**Constructing a Water Budget for Deep Creek Lake**

Below is an outline a possible methodology for developing a water allocation budget for Deep Creek Lake. This is an optimization problem, that is, given how much and at what time water comes into the lake, what is the best way to apportion the amount of water to the various needs.

The inputs are:

- Direct rainfall on the lake
- Direct runoff, including from stormwater management systems
- Streams
- Groundwater, including springs at the bottom of the lake

The outputs or losses from the lake are:

- Release through the hydro-electric generator station, including wicket gate leakage and bypass
- Groundwater loss around the dam area
- Evaporation
- Water for Wisp, ASCI, and Thousand Acres

The constraints are:

1. The lake cannot get fuller than a level of 2462 ft.
2. The hydroelectric facility cannot discharge more than 630 cfs/hr
3. The lake level cannot fall below 2457 ft during the months of May-September
4. The water temperature at Sang Run bridge cannot go above 25 C during the months of June-August
5. The flow rate at Hoyes should always be greater than 40 cfs during the months of June-August
6. The white-water needs are as expressed in the permit
7. The maximum amount of water that can be discharged by the power plant is as per permit
8. The maximum amount of water permitted for Wisp, ASCI, and Thousand Acres

It is entirely possible that not all of these constraints can be satisfied on every day. Hence, each of these constraints must come with a plan B.

For example, suppose that the 25 C limit is the only one that could not be met, but that 26 C could for that one day. Would that be acceptable? Or, by going to a lake level of 2456.8 ft all other constraints could be satisfied, would that be acceptable? This analysis requires some thought.

An optimization or minimization problem requires an objective function. One such function that is useful for the boating needs on the lake might be: "Ensure that the number of days of average water levels are greater than 2457 ft during the months of May-September"

Now, if I were a trout fishing guy, I might state the objective function as: "Make sure that the river temperature at Hoyes Run bridge is never above 25C"

Or if I were a white water enthusiast, I might want to state it as: "Make sure that there are white water releases for the day and time schedule specified in Table X."

These ideas and their ramifications can be tested with historical data (2008-2013?). I think we have all the data:

- Daily rainfall for the year
- The daily average lake level for the year
- The daily number of hours that the power plant has run during the year (from this a good estimate of a profile of all net available water could be reconstructed)

The basic software to do this is relatively simple. The difficulty is going to be in selecting the right optimization technique so that the process converges to acceptable solutions. There are many such methods, each designed to handle a certain class of problems.

PLV: 5/5/2014