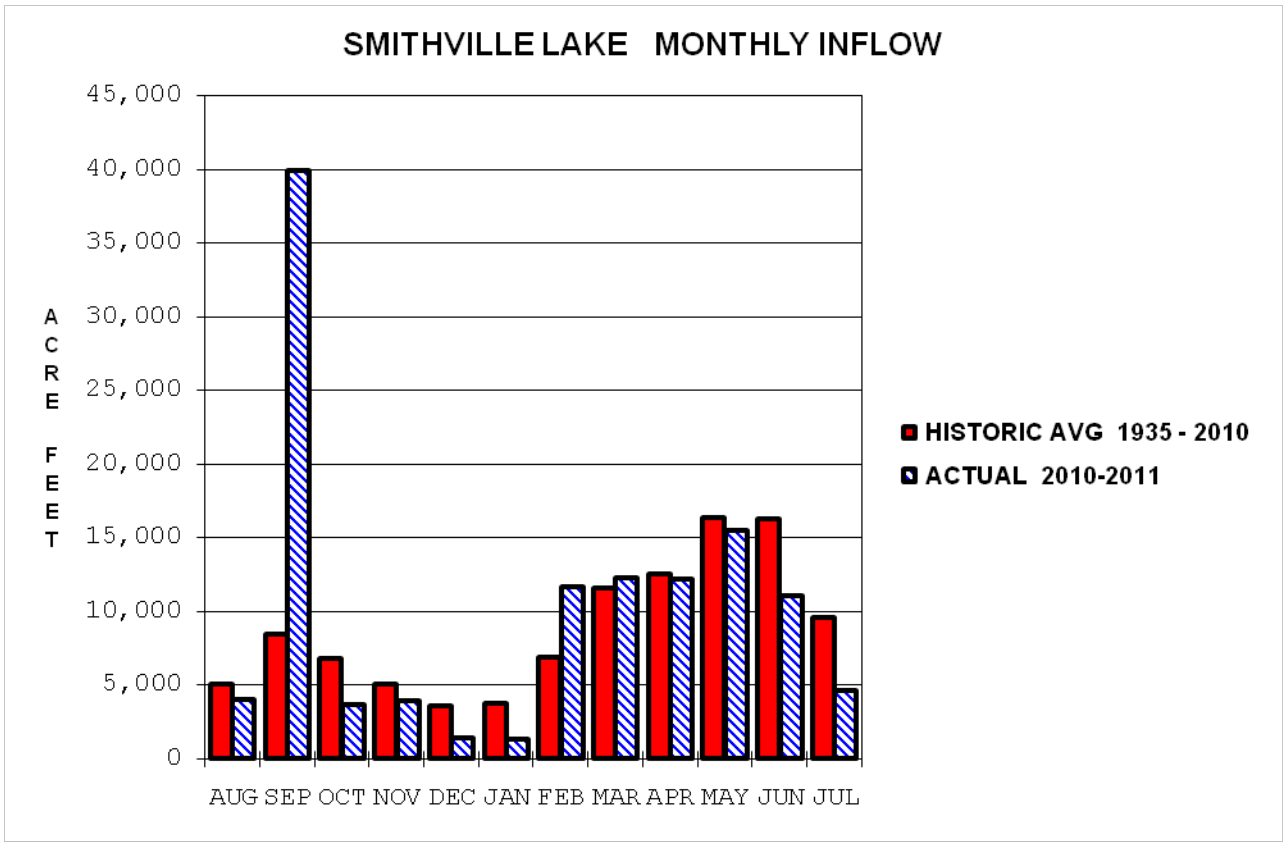


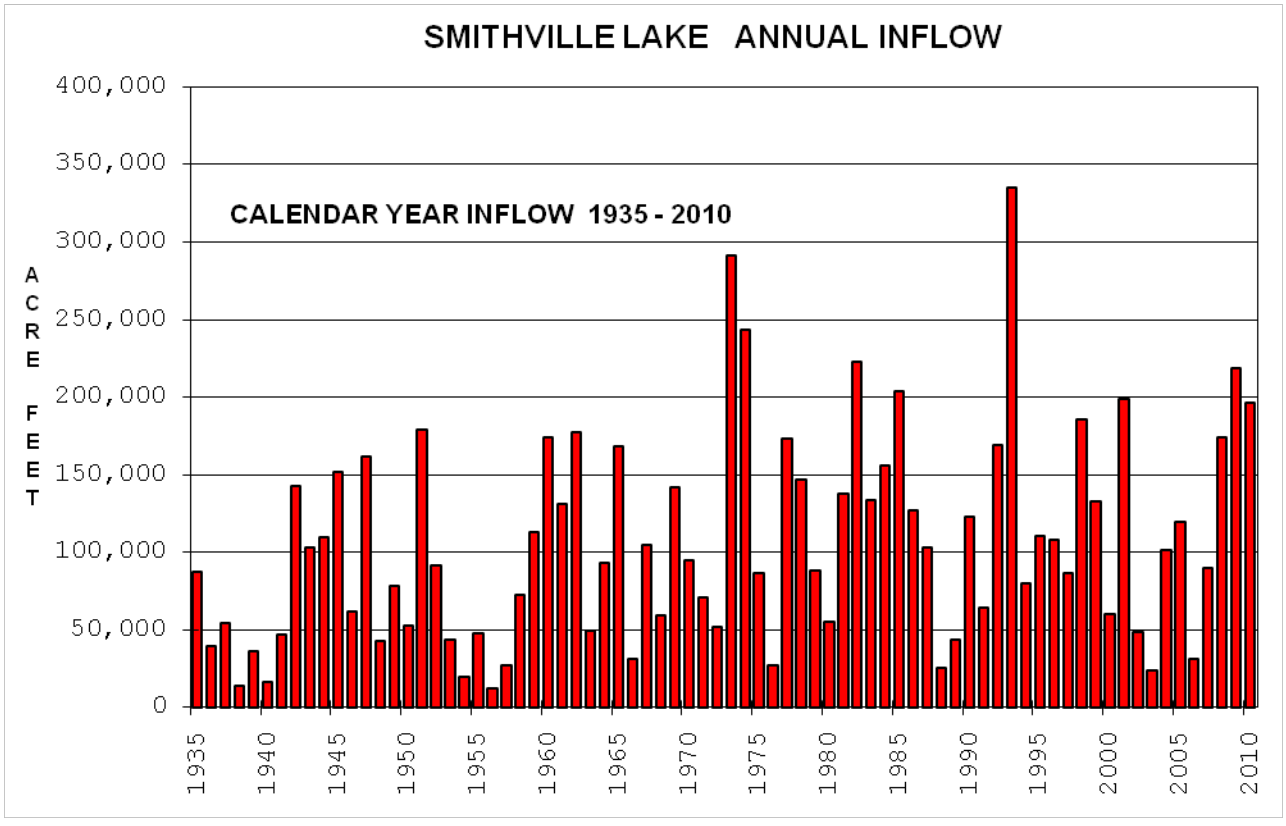


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
864.32 1 Aug 10	**865.35 31 Jul 11**	**868.03 26 Sep 10**	**862.36 7 Mar 11**	**874.31 27-28 Jul 93**	**858.86 19 Jan 93**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
4,900 22 Sep 10	**121,008**	**1,600 1 Oct 10**	**8 Many Days**

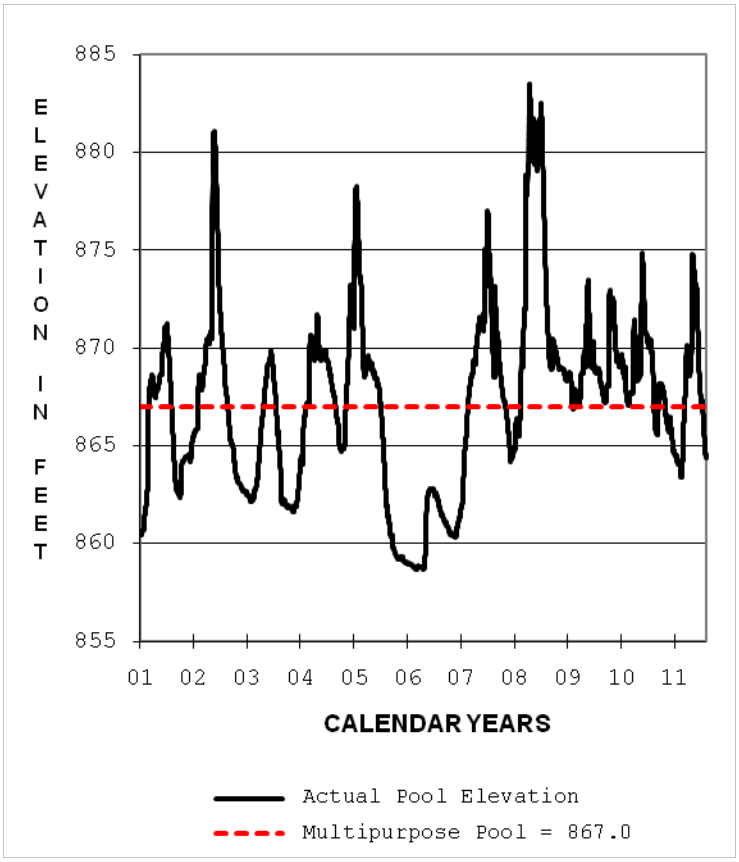
Minimum required release is 8 cfs. Releases cut to 0 during flooding and for maintenance and inspections.

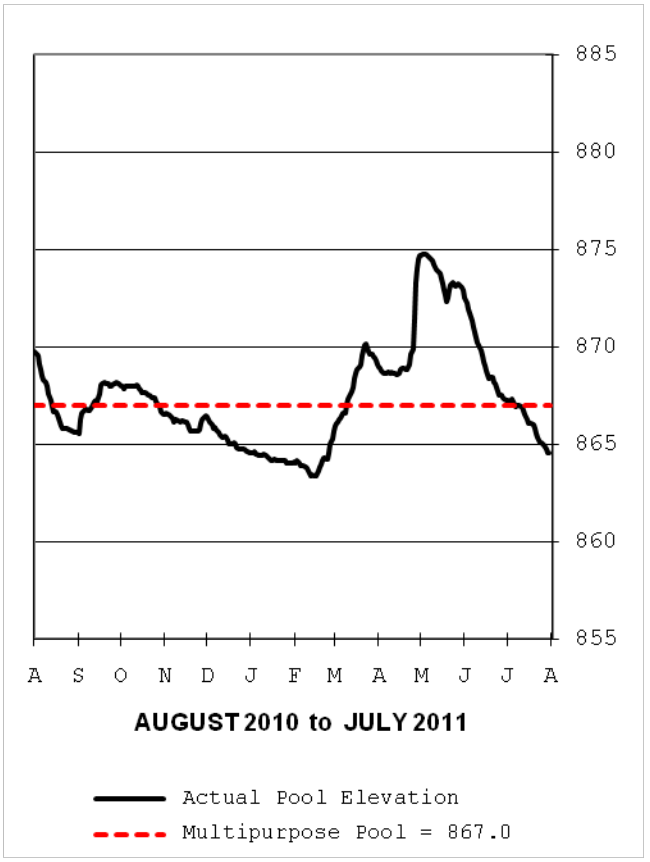

SMITHVILLE LAKE MONTHLY INFLOW
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
ACRE FEET
AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL
HISTORIC AVG 1935 - 2010
ACTUAL 2010-2011


SMITHVILLE LAKE ANNUAL INFLOW
CALENDAR YEAR INFLOW 1935 - 2010
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
ACRE FEET
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

STOCKTON LAKE
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

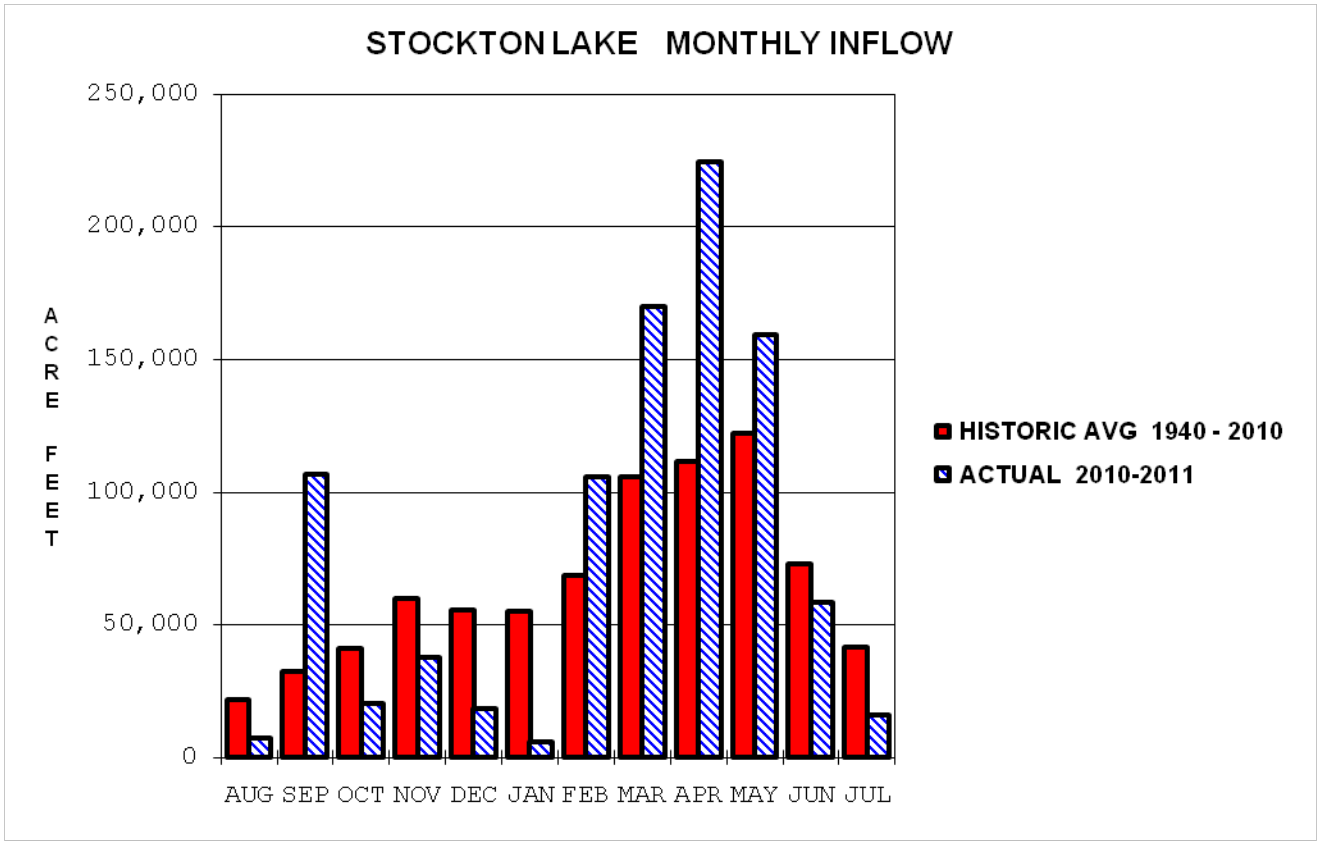


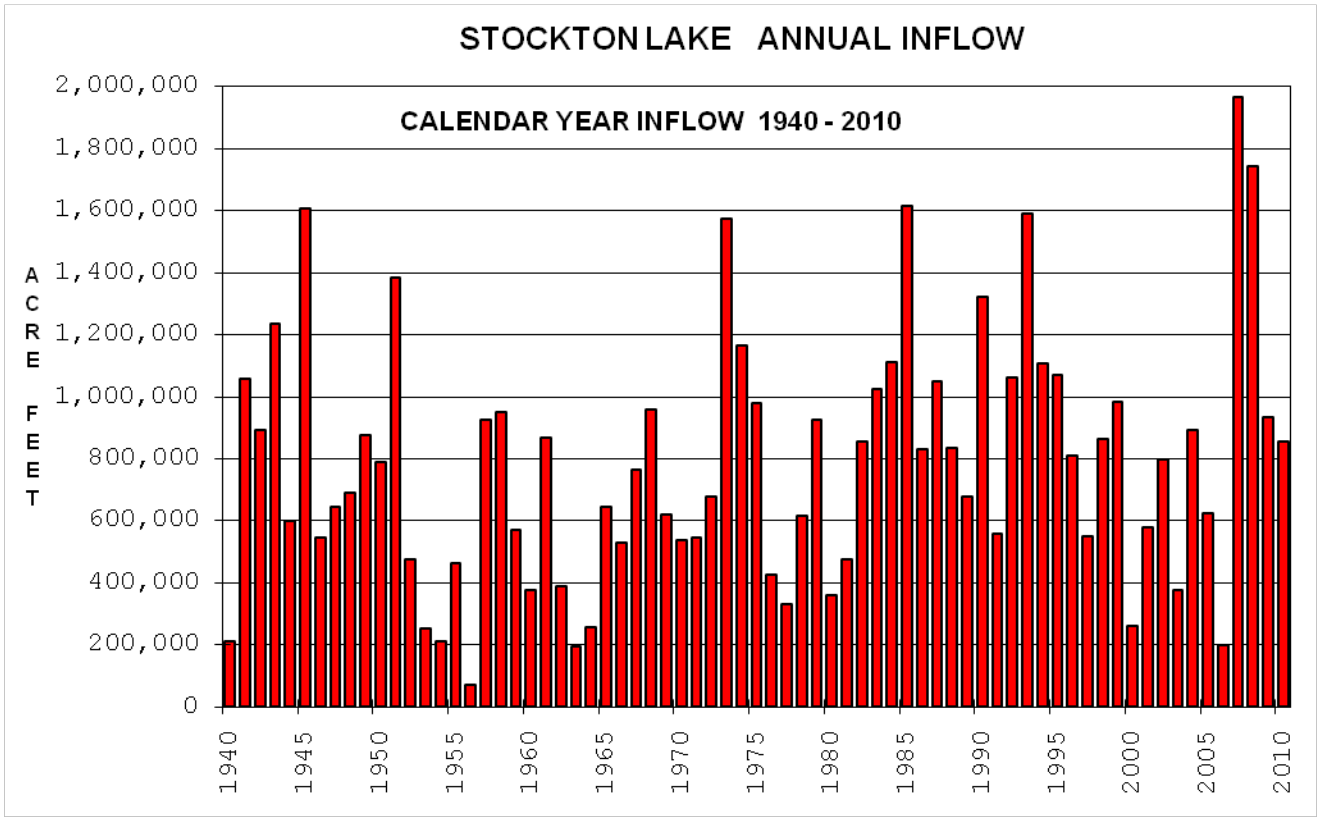


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
869.71 1 Aug 10	**864.26 31 Jul 11**	**874.78 3 May 11**	**863.40 12 Feb 11**	**885.94 28 Apr 73**	**851.86 2 Feb 77**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
23,000 27 Apr 11	**927,212**	**5,378 19 May 11**	**0 Many Days**

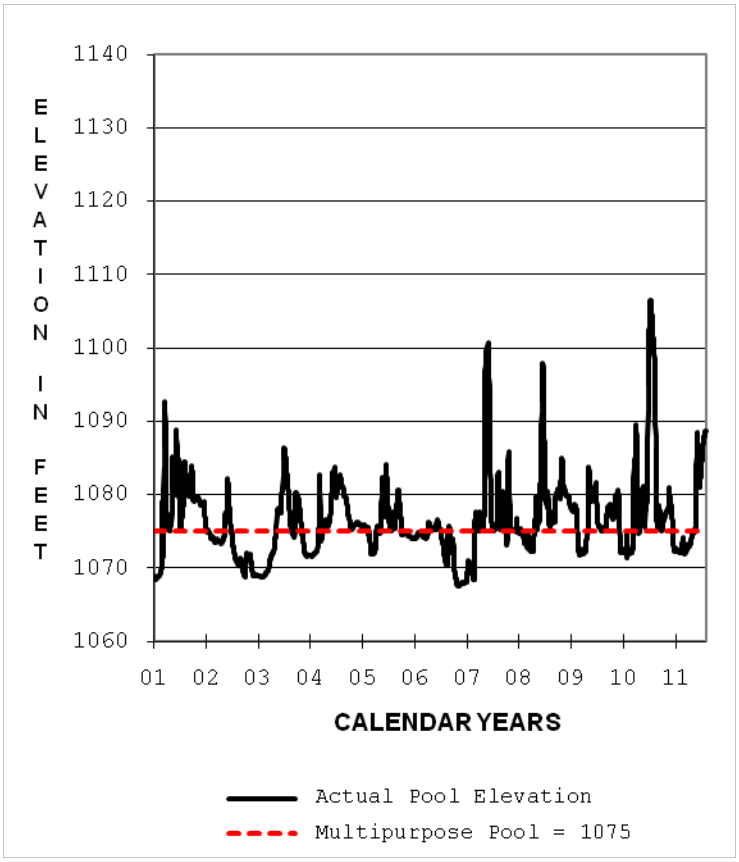
Listed outflows include turbine releases and spill to the river. Minimum required release is 40 cfs.

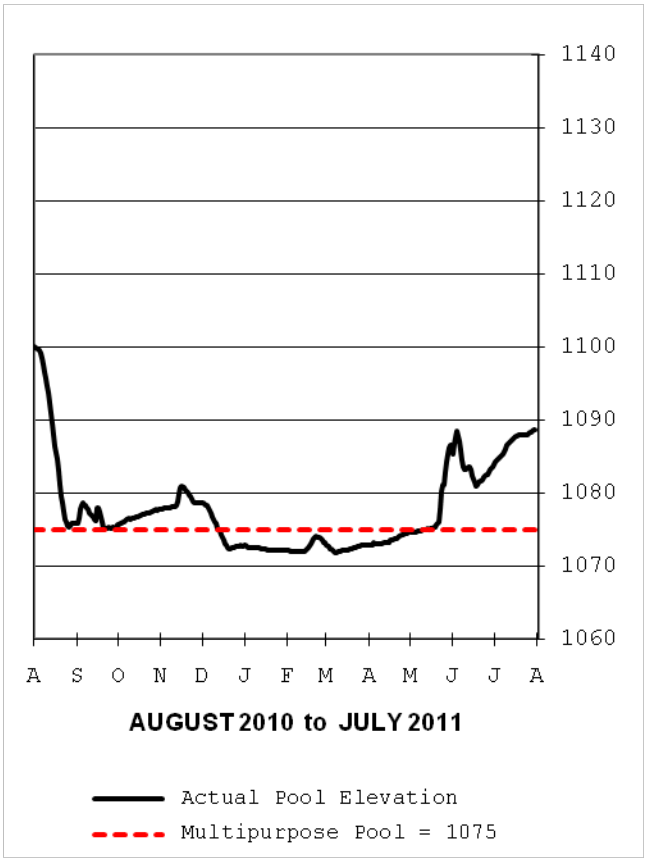

STOCKTON LAKE MONTHLY INFLOW
250,000
200,000
150,000
100,000
50,000
0
ACRE FEET
AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL
HISTORIC AVG 1940 - 2010
ACTUAL 2010-2011


STOCKTON LAKE ANNUAL INFLOW
CALENDAR YEAR INFLOW 1940 - 2010
2,000,000
1,800,000
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
ACRE FEET
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

TUTTLE CREEK LAKE
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

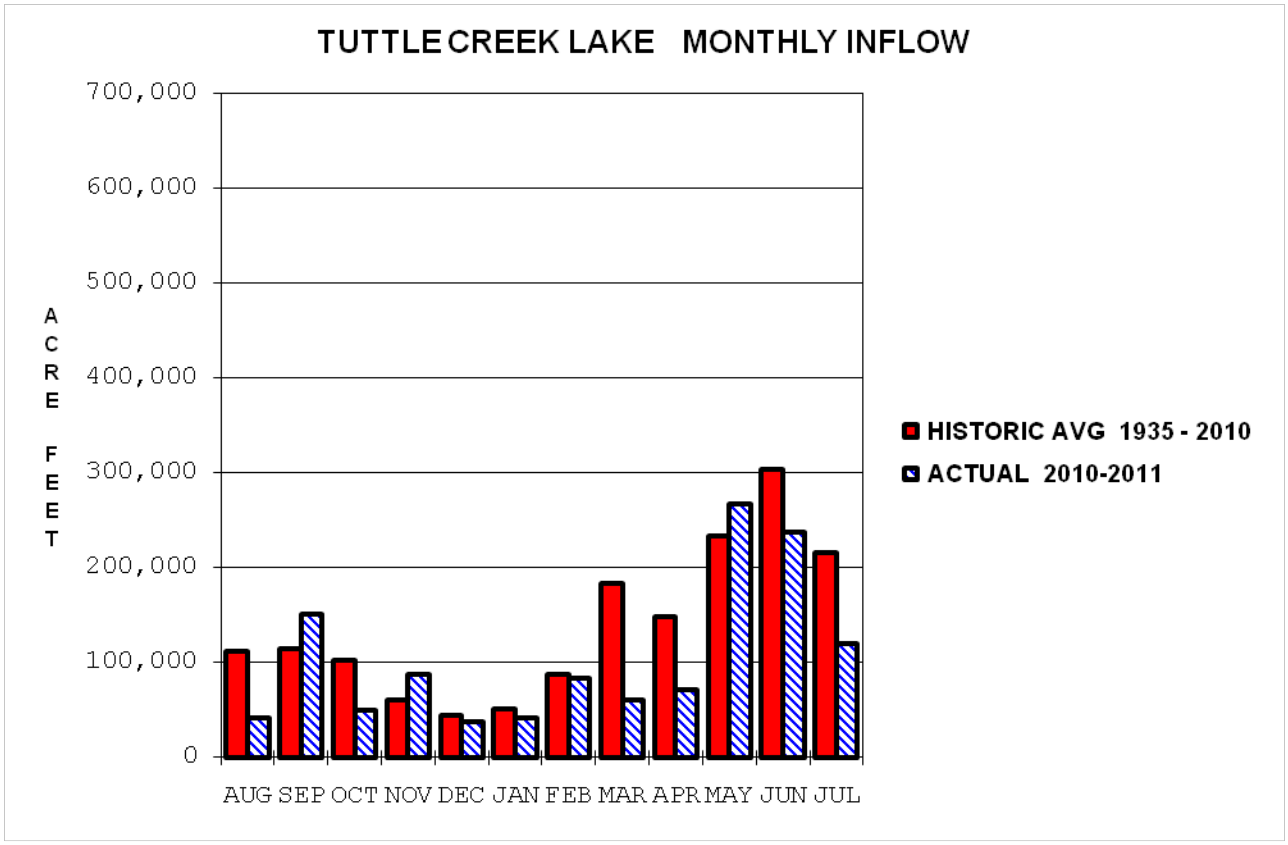


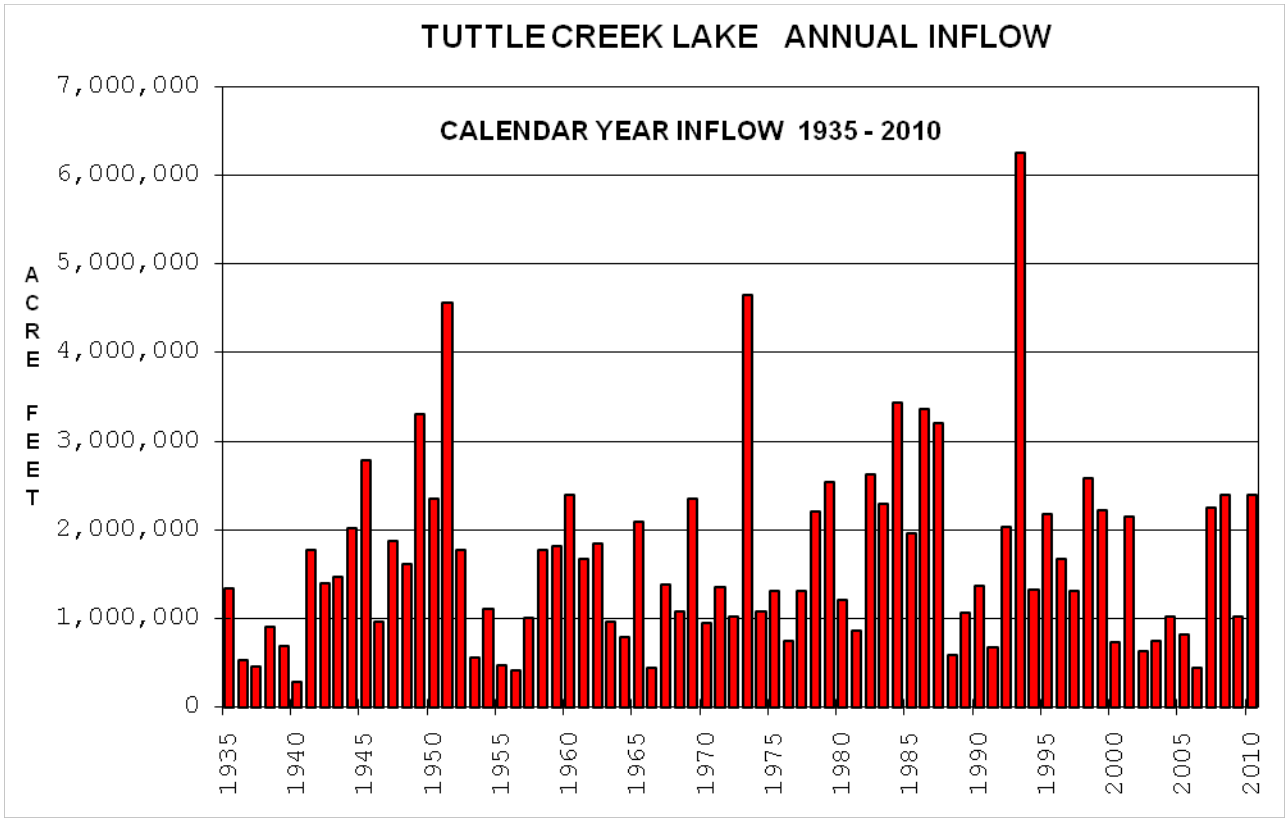


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1099.97 1 Aug 10	**1088.71 31 Jul 11**	**1099.97 1 Aug 10**	**1071.87 7 Mar 11**	**1137.77 22 Jul 93**	**1060.82 4 Jan 67**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
28,000 2 Jun 11	**1,249,230**	**16,000 13 Aug 10**	**0 30 Sep 10**

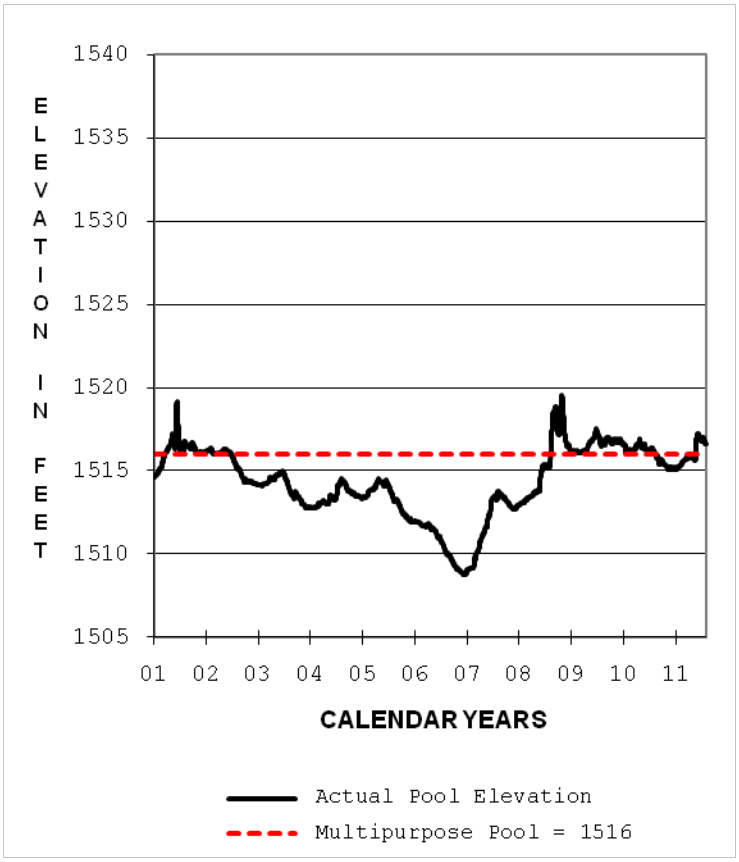
Minimum required release is 50 to 100 cfs. Releases may be cut to 0 for maintenance and inspection periods.

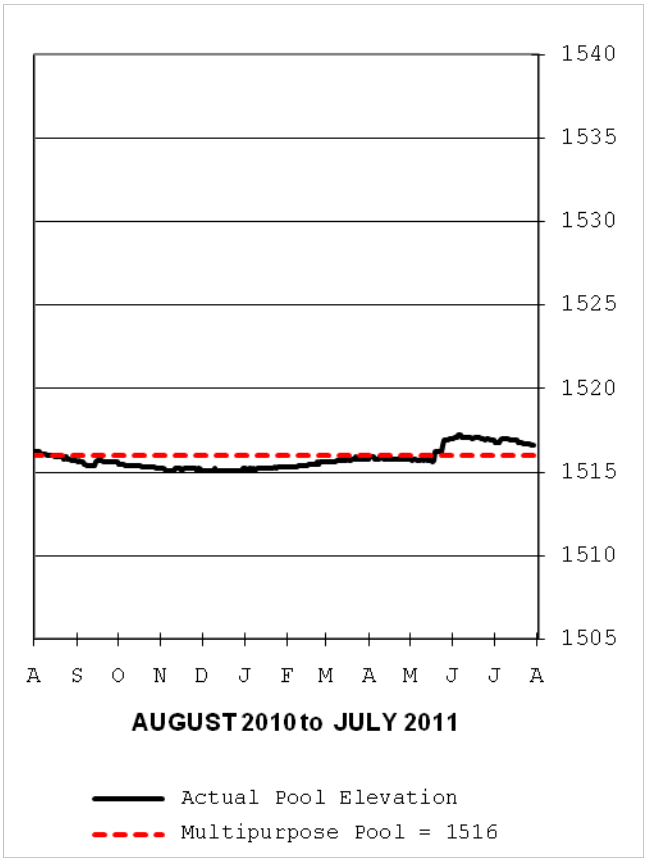

TUTTLE CREEK LAKE MONTHLY INFLOW
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
ACRE FEET
AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL
HISTORIC AVG 1935 - 2010
ACTUAL 2010-2011


TUTTLE CREEK LAKE ANNUAL INFLOW
CALENDAR YEAR INFLOW 1935 - 2010
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
ACRE FEET
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

WILSON LAKE
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.

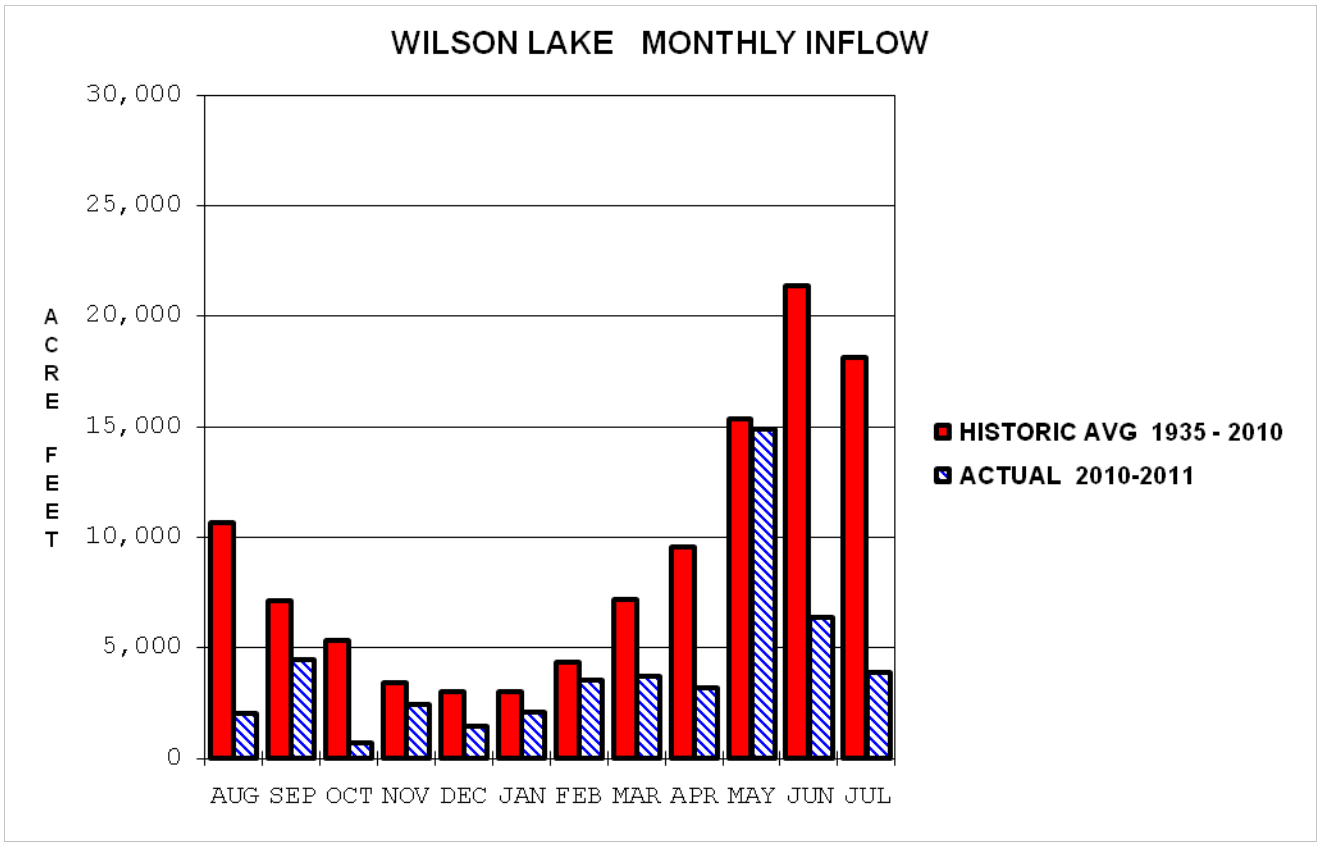


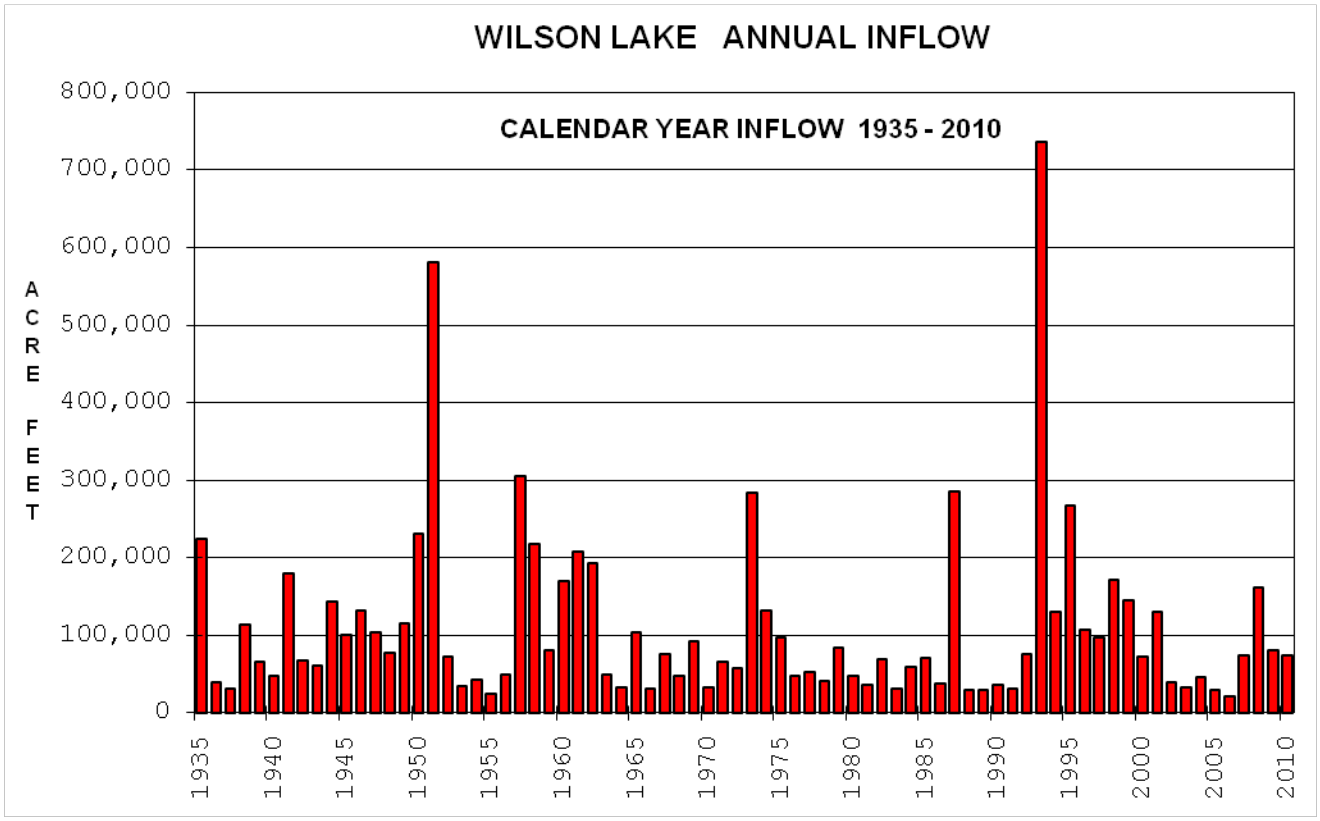


Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1516.2 1 Aug 10	**1516.6 31 Jul 11**	**1517.2 5 Jun 11**	**1515.1 5 Nov 10**	**1548.27 13 Aug 93**	**1508.73 19 Dec 06**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
2,100 20 May 11	**49,342**	**889 2 Jun 11**	**0 15 May 11**

Minimum required release of 5-15 cfs varies seasonally. Releases cut to 0 for maintenance and inspections.


WILSON LAKE MONTHLY INFLOW
30,000
25,000
20,000
15,000
10,000
5,000
0
ACRE FEET
AUG SEP OCT NOV DEC JAN FEB MAR APR MAY JUN JUL
HISTORIC AVG 1935 - 2010
ACTUAL 2010-2011


WILSON LAKE ANNUAL INFLOW
CALENDAR YEAR INFLOW 1935 - 2010
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
ACRE FEET
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010

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

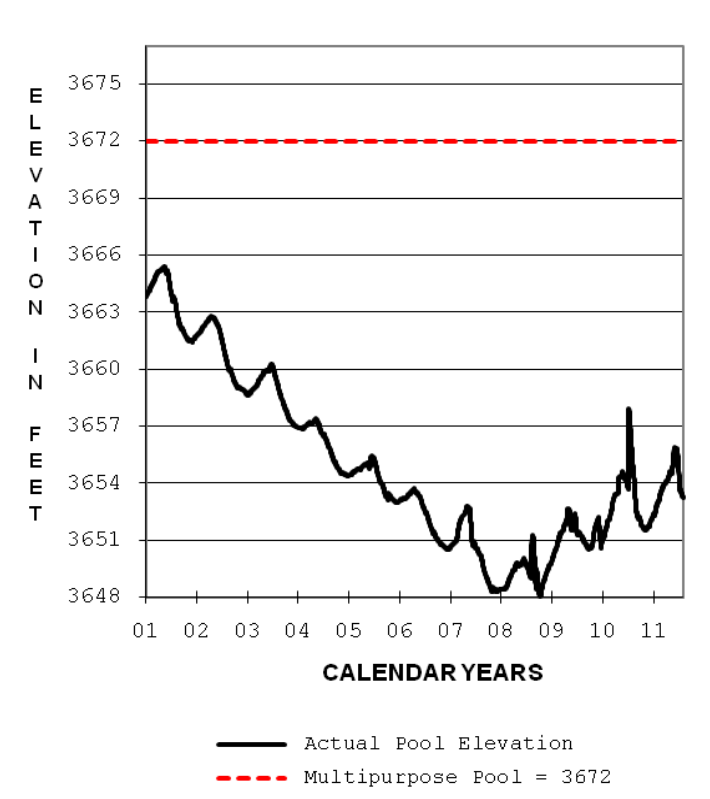
SWANSON LAKE
(Trenton Dam)

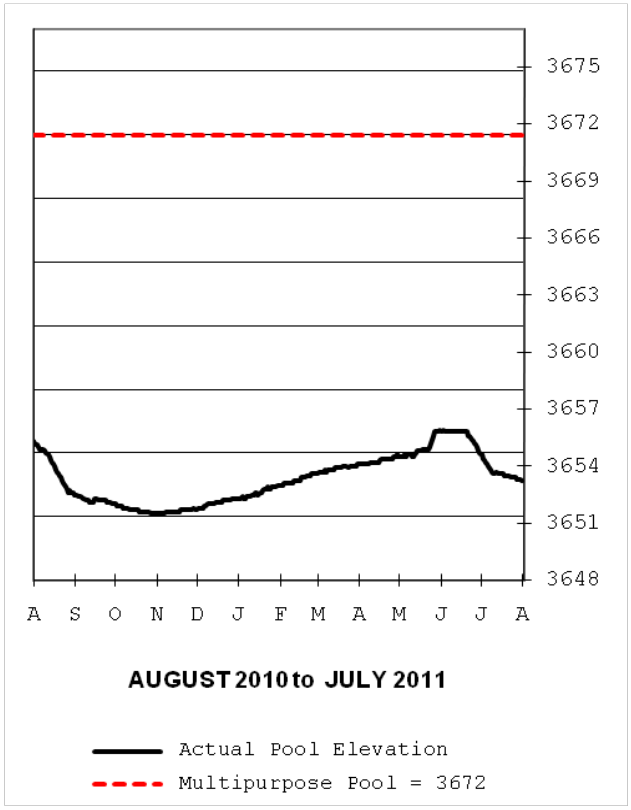
WACONDA LAKE
(Glen Elder Dam)

WEBSTER RESERVOIR

BONNY RESERVOIR
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



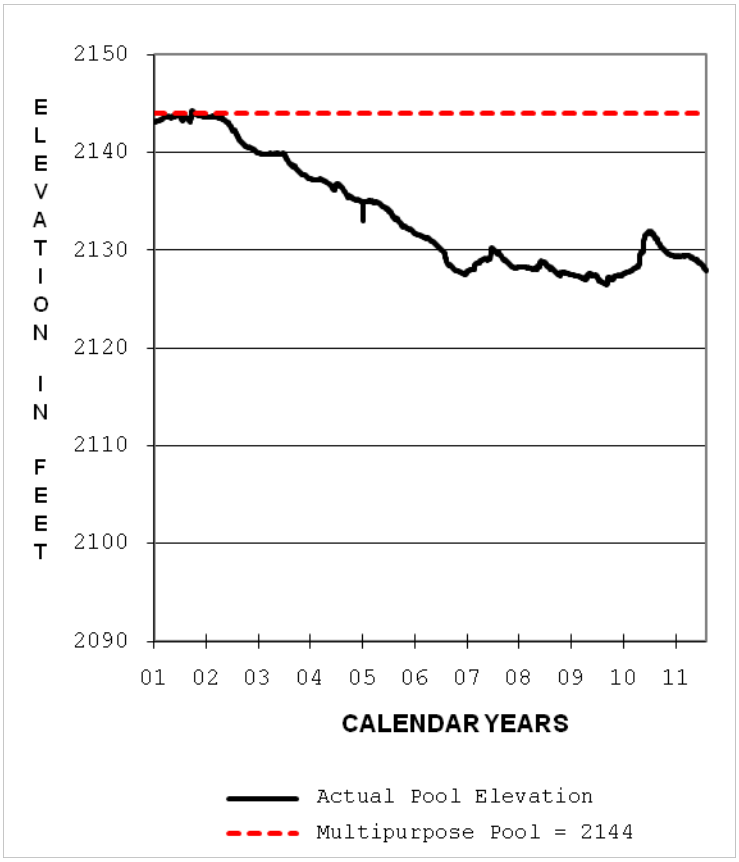


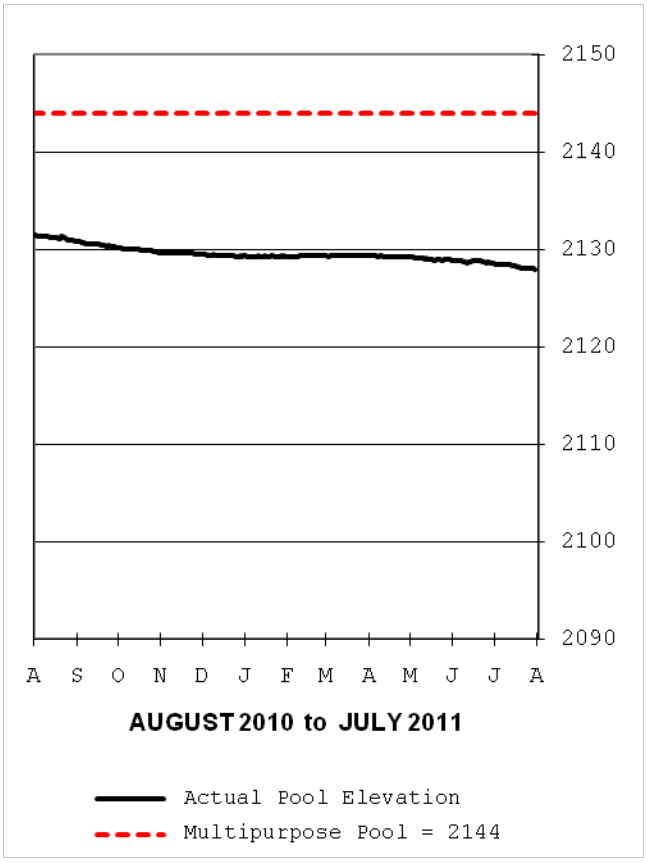
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
3655.20 1 Aug 10	**3653.24 31 Jul 11**	**3655.89 2 Jun 11**	**3651.51 28 Oct 10**	**3678.10 17 May 57**	**3648.05 9 Oct 08**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
110 25 May 11	**10,994**	**65 1 Aug 10**	**3 Many days**
Maximum daily outflow is river release only. Minimum required release is 5 cfs.			

CEDAR BLUFF RESERVOIR
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.





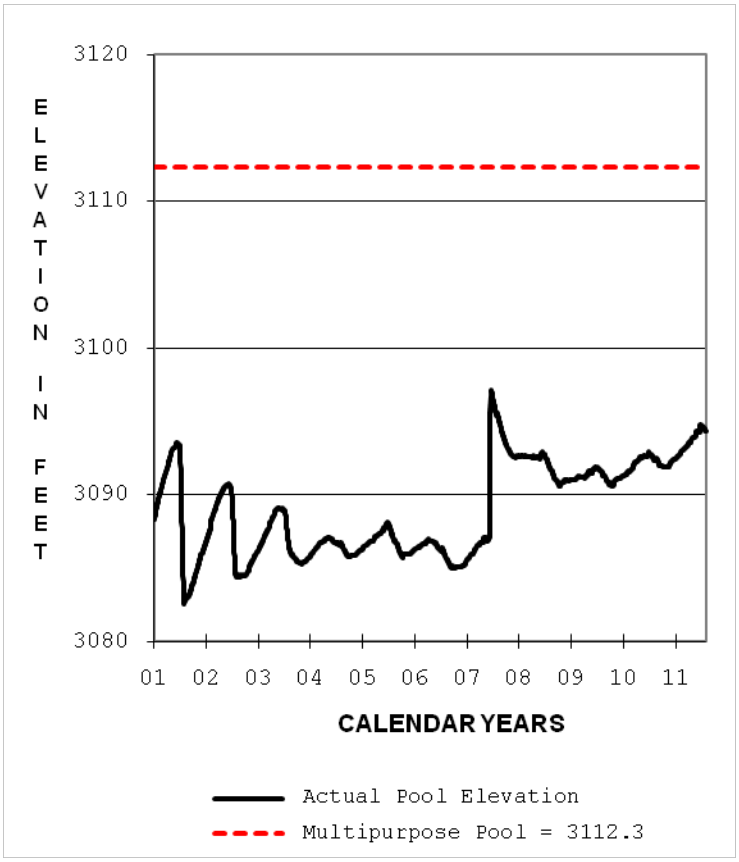
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2131.50 1 Aug 10	**2127.90 31 Jul 11**	**2131.50 1 Aug 10**	**2127.90 31 Jul 11**	**2154.90, 2 Jul 51 4-5 Jul 57**	**2091.78 9-19 Nov 92**

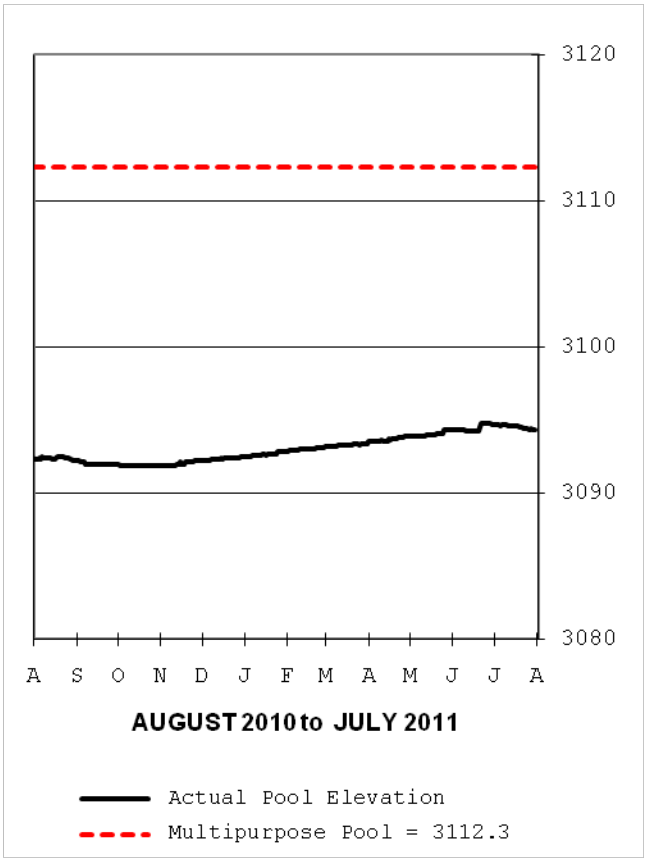
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
370 7 Jun 11	**9,277**	**0 All Year**	**0 All Year**

No minimum required release. Minor releases to the fish hatchery are not reported on a daily basis.

ENDERS RESERVOIR
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW
WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.





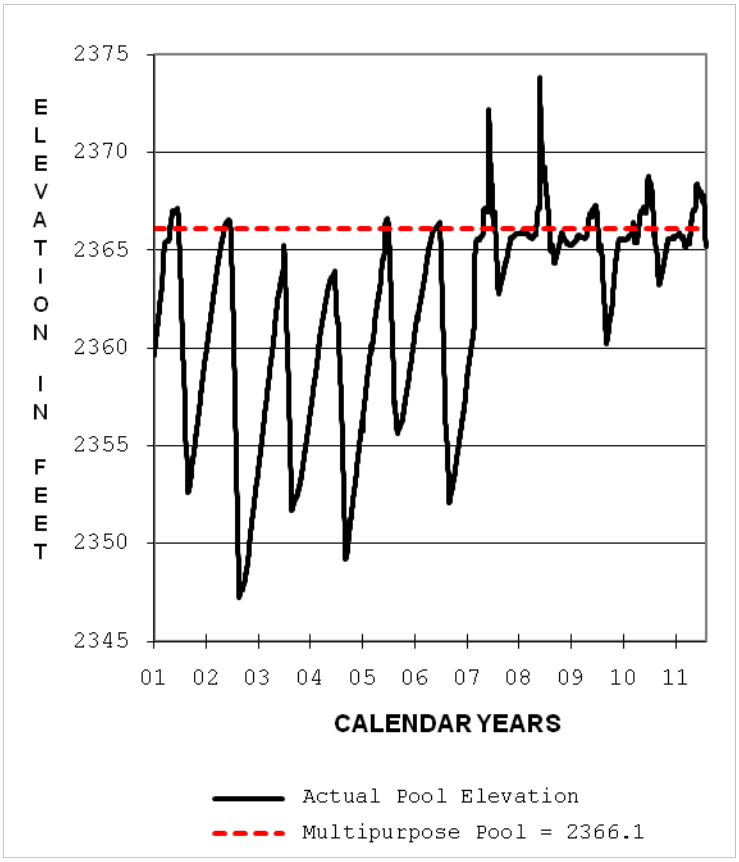
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
3092.30 1 Aug 10	**3094.30 31 Jul 11**	**3094.80 21 Jun 11**	**3091.90 2 Oct 10**	**3118.20 25 Mar 60**	**3080.67 28 Aug 78**

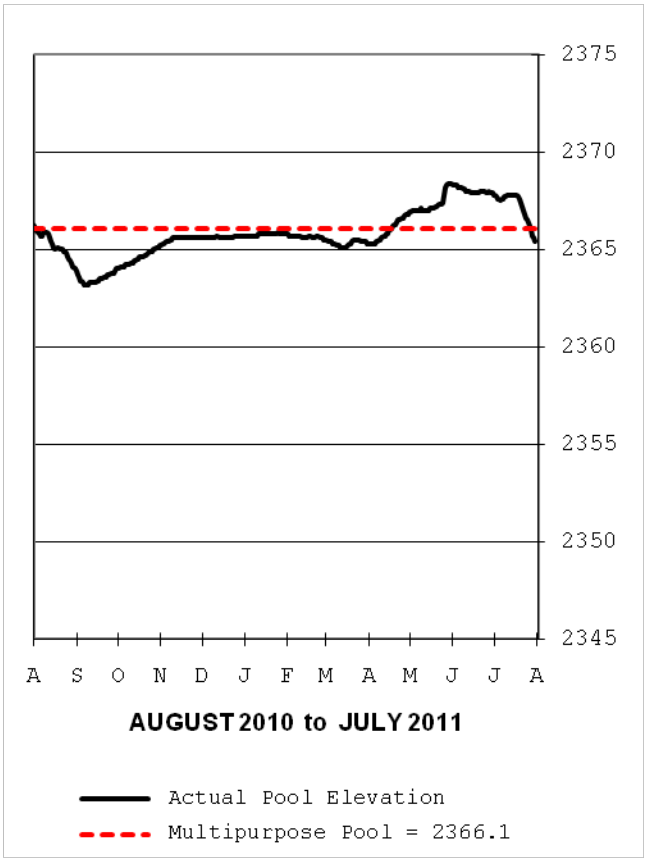
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
165 21 Jun 11	**8,884**	**5 All year**	**5 All year**

No minimum required release. The outflow is mostly seepage.

HARRY STRUNK LAKE
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.





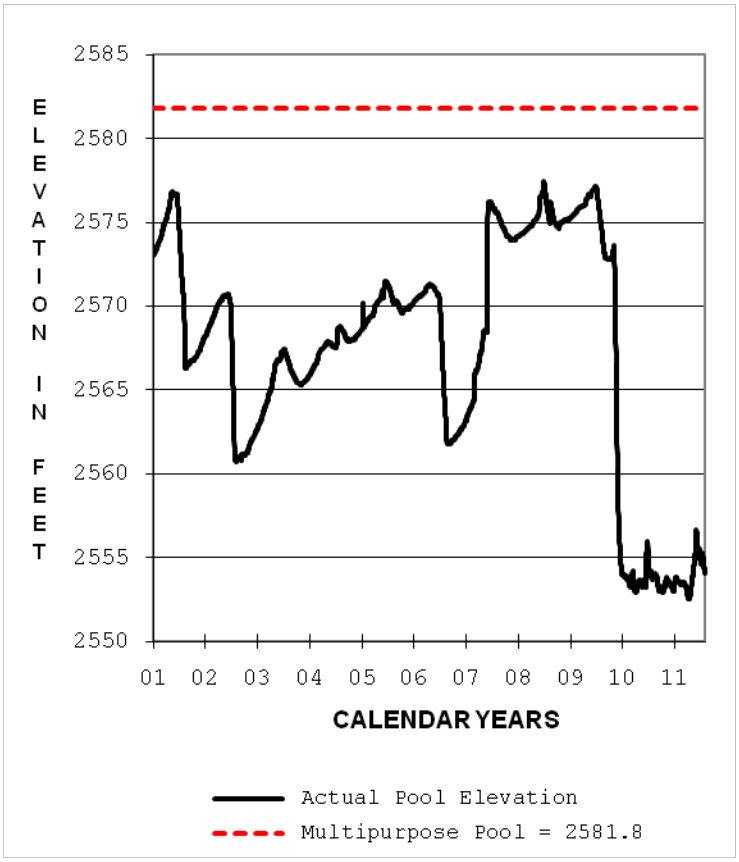
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2366.2 1 Aug 10	**2365.2 31 Jul 11**	**2368.4 28 May 11**	**2363.2 6 Sep 10**	**2374.10 23 Mar 60**	**2340.42 8 Sep 78**

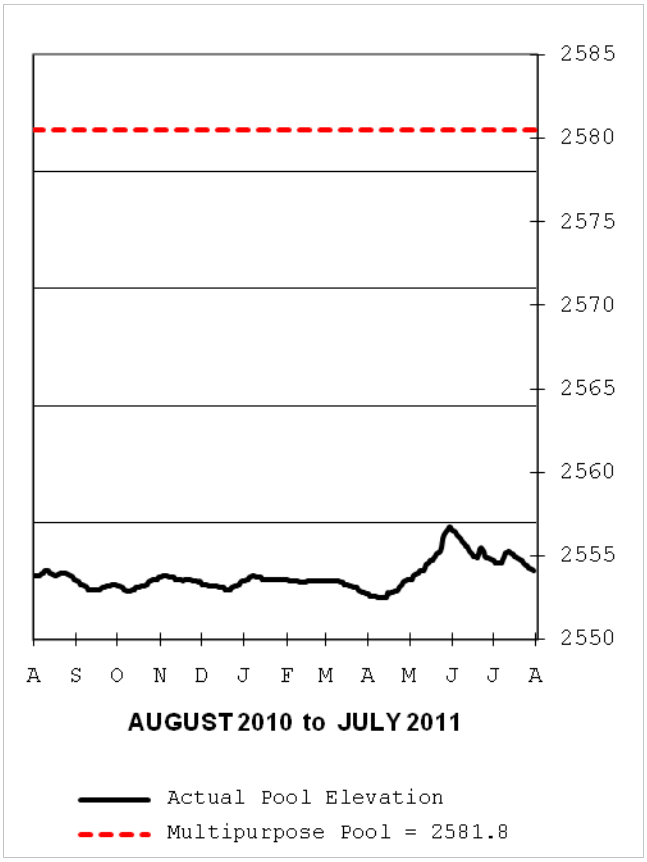
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
525 25 May 11	**43,944**	**257 26 Jul 11**	**1 Many Days**

Max daily outflow occurred as part of normal irrigation releases. All releases to the river. No min required release.

HUGH BUTLER LAKE
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



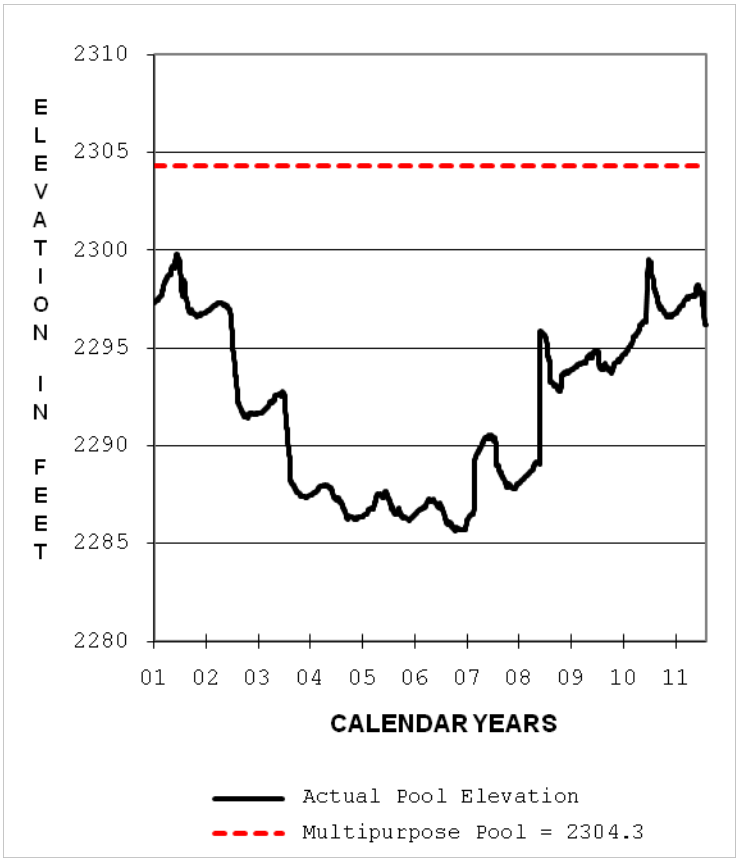


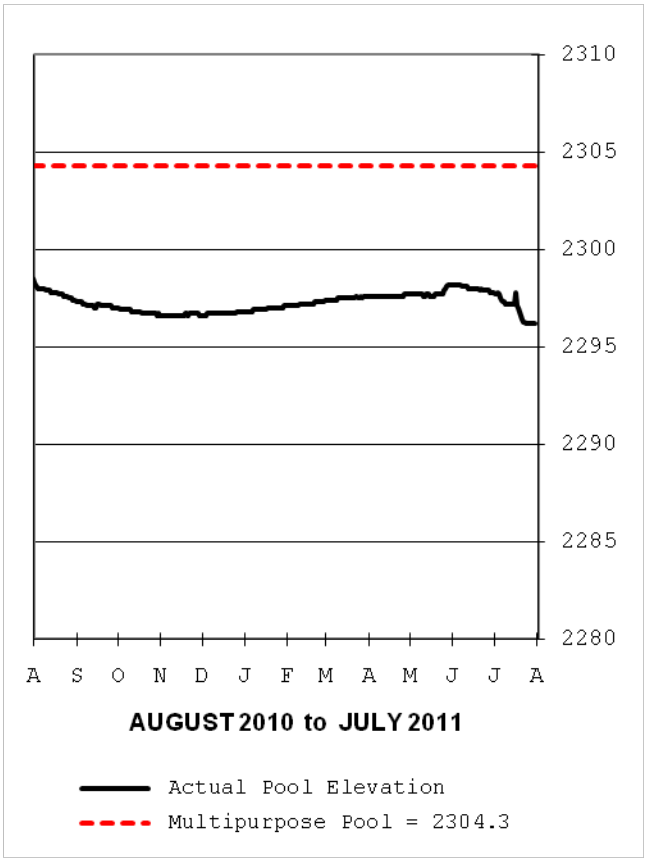
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2553.8 1 Aug 10	**2551.4 31 Jul 11**	**2556.7 29 May 11**	**2552.5 7 Apr 11**	**2584.11 16 Jul 67**	**2552.5 7 Apr 11**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
150 21 Jun 11	**14,907**	**125 23 Jun 11**	**4 Many Days**
No minimum required release. The outflow is mostly seepage.			

KEITH SEBELIUS LAKE
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD E XPANDED FOR READING EASE.





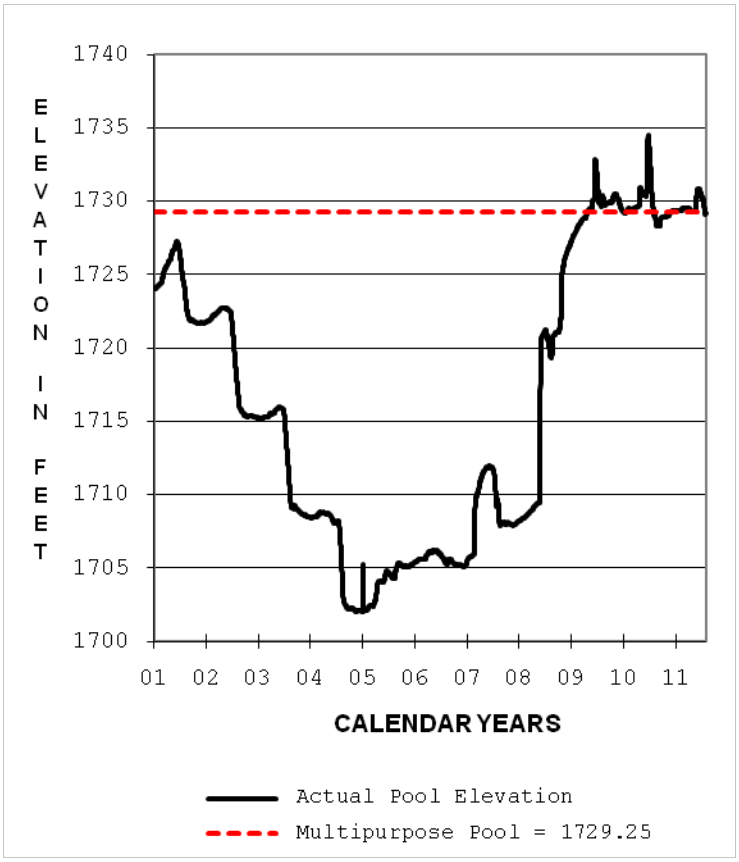
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2298.3 1 Aug 10	**2296.2 31 Jul 11**	**2298.3 1 Aug 10**	**2296.2 31 Jul 11**	**2306.47 15 Feb to 4 Mar 97**	**2275.82 1 Feb 82**

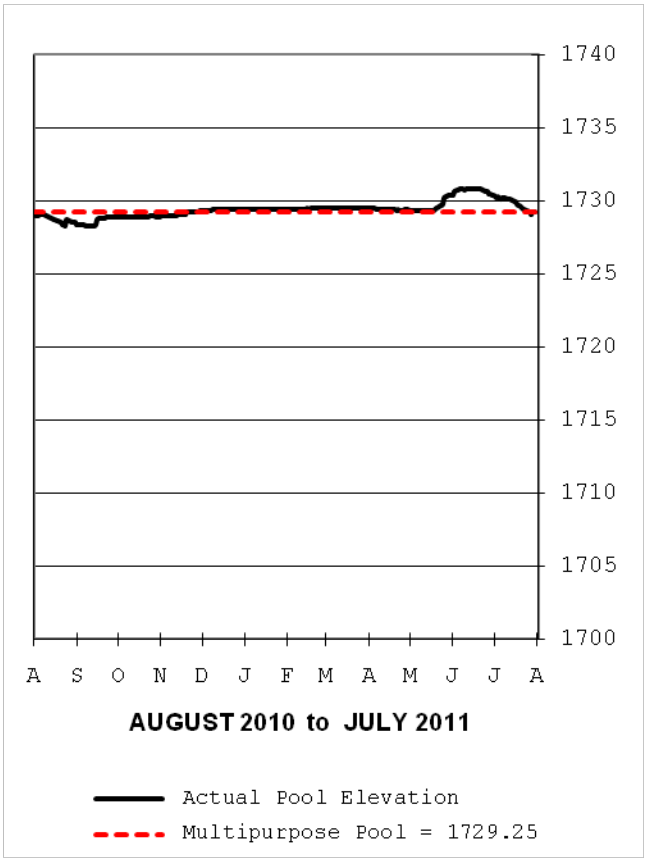
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
150 25 May 11	**6,997**	**121 5 Jul 11**	**1 26 May 10**

No minimum required release. The normal outflow is mostly seepage.
Historic Minimum Pool Elevation of 2275.82 occurred on many days 28-29 Nov 81 and 20 Jan to 1 Feb 82.

KIRWIN RESERVOIR
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.





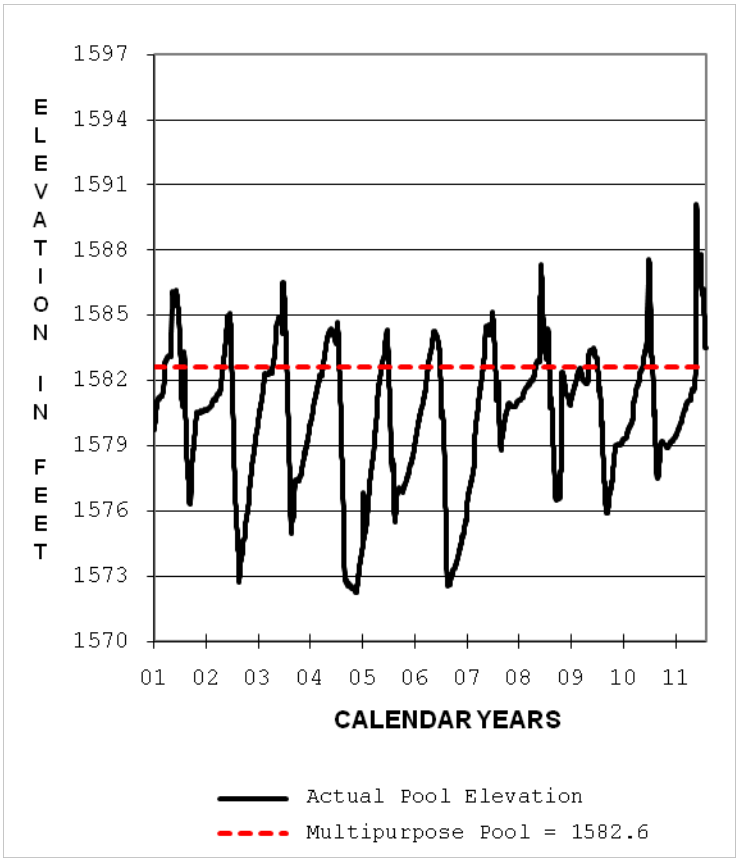
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1729.1 1 Aug 10	**1729.2 31 Jul 11**	**1730.8 5 Jun 11**	**1728.3 23 Aug 10**	**1737.07 2 Jun 95**	**1695.45 11 Feb 81**

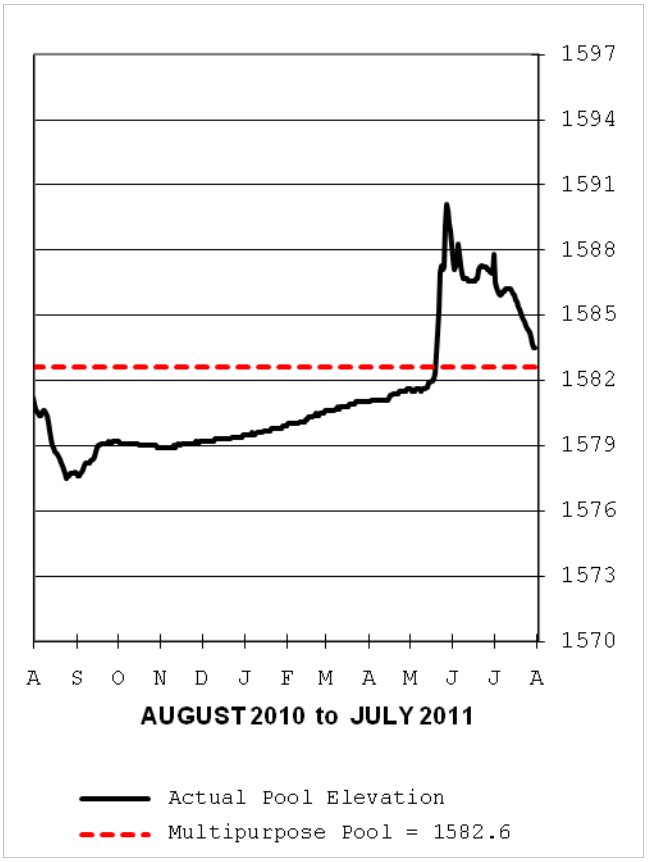
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
1000 25 May 11	**51,533**	**182 1 Aug 10**	**0 Many Days**

Max daily outflow is river release only. Max release to canal was 150 cfs on 7 Aug 04. No min required release.

LOVEWELL RESERVOIR
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.





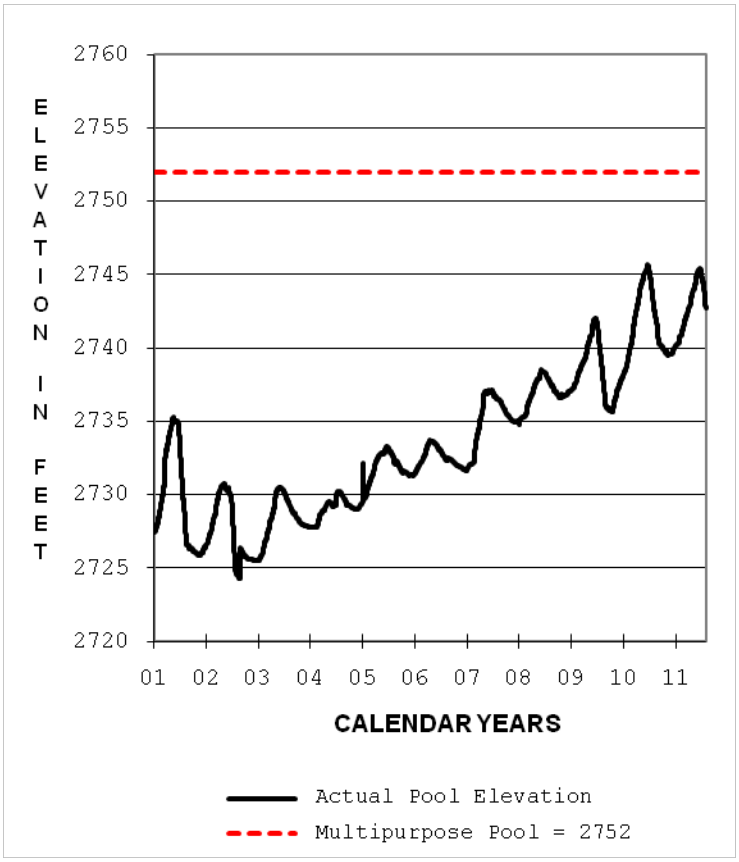
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1580.9 1 Aug 10	**1583.5 31 Jul 11**	**1590.1 27 May 11**	**1577.5 24 Aug 10**	**1595.34 22 Jul 93**	**1570.20 22 Aug 91**

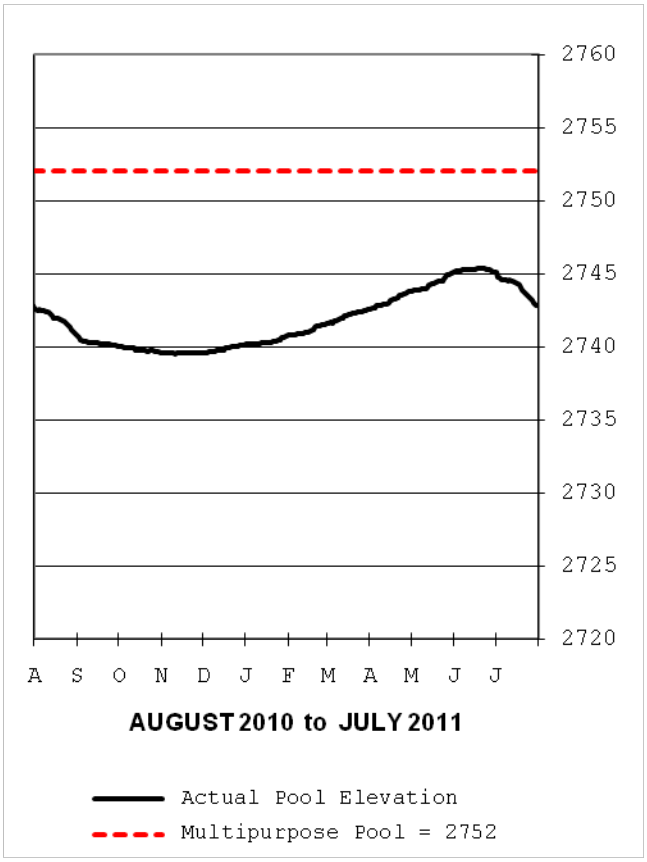
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
4,000 26 May 11	**71,505**	**1250 28 May 11**	**0 Many Days**

Max daily outflow is river release only. Max release to canal was 425 cfs on 6 Aug 04. No min required release.

SWANSON LAKE
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.



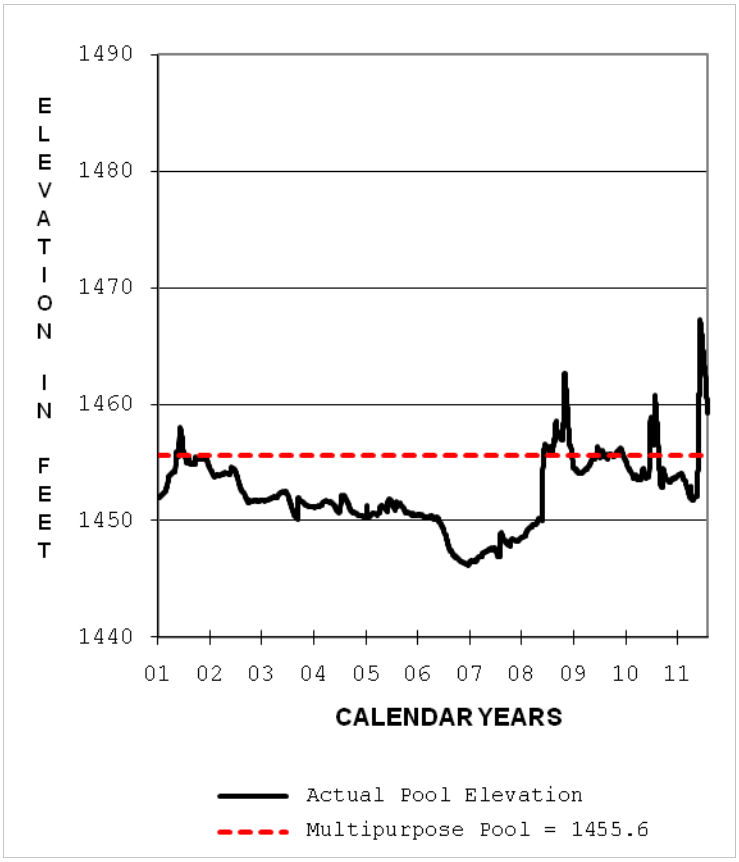


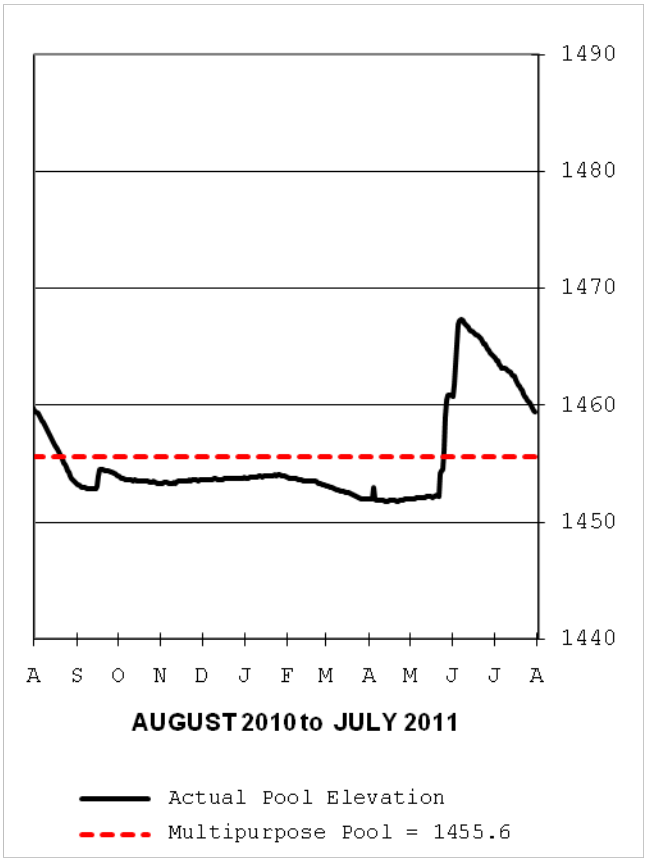
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
2742.7 1 Aug 10	**2742.7 31 Jul 11**	**2745.4 17 Jun 11**	**2739.5 11 Nov 10**	**2757.40 3-4 Aug 62**	**2724.30 26 Aug 02**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
500 24 May 11	**34,959**	**193 1 Aug 10**	**1 Many days**
Maximum daily outflow is river release only (mostly seepage). No releases from canal. No min required release.			

WACONDA LAKE
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.





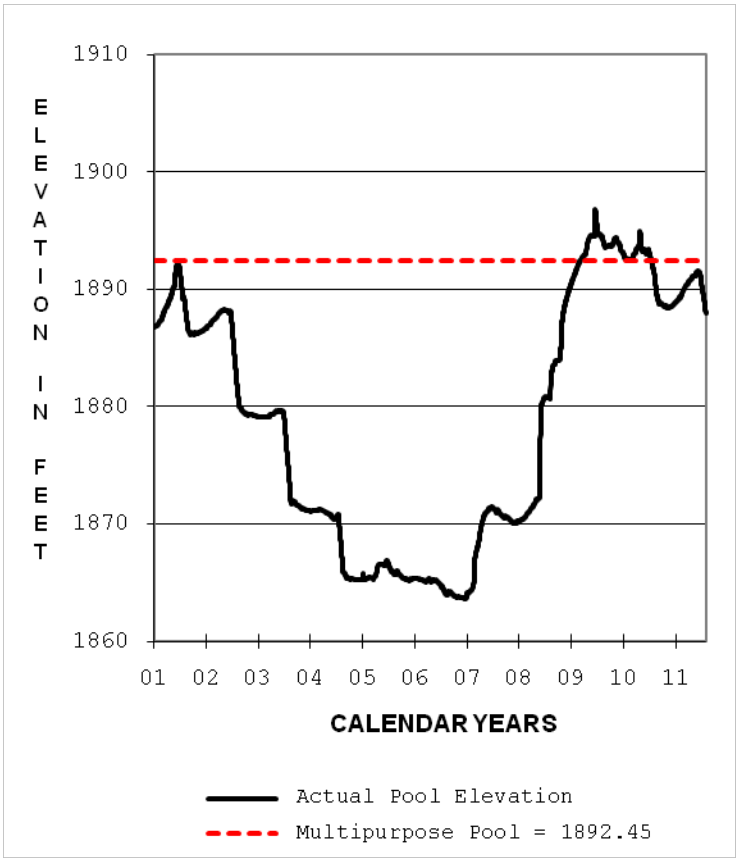
Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1459.6 1 Aug 10	**1459.2 31 Jul 11**	**1467.3 7 Jun 11**	**1451.8 12 Apr 11**	**1487.02 29 Jul 93**	**1446.18 19 Dec 06**

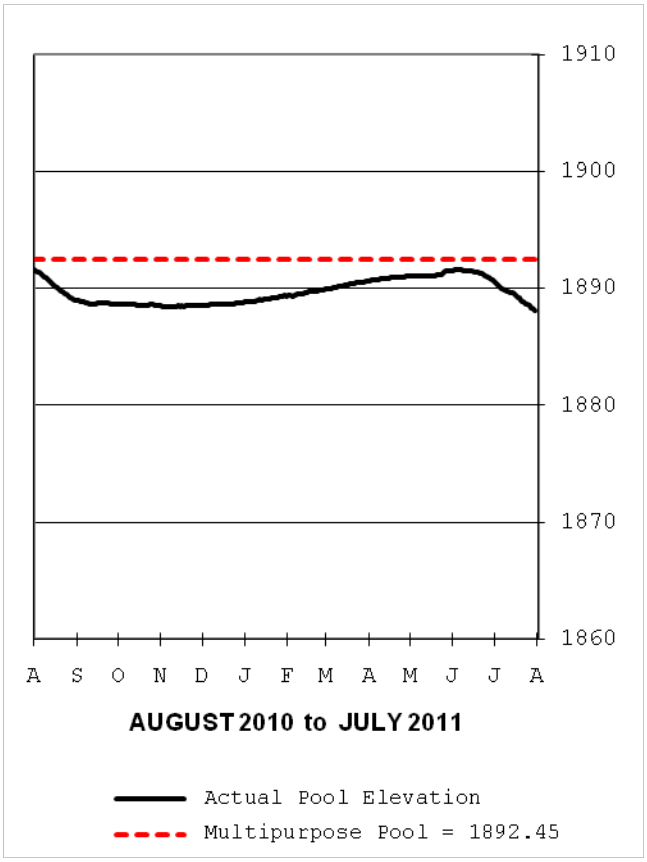
Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
30,000 3 Jun 11	**457,594**	**1,701 1 Aug 10**	**1 4 Jun 11**

Max daily outflow is river release only. No min required release, but min mean monthly flow of 24 cfs is desirable.

WEBSTER RESERVOIR
2010 - 2011 REGULATION

A 10-YEAR POOL ELEVATION HYDROGRAPH IS SHOWN BELOW WITH THE CURRENT REPORTING PERIOD EXPANDED FOR READING EASE.





Pool Elevation, ft. msl.					
Starting Period	Ending Period	Period Maximum	Period Minimum	Historic Maximum	Historic Minimum
1891.57 1 Aug 10	**1888.03 31 Jul 11**	**1891.57 1 Aug 10**	**1888.03 31 Jul 11**	**1907.04 5 Jun 95**	**1857.35 22-29 Oct 71**

Report Period Inflow and Outflow			
Maximum Daily Inflow Day Second Feet	Period Total Inflow Acre Feet	Maximum Daily Outflow Day Second Feet	Minimum Daily Outflow Day Second Feet
180 25 May 11	**20,202**	**140 10 Aug 10**	**0 Many Days**

All releases to river. Max daily outflow occurred as part of normal irrigation releases. No minimum required release.