Placer County Water Agency
Middle Fork American River Hydroelectric Project
(FERC No. 2079)

DRAFT

RALSTON AFTERBAY RECONNAISSANCE-LEVEL HARDHEAD WATER TEMPERATURE SUITABILITY INVESTIGATION STUDY PLAN

Prepared for:

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Revised April 17, 2006

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1.0 INTRODUCTION

During the Placer County Water Agency's (PCWA's) Middle Fork American River Project (MFP or Project) flow-temperature subcommittee meeting held on May 6, 2005, the U.S. Forest Service requested that PCWA conduct a reconnaissance-level investigation to evaluate the suitability of water temperature in Ralston Afterbay Reservoir for hardhead (*Mylopharodon conocephalus*). Ralston Afterbay is located about 80 km northeast of Sacramento, California, and about 52 km upstream from Folsom Dam. It serves as a re-regulating reservoir for Ralston Powerhouse, which is located at the upstream end of the reservoir on the Rubicon River.

Hardhead are large minnows (family *cyprinindae*) found throughout low- to mid-elevation streams in the Sacramento-San Joaquin drainage, as well as the Russian River. Hardhead tend to favor waters with summer temperatures in excess of 68°F (20°C), selecting the warmest available water within the stream (e.g., Baltz et al. 1987). Laboratory preference studies indicated that hardhead choose water temperatures between 75.2-82.4°F (24-28°C) (SMUD 2004). Hardhead also tend to prefer stream reaches with sand-gravel-boulder substrates, slow (20-40 cm/sec) velocities and higher oxygen levels (e.g., Moyle and Nichols 1973). Nearly always found in association with Sacramento pikeminnow (*Ptychocheilus grandis*), hardhead tend to be absent from streams populated primarily by introduced species. Although they tend to be negatively associated with highly disturbed areas, hardhead are known to be abundant in a few mid-elevation hydroelectric reservoirs (e.g. Redinger, Kerkhoff, and Britton Reservoirs) (Moyle and Nichols 1973). Within Britton Reservoir, hardhead are most abundant in the upstream reaches where habitat is more riverine, versus the more lacustrine downstream reaches favored by introduced predatory fish (e.g., bass). The margin habitat areas of reservoirs are used by juvenile hardhead (SMUD 2004).

PCWA's consultant, Surface Water Resources, Inc. (SWRI) will conduct a reconnaissance-level investigation into the potential suitability of water temperature in Ralston Afterbay Reservoir for hardhead. On July 14, 2005, SWRI applied the draft assessment methodology described in this Study Plan in an effort to fine-tune the methodology and to become familiar with Ralston Afterbay Reservoir and its habitats. Upon approval of this Study Plan, SWRI anticipates performing a site final assessment for potential water temperature monitoring locations during June, pending streamflow conditions. The water temperature loggers will be installed following completion of the site assessment.

2.0 OBJECTIVES

The objective of the site assessment is to locate six sites in the Ralston Afterbay Reservoir where stationary water temperature loggers would be installed. Monitoring site selection criteria will include reported hardhead habitat preferences, including depth, water velocity, substrate, water quality, and vegetation. Overall, sites will be selected for water temperature monitoring that: (1) are representative of the available

habitat in Ralston Afterbay Reservoir; (2) contain habitat characteristics that resemble those habitat conditions reported to be suitable, ideal, or preferred for the various life stages of hardhead; and (3) allow for the sufficient longitudinal coverage of the reservoir. Individual sites selected may not meet each of the aforementioned criteria but, when combined, the overall monitoring program should. The goal of this study, along with the on-going reservoir water temperature profiling, is to characterize the water temperature regime in Ralston Afterbay under typical operations.

3.0 HISTORICAL RALSTON AFTERBAY RESERVOIR ELEVATION FLUCTUATION

Ralston Afterbay Reservoir may experience daily fluctuations in reservoir elevation depending upon: (1) daily power generation peaking operations at Ralston Powerhouse and a non-coincident release pattern at Oxbow Powerhouse; and (2) seasonal fluctuations in response to (1) (above) and the amount of total runoff for the season. An inspection of Ralston Powerhouse generation records for the past ten years (1994 - 2004) shows that based on delivered generation, 2001 represents the approximately driest one-third of years, 2000 represents the approximately average one-third of years, and 1995 represents the approximately wettest one-third of years. Additionally, there are more 'extreme' wet and dry years. Figures 1 through 15 present Ralston Afterbay Reservation daily elevation (in feet) for the June through October periods in 1995, 2000, and 2001. Note that the decrease in Ralston Afterbay Reservoir elevation during September is the result of scheduled annual maintenance of Ralston and Oxbow powerhouses, and maintenance work on Ralston Dam. An outage of two to three weeks (depending on required maintenance and safety work) is scheduled each year during September. The subsequent increase in Ralston Afterbay Reservoir elevation during October represents refilling of the Ralston Afterbay and resuming power generation at Ralston and Oxbow powerhouses following the completion of the maintenance activities.

It is premature to anticipate the operations of the Ralston Powerhouse during 2006. Based on past operations, the Ralston Afterbay Reservoir elevation likely would remain relatively constant from May through the first half of September, at which point a substantial decrease in elevation would occur resulting from powerhouse maintenance. However, diurnal fluctuations or fluctuations of a few days of up to several feet as a result of power generation requirements or other factors are likely. The range of possible reservoir elevation fluctuation will be considered when assessing and installing water temperature monitoring sites because of the potential for dewatering the water temperature loggers.

Additionally, Figures 1 through 15 also illustrate the potential inter-annual variability in reservoir elevation at Ralston Afterbay. The year-to-year variability in reservoir elevation fluctuation, coupled with climatological and hydrological variability, is anticipated to have direct impacts to the seasonal and annual Ralston Afterbay water temperature regime. Therefore, water temperatures in Ralston Afterbay Reservoir potentially exhibit relative large year-to-year variation.

4.0 PAST RALSTON AFTERBAY RESERVOIR THERMAL PROFILE RESULTS

Reservoir water temperature profiles were taken at Ralston Afterbay Reservoir on July 14, August 16, September 19, and October 25, 2005. Figure 16 presents the results of the water temperature profiles. The profiles were taken in the deepest part (approximately 23-26 feet deep) of the reservoir, in the middle, that is legally accessible by boat (the section of reservoir near the dam face is restricted for safety). The profile location is presented in Figure 17. As illustrated in Figure 16, the upper approximately 10 feet, especially the upper 5 feet, of Ralston Afterbay Reservoir is subject to some thermal heating and the lower approximately 15 feet is fairly homogeneous at approximately 47-51ºF. Surface water temperatures during the warmest months (July and August) were up to about 8ºF warmer than surface temperatures in September and October. Reservoir profiling will continue to be conducted at Ralston Afterbay Reservoir during 2006.

5.0 MONITORING LOCATION SITE SELECTION METHODOLOGY

At least ten potential monitoring locations will be assessed as part of the investigation. The ten potential monitoring locations to be assessed will be identified by stratifying Ralston Afterbay Reservoir into six approximately equal-length reaches (Figure 17). Reach 1 will not be assessed because it is located in a restricted portion of the reservoir (between the dam and the log boom, where boats are not allowed as a safety precaution). The potential monitoring sites to be assessed will then be selected in the field by weighting factors such as slope, depth, water velocity, water temperature, and representativeness of the available habitat within the specific reach. Within each reach, at least one relatively deeper site and one relatively shallower site will be assessed. More sites will be assessed if time permits.

The monitoring location assessment will generally focus on the margins of Ralston Afterbay Reservoir because, although Ralston Afterbay Reservoir is generally steep-sided, the margins of the reservoir will generally provide relatively shallow water compared to the main channel. The investigation will focus on margin habitat also because these areas are generally subject to more thermal heating due to the relatively slow water velocities and shallower habitat conditions. Additionally, although the literature suggests that hardhead may prefer the upstream, more riverine portion of Ralston Afterbay Reservoir, a reach was not established at the upper end of the reservoir because: (1) water velocities at the upper end of the reservoir (downstream from the Ralston Powerhouse outlet) minimize potential lateral water temperature variation; and (2) water temperature is currently being monitored at the upper end of the reservoir (OX1) by stationary water temperature loggers that were installed in 2004.

Utilizing this location selection methodology will result in a water temperature monitoring station array that contains sufficient spatial coverage in Ralston Afterbay Reservoir to allow for a broad characterization of available water temperatures as well as one that considers hardhead habitat suitability.

At each potential monitoring station, the following data will be collected:

- Time
- Location in UTM
- Water temperature in degrees Celsius
- Air temperature in degrees Celsius
- Depth in meters at the expected installation point
- Water column velocity in centimeters per second
- Dissolved oxygen content
- Large woody debris: presence and number of logs in each of four size classes (1-5 cm, 6-10 cm, 11-50 cm, >51cm)
- Root wads: presence and total count
- Submerged vegetation: percent cover of both rooted and floating vegetation
- Fish species observed
- Substrate: percent cover of silt, sand, gravel, cobble, and boulder substrate classes
- Turbidity: rated on a scale from one to five, with one being completely clear and five being opaque
- Riparian zone width in meters on each bank
- Bank description including the presence of undercut banks, as well as composition, slope, dominant vegetation, and signs of bank erosion
- Channel width in meters
- Stream habitat type: riffle, pool, or run
- Anthropogenic channel alterations

The draft data collection data sheet is attached for reference (Appendix A).

6.0 LOCATION ASSESSMENT ANALYSIS

After collection, the data from each location that was assessed will be examined and compared to hardhead habitat preferences reported in the literature. Numerous studies

have identified water temperature, substrate, depth, and velocity as the most important factors affecting microhabitat choice by hardhead (e.g. Moyle and Nichols 1973), thus, these variables will be important factors affecting site selection. The remaining habitat variables will be used to further narrow the selections, as necessary. Six sites will be selected for water temperature logger installation that, when combined, meet the aforementioned site selection criteria:

- Represent the available habitat in Ralston Afterbay Reservoir;
- Contain habitat characteristics that resemble those habitat conditions reported to be suitable, ideal, or preferred for the various life stages of hardhead; and
- Sufficiently cover the reservoir longitudinally.

7.0 WATER TEMPERATURE LOGGER INSTALLATION METHODOLOGY

The six water temperature loggers will be installed using a float, tether, and anchor. A piece of driftwood will be utilized as the float and will be anchored with a small diameter nylon rope using enough weight to ensure that it is not moved downstream by the current. The water temperature logger will be attached to the rope one meter below the float.

There is some concern that changes in Ralston Afterbay Reservoir elevation will cause the float, tether, and logger to move or possibly be beached. To ensure that the water temperature loggers remain in their proper positions, SWRI will communicate with PCWA Power Systems throughout the monitoring period to obtain current information on reservoir levels. In the event that a substantial reservoir elevation change is planned for a long duration (i.e., greater than a few days), SWRI will visit the water temperature monitoring locations and adjust the position of loggers, if appropriate.

8.0 DATA COLLECTION

The six water temperature loggers will be visited at least once a month following installation through late-September for general site maintenance and data download. Additional site maintenance will occur as necessary. Data download protocols will follow those identified in the Water Temperature Study Plan. These protocols will be evaluated based on the results obtained throughout the season and adjustments may be made as necessary to the monitoring program to respond to challenges. The water temperature loggers will be removed following the September data download, prior to the Ralston Powerhouse annual maintenance.

9.0 REPORTING

A summary report will be prepared following data collection. The summary report will follow the reporting outline provided in the Water Temperature Study Plan.

10.0 REFERENCES

Baltz, D.M., B. Vondracek, L.R. Brown, and P.B. Moyle. 1987. Influence of temperature on microhabitat choice by fishes in a California stream. Transactions of the American Fisheries Society 116:12-20.

Moyle, P.B. and R. Nichols. 1973. Ecology of some native and introduced fishes of the Sierra Nevada foothills in central California. Copeia 1973(3): 478-490.

Sacramento Municipal Utilities District (SMUD). 2004. Upper American River Project, FERC Project No. 2101, Appendix B, Habitat Suitability Criteria Development Figures and Curves Coordinates.

FIGURES

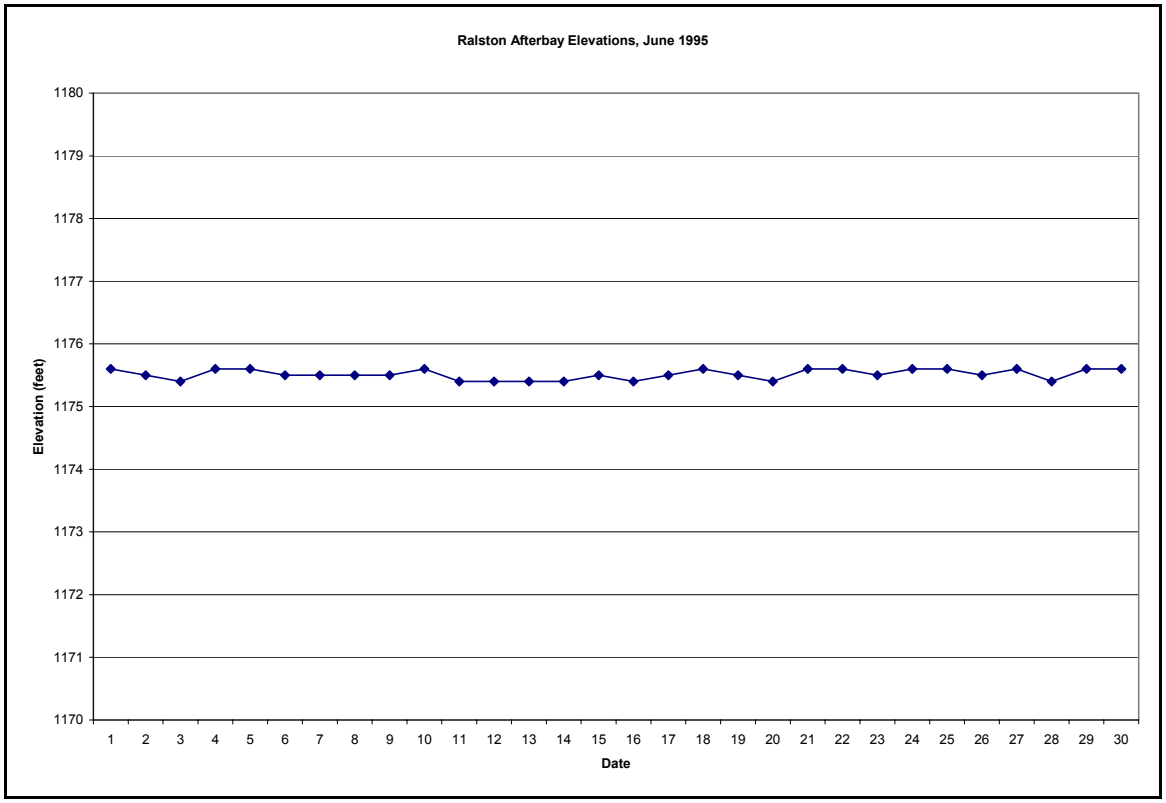

Figure 1. Ralston Afterbay Reservoir elevation (in feet) during June 1995.

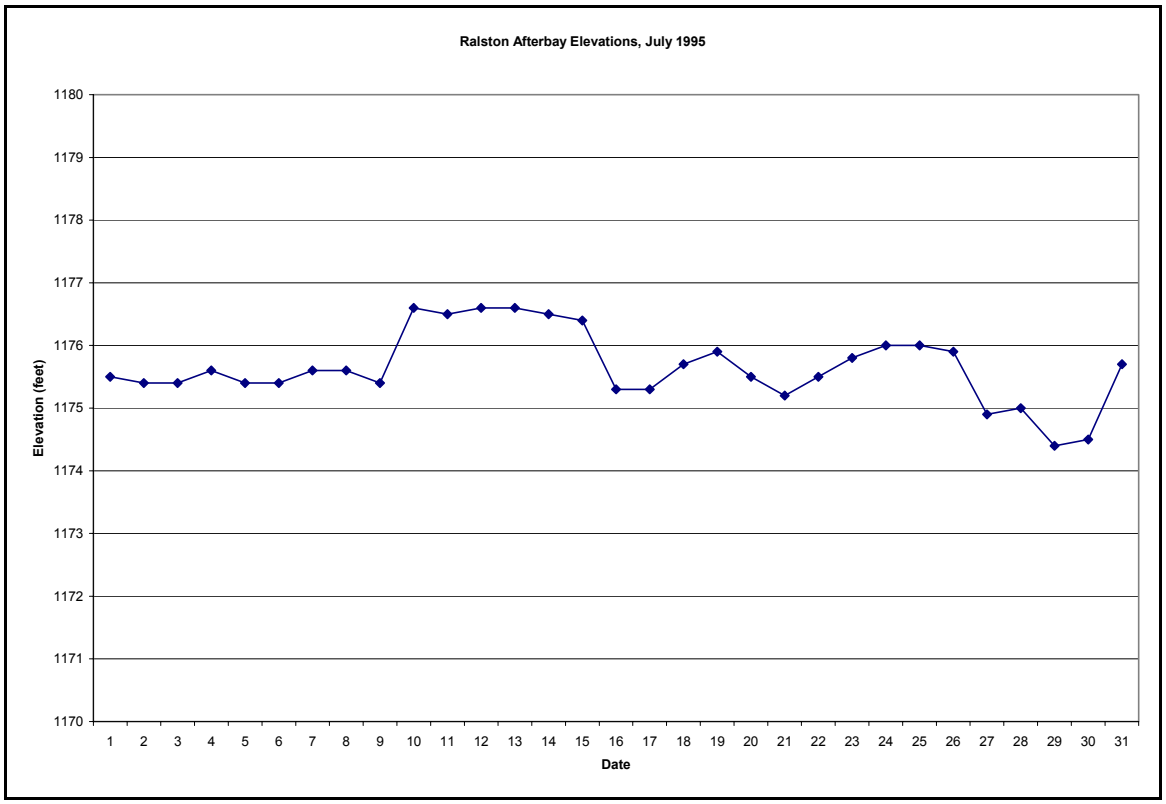

Figure 2. Ralston Afterbay Reservoir elevation (in feet) during July 1995.

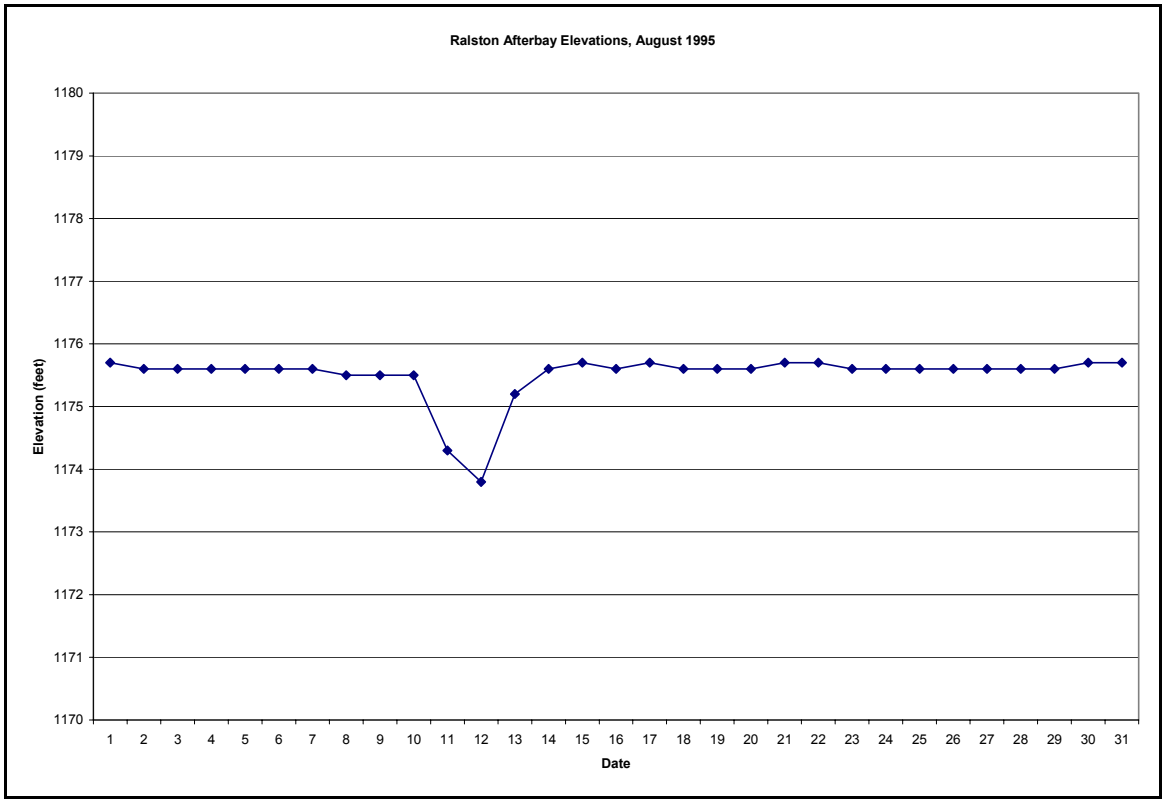

Figure 3. Ralston Afterbay Reservoir elevation (in feet) during August 1995.

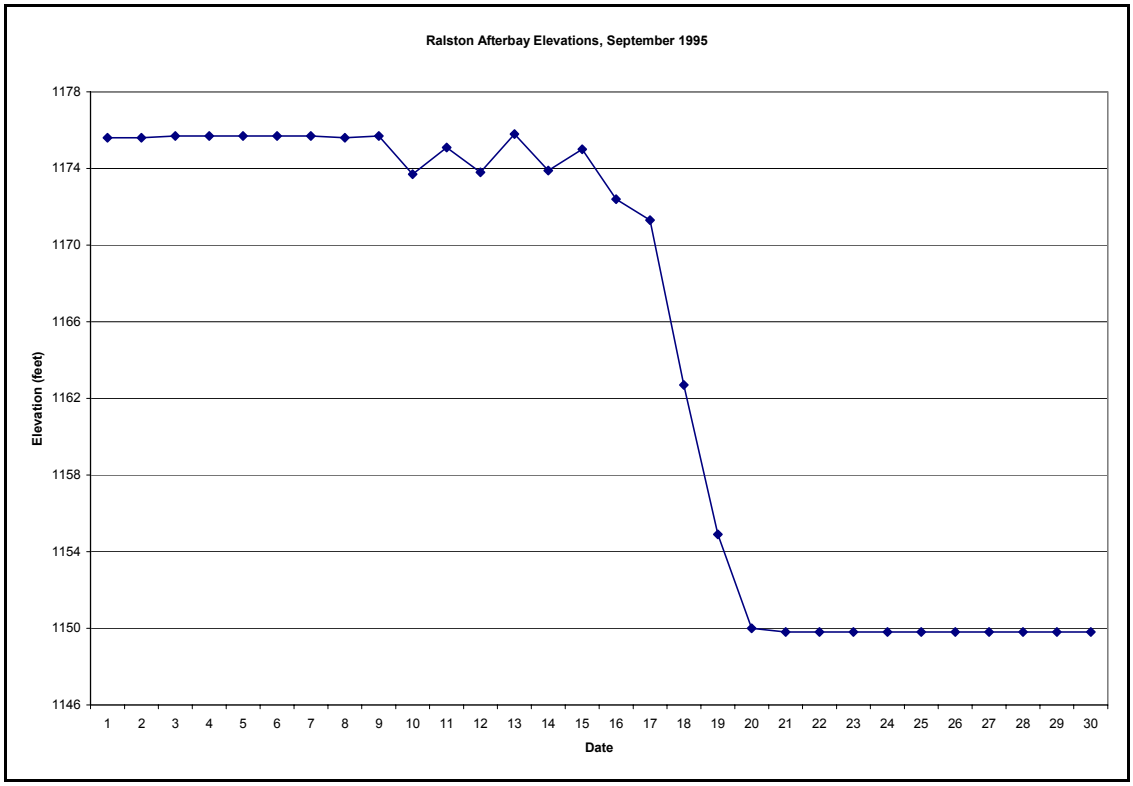

Figure 4. Ralston Afterbay Reservoir elevation (in feet) during September 1995. Please note scale change.

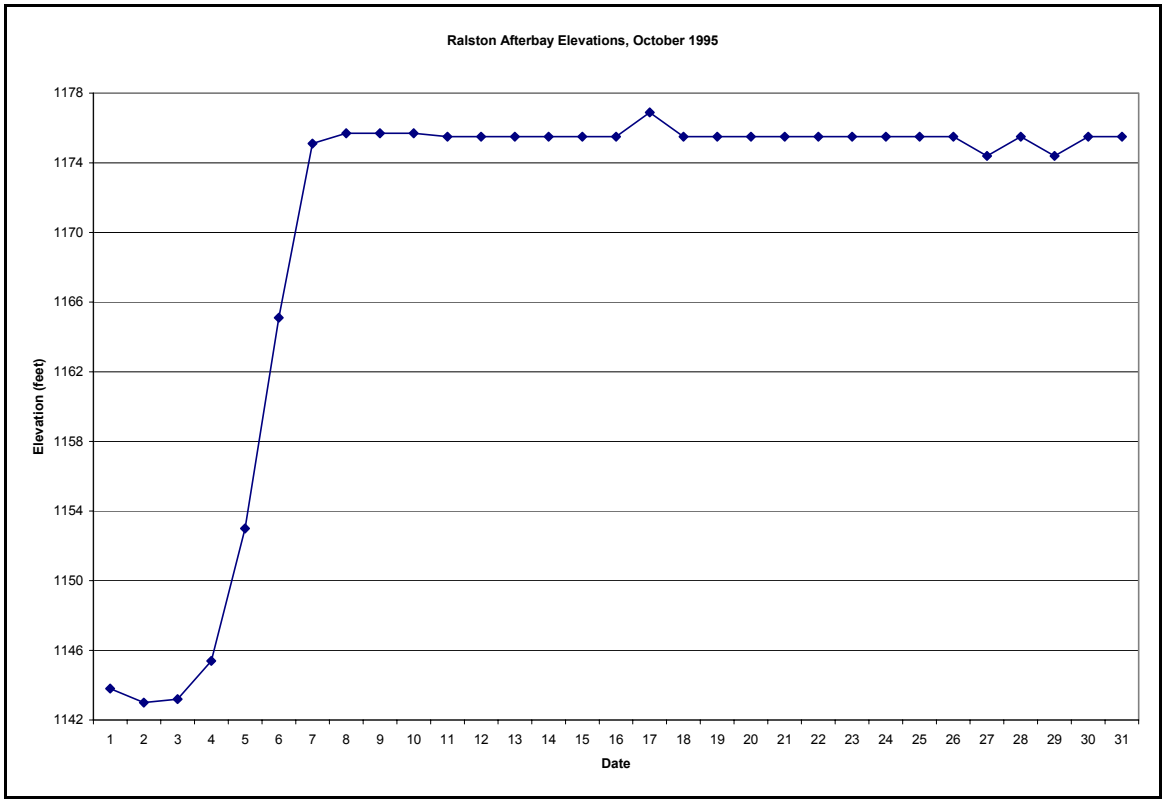

Figure 5. Ralston Afterbay Reservoir elevation (in feet) during October 1995. Please note scale change.

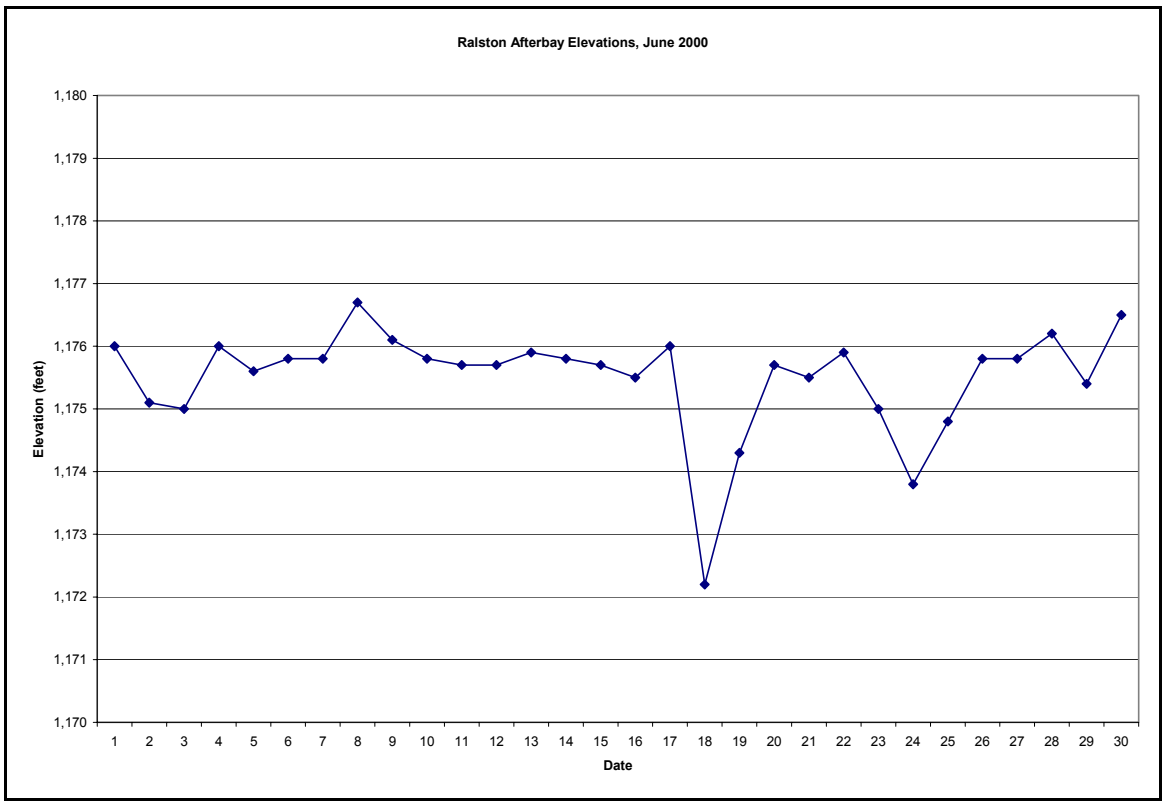

Figure 6. Ralston Afterbay Reservoir elevation (in feet) during June 2000.

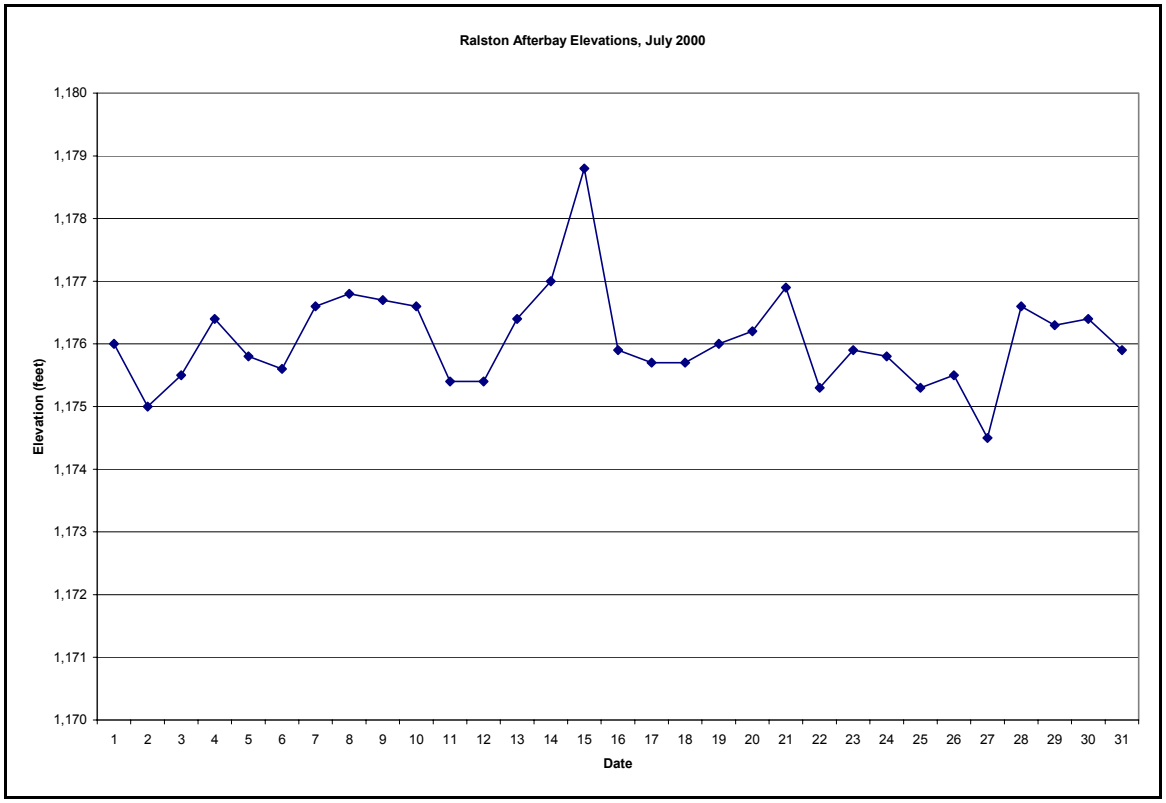

Figure 7. Ralston Afterbay Reservoir elevation (in feet) during July 2000.

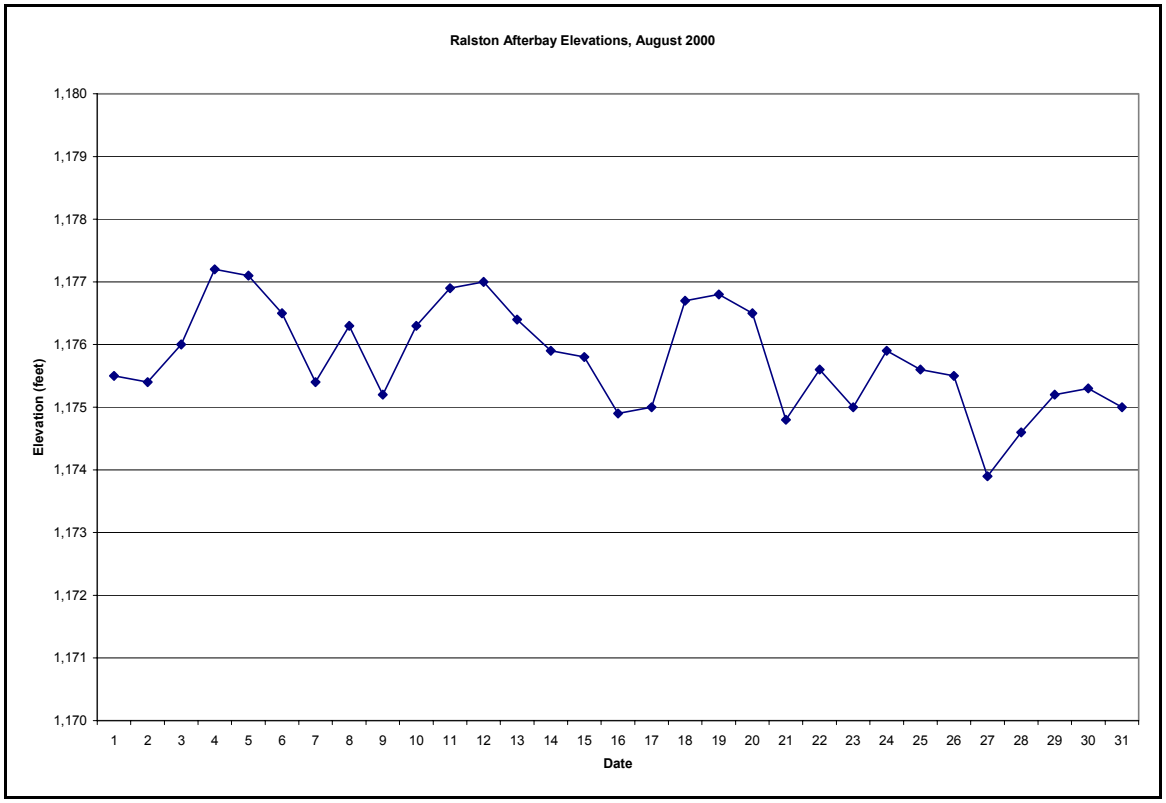

Figure 8. Ralston Afterbay Reservoir elevation (in feet) during August 2000.

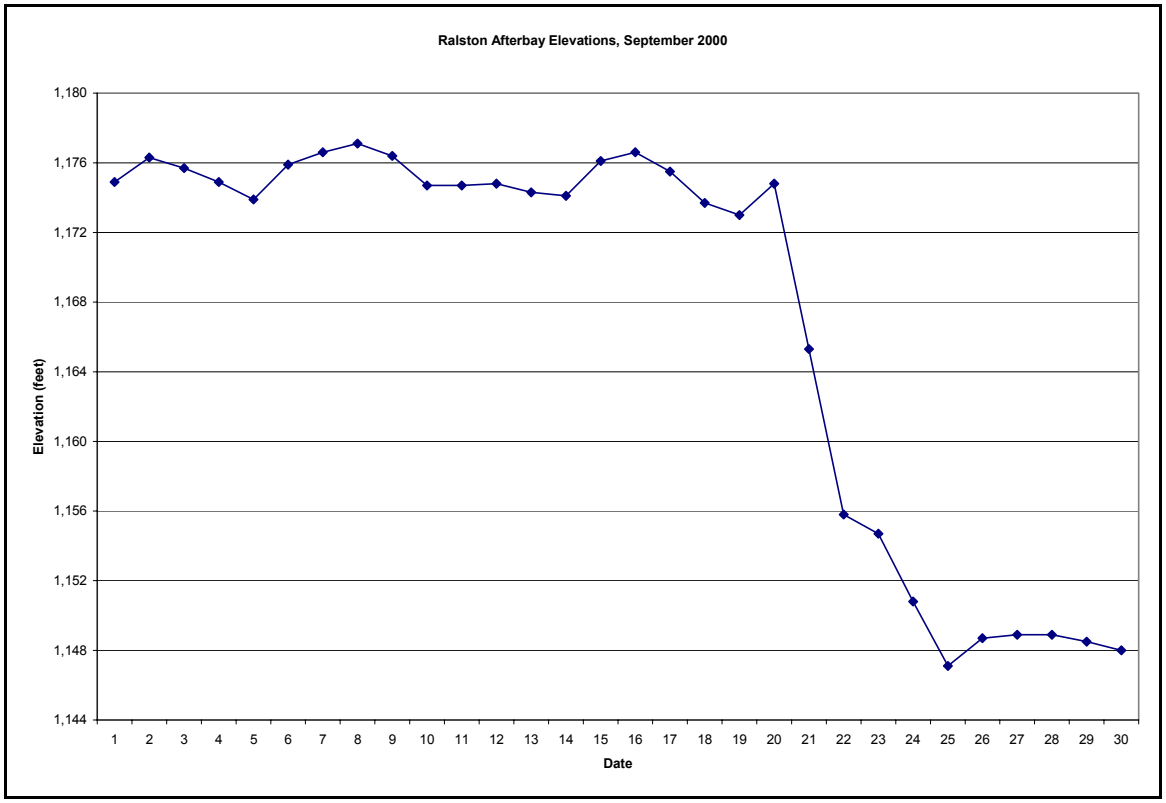

Figure 9. Ralston Afterbay Reservoir elevation (in feet) during September 2000. Please note scale change.

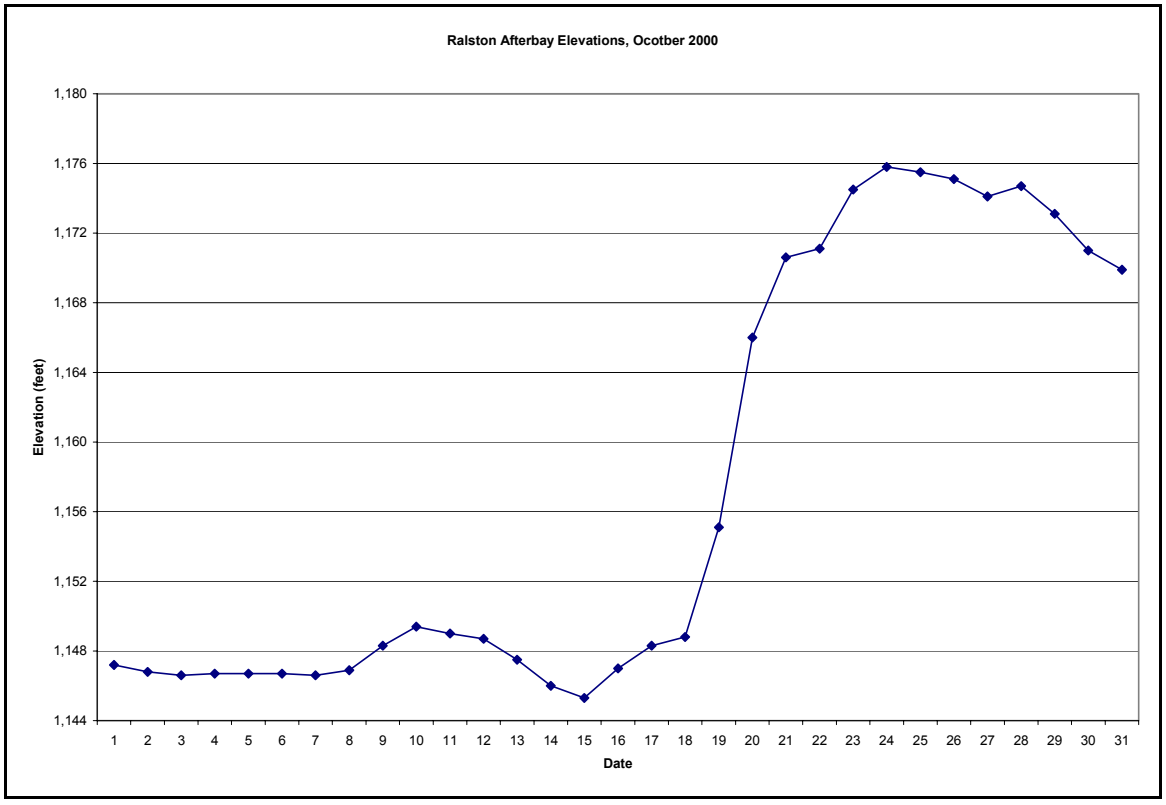

Figure 10. Ralston Afterbay Reservoir elevation (in feet) during October 2000. Please note scale change.

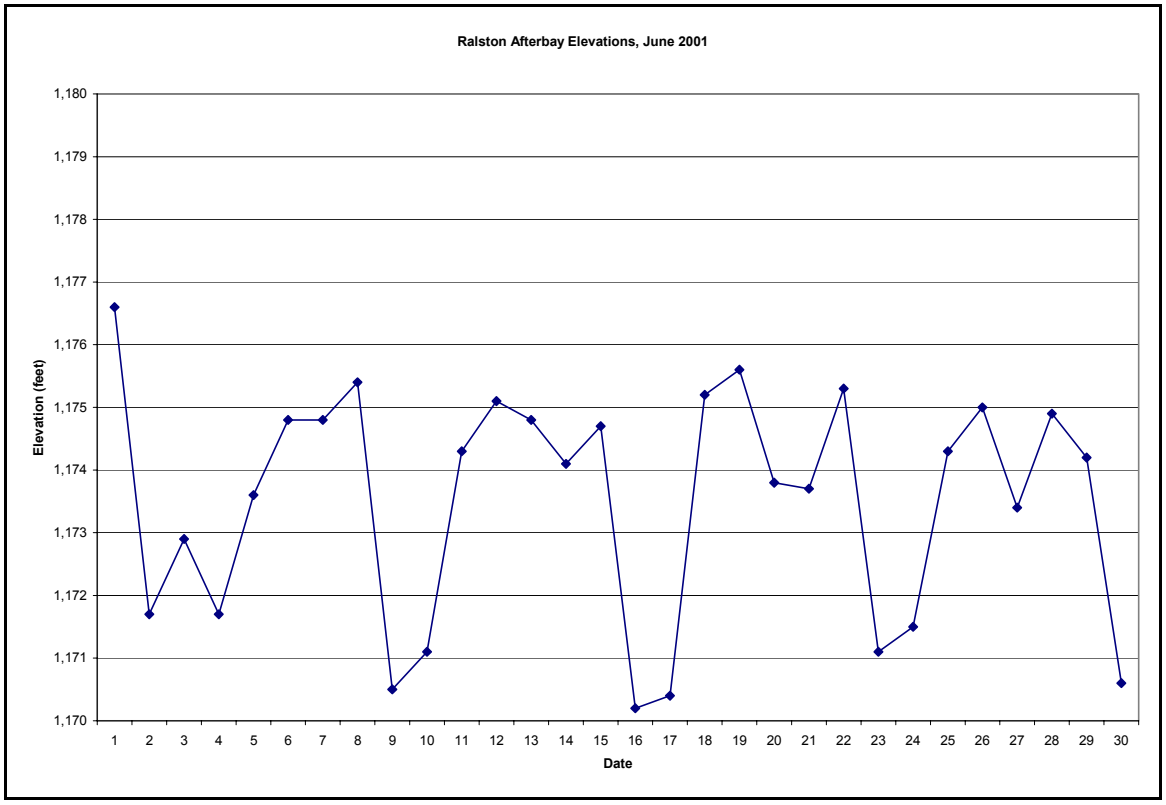

Figure 11. Ralston Afterbay Reservoir elevation (in feet) during June 2001.

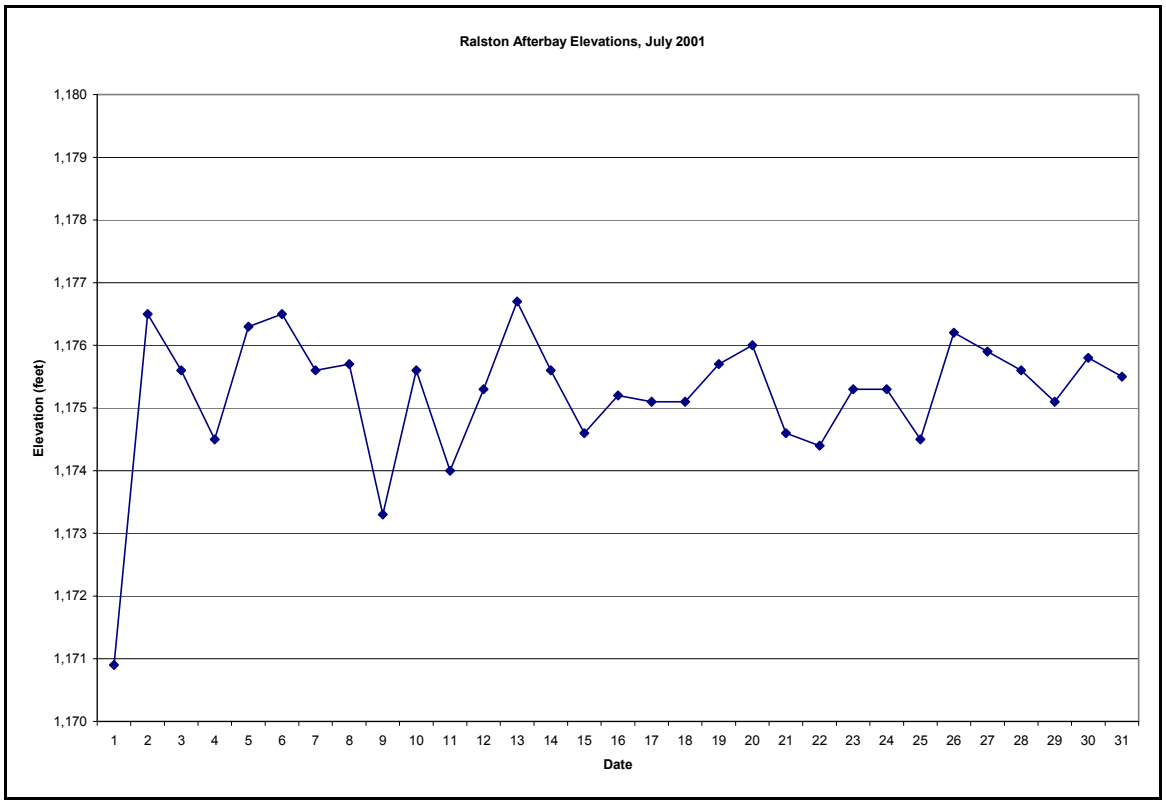

Figure 12. Ralston Afterbay Reservoir elevation (in feet) during July 2001.

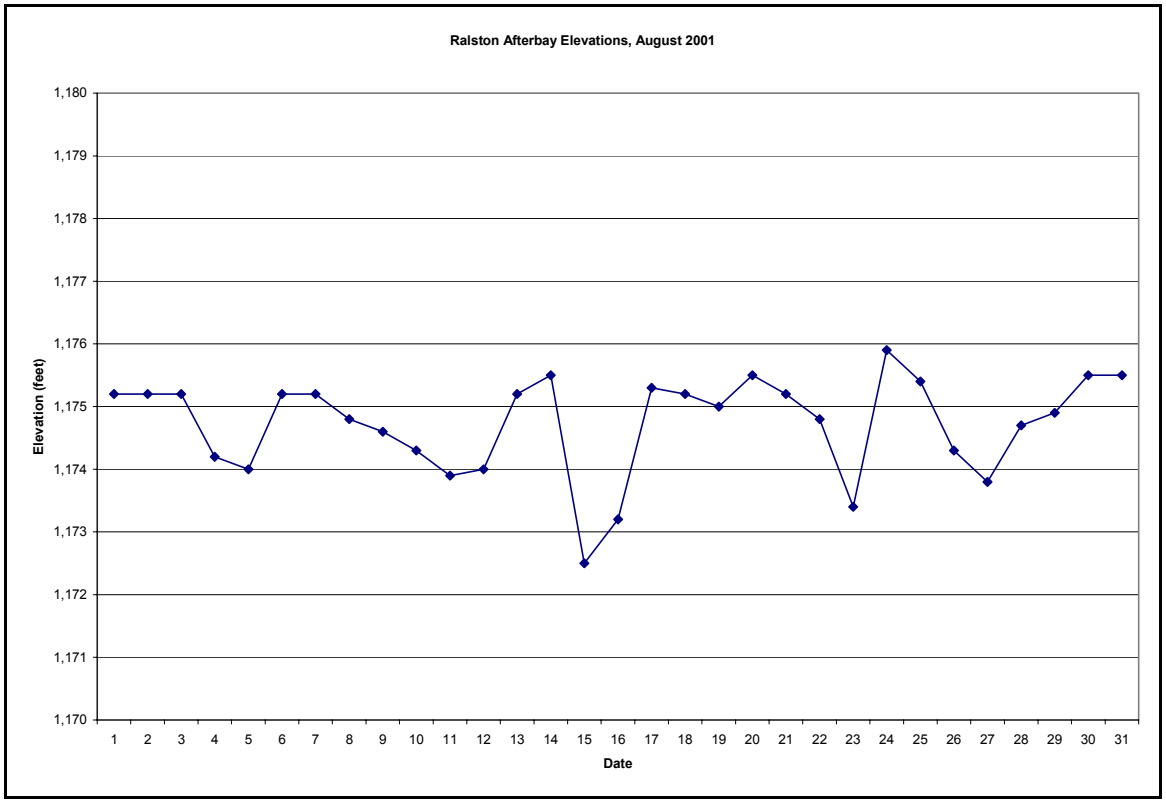

Figure 13. Ralston Afterbay Reservoir elevation (in feet) during August 2001.

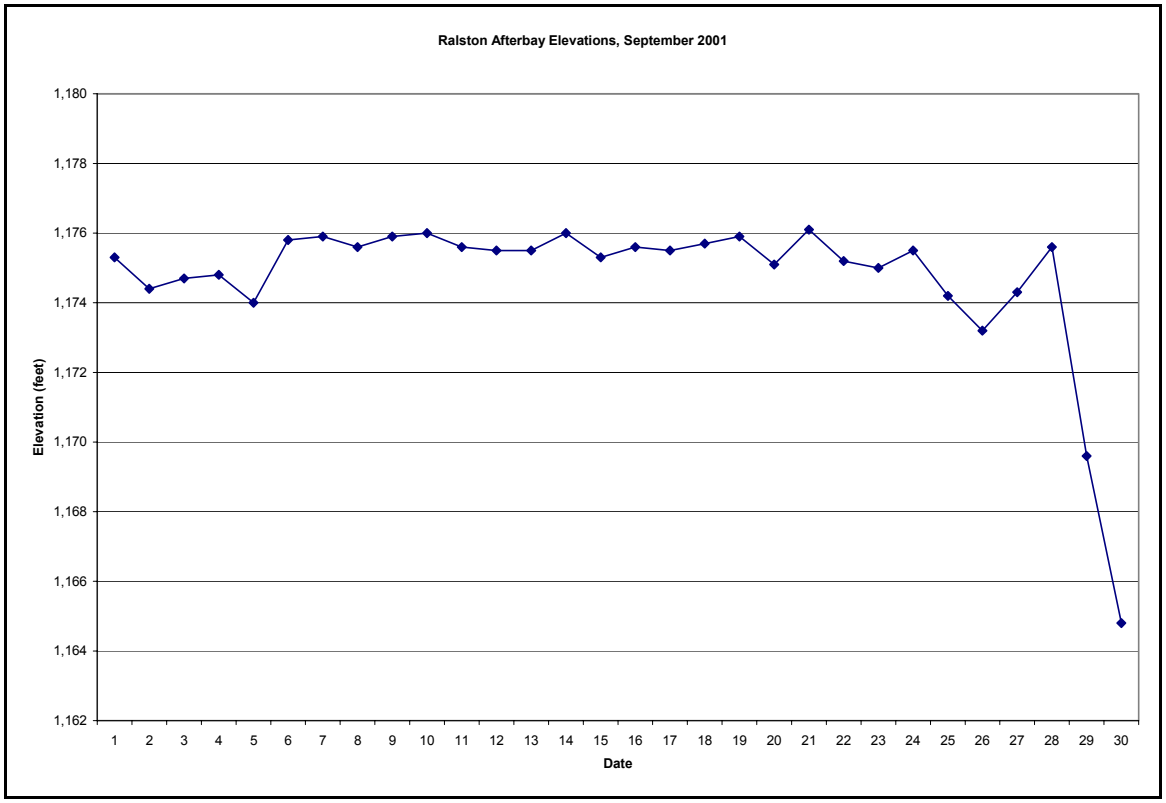

Figure 14. Ralston Afterbay Reservoir elevation (in feet) during September 2001. Please note scale change.

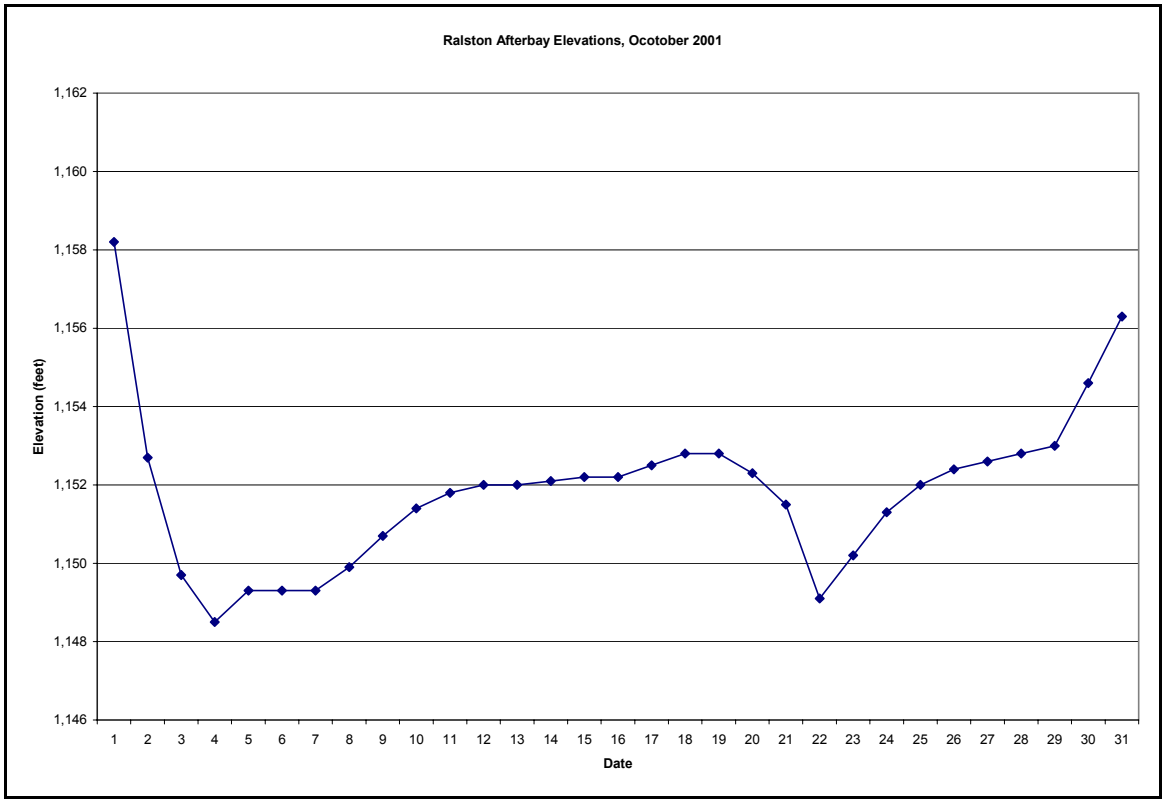

Figure 15. Ralston Afterbay Reservoir elevation (in feet) during October 2001. Please note scale change.

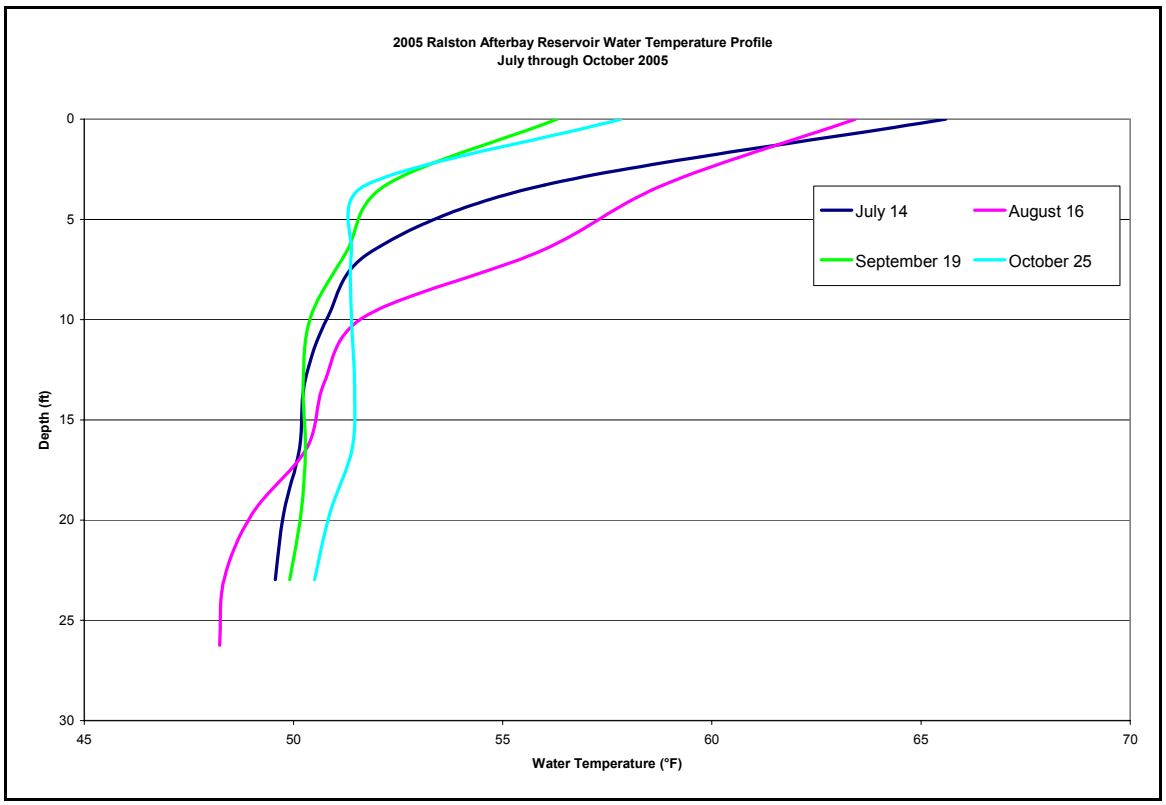

Figure 16. Ralston Afterbay Reservoir water temperature profiles collected during July through October 2005.

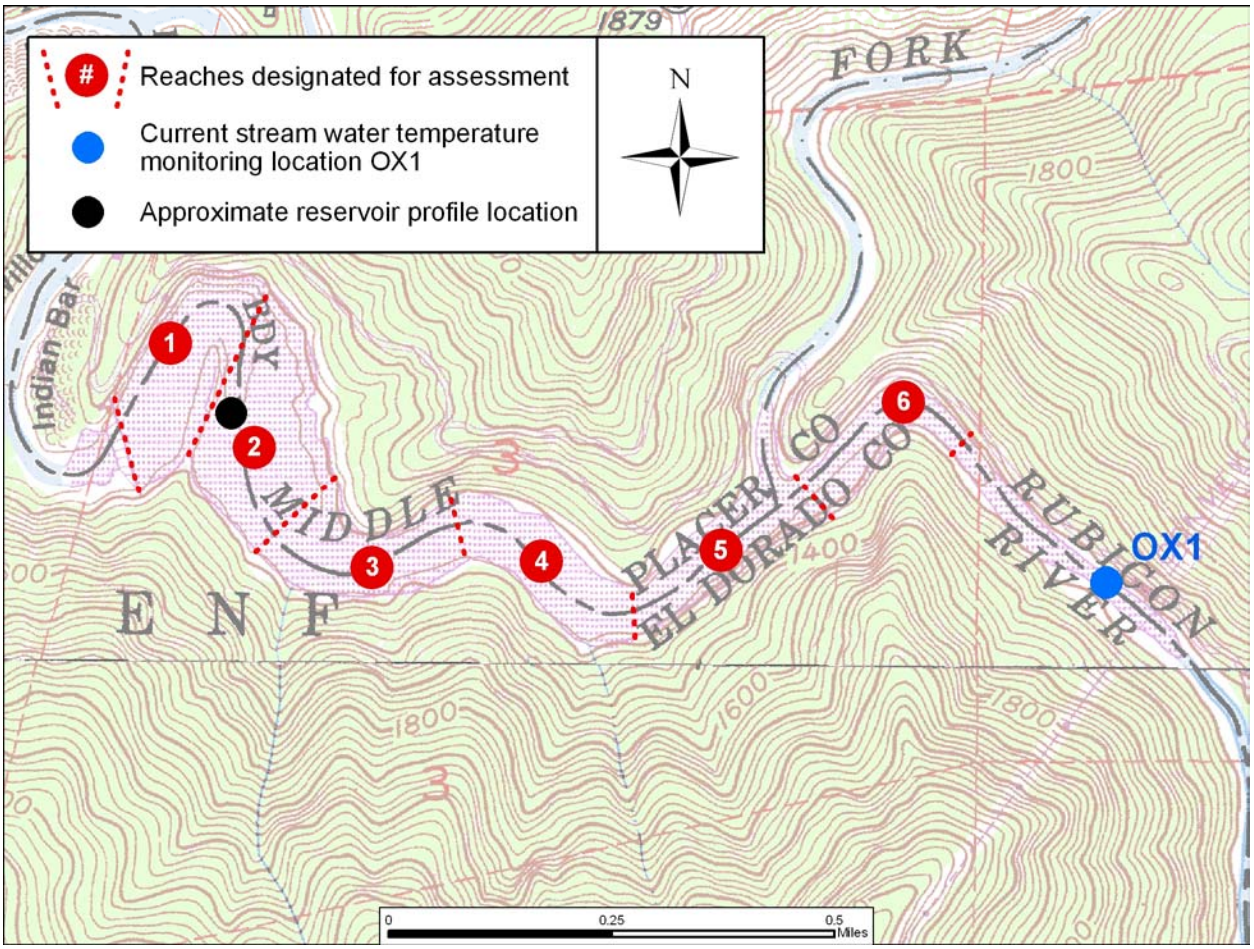

Figure 17. The six Ralston Afterbay Reservoir reaches to be assessed for potential hardhead habitat suitability. After assessing the two locations within each reach (at total of 10 locations), six will be selected for water temperature monitoring.

APPENDIX A

Draft Data Collection Data Sheet

Ralston Afterbay Water Temperature Monitoring Location Assessment Data Sheet

Location:			Observer:		
Date:			Time:		
Digital Photo # (s):					
Site GPS:	Data used:	Easting:		Northing:	
Water Temperature:			Air Temperature:		
Depth:		Approx. Water Column Velocity:			DO:
LWD: Yes❑ No❑	# Observed by size class (cm):	1-5:	6-10:	11-50:	>51:
Root Wads: Y❑ N❑	# Observed:				
Submerged Vegetation (approximate % cover):	Rooted:	Floating:	Fish Observed: Y❑ N❑		
			Species:		
			# observed:		
Substrate:	Silt (%):	Sand (%):	Gravel (%):	Cobble (%):	Boulder (%):
Turbidity: (1-5; 1=clear, 5=opaque)		Level of Substrate Embeddedness:			
Riparian Zone Width (m):	Right Bank:	Left Bank:	Dominant Veg.:		
% of Stream Shaded:					
Bank Description:	Undercut? Y❑ N❑		Approx Slope: Left:	Right:	
	Bank Composition:			Signs of Erosion?: Y❑ N❑	
	Dominant Bank Vegetation:				
Approx. Channel width (m):		Stream Habitat Type (pool, run, etc.):			
Notes:					