

# Arrow Lakes Reservoir Mid-Elevation Scenarios: Scoping Evaluation

## Addendum

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This Addendum proposes a third Mid-Elevation Scenario for the Arrow Lake Reservoir in response to what has been learned from the information reviewed in the main report. The objectives of the new scenario are:

- to maintain and/or enhance the potential benefits identified for Scenario 2;
- to establish a seasonal pattern of reservoir levels closer to the natural seasonal pattern present in Upper Arrow Lake prior to dam construction; and,
- to allow for flexibility in reservoir management to increase downstream benefits and/or decrease potential downstream negative impacts (e.g. flow increases for fish passage, decreases for flood control).

Scenario 3 maintains the basic structure of Scenario 2: a relatively stable mid-elevation reservoir level in 6 out of 7 years centered on 1,420 ft., and a 1 in 7 year allowance for raising the level to full pool for major flood years. The primary changes associated with Scenario 3 are:

- defining an allowable range and seasonal pattern of elevation variation during the non-flood years (6 of 7 years), and
- allowing increased drawdown during predicted flood years (on average 1 of 7 years).

Records of Upper Arrow Lake levels prior to construction of the Hugh Keenleyside Dam (1922-1968), indicate that the lake varied from 1,375 ft. to 1,409 ft.(34 ft.). Annual variation ranged from 19 ft. to 34 ft., averaging 25 ft. In contrast, annual variation in the reservoir post-dam (1970-2012) has varied from 24 ft. to 70 ft., averaging 47 ft. (see Figure 1)

Scenario 3 proposes that annual variation during 6 of 7 years would target 6 ft. in variation, with an allowance for variation of up to 12 ft. The target elevation range is between 1,417 ft. and 1,423 ft., and the allowable variation is between 1,415 ft. and 1,427 ft. (see heavy dark green line in Figure 2). The upper elevation maximum is intended to protect the potential re-vegetated area above 1,430 ft. from wave action and erosion. The maximum and minimum allowable levels for 6 of 7 years are indicated by the orange and dark blue lines in Figure 2.

Historically the dates of peak elevations in Upper Arrow Lake ranged from May 27<sup>th</sup> to July 19<sup>th</sup>, with 90% falling between June 1<sup>st</sup> and July 15<sup>th</sup>. The 90% range was used to define the seasonal peaking window for Scenario 3 (red lines in Figure 2).

The 1 of 7 flood year allows drawdown to 1,412 ft. to increase flood storage pre-freshet (see light blue line in Figure 2). As in Scenario 2, flooding above 1,430 ft. must not exceed 35 days, requiring rapid infill and evacuation of the reservoir above this level. The example of a 1 in 7 flood year (heavy light green line in Figure 2 ) shows an infill rise above 1,430 ft. of 0.9 ft./day and evacuation rate of 0.65 ft. day, reaching a peak of 1,443 ft, just one foot below maximum pool height. Both these infill and evacuation rates, although high, have been achieved in the past. Reduced pool height would be the result of lower infill and evacuation rates if the maximum 35 day target for inundation at 1,430 ft. is to be achieved. Conversely, filling to full pool would require greater infill and/or evacuation rates. The date of the peak should fall between June 1<sup>st</sup> and July 15<sup>th</sup> if historical peaking patterns are to be mimicked. If climate change brings earlier peak flows, as is projected at present, the peaking window may have to extend into May.

Drawdown to 1,427 ft. at the end of the flooding period should occur as soon as possible, but definitely within 10 days following drawdown below 1,430 ft. to reduce the risk of wave damage to re-vegetated areas above 1,430 ft. In the 1 in 7 years, once the drawdown is below 1,427 ft. the drawdown must then remain below the maximum for the 6 in 7 years (orange line in Figure 2).

The annual storage volume for the 6 of 7 year seasonal target under Scenario 3 is approximately 0.69 million acre-ft. (1,417-1,423 ft.). Utilization of the full potential elevation range for 6 of 7 results in approximately 1.38 million acre-ft. of storage (1,415-1,427 ft.). The 1 in 7 storage potentially increases to approximately 3.83 million acre-ft. (1,412-1,444 ft.).

The intention of providing a “target” for the 6 of 7 year portion of Scenario 3 is to indicate the preferred operating regime for those years. Ideally implementation of Scenario 3 would include an operational rule that requires that at least 3 or 4 of the 6 years should be within 1 foot of the target at all times, and deviations outside that range would only occur under specified conditions (e.g. moderate flood years, or drought conditions). The central concept is to provide more stable reservoir levels while providing for increased flexibility, but only when it is required to meet limited specified requirements (e.g. fish flows, flooding, etc.).

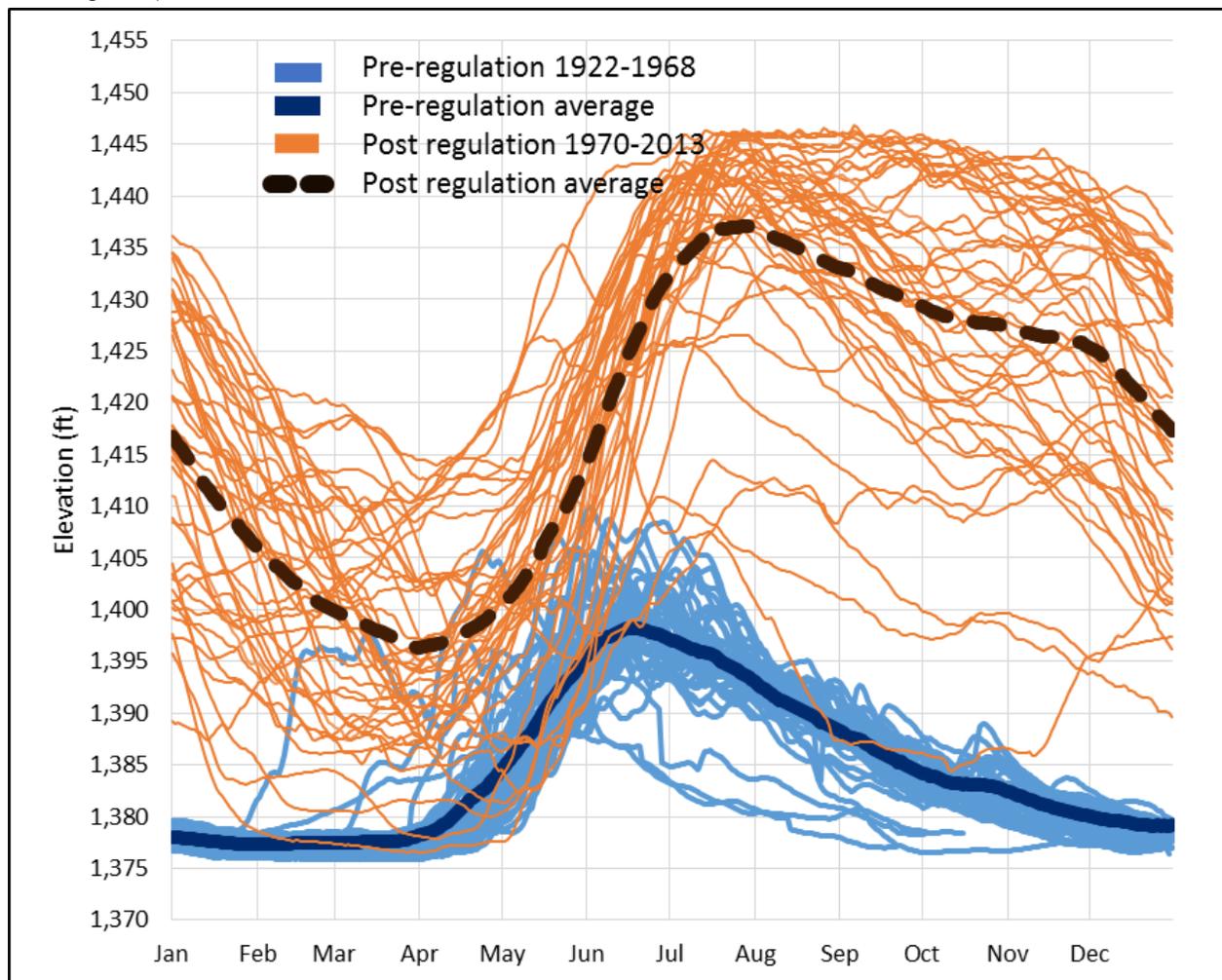


Figure 1. Pre- and post dam elevations in Upper Arrow Lake and the Arrow Lakes Reservoir.

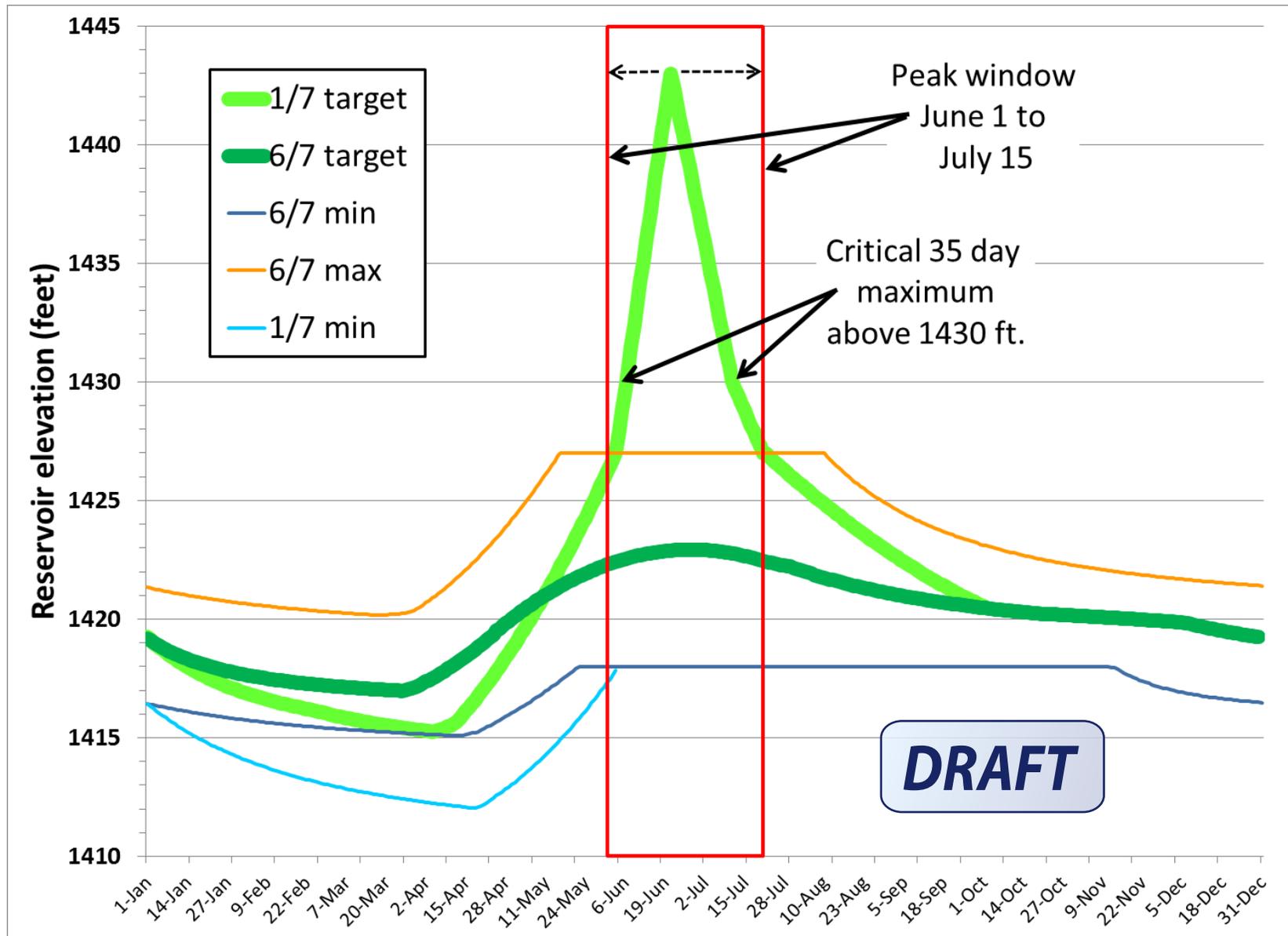


Figure 2. Annual and seasonal patterns in water levels for Scenario 3.