PG&E Responses
October 14, 2004

Prattville Temperature Issues
August 25, 2004

The following statements are a compilation of comments made at various public meetings in Chester and Chico, comments and concerns raised by Ron Decoto in a letter to FERC dated June 14, 2003 and recent comments by Bill Dennison in regard to the September 2, 2004 2101LG meeting. The statements do not reflect all comments made on the subject of temperature reduction. The statements are biological or physical in nature only and with one exception do not reflect any comments made concerning cost or economic impacts.

A common thread running through statements concerning the temperature curtain evaluation is that the statements nearly universally are defined in terms of the maximum predicted change in a physical attribute. For example, it has been predicted that in certain situations the depth to the Lake Almanor thermocline will increase by 10 feet. It is then assumed that the 10-foot change will occur every year. What is vitally necessary for the full understanding of the potential changes that might take place is to define those changes in terms of water year type and summer meteorology. By placing impact within the context of climate we will be able to see how frequently an impact of a given magnitude is expected to occur and whether the predicted impact is within the range of variability currently experienced.

Questions are in no particular order of importance but generally start at Lake Almanor and move downstream.

1. Cultural resource surveys have been conducted on the portion of Lake Almanor exposed during low lake levels. There is a possibility that sites are located beneath the lake in the vicinity of the Prattville Intake. Local tribes have knowledge of sites now inundated by Lake Almanor. Photos of construction of the Prattville Intake would be beneficial in identifying probable sites. Surveys, if undertaken, could take place under water. How will local tribes be assured that removal of levee material and associated construction of the temperature curtain will not impact sites?

   <u>Response</u>: In 2001-2002 the Prattville intake area above low lake level was surveyed for cultural resources. No cultural sites were found in this area. However, a survey of the seven areas below low lake level that are currently being evaluated as part of the dredging alternative was not feasible due to inundation. These seven areas have been mapped and are shown on Figure 4-1 in the Prattville Intake Modifications - Phase 3 - Feasibility Study – Final Report, dated January 20, 2004, Black & Veatch. The seven areas identified consist of manmade dikes or levees constructed of previously excavated material taken from the existing intake channel that extends into the lake. These manmade dikes or levees were built in the early 1900's. No detailed records exist about this early channel excavation and dike/levee construction. It is therefore unknown if the dike/levee material contains any cultural artifacts or if cultural sites exist under these structures. However, it is believed that the natural channel areas from which the dike/levee material was taken were low in topography in relation to the immediate area and were relatively marshy. As cultural sites are generally located on higher ground away from such marshy areas, it is likely that the natural in-channel low areas contains few cultural sites although it may have been utilized by tribal groups to hunt, gather, and

procure resources. The material removed from this area to construct the dike/levees therefore likely contains little cultural site material. Following this same line of thinking however, the land upon which the dikes/levees were constructed was slightly higher in elevation that the lower natural channels and therefore may have been more suitable for human habitation. These lands underneath the dikes/levees are more likely to contain cultural sites than the dikes/levees.

In PG&E's Application for New License, Volume 4, Exhibit G-7 the original town of Prattville is mapped. This town was located about one-half mile east of the Prattville Intake and was flooded when the reservoir was filled. PG&E has brief records of the old Prattville town cemetery and the relocation of graves by Great Western Power Company. There is one brief record describing a Native American cemetery located one mile east of the old town of Prattville. However, the precise location of these areas is unknown and would now be difficult to determine. While cultural studies for the Upper North Fork Feather Relicensing also did not result in the documentation of any grave sites in the area, Tribal representatives have expressed concern about the existence of such sites in the past.

Underwater cultural surveys of the dike/levee areas are not feasible and will not be effective in determining whether or not cultural sites or materials are present. Poor visibility (approx. 40-50' water depth) and the presence of silt and light organic matter at the bottom of the lake would make artifact discovery and site recordation virtually impossible. Underwater digging or suction dredging for artifacts could be undertaken; however this method could not be accomplished in a scientific manner that would provide precise provenience information that would lead to meaningful results. Finally, if sites are present and could be documented, their integrity would be questionable due to historic impacts as a result of levee/dike construction.

In conclusion, there is no specific information that demonstrates that cultural deposits are present either within the dike/levee material, within the adjacent underwater area, or underneath the dike/levee areas. If there are either disturbed or undisturbed cultural sites present, there is no reasonably feasible way to document them or to assure they will not be impacted by the removal of dike/levee material and associated construction of the temperature curtain.

2. As water is withdrawn from Lake Almanor, the thermocline perimeter decreases. The change in perimeter is dependent on lake elevation at the beginning of summer, rate of water withdrawal, and summer meteorological conditions. Based on the 33 years of synthesized reservoir operations, what is the total reduction in perimeter under various combinations of water year type, and cool, average, and above average summer meteorological conditions with and without the Prattville curtain? Since water year type is not necessarily a good predictor of reservoir elevation at the beginning of the summer, use initial elevation if that gives more predictable results.

   Response: Distributed to the 2105LG and posted in the web site (http://www.project2105.org), a relative volumetric reduction of colder than 16 °C water in Lake Almanor is calculated to illustrate the temperature effect induced by Prattville curtain (see Figure 2A). Available cold-water changes dynamically with time and is more pronounced as summer progresses. To be conservative, the cumulative total losses of cold-water on September 30 were used to compare effect induced by the curtain. MITEMP model was used to simulate 33 years of synthesized operations (1970-2002) with and without Prattville curtain. The net losses of cold-water on September 30 are grouped by four water year types, Critical Dry (CD), Dry, Normal and Wet water year. Depending on the water year type, the volumetric reduction rates vary: CD years averaged 1.2% to a maximum 6.9%; Dry years averaged 0.7% to a maximum 2.8%; Normal years averaged 13.5% to a maximum 25%; Wet years averaged 24.9% to a maximum 41%. Two individual years in each water year type were selected to represent the 'typical' and the 'extreme' case for detail comparison. These are: 1992 (typical) and 1986 (extreme) for CD, 2002 for Dry, 1980 (typical) and 1999 (extreme) for Normal year, and 1984 (typical) and 1982 (extreme).

Meteorological condition often is dynamic in this region and typically has a cycle of one to two weeks interval, i.e., a warm spill for a week is often followed by a cold spill. MITEMP model predicted temperature profiles on the daily basis for the entire summer and takes into account the cyclic variation of meteorological conditions. To isolate meteorological effect would require data analysis on a daily or weekly basis. This would be a major undertaking given the enormous amount of data being generated. The dynamic meteorological effect is embedded in the statistics of the prediction using monthly intervals.

3. Under current conditions, water withdrawn from Lake Almanor by the Prattville Inlet is composed of both warm and cold-water. Construction of the Prattville temperature curtain will result in withdrawal of cold-water only in wet and normal years. In Dry and Critically Dry years little cold-water is available for withdrawal. Surface water temperatures are predicted to change up to one-half degree Centigrade with installation of the temperature curtain. Based on the 33 years of synthesized reservoir operations, what is the expected change in surface temperature under various combinations of water year type, and cool, average, and above average summer meteorological conditions with the Prattville curtain? Compare the predicted surface temperatures to existing conditions for the 33 years of record.

   Response: In the 2105LG meeting on September 2, 2004, PG&E has presented temperature profiles on 6/15, 7/15, 8/15 and 9/15 with and without curtain for four different water year types. Seven years have been selected for comparison using criterion described in the response to question No. 2. These figures are being distributed to the Collaborative Group and are posted in the web site hosted by Plumas County (http://www.project2105.org). These figures showed little difference in surface temperature between the two Prattville conditions for the period June-September. The only noticeable difference in surface temperatures (about 0.5 ^{o}C or less) occurs in September.

4. Under current conditions the depth to the thermocline in Lake Almanor during the summer is controlled somewhat by the non-selective nature of the Prattville Intake. Construction of the temperature curtain at Prattville will result in selection of cold-water at the expense of warm water. The depth to the thermocline is expected to increase under certain combinations of summer temperature and water year type. Based on the 33 years

of synthesized reservoir operations, what is the expected increase in the depth to the thermocline under various combinations of water year type, and cool, average, and above average summer meteorological conditions with and without the Prattville curtain? Since water year type is not necessarily a good predictor of reservoir elevation at the beginning of the summer, use initial elevation if that gives more predictable results.

Response: Temperature profiles under existing Prattville and Prattville curtain conditions are compared for seven selected years. Examples showing two years (a wet year and a normal year) are provided in Figures 3A and 3B. The trend of thermocline deepening by Prattville curtain varies with time and is affected by the water year type and by the extent of generation operation. Generally, deepening starts in July and is more pronounced in September. Deepening is larger for wet years than for critical dry years. Under the average operation years (1984, 1980, 2002 and 1992 for Wet, Normal, Dry and Critical Dry water year type, respectively), deepening of 1-5 feet is predicted. The most pronounced deepening is about 8-10 feet in September 1982.

Figures 4A and 4B illustrate the temporal change of temperature levels at 20, 16 and 12 ^{o}C. For an averaged condition (1980), water with 20 ^{o}C temperature level was deepened starting early August and reached 2 feet by mid-September. For an extreme operation in the wet year, 1982, the 20 ^{o}C water showed deepening as early as July and reached a maximum of 8 feet near mid-September.

5. During the summer salmonids prefer a layer of water located just above the thermocline that meets temperature preferences and also contains adequate dissolved oxygen for survival. As water is withdrawn from Lake Almanor, the volume of water occupied by salmonids shrinks necessitating movement by salmonids if they are to remain in preferred water temperature and dissolved oxygen conditions. Where do salmonids go to take refuge from high water temperatures and low dissolved oxygen levels during stressful conditions caused by low lake level or unusually warm air temperatures? Based on 33 years of reservoir operations, how are these places of refuge impacted with and without the Prattville curtain?

   Response: No specific studies have been conducted to track the movement of salmonids in Lake Almanor to determine specific movements in relation to changing water temperature and/or oxygen conditions. However, based upon prior experience and discussions with local fisherman, the salmonids in the lake seek the mouths of tributaries and springs during periods of thermal stress (generally greater than 20^{o}C), and within a layer of the thermocline in the lake that provides both suitable temperature and oxygen levels as the upper layers increase in temperature while the lower levels decrease in oxygen level. Major tributaries to the lake include: North Fork Feather River at Chester, Bailey Creek, Benner Creek, Last Chance Creek, and Hamilton Branch. Twelve underwater spring areas were identified in the *Environmental Impact Report Lake Almanor Project* (Dept. of Water Resources (DWR), 1976); the biggest and most important of these springs (three closely associated areas on Figure 10 of the DWR report) are Big Springs located just northwest of Hamilton Branch cove. Six of the remaining nine are located in the western portion of Lake Almanor and three in the eastern portion. All of the lakes springs combined are estimated to provide between about 300-450 cubic feet per second (CFS); there are no specific estimates of flow for any individual springs. However, based on their name, Big Springs are generally thought to be either one of or the most important spring areas in Lake Almanor. Sporadic in-situ data at “seepage” flows near Big Springs indicated a temperature of about 9.3 ^{o}C with dissolved oxygen of 7.2 mg/l (12:35 pm, September 16, 2003).) Other undocumented springs undoubtedly also exist in the lake, providing some additional refuge areas as well.

Specific impacts to the value of the tributaries and spring areas as refuges are difficult to impossible to answer because of the depth of the thermocline and the temperature of the water above it (epilimnion) can and does vary significantly between years as described in the Jones and Stokes (JSA) report (2004)(17-40 ft from the surface, figures 12b, c, g, and h), and as illustrated in figures 5A-G (22-39 ft from the surface). The impact to tributary refuge areas is probably minimal. As the cooler and denser water from a tributary enters Lake Almanor, it will both diffuse into the warmer surrounding waters and also sink into the water column until it reaches water of similar temperature and density. The deeper the thermocline, the further the flow of this water will have to travel to meet it. If there is sufficient flow of cold-water, it will meet the thermocline and provide a refuge for the total distance. When there is little flow and/or little difference between the tributary water temperature and that of the lake, the flow may rather quickly diffuse into the warmer epilimnion, and never make it to the deeper thermocline area. Both the JSA report (2004) and a review of selected years of the 33–yr synthesized lake temperature profiles indicate that with a temperature control curtain in place, the thermocline depth may be increased by up to 10 ft in some months of some years. Consequently, in those years in which the thermocline is deeper, the flow from the tributaries may be slightly extended into the lake, and provide some marginally additional area of refuge

Because the exact locations, depths, aerial extent, general topography, flow, temperatures, and oxygen levels for most of the springs are unknown, the potential benefits/impacts are virtually impossible to predict. In general, for a spring to provide refuge from unsuitable conditions in Lake Almanor, it would have to provide, at a minimum, water temperatures and/or DO levels that are better than that in either the epilimnion or thermocline regions of the lake. Because the springs are at a fixed elevation and location on the lake bottom, their relative depth to the surface and thermocline changes both during a single year as the lake is drawn down toward the end of summer and between years due to initial starting elevations and water year conditions (critical dry, dry, normal, or above normal snow/rainfall).

In reviewing a historical topographic map of Lake Almanor (PG&E, 1927), the twelve identified spring areas occur between about elevation 4430 to 4470 ft (PG&E datum). The three springs that make up Big Springs occur at an estimated elevation between about 4430-4435 ft. However, personal observations by Scott Tu during the winters (Feb.) of 2000 and 2001 indicate that at least part of one or more of these springs were present near the lakes surface at an elevation of approximately 4475 ft These springs are well documented as providing thermal refuge to salmonids in the lake. The remaining nine documented springs occur between about elev. 4445 and 4470 ft. The relative elevations of these twelve spring areas under the existing and Prattville curtain condition are presented in Figures 5A-G, which represent both average and extreme operating conditions for wet, normal, dry, and critical dry years.

Based on the data presented in Figures 5A-G, it can be seen that no change in initial thermocline elevation occurs in June and July of any year between existing and curtain condition. Increase in depth to thermocline ranged from 0 to 6 ft in August (1982, Wet and extreme), and averaged about 2.3 ft for all years and operating conditions reviewed. Increase in depth to thermocline ranged from 1 to 9 ft in September (1982, Wet and extreme), and averaged about 4.5 ft for all years and operating conditions reviewed. Big Springs is consistently below the thermocline for all months and all years reviewed under both conditions. Under both existing and the Prattville curtain condition, it can be seen that changes in thermocline depths relative to the other springs vary a little between months and years, with more spring areas being at or above the initiation of the thermocline (i.e., in the epilimnion), but some are always above and others appear to be partially below it. In reviewing the figures for the seven years representing the range of water year types (Wet, Normal, Dry, and Critically Dry) under extreme and normal operations, no clear consistent pattern of spring exposure to thermocline initiation was apparent. Ranking the seven years from most to least springs exposed are as follows: 1992, Critically Dry and extreme; 2002, Dry and average; 1999, Normal and extreme; 1982, Wet and extreme; 1984, Wet and average; 1987, Critically Dry and extreme; and 1980, Normal and average.

However, trying to assess any potential impacts to the value of these springs with the 33-yr period of modeled data is severely confounded by the lack of specific information known about them (i.e., the exact locations, depths, aerial extent, general topography, flow, temperatures, and oxygen levels). Also, there is no current biological data on which species, how many, and time of use (seasonal and/or diurnal) for any of the springs. Without more specific information, the potential benefits/impacts are virtually impossible to predict.

6. Observations have shown that salmonids will move to the vicinity of springs located in Lake Almanor to take refuge from high summer water temperatures. Based on the 33 years of synthesized reservoir operations how might access to the cold-water discharging from the springs be impacted under various water year types and cool, average, and above average summer meteorological conditions with and without the Prattville temperature curtain? Under existing conditions what proportion of salmonids are found in areas other than immediately surrounding springs?

   Response: The first part of this question is similar to question No. 5 above, with the addition of specifically including impacts associated with various meteorological conditions to the various water year types in the 33-yr synthesized data set. Meteorological condition is often dynamic in this region and typically has a cycle of one to two weeks interval, i.e., a warm spell for a week is often followed by a cold spell. The MITEMP model used in this analysis predicted temperature profiles on a daily basis for the entire summer and takes into account the short-term cyclic variation of meteorological conditions. In order to isolate a meteorological effect, it would require data analysis on a daily or weekly basis. This would be a major undertaking given the enormous amount of data being generated. The dynamic meteorological effect is embedded in the statistics of the prediction of the thermocline profiles using monthly intervals. Due to the lack of specific information available on the characteristics of the springs and how and when they are utilized by salmonids, having more specific information on a daily or weekly basis would not allow for any more meaningful analysis than presented in the response to question No. 5 above.

Of the original 29 electrofishing stations sampled as part of the relicensing studies, only 6 were located near identified spring areas (as shown on Figure 10 of the DWR 1976 report). No salmonids were collected at any of these 6 sites; consequently, 100% of collected salmonids were found in areas not associated with springs. However, because the lakes surface elevation was approximately 4486 ft at the time of the August 2000 sampling effort, and as previously discussed the underwater springs are at elevations between about 4430 to 4470 ft, they would have been about 16 ft or more below the surface level of the lake. Because the electrofishing boat is only effective in collecting fish to about 5-7 ft deep and sampling sites were typically near the shoreline, it is not too surprising that no salmonids were collected at these particular stations. Very few salmonids were collected in the study probably because surface water temperatures were above 20°C, and the fish had sought deeper, cooler areas that could not be effectively sampled with this technique.

7. Warm water preferring fish occupy the upper layers of Lake Almanor during the summer. In some water year types and meteorological conditions the depth to the thermocline will increase as cold-water is withdrawn at the Prattville Intake with installation of the Prattville temperature curtain. In such years, will warm water preferring fish be favored in terms of individual growth or numbers?

Response: As previously discussed in response to question No. 5, the thermocline is not an absolute number or condition, but represents a dynamic temperature gradient that changes seasonally and yearly in response to varying meteorological conditions. While the basic shape is similar between months and years, there can be significant differences over any extended period of time. For a warm water species to be favored for either growth and or increased population, it would require that better than the existing condition or conditions occur consistently over several months each year and for multiple years. This situation is not characterized by either the 33-yr modeling effort or by the JSA report (2004).

In a month-to-month comparison of elevation changes to the thermocline for the 7 representative years and conditions from the 33-yr synthesized data set (Figures 5A-G), no changes were observed in the initial thermocline elevation in the months of June and July between the existing and curtain condition. Increase in thermocline depth ranged from 0 to 6 ft in (August 1982, Wet and extreme), and averaged about 2.3 ft for all years and operating conditions reviewed between the existing and curtain condition. Increase in depth to thermocline ranged from 1 to 9 ft in (September 1982, Wet and extreme), and averaged about 4.5 ft for all years and operating conditions reviewed between the existing and curtain condition. A review of the thermocline figures in the JSA report (2004) showed similar results. The greatest increase in thermocline depth generally occurred about mid-way along the transitional zone (the horizontal sloping section connecting the upper and lower vertical isothermal portions), and for some months showed additional increases in depth by up to 3 ft (7 to 10 ft) compared to the initial starting depth (Sept. 1999, normal and extreme).

Not only are these increases in thermocline depths variable between both months in a single year and between years, but the greatest changes also occurred at water temperatures and depths below that preferred by adult smallmouth bass (the dominant warm water game species in Lake Almanor) of 20-27°C and 33 ft (Moyle 2002). Temperatures and depths at which the greatest increase in thermocline depths occurred generally ranged from about 13 to 17.5°C and 40 to 44 ft, which are both in less than preferred conditions. Juvenile smallmouth bass have also been documented to select water temperatures of 29-31°C. These types of temperatures are only found in shallow inshore waters, and not the deeper thermocline regions, and are not affected by any change in thermocline depths associated with the Prattville curtain condition.

Based on the general habitat and temperature preferences of juvenile and adult smallmouth bass and the inconsistent, variable, and increased depths of the thermocline region as depicted in the reviewed 33-yr synthesized data set and as described in the JSA report (2004), it is unlikely that any significant changes in either growth or population of warmwater fish will occur in Lake Almanor.

8. Currently Lake Almanor is occupied by both warm and cold-water fish each occupying preferred habitat conditions. Water year type and meteorological condition variability would appear to favor one or the other at times. By utilizing the 33 years of synthesized operations, is it likely that warm water fish abundance would change with construction of the Prattville curtain?

   Response: In any ecosystem that is subject to natural conditions, the scenario posed in the question is always occurring. In any short period, it is possible and often probable, that conditions will favor either a species or group of species with similar habitat needs over some other specie or species with different and complementary needs (i.e., warm vs cold-water fish, for example). However, as described in response to question No. 7 above, for a significant and permanent change to occur, general habitat conditions favoring one group over another would have to consistently occur over most or the entire yearly period that Lake Almanor stratifies and for multiple years in a row. Because changes associated with the operation of the Prattville curtain (i.e., variable changes in thermocline depth of 1-10 ft and temperature increases of 0-0.5°C in the epilimnion in August and September of some years) are not consistent between months and years and result in increased physical habitat at either depths and/or temperatures that are less than generally preferred (see also response to questions No. 7 above), it is very unlikely that a significant and measurable change in warm water fish abundance would occur with the construction of the Prattville curtain.

9. During the summer, water in Lake Almanor is heated from above by solar radiation and convection and cooled from the bottom by the lakebed causing temperature stratification in the lake. The temperature stratification is also equivalent to stratification by density as well with the warmer and less dense water lying on top of the cooler, and more dense water. The Prattville temperature curtain if deployed would extract cool water from

below the thermocline. Would withdrawal of cold-water initiate currents within the cold-water pool that would result in unequal distribution of cold-water or is the cold-water pool of equal consistency throughout the reservoir?

Response: Lake Almanor consists of two lobes, the Chester and the Hamilton Branch arms. Chester Arm is generally shallow. Less than a quarter of Chester Arm has area with elevations lower than 4445 feet (PG&E datum). In contrast, nearly all Hamilton Arm has bottom elevations lower than 4445 feet. Prattville curtain, as evaluated in the University of Iowa study, withdraws cold-water from strata with elevations lower than 4445 feet. Because of this unique lake configuration between the two arms and the withdraw characteristics of Prattville curtain, cold-waters drawn by Prattville curtain will not be equal. Cold-water will be primarily drawn from Hamilton Branch Arm. Consequently, the underflow current will be more pronounced in the Hamilton Branch than that in Chester Arm. Lowering of thermocline (described in Question 4) is expected to have effect in the lower one quarter portion of the Chester Arm. About three quarters of Chester Arm have bed elevations higher than what is accessible to Prattville curtain. Little effect, if any, is expected on the upper three quarters of the Chester Arm. Note that NFFR water enters Lake Almanor near Chester with flows ranging from 60 to 190 cfs in July and August (PG&E data of 2000 and 2001). These inflows are cold (11 to 14 C) and are denser than the receiving water. These cold-waters will flow along the bottom of the lake downhill in the upper three quarters of the Chester Arm as if there is no Prattville curtain downstream.

10. During the summer surface inflow, and to some extent depending on location and the elevation of Lake Almanor, is cooler than the receiving water. As the cool water descends through the warmer lake water, drag is exerted on the adjacent warm water entraining some of that water in a downward motion. The warm water is replaced to some extent by upwelling cold-water. What changes in biological activity and water chemistry would be expected at these inflow points with operation of the Prattville temperature curtain?

    Response: From MITEPM modeling tests, entrance mixing (or entrainment ratio) is determined to be insignificant. The sensitivity tests suggested that too high entrainment from the spring inflows would result in unrealistically higher hypolimnion water temperature as compared to the measured values at Canyon Dam release. This assumption is consistent with personal observation (Scott Tu, 2000-2001) that the observed springs (near Big Springs Cove) seeps into Lake Almanor within a wide region and they enter the receiving water in a much dispersed pattern that they can not be measured by any velocity meters at any specific locations. Due to the insignificant entrance mixing just described, no measurable biological effects are expected to occur.

11. During low inflow years, Lake Almanor does not fill to the extent it does in wet years. As water is drawn into the Prattville intake in low elevation years, the proportion of warm versus cold-water increases since the thermocline elevation will be quite close to the inlet elevation. In Dry and Critically Dry years what is the difference in volume of cold-water

removed with and without the Prattville temperature curtain? Would differences be better illustrated if withdrawal was described in calories rather than volume of water?

Response: Using 2002 (Dry year) and 1987 (Critical Dry), the corresponding cold-water volumes remained in Lake Almanor are shown in Figures 11A and 11B with and without Prattville curtain. Assuming cold-water of interest is defined between 20 °C to 12 °C strata, there are approximately 260,000 acre-feet of 12-to-20 °C water available on July 15 in 2002 (dry year). As time progresses, volume of 12-to-20 °C water is depressed by Prattville curtain. By September 15, the 12-to-20 °C water still have approximately 170,000 acre-feet under existing Prattville condition, whereas the same 12-to-20 °C would be reduced to 120,000 acre-feet under Prattville Curtain condition (defined by the dashed lines). For a critical dry year such as 1987, the 12-to-20 °C cold-water started to reveal some small difference around the end of August when the dashed lines start to deviate from solid lines. This is because the Prattville curtain can only access water below 4445 feet (PG&E datum) and little generation occurred in 1987. In 1987, the monthly averaged generation waters for June, August and September were 40, 10 and 910 cfs. The corresponding monthly generation waters for 2002 were 480, 1020 and 1240 cfs, respectively. The above difference could have been described by energy units (such as BTU or Calories) using the product of flow and temperature levels, however, it would involve more explanation for lay persons and would require re-programming.

12. The Chester arm of Lake Almanor is quite shallow compared to the Hamilton Branch arm. The bottom of the reservoir in the Chester area was once a rather extensive meadow with a gentle slope. Residents have commented that aquatic plants have been a problem in the past. If the Prattville temperature curtain is constructed the perimeter of the lake will not change since the quantity and timing of water withdrawal from the lake will be the same with or without the Prattville curtain. The surface temperature of the lake and depth to the thermocline will increase under some conditions. Will aquatic plant volume or area increase with operation of the temperature curtain due to the presence of warmer water in contact with the reservoir bottom under certain conditions? Which combinations of water year type and summer meteorological conditions will result in additional aquatic plant growth? What is the maximum rooting depth of aquatic plants commonly found in Lake Almanor?

    Response: Based on the generally rather shallow nature of the Chester arm of Lake Almanor and it having been an extensive meadow prior to the formation of the lake, abundant growth of rooted aquatic plants in this area each summer is a certainty. Based on a review of the historic topographic map of the lake (PG&E 1927), a significant portion of this area, extending almost 2 miles from shore, is less than 30 ft deep at the maximum surface elevation (4494 ft). As reported by the JSA report (2004) and observed in the profiles of selected water year types and operating conditions of the 33-yr synthesized thermocline data set, the upper (epilimnion) water temperatures typically exceeds 20°C between June and September in most years. A maximum increase in temperature of up to 0.5°C was observed in the JSA report (2004) in August and September and only in September in the 33-yr synthesized data set between the existing and with curtain condition.

    The upper, warmer eplimnion water layer varies between about 20 to 40 ft in depth between June and September each year, regardless of water surface elevation and operation under the existing condition and increases between 1-9 ft in August and September under the Prattville curtain condition. A review of the literature on rooted aquatic plants (no studies have been conducted to identify the plants specific to Lake Almanor) indicates that most species occur at maximum depths of between about 20 to 30 ft deep. Consequently, because most of the Chester arm is less than the general maximum rooting depth of most rooted aquatic plants and as described in the JSA report (2004) that low amounts of essential nutrients limit algae production in the lake, it is unlikely that the construction of the Prattville curtain would result in any additional volume or aerial extent of the existing rooted aquatic vegetation beds currently present.

13. Will the withdrawal of cold-water and the increase in depth to the thermocline in some years result in increased algae production in Lake Almanor? Would additional algae reduce the depth to the thermocline by intercepting sunlight?

    Response: As reported by JSA (2004), algae levels (non rooted plants) are limited by lack of essential nutrients, and are too small to have a large affect on either DO concentrations or temperature profiles. Because their simulations showed that algae blooms occurred in June and the maximum change in the lakes thermocline occurs in August and September, it is unlikely that any significant changes in algae production will occur.

14. The dissolved oxygen content of cold-water withdrawn from Lake Almanor will be quite low. When released into Butt Valley Reservoir at the Butt Valley Powerhouse, the cooler, dissolved oxygen deficient water is likely to not mix readily with Butt Valley Reservoir water. What is the impact of the release of oxygen deficient cold-water on the Butt Valley Reservoir fishery and what mitigating measures could be taken to increase the dissolved oxygen content of the water?

    Response: PG&E is currently evaluating various methods to ensure that any water released by the Butt Valley Powerhouse into Butt Valley Reservoir meets basin dissolved oxygen criteria for maintaining aquatic life in good health. Various measures could include, but are not limited to, air/oxygen injection prior to release from the powerhouse as well as dikes/weirs in the tailrace to re-oxygenate the water prior to it entering the reservoir. Consequently, no impacts due to reduced oxygen are expected.

15. As cold-water from Lake Almanor passes through Butt Valley Reservoir warming takes place negating a portion of the cold-water benefit. Temperature modeling has demonstrated that it is possible to recapture a portion of temperature gain by construction of a temperature curtain at the Caribou 1 and 2 intakes as well as the tailrace of Butt Valley Powerhouse. The recapture is greatest with two curtains in Butt Valley Reservoir. What is the estimated cost of constructing curtains at Butt Valley Powerhouse and near the Caribou 1 and 2 intakes? Black and Veatch has provided the estimated cost of constructing the Prattville temperature curtain. What is the estimated annual cost of maintaining the curtains? Will replacement be necessary during the term of the license?

Response: No detailed cost estimates have been conducted for construction of two curtains in Butt Valley Reservoir. On 8/31/04 Black and Veatch provided an updated opinion of probable cost for a fixed Prattville Curtain. The fixed Prattville Curtain cost estimate is $17.8 million which includes dredging of approximately 22,750 cubic yards of material. Each curtain in Butt Valley would be similar in length and size and would entail similar construction techniques as the Prattville Curtain, therefore their costs would be in the same order of magnitude as the Prattville Curtain costs.

No detailed estimate of the annual cost of maintaining the curtains has been conducted. It is expected that annual curtain maintenance would include inspection and replacement of cable, chain and buoy connections. Replacement of buoys and curtain fabric would probably be done on a 15-20 year basis. Underwater diving would be required for some of the curtain maintenance tasks.

16. The Prattville temperature curtain if constructed would occupy approximately 14 of the 27,000 acres or five one-hundredths of one percent (1 in 1,929) of the surface area of Lake Almanor. On an expansive scale the curtain is insignificant. The curtain may have aesthetic impacts if seen from nearby residences. Would the curtain be visible from nearby residences? Would the curtain add to the visual impact of the existing intake structures and associated PG&E on-shore facilities? Are their mitigating measures that would reduce the visual presence of the curtain structure?

Response: Components of the Prattville Curtain would be visible from nearby residences and boaters in the Prattville vicinity. The visible on-water components of the Prattville Curtain would be the string of floating tanks, larger stabilizing tanks and boater warning buoys/signs. Concerns about boater safety warrant making the on-water components highly visible. The visible on-shoreline component of the Prattville Curtain is the bin-type wall needed to secure the string of floating tanks. When viewed from the shoreline, the viewer would see a U-shaped string of connected floating fabricated galvanized tanks which extend about 900 feet from the shoreline. The width of the floating string of tanks is about 700 feet. Also, a series of larger floating fabricated galvanized stabilizing tanks would be visible. On the shoreline each end of the string of floating tanks would be secured to a bin-type wall structure. The top of this bin-type wall would be at elevation 4495 feet (PG&E datum). A series of boater warning buoys and signs would also be visible. The plan view of the curtain details is seen on Figure 5-6 in the report titled "Prattville Intake Modifications Phase 3, Feasibility Study, Final Report, January 20, 2004" by Black & Veatch.

The components of the potential Prattville Curtain would add to the visual impact of the existing intake structures and associated PG&E on-shore facilities.

No mitigation measures that would reduce the visual presence of the curtain structure have been identified at this time.

17. Currently large numbers of Japanese pond smelt pass through the Prattville tunnel and Butt Valley powerhouse to emerge as chum for brown trout. With construction of the

temperature curtain, the pond smelt will no longer be drawn into the tunnel. What is the effect of reduction of chum to Butt Valley Reservoir and the increase in numbers of pond smelt remaining in Lake Almanor? If the Prattville temperature curtain is constructed in a manner to allow opening of the curtain, would Japanese pond smelt be drawn into the Prattville Intake?

Response: If a significant reduction in the entrainment of pond smelt through Butt Valley Powerhouse would occur, it would result in a significant reduction in the number of large trout that currently occur in the immediate tailrace area. Because entrainment studies conducted downstream at the Caribou 1 and 2 powerhouses showed similar numbers of entrained pond smelt during the relicensing studies, pond smelt are probably successfully reproducing in Butt Valley Reservoir. The current fishery for large trout at other locations around the reservoir away from the immediate vicinity of the powerhouse tailrace probably do not depend on the daily input of entrained pond smelt, and would be expected to be minimally affected by any reduction.

Pond smelt were introduced into Lake Almanor in 1972 under existing project operations, and within only a few years were credited by the California Department of Fish and Game with out-competing and causing the extirpation of Kokanee salmon (CDFG 1987). Given their relatively short life span of 1-2 years, suggests that populations will respond quickly to environmental changes. The present population is presumably in equilibrium after more than 30 years since their original introduction, with annual population changes the result of natural variation between years.

Given the lack of quantitative data concerning pond smelt populations in Lake Almanor, a definitive analysis of the potential impacts on the aquatic resources of Lake Almanor if there was a significant reduction in their entrainment through the Prattville Intake is impossible. It is known that large numbers of pond smelt are typically entrained, and that large populations exist in Lake Almanor. However, the proportion of the population in Lake Almanor which is entrained is not known. Thus, it cannot be determined whether the entrainment represents a significant impact on the pond smelt population under existing conditions. The ability of pond smelt to increase to population levels that were able to drive Kokanee salmon to extinction within only a few years of their introduction into Lake Almanor, the wide distribution of pond smelt throughout the lake, and lack of a distinguishable concentration around the intake during hydroacoustic observations made as part of the UNFFR relicensing studies suggests that only a small proportion of the overall population is entrained annually, and if their entrainment was significantly reduced under the Prattville curtain condition, the overall impact on the lake would be minimal and immeasurable.

However, if the current entrainment of pond smelt significantly impacts the density in Lake Almanor and the thermal curtain eliminates that entrainment, the population of smelt could temporarily increase. The pond smelt population could be expected to exhibit short-term population swings until a new equilibrium was established over a several year period (perhaps accompanied by large die-offs). A limited and potentially insufficient food supply could result in increased competition for food (primarily zooplankton) both within the pond smelt population as well with other, generally younger life stages of both warm and cold-water fish species which they compete with. Because pond smelt only live for 1-2 years, a new base population should consequently be established within few year period.

An opening in the curtain would increase the likelihood of maintaining the current levels of pond smelt entrainment, but would also have the opposite effect on its efficiency of selectively withdrawing the cooler and deeper water out of Lake Almanor. The size and location of the opening would be critical in maximizing entrainment of the pond smelt and minimizing the withdrawal of the warmer, surface water. Although it would be possible to model various scenarios to determine temperature benefits versus reduction in entrainment levels, since the current benefits are only a few degrees, any curtain less efficient than the current proposal could quickly be reduced to only a single degree, or less.

18. A fixed curtain installed at Prattville will withdraw cold-water year-long. Is there a combination of timing and selective withdrawal that minimizes the additional depth to the thermocline experienced with the fixed curtain?

    Response: Variable timing in the deployment of a portable curtain has been considered and modeled to determine the feasibility of preserving cold-water for late summer. Modeling results suggested that a deployment timing strategy would not yield any noticeable change in the thermal structure of the lake.

19. Would additional warm water under certain combinations of water year type and summer meteorological conditions impact existing programs designed to improve fish habitat in Lake Almanor? Is the impact positive or negative? If negative, what is the expected frequency of negative impact years?

    Response: The only fishery enhancement program that PG&E is aware of is the caged trout program that is located in Hamilton Branch cove. As described in several responses above, the upper epilimnion layer of water in Lake Almanor did not indicate a measurable change in temperature in the months of June and July based on either the JSA report (2004) or the representative years of the 33-yr synthesized data set. Because the program generally runs from November through the following May or June time period, no impacts, positive or negative, are expected to occur to this program.

20. What water quality, aquatic habitat and fish monitoring will take place in order to quantify changes in Lake Almanor and Butt Valley Reservoir due to withdrawal of cold-water. Is it possible to modify the existing aquatic and water quality program or will new monitoring be necessary?

    Response: As described above in response to various fishery and water quality questions, no significant changes to either the basic water quality or significant changes in habitat quality for either warm or cold-water fish is expected to occur in either Lake Almanor or Butt Valley Reservoir outside of the current range of long term conditions. The only significant biological impact identified is that to the pond smelt entrainment from Lake Almanor to Butt Valley Reservoir. The Thomas R. Payne and Associates interim report

(2004,) indicates that up to a 99% reduction in pond smelt entrainment could occur under certain conditions. This results in two conditions: more ponds smelt in Lake Almanor (as described earlier) and less entrained through the Butt Valley Powerhouse into the tailrace. This reduction in entrainment would be expected to significantly affect the tailrace fishery, both in number and size of fish present. Some reduction in size and abundance of trophy fish could also occur from the general reservoir area, but documenting this with any study could potentially be very difficult.

21. How might wind, waves and ice impact the Prattville temperature curtain?

Response: The Prattville Curtain would be designed to withstand natural conditions including wind, waves and ice. Periodic inspections and maintenance will be performed to insure its continued safe operation.

22. If it is assumed that the temperature curtain with levee removal takes place in Lake Almanor and temperature curtains are constructed at Butt Valley Powerhouse and at the Caribou inlets and mitigation of dissolved oxygen deficiencies occurs:

What are the anticipated reductions in water temperature at Butt Valley Powerhouse?
What is the anticipated warming of water temperature as it passes through Butt Valley Reservoir?
What warming occurs in the Belden Forebay?
What is the anticipated warming of water temperature in the Belden reach?
What is the "best and worst case scenario" for the expected August temperature in the Rock Creek and Cresta reaches during Wet, Normal, Dry, and Critically Dry water year types?

Response: 33 years of daily predictions for water temperatures at various outflow locations for both Lake Almanor and Butt Valley Reservoir were simulated. Because the reservoir operation and meteorological conditions are dynamic in nature, the predicted outflow temperatures vary continuously with time. Each month there is a unique temperature distribution curve that shows how temperatures spread with time. These "S" shaped temperature distribution curves were presented in the various 2105LG meetings. From these "S" curves, five statistics are extracted and summarized in Table 22A. The 50% exceedance level represents the median value. The 25% exceedance level represents a value that would be exceeded by 25% of the time for that particular month and the 10% exceedance value is expected to be exceeded by 10% of the time. On the colder side of the temperature distribution, the counterparts of temperatures are represented by the 90% and 75% exceedance. The occurrence of the 10% exceedance events is exclusively associated with reservoir operation during multiple drought years.

1. Using the median values in Table 22A, the anticipated temperature reductions in water temperature at Butt Valley Powerhouse are 3.8 and 3.5 °C for July and August, respectively.

2. Warming through Butt Valley Reservoir occurs naturally under existing condition, varying from 0.9 to 3.3 °C depending on the month and the exceedance levels. With three curtains scenario, warming through Butt Valley Reservoir is minimized to a range of 0.9 to 1.9 °C.

3. It is expected that warming in Belden Forebay is minimal because of its small capacity compared to the large volume of water coming from Caribou powerhouses. The Forebay has a capacity 2477 acre-ft and typical combined flow from Caribou 1 and 2 units is 1500 cfs, the calculated retention time is about 20 hours.

4. Because the dynamic change of reservoir outflow temperatures, the starting temperatures at dams in NFFR also re-acts dynamically. Meteorological condition exerts energy directly and effectively upon the river due to its relative shallowness as compared to the energy exchange process in reservoir. Consequently, temperatures in NFFR increase with distance in a non-linear manner depending on the stream geometry and its shading. A series of stream temperature models (SNTEMP) are being developed to predict daily averaged water temperatures. PG&E has adopted a watershed approach to track water temperature for NFFR. A total of five stream reaches is being used, including Seneca, Belden, Rock Creek, Cresta and Poe. Major tributaries and all powerhouses in each respective reach are included in the model simulation. Water temperature profiles are integrated together in one figure for the entire NFFR and information has been presented in the various 2105LG meetings. In the context of capturing the entire spectrum of possible variation of water temperatures, model simulation used an 'envelope' approach. SNTEMP simulated five 'static' conditions representing the normal case, two extremes for temperatures above the normal case (the practical dry-warm and the extreme dry-warm), and two extremes for temperatures below the normal case (the practical wet-cold and the extreme wet-cold). These five conditions are equivalent to those five statistics extracted from the "S" shaped curve discussed earlier. The normal condition represents the case of most frequent occurrence (50% exceedance level). The practical dry-warm case assumes a 25% exceedance values in defining all input data (except the meteorological input is based on the 10% exceedance), while as the extreme dry-warm case assumes the 10% exceedance values. Conversely, all predictions on the colder side use the 90% and 75% exceedance values. Model results for the wet-cold conditions are not yet available at the time of this writing. One series of the NFFR watershed temperature profiles under the second-five year instream flow release plan for Rock Creek-Cresta are provided in Figure 22A for July and August and under the 50% and 25% exceedance levels, respectively. From these figures, warming in Belden Reach is marginal (less than few tenths of degrees) largely due to the heavy shading. Warming is more pronounced (about one degree) with colder starting temperatures under the 'three curtains' scenario. In extreme warm-dry condition and/or when the starting temperatures are warm (which typically occur in August when lake level is low), NFFR water temperatures decreases with distance due to the shading effect.

5. Water temperatures in NFFR can not be exclusively related to water year types. It is determined that the upstream temperatures as released from Butt Valley and Caribou powerhouses are the dominating factor and therefore ranking of these upstream temperatures serves a more systematic approach to the determination of the NFFR water temperatures. For comparison purpose, we use the 50% and 25% exceedance levels to define the 'best' and 'worst' case scenario. Under the FERC 1962 second-five year in-stream flow release plan, the August temperatures at NFFR above Bucks Creek Powerhouse are 20.8 °C (best case scenario) and 21.9 °C (worst case scenario) under existing upstream condition. If improved with three curtains in Lake

Almanor and Butt Valley Reservoir, the corresponding temperatures are 18.5 °C (best case) and 20.1 °C (worst case). These are equivalent to a temperature reduction of 2.3 °C (best case) and 1.8 °C (worst case). The August temperatures at NFFR above Cresta Powerhouse are 20.2 °C (best case) and 22.0 °C (worst case) under existing upstream condition, and 18.3 °C (best case) and 20.5 °C (worst case) under three curtains scenario. The equivalent temperature reductions are 1.9 °C (best case) and 1.5 °C (worst case) at this location.

23. Modeling of the effectiveness of the Prattville temperature curtain in reducing downstream stream temperature has demonstrated that any combination of curtains in Lake Almanor and Butt Valley Reservoir will reduce downstream water temperature under some but not all situations. Based on the 33 years of synthesized reservoir operations, what is the expected reduction in stream temperature under various combinations of water year type, and cool, average, and above average summer meteorological conditions in the Rock Creek and Cresta reaches?

    Response: See last response to question No. 22.

24. Reductions in stream temperature in the Rock Creek and Cresta reaches will not occur in all water years. It appears that reductions in temperature will occur in Wet and Normal years with Dry and Critically Dry years receiving little if any temperature reduction. Since the area climate tends to exhibit precipitation extremes, Dry and Critically Dry years frequently occur. What physical and biological parameters will be used to monitor aquatic environment response to installation of temperature curtains? How will improvements in aquatic health be quantified?

    Response: PG&E is currently conducting a series water quality and aquatic resources (i.e., fishery population) studies over a 15-yr period between 2002 to 2017 as part of the Rock Creek-Cresta License (FERC no. 1962) in the Rock Creek and Cresta river reaches. These studies, although originally envisioned to help document water quality and fish population changes as a result of variable flows during the first 15 years of the license, will also be able to be used to help determine if there is any response to temperature changes in these reaches. However, required flow level changes during the 2nd and 3rd 5-year study periods could confound the analysis of any temperature versus flow induced water quality or fish population changes.

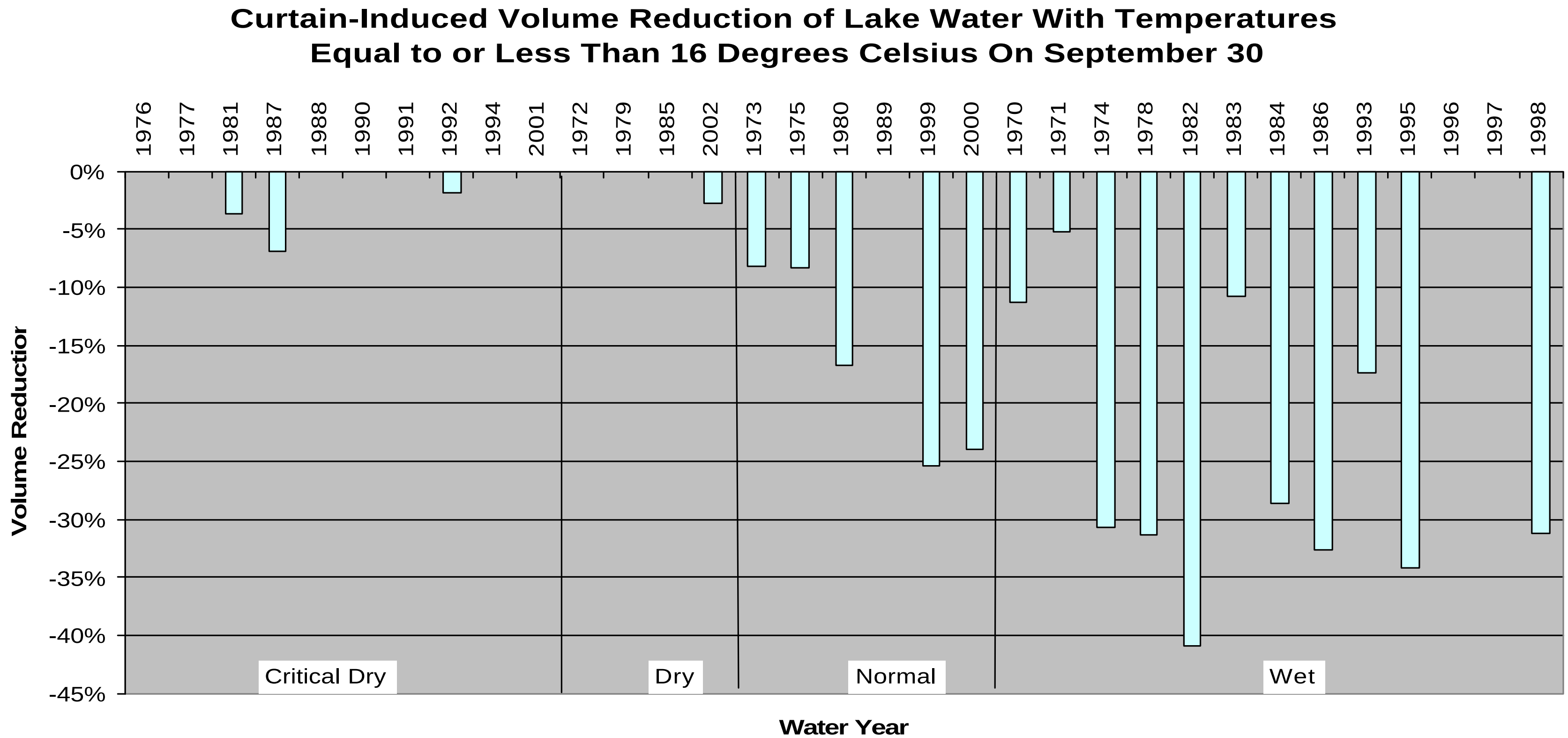


Figure 2A. 33 Years of Relative Volume Reduction by Prattville Curtain for Water Colder Than 16 °C In Lake Almanor Based On Prediction On September 30

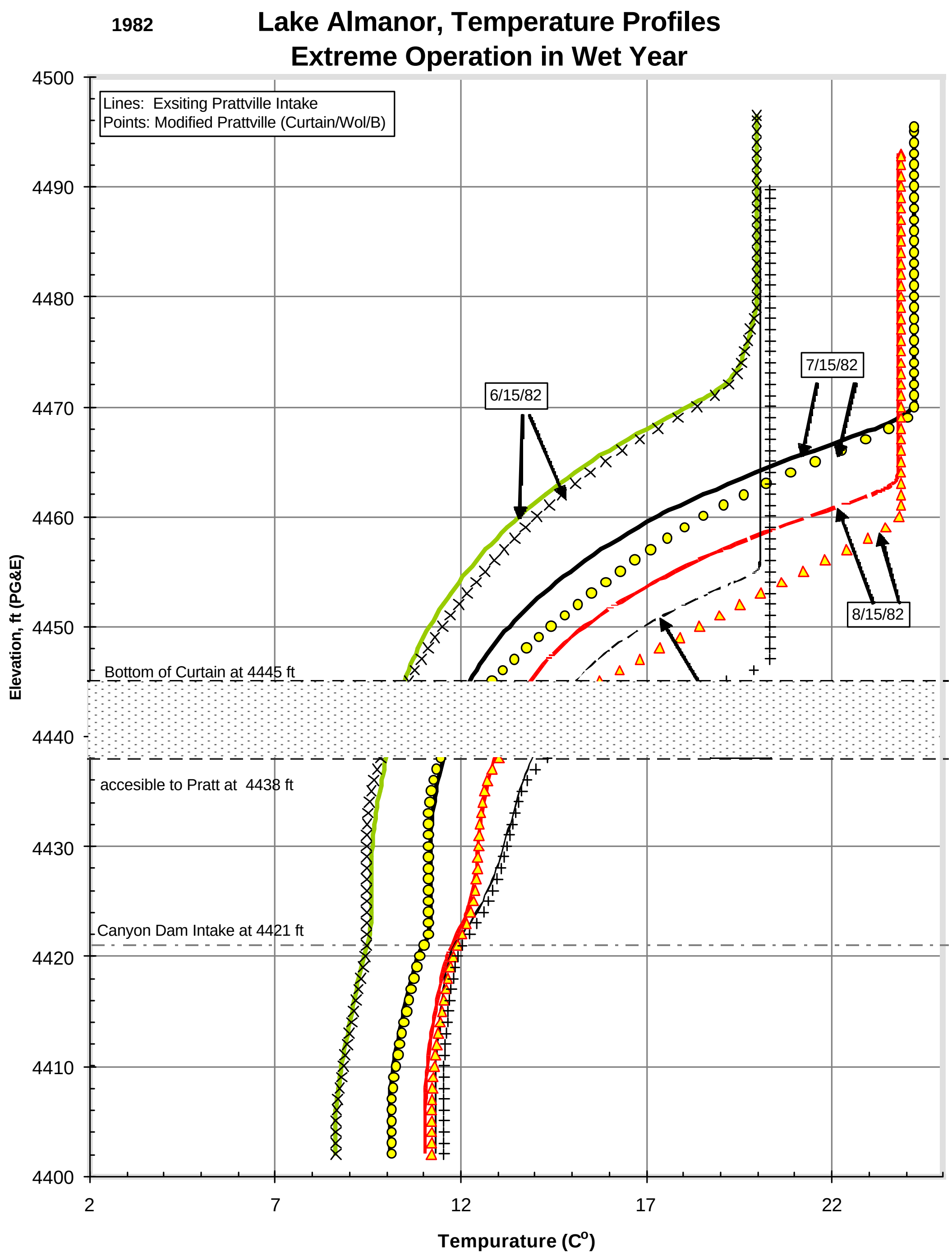


Figure 3A. Temperature Profile Comparison with and without Prattville Curtain on 6/16, 7/15, 8/15 and 9/15 for 1982, an Extreme Operation in Wet Water Year Type

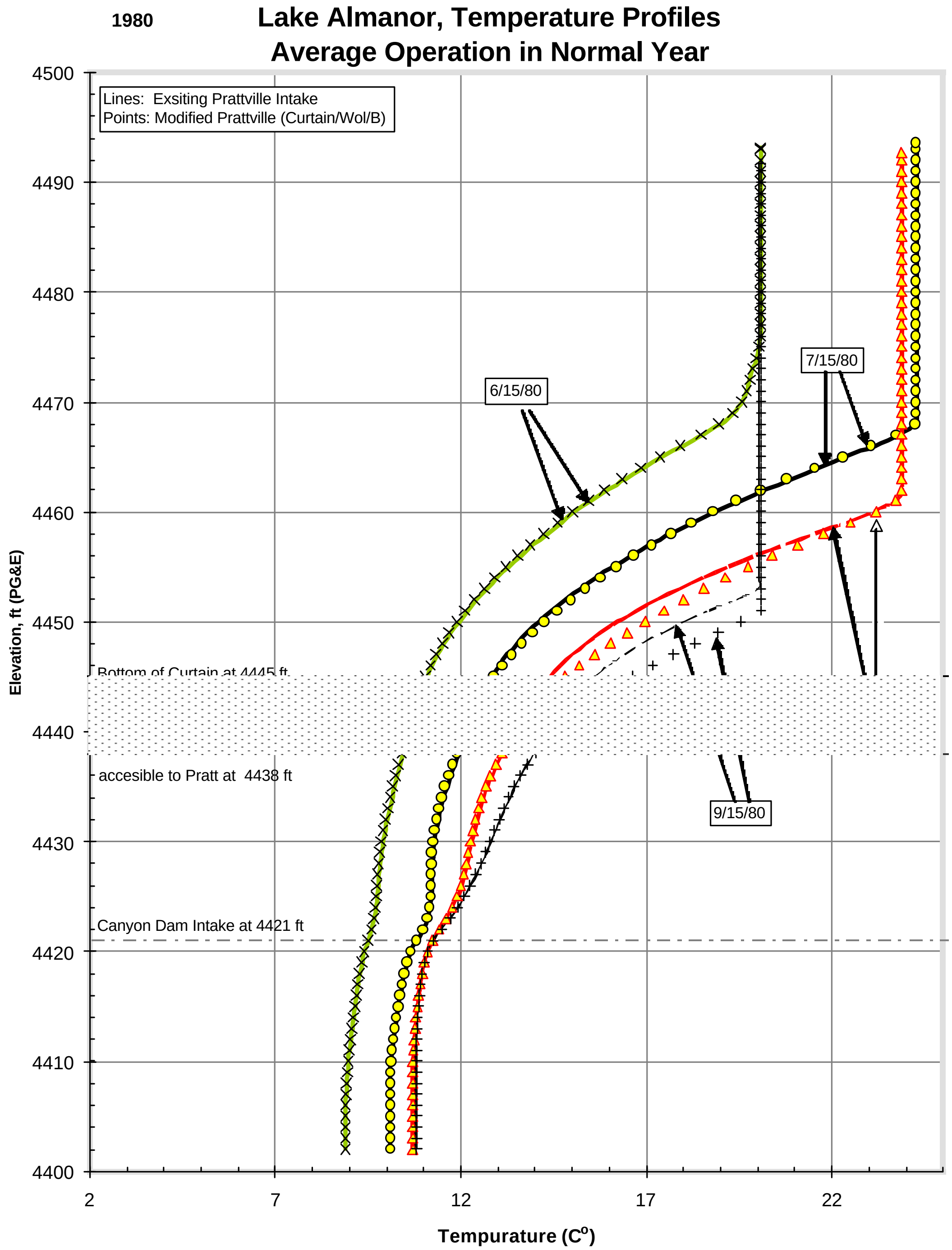


Figure 3B. Temperature Profile Comparison with and without Prattville Curtain on 6/16, 7/15, 8/15 and 9/15 for 1980, an Average Operation in Normal Water Year Type

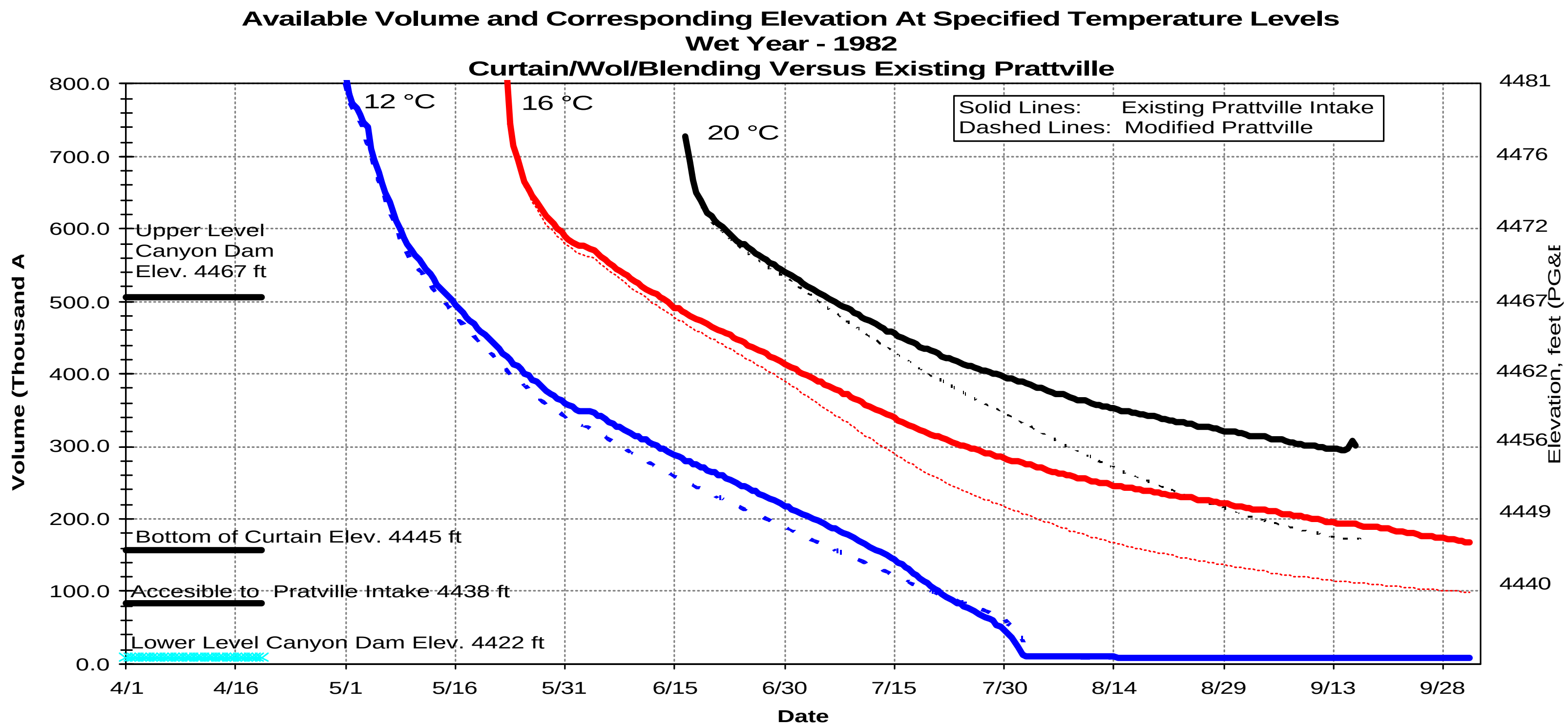


Figure 4A. Time Series of Volumetric and Corresponding Elevation Change for Three Specified Temperature Levels in Lake Almanor with and without Prattville Curtain for 1982, an Extreme Operation in Wet Water Year Type.

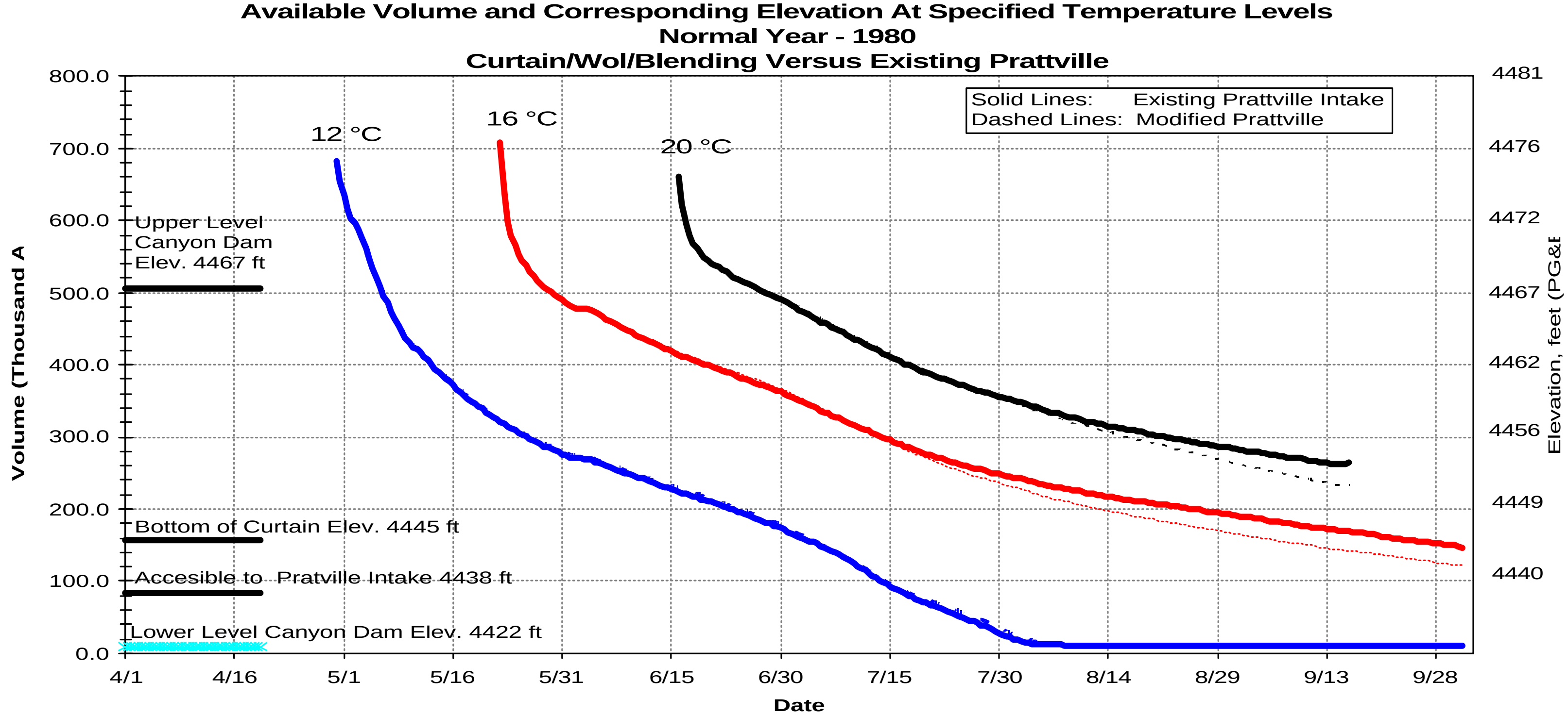
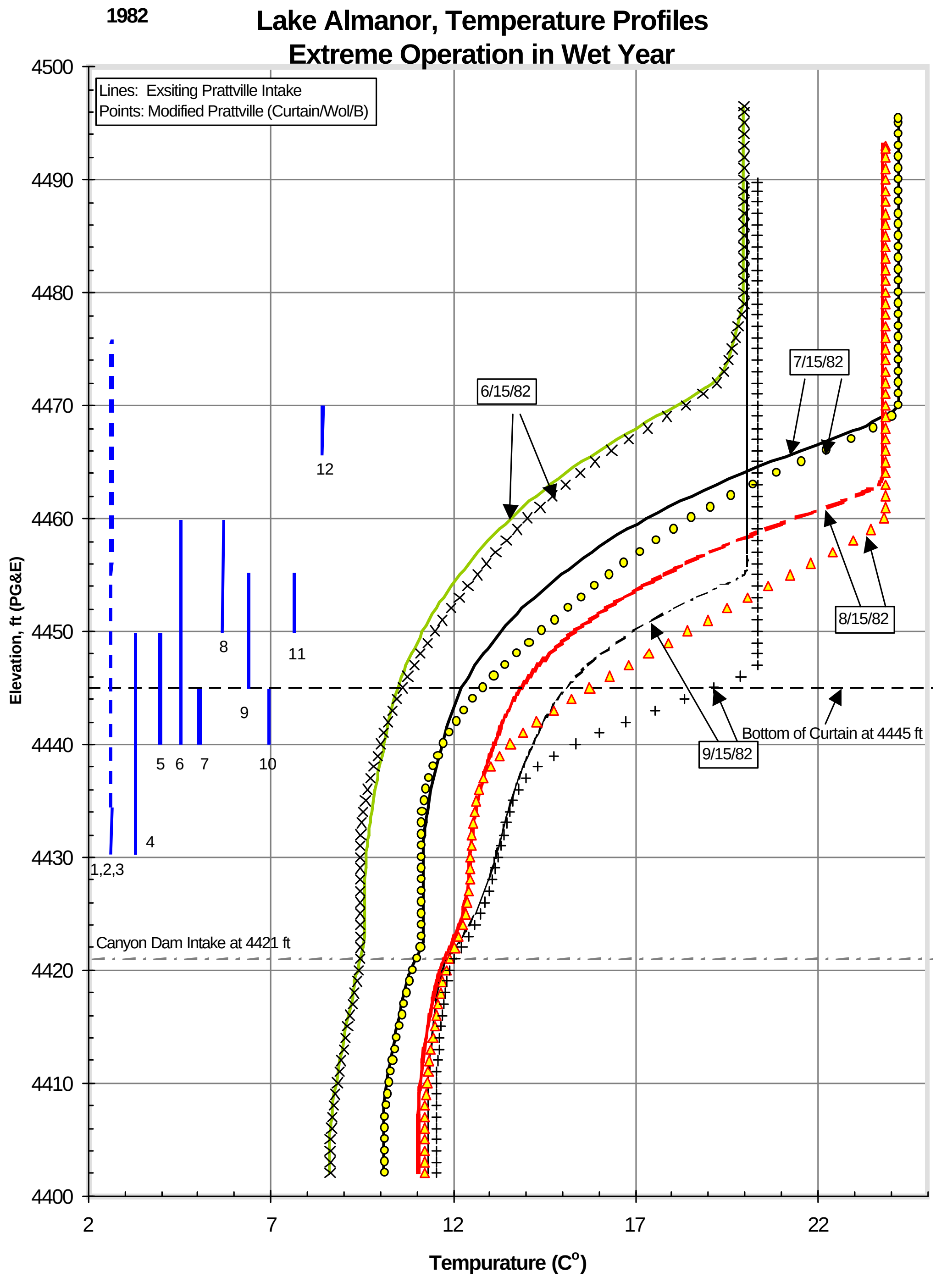


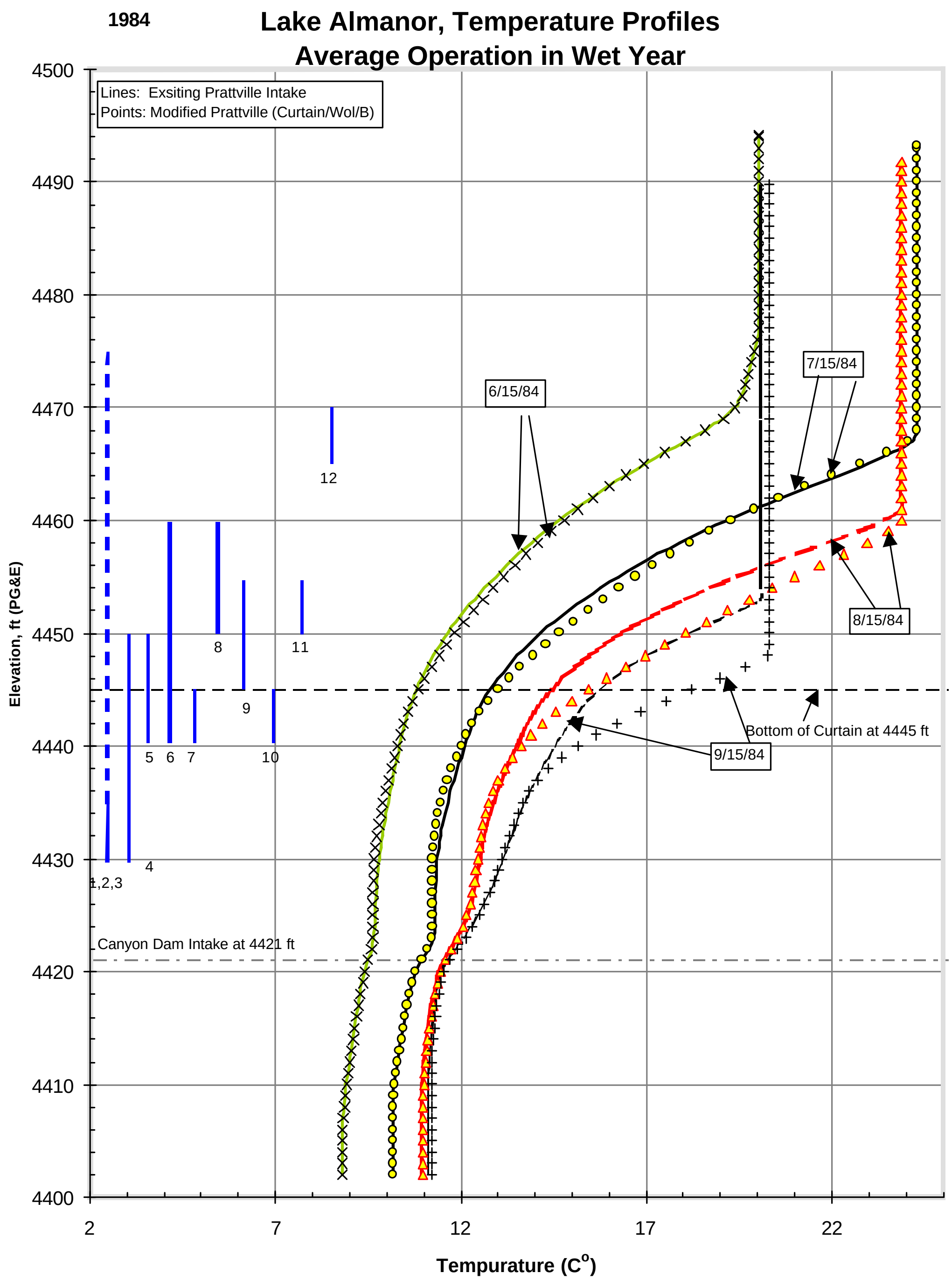
Figure 4B. Time Series of Volumetric and Corresponding Elevation Change for Three Specified Temperature Levels in Lake Almanor with and without Prattville curtain for 1980, An Averaged Operation in Normal Water Year Type

Figure 5A



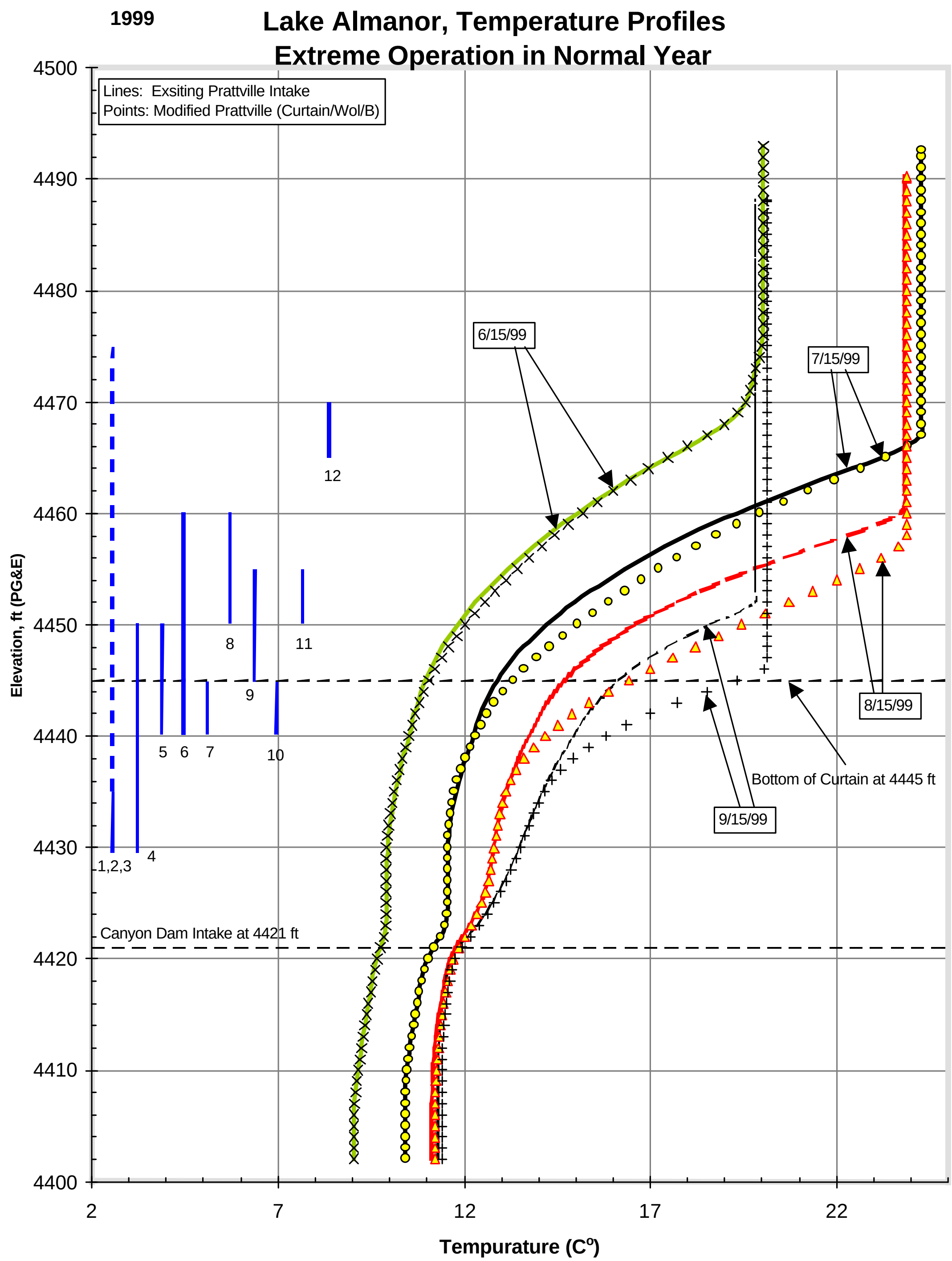
Note, blue numbered vertical lines (left side of figure) represent identified springs in Lake Almanor by elevation based on 1927 topographic map (PG&E datum). Location of vertical lines are not related to temperature axis.

Figure 5B



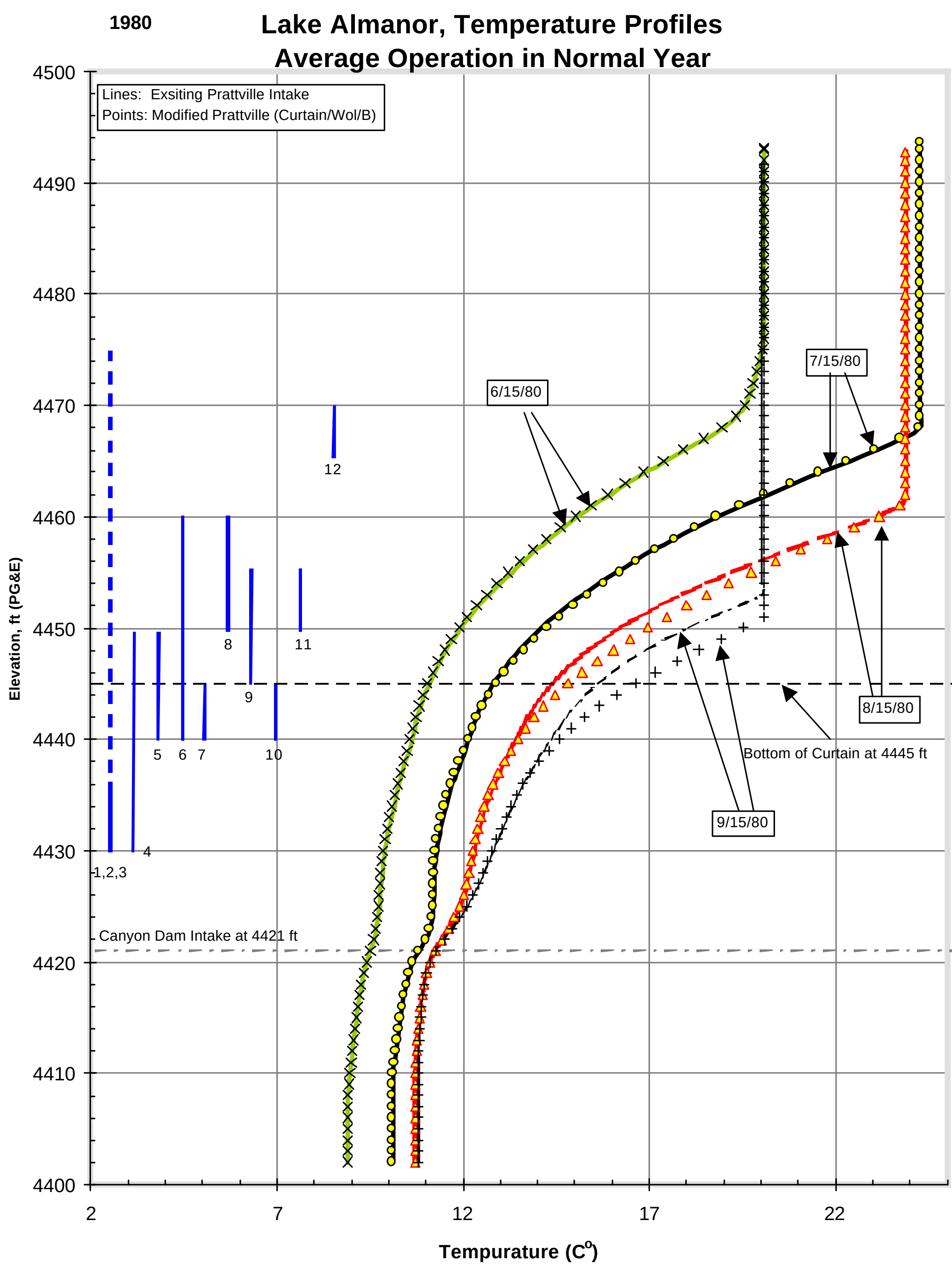
Note, blue numbered vertical lines (left side of figure) represent identified springs in Lake Almanor by elevation based on 1927 topographic map (PG&E datum). Location of vertical lines are not related to temperature axis.

Figure 5 C


1999
Lake Almanor, Temperature Profiles
Extreme Operation in Normal Year
Lines: Exsiting Prattville Intake
Points: Modified Prattville (Curtain/Wol/B)
6/15/99
7/15/99
8/15/99
9/15/99
Bottom of Curtain at 4445 ft
Canyon Dam Intake at 4421 ft
1,2,3
4
5
6
7
8
9
10
11
12
Elevation, ft (PG&E)
Tempurature (C°)
4500
4490
4480
4470
4460
4450
4440
4430
4420
4410
4400
2
7
12
17
22

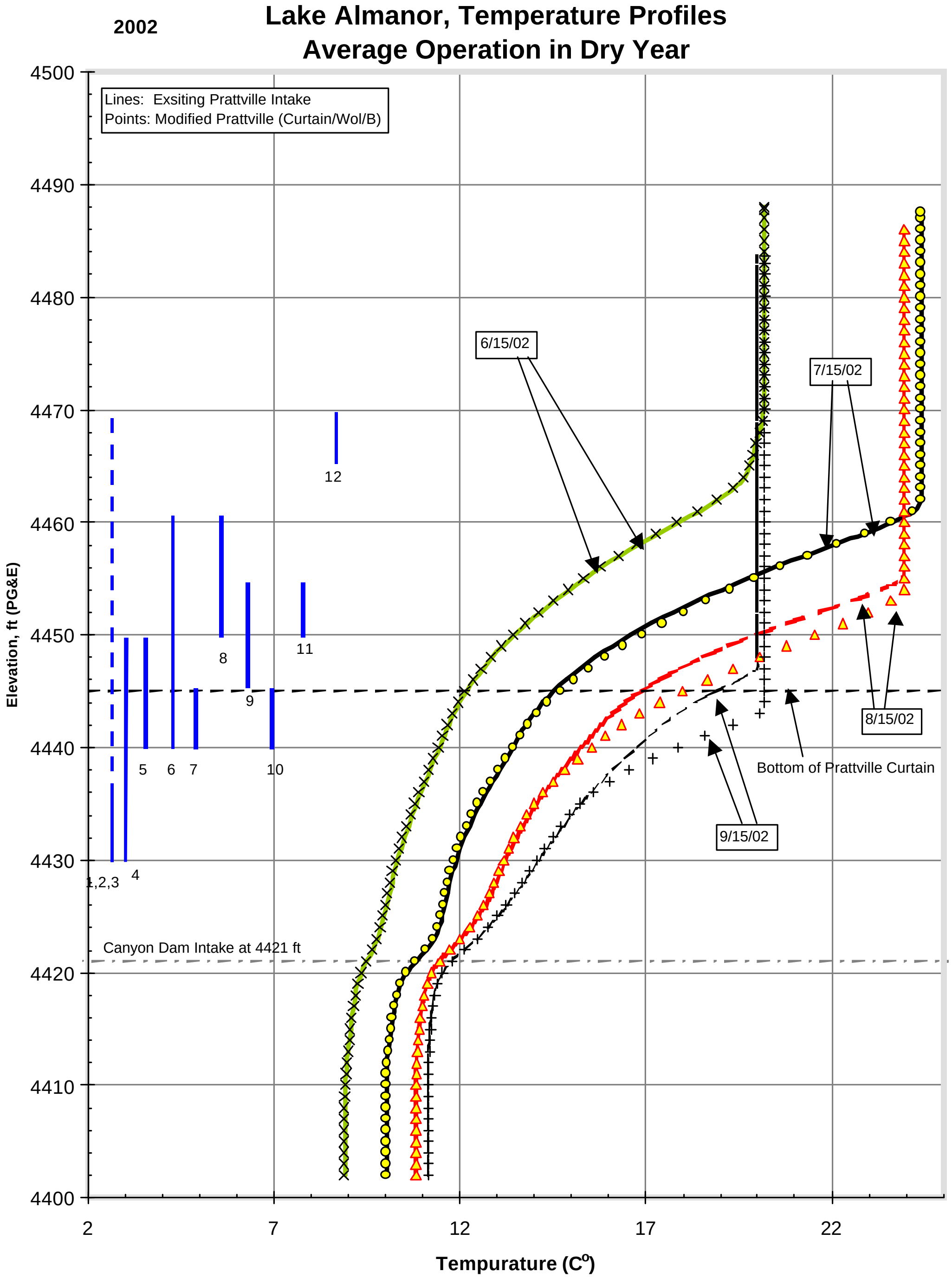
Note, blue numbered vertical lines (left side of figure) represent identified springs in Lake Almanor by elevation based on 1927 topographic map (PG&E datum). Location of vertical lines are not related to temperature axis.

Figure 5D



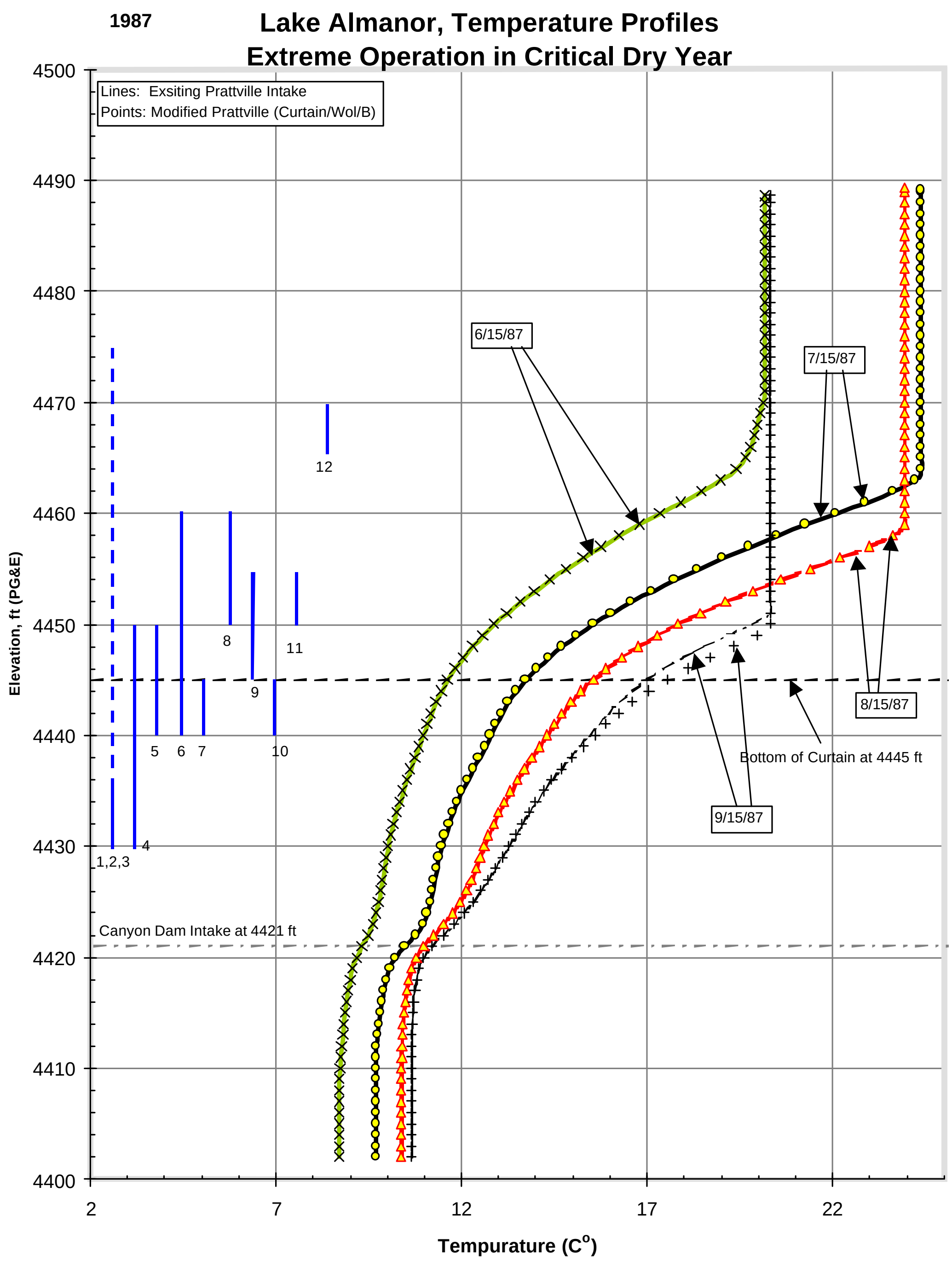
Note, blue numbered vertical lines (left side of figure) represent identified springs in Lake Almanor by elevation based on 1927 topographic map (PG&E datum). Location of vertical lines are not related to temperature axis.

Figure 5 E



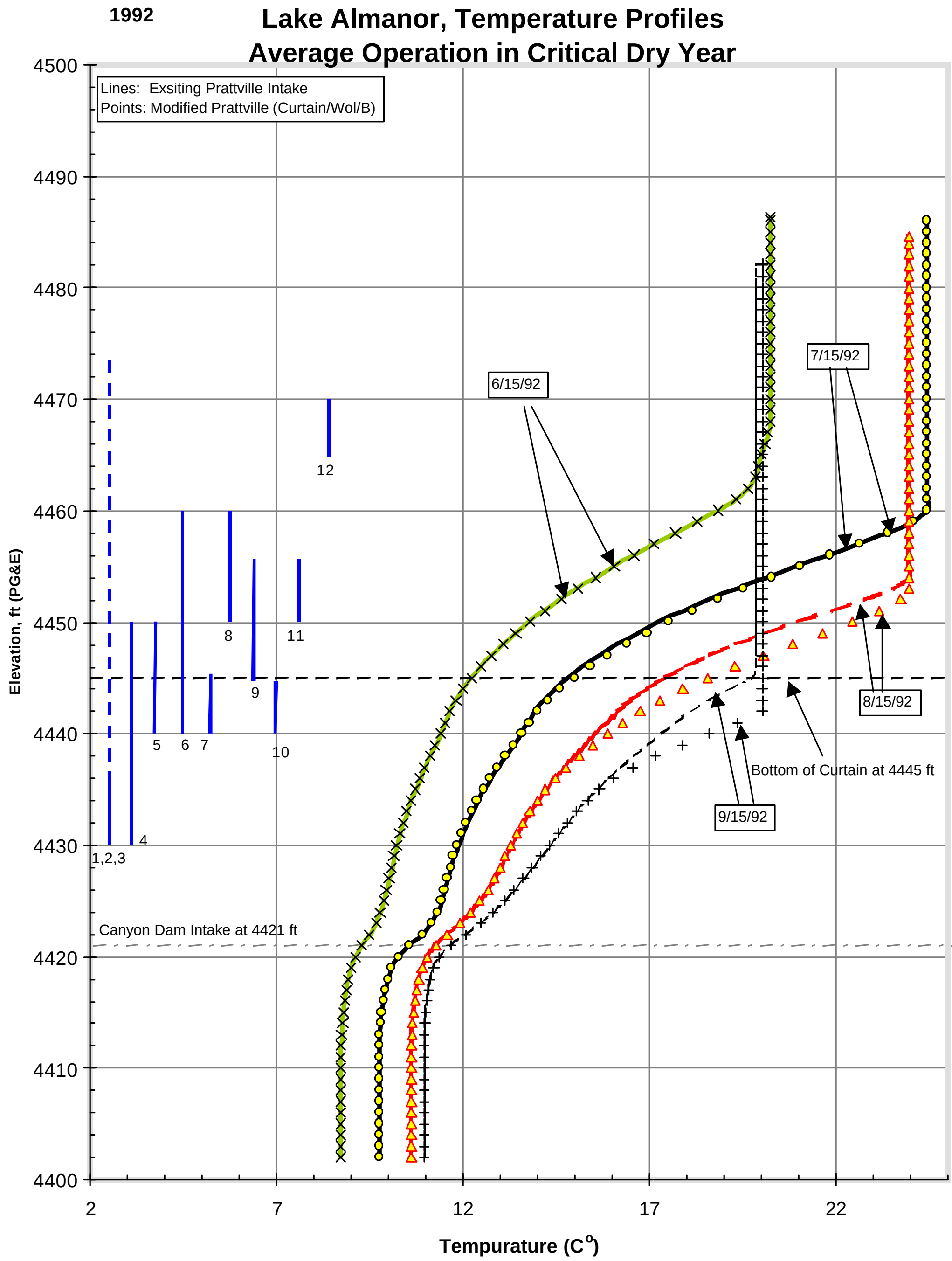
Note, blue numbered vertical lines (left side of figure) represent identified springs in Lake Almanor by elevation based on 1927 topographic map (PG&E datum). Location of vertical lines are not related to temperature axis.

Figure 5F



Note, blue numbered vertical lines (left side of figure) represent identified springs in Lake Almanor by elevation based on 1927 topographic map (PG&E datum). Location of vertical lines are not related to temperature axis.

Figure 5G



Note, blue numbered vertical lines (left side of figure) represent identified springs in Lake Almanor by elevation based on 1927 topographic map (PG&E datum). Location of vertical lines are not related to temperature axis.

Key to Springs for Figures 5A-G

Spring No.	Name/Description	Min Elev.	Max. elev.	Ave. elev.
1	Big Springs*	4430	4435	4432.5
2	Big Springs*	4430	4470	4450.0
3	Big Springs*	4430	4470	4450.0
4	east side pennisula	4430	4450	4440.0
5	Bunnel Point	4440	4450	4445.0
6	Dakasu Islands	4440	4460	4450.0
7	West Arm mid-channel	4440	4445	4442.5
8	Almanor West north	4450	4460	4455.0
9	Almanor West south	4445	4455	4450.0
10	west side pennisula, south	4440	4445	4442.5
11	west side pennisula, north	4550	4455	4502.5
12	Catfish Beach	4465	4470	4467.5

* Personal observations by Scott Tu in February of 2000 and 2001 indicates that one or more springs were present near the surface at an approximate lake elevation of 4475 ft (PG&E datum).

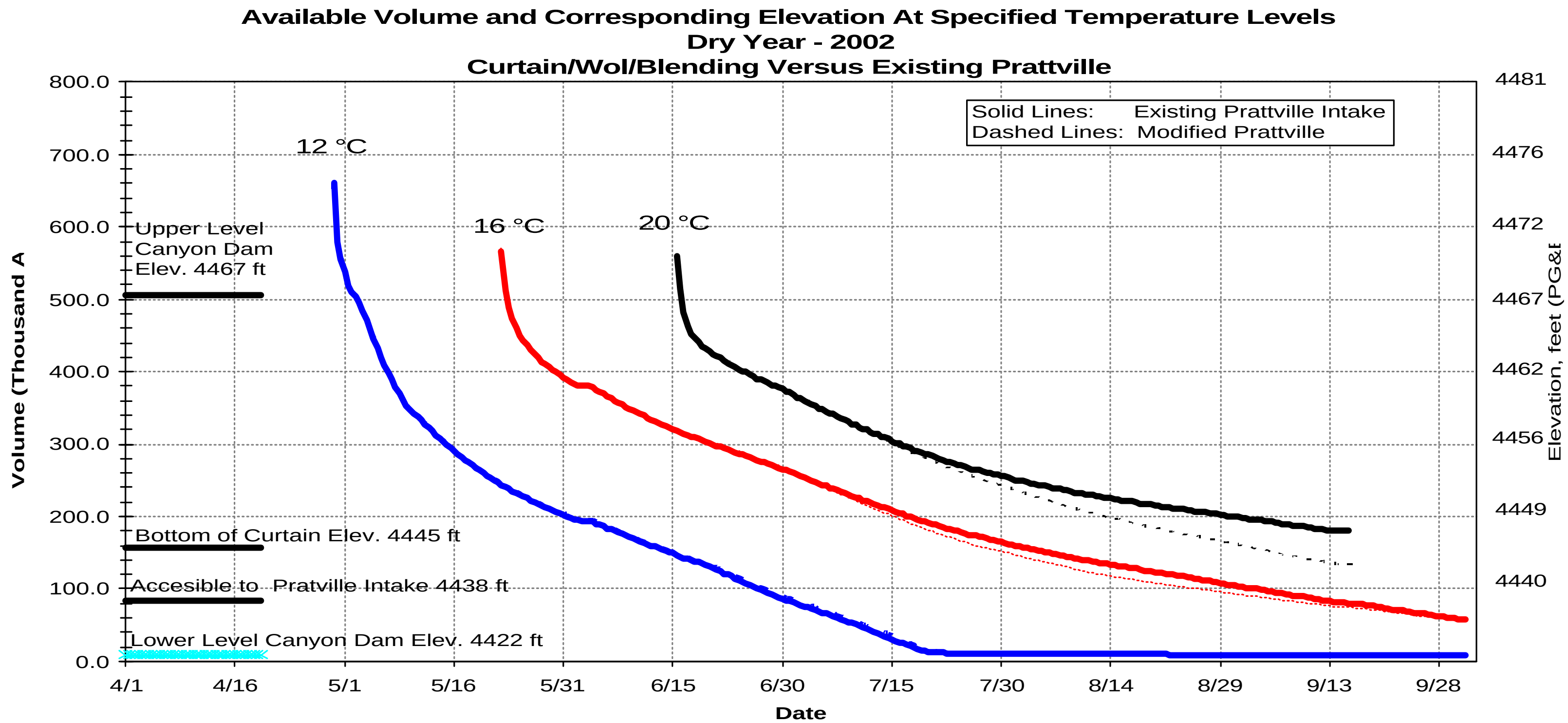


Figure 11A. Time Series of Volumetric and Corresponding Elevation Change for Three Specified Temperature Levels in Lake Almanor with and without Prattville Curtain for 2002, Operation in Dry Water Year Type

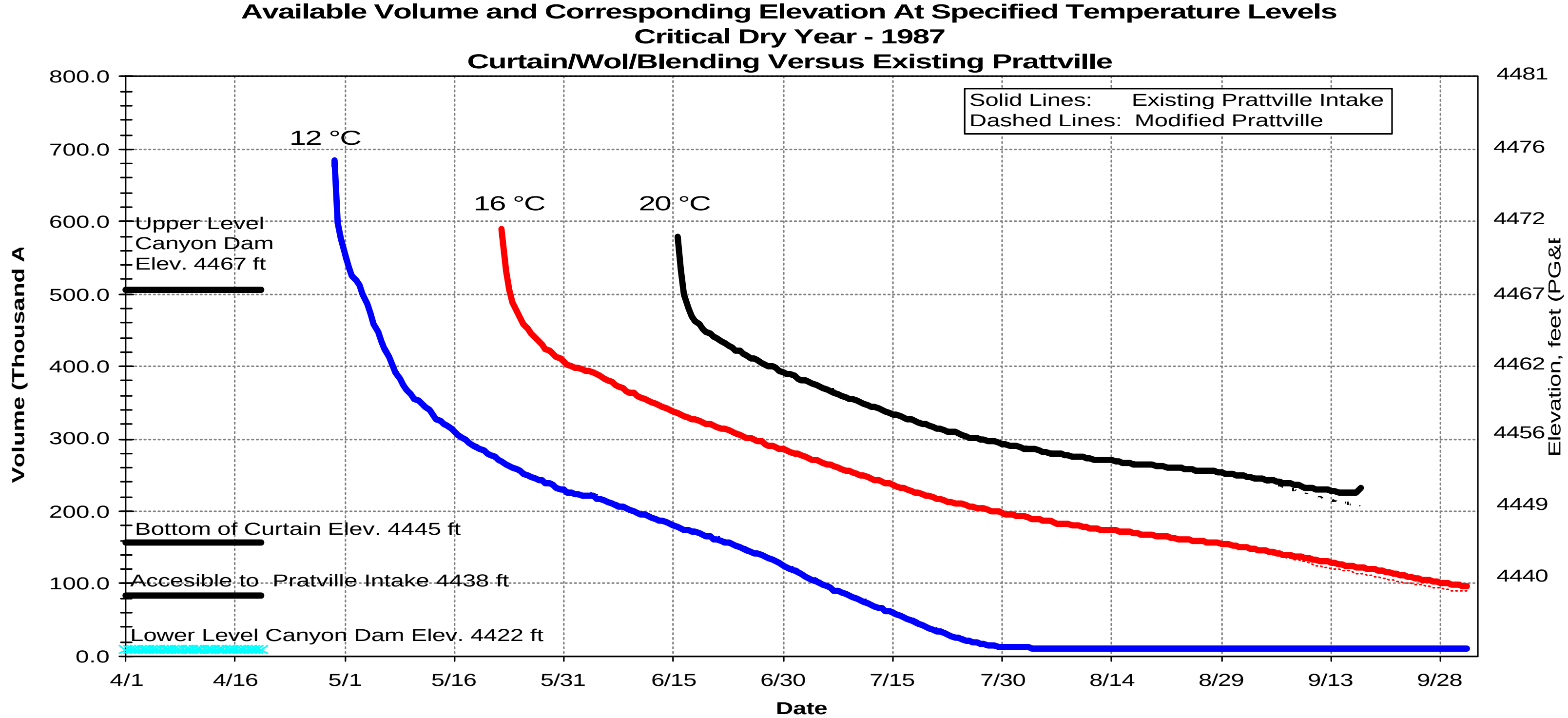


Figure 11B. Time Series of Volumetric and Corresponding Elevation Change for Three Specified Temperature Levels in Lake Almanor with and without Prattville Curtain for 1987, an Extreme Operation in Critical Dry Water Year Type.

Table 22A
Daily Average Water Temperatures at Butt Valley and Caribou Powerhouses for Various Exceedance Levels with and without Prattville/Butt Valley Reservoir Curtains

Temperature of Butt Valley Powerhouse (Celsius)

	Exceedance Levels Based on 33 years MITEMP Daily Prediction														
Month	90%	75%	50%	25%	10%	90%	75%	50%	25%	10%	90%	75%	50%	25%	10%
	Existing Prattville					3 curtains scenario					Temperature Reduction				
July	15.5	16.7	18.2	19.4	20.5	12.8	13.5	14.4	15.5	16.5	2.7	3.2	3.8	3.9	4.0
August	18.8	19.6	20.6	21.3	21.8	15.2	16.0	17.1	18.3	19.7	3.6	3.6	3.5	3.0	2.1

Temperature of Flow-weighted Caribou No. 1 and 2 Units (Celsius)

	Existing Prattville/BVR					3 curtains scenario					Temperature Reduction				
July	18.8	19.6	20.6	21.3	22.0	14.7	15.4	16.1	16.8	17.6	4.1	4.2	4.5	4.5	4.4
August	20.7	21.3	21.6	22.3	22.7	16.6	17.5	18.3	19.2	20.4	4.1	3.8	3.3	3.1	2.3

Warming through BVR (Celsius)

	Existing Prattville/BVR					3 curtains scenario				
July	3.3	2.9	2.4	1.9	1.5	1.9	1.9	1.7	1.3	1.1
August	1.9	1.7	1.0	1.0	0.9	1.4	1.5	1.2	0.9	0.7