Serene Lakes Depth Analysis

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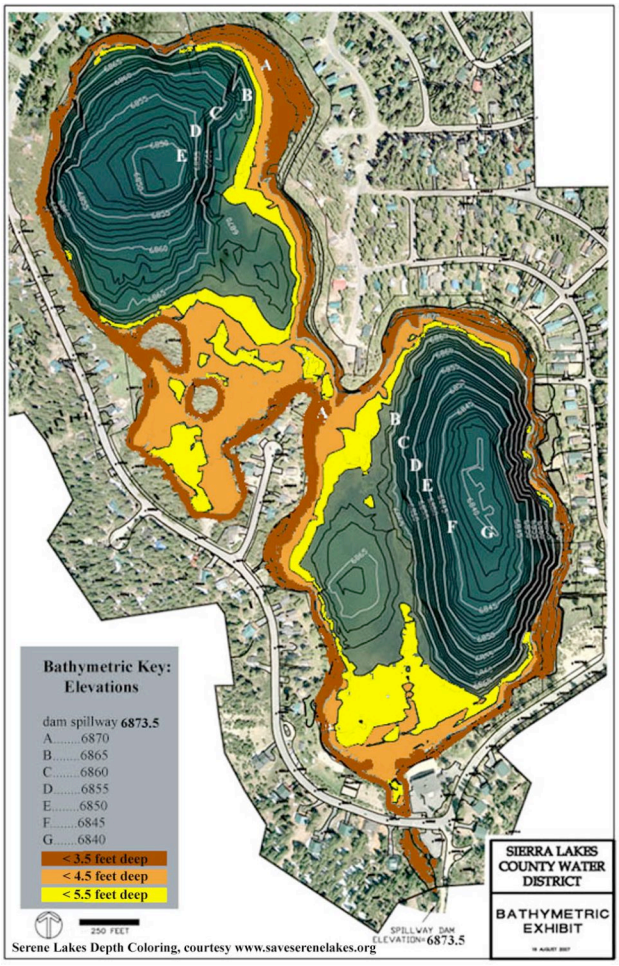
A new bathymetric study of Serene Lakes was released in August 2007. An analysis of the study highlights the problems with increasing the water draw from Serene Lakes beyond what is currently used and what is currently lost through evaporation and seepage. What the analysis shows is that the current low water level for the lakes is already close to the limit for both the recreational value of the lakes and the health of the lakes. The key concern, for both recreational use and for water quality, is how much of the lakes' area is too shallow. Shallow water is not suitable for recreation, and large shallow areas can be a danger to the lakes' health due to turbidity, warmth, decaying vegetation and algae growth.

The Bathymetric Study

As part of the bathymetric study, Sierra Lakes County Water District (SLCWD) released a contour map of the lakes' bottom and several charts showing the volume of water in the lakes as a function of depth. These can be found on the "Documents" page of www.saveserenelakes.org. These documents are the basis of this analysis.

A new map was generated that highlights the lakes' shallow areas. This map is shown in Figure 1. A larger version can be found on the "Documents" page of www.saveserenelakes.org as Serene Lakes Depth Map. The red area around the shore shows where the lakes are less than 3.5 feet deep, the orange area shows where the lakes are less than 4.5 feet deep, and the yellow area shows where the lakes are less than 5.5 feet deep.



"If the lakes' level is allowed to drop by 3.5 feet, then the red areas of the map will be dry and the orange areas will have an average depth of only 6 inches. The yellow areas will have an average depth of 18 inches. The lakes will be ruined for recreation and the added turbidity, decaying vegetation and algae growth would harm the lakes' health."

Figure 1: Serene Lakes Depth Map

The new map also shows how much of the lakes' area will dry up as the water level drops. If the water level drops 3.5 feet, then the red area will be a mud ring around the lakes. The orange area will be on average 6 inches deep, and the yellow areas will be on average 18 inches deep. The combined orange and yellow areas show how much of the lakes' area will be much to shallow for recreation use once the water drops 3.5 feet.

The new bathymetry studies were also used to generate the following Water Level Analysis table. A complete version of the table can be found on www.saveserenelakes.org as Water Level Analysis.

Table 1: Water Level Analysis

Water Level (feet)	Water Loss (usage plus evaporation) (AF)	Water usage only (AF)	Surface Area (acres)	"Bathtub" Ring area (acres)	Average Ring Width (feet)
0	0	0	78	0	0
-0.5	39	0	76.5	1.5	5
-1.5	114	14	75	3	11
-2.5	187	87	73	5	18
-3.5	256	156	69	9	33
-4.5	317	217	61	17	62
-5.5	367	267	50	28	102
-6.5	407	307	40	38	139
-7.5	441	341	34	44	161
-8.5	472	372	31	47	172
-9.5	500	400	28	50	183
-10.5	527	427	27	51	187

The water levels are color coded to match the Lake Depth Map in figure 1. The water loss column is the total amount of water drawn from the lakes when each level is reached. This water loss is a combination of evaporation (or seepage) and water usage by the community. The "Water usage only" column tabulates just the water used by the community. This column assumes that evaporation and seepage represents 100 acre-feet (AF) every summer, an assumption that agrees with the low lake level of -2.5 feet under current water usage conditions.

The Surface Area column shows how the lakes' water surface area decreases as the water is drawn down. The difference between the lakes' surface area and the full lakes' surface area is the size of the "bathtub ring" around the lakes. By dividing the perimeter of the ring by the area of the ring, one can calculate the average width of the ring around the lake as water is drawn down. This is shown in the final column.

As Figure 1 shows by the width of the red ring, much of the ring is concentrated in a few areas, such as the north-east corner of Lake Serena, around Island Way between the lakes, and the top and bottom of the east shore of Lake Dulzura. In these areas the ring is very wide, in others the ring is narrow. The last column shows the average width.

The average width change is dramatic. As the lake level goes down from -2.5 feet to -3.5 feet, the ring width jumps from 18 feet to 33 feet. Another foot drop in level and the ring almost doubles to 62 feet.

The "Bathtub Ring" represents a drastic change in the recreational use of the lakes. When the ring reaches 20 feet in width (just over a 2.5 foot drop in level) almost all homeowner docks are in stranded in mud. When it reaches 50 feet in width (just under a 3.5 foot drop in level), even Ice Lakes Lodge's dock is high and dry.

Current Water Usage

According to the Royal Gorge Water reports from last May, the water district records for 2005 and 2006 show that the water level in the lakes dropped to a low point of -2.5 feet with a water usage of 115 AF. Assuming that 25% of this usage occurs during the spring snow melt season when the lake is being re-filled, then 75%, or 86 AF, of the 115 AF would contribute to the lake's level drop. This matches the entry shown in Table 1, where a usage of 87 AF predicts a level drop of 2.5 feet.

Health and Recreational Use of the Lakes

At the normal level drop of 2.5 feet, the water depth around the shore (orange and yellow areas) is an average of 2 feet deep, even in the shallowest areas around the islands and through the channel between the lakes. An average depth of 2 feet in theses areas seems acceptable for most recreational use. Boats can make it across these shallows, even sailboats if their centerboards are raised. A depth of 2 feet is also healthy for the lakes. If the water gets any shallower, then water disturbances such as from boats, wind and storms, could stir up mud and debris and dramatically increase the water turbidity. Shallower water would also accelerate water-warming, die off of vegetation and potential algae growth.

If the total usage increases by another 70 AF, then the water level drops another foot to -3.5 feet, and the situation changes dramatically. At -3.5 feet 12% of the lakes is dry, another 10% is an average of 6 inches deep, another 14% is an average of 18 inches deep, and the channel between the islands is all but dry. Recreational use will be ruined and the health of the lakes due to turbidity, warming, vegetation decay and algae, will be compromised.

Future Water Usage

It is yet to be determined what the effects of a sustained drought, higher occupancy by current homeowners, or more evaporation due to hotter weather will do to the lakes' level. It seems like the number of full time residents in Serene Lakes is increasing every year. As the number of baby boomers reaching retirement age increases every year, it would seem likely that the number spending more time at Serene Lakes will also increase. With that increase comes more water usage. Will the occupancy, and the water required, double over the next ten years? Twenty years? If so, then another 86 AF will be taken from the lakes. This increases the seasonal loss to 187+86=273 AF.

The winter of 2005/2006, which was used to determine the current lake level drop of 2.5 feet, was a wet one. Not a record snow year, but one where the spring runoff was still going strong in June. This decreased the effects of water usage and evaporation. Will a drought year, where runoff ends in May add an extra month to the water usage? Will the usage evaporation and seepage go up 10%, or maybe 20% during drought years? Addng another 15% to the 273 yields 314 AF.

There are at least 100 lots yet to be developed in the community. That alone will be an increase of 11% in the usage over the existing 900 homes. Add another 11% and the total is 349 AF.

The cumulative effect of these future issues is that the water loss from the lakes could almost double from 187 AF to 349 AF. The table shows that a loss of 349 AF will reduce the lakes' level by more than 5 feet, leaving the orange and yellow areas, over 36% of the lake area, dry.

Is Dredging the Answer?

Unfortunately, no. Even if a method of dredging were invented that didn't require emptying Lake Serena and bulldozing the lake bottom, and even if a method of hauling away 60 AF of wet muck were proposed, the end result will not be much different. Royal Gorge has proposed removing 60 AF of muck from the bottom of Lake Serena, increasing the depth of the lake to 5 feet all around its shore. This means that the red ring in figure 1 would become a narrow strip all around Lake Serena, and all of its orange areas would be come yellow. The yellow areas would not change, nor would the red or orange areas in the un-dredged Lake Dulzura.

If the same criteria of keeping the water depth at no less than 2 feet in the orange and yellow areas is applied to the dredged lake, then the lakes could be drained to a level of -3 feet, rather than the pre-dredging level of -2.5 feet. Of course, this ignores the fact that the orange areas in Lake Dulzura would be an average of only 12 inches deep when the water level is at -3 feet.

The water volume in the lakes' top three feet after dredging can be calculated as the water in the top three feet of Lake Dulzura, which isn't dredged, plus the top 3 feet of the dredged Lake Serena. The surface areas of both lakes is approximately the same, so the water in the top three feet of Lake Dulzura is approximately half of the water loss shown in Table 1 when the level is at -3 feet. Extrapolating between the entries for -2.5 feet and -3.5 feet yields a loss of 222 AF, half of which is 111 AF. The volume of the top three feet of water in Lake Serena after dredging can be calculated by assuming that the shoreline is dredged to a slope of 1 foot in depth for every 4 feet laterally. This means that the surface area of the lake will shrink by 12 feet in all dimensions when the lake is 3 feet lower. A good approximation of the water in the top three feet would be the surface area at the mid-point times the 3 feet in depth. The surface area at the midpoint is the original surface area of 39 acres, minus a ring six feet wide times the circumference of the lake. With a circumference of 5,950 feet, the mid-point area works out to be an acre less than the original 39 acres, or 38 acres. Times the 3 foot depth yields 114 AF. Add this to the 111 AF from Lake Dulzura and the total water volume is 225 AF.

The net gain, therefore, by dredging is to be able to use an extra 38 AF of water by lowering the level by another half-foot. Hardly worth the effort, especially since Lake Dulzura is not dredged. In addition, that extra half-foot drop to a depth of 3 feet means that all of the orange areas in Lake Dulzura (the swimming lake) will be less than 12 inches deep.

Conclusions

The lakes are currently healthy, are good for recreation, and will continue to be so if the lake level drop can be held at the current 2.5 foot point. Any additional water draw will quickly leave the lakes too shallow for recreation, and too shallow for the health of the lakes. Unfortunately, the future use by current residents, and the use by future residents planning on building on their empty lots, will increase the water demand on the lakes. When this happens, the water district will need to impose water conservation measures on the community in order to save the lakes.

There also won't be any extra water available for future development. Nor is dredging the answer, as the increase in available water is only 38 AF, not enough to justify draining and bulldozing the lakes.