not examine WCOs for the entire Bow River System. However, participants agreed to use the WCO at Bassano as a proxy for meeting WCOs along the river.

Figures 5 and 6 show the sections of the Bow River System where impacts of the scenarios would be most apparent.

FIGURE 5. The Kananaskis Section of the Bow River System
{SOURCE: Bow River Basin Council}

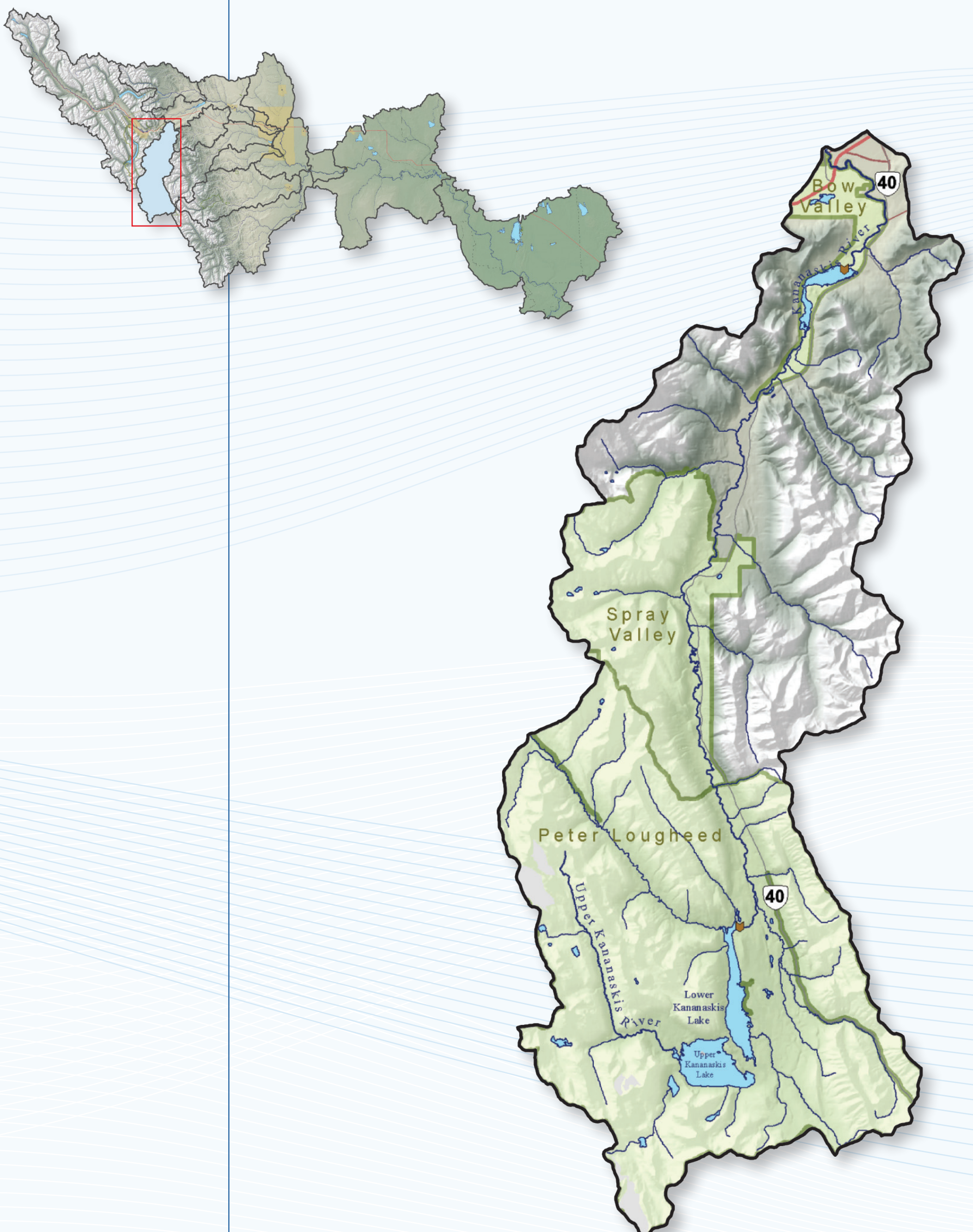
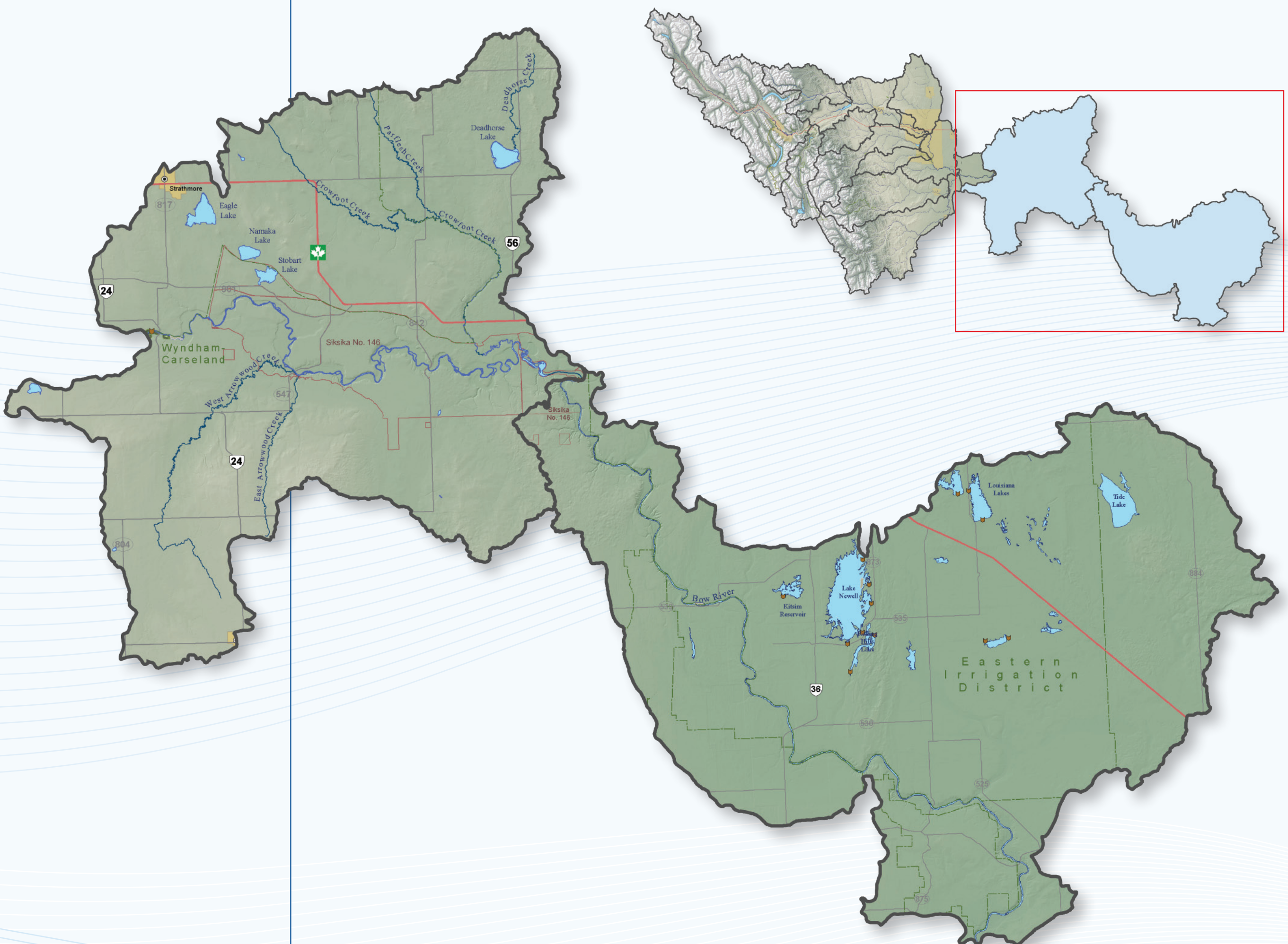


FIGURE 6. The Bow River from Carseland to its confluence with the Oldman River
{SOURCE: Bow River Basin Council}



Based on the results of this work, four additional scenarios were considered:

A: Kananaskis Stabilization

This scenario was developed to examine the effects of stabilizing Lower Kananaskis Lake as well as steadying flows into the Kananaskis River from the Pocaterra power plant.

B: Restored Spray Lakes Reservoir

This scenario was developed to model the effect of restoring the capacity of Spray Lakes Reservoir (Spray) to its original design specifications, thus increasing storage by 75,200 dam^3 (61,000 acre feet). In the initial run, this extra storage was used to maintain some measure of Calgary flow in the summer and to assist in meeting Bassano WCOs.

C: Barrier Lake

This scenario was developed to use Barrier Lake to serve the same purpose as the Restored Spray scenario, but with less storage. Barrier Lake would fill and empty with the objective of meeting the extra flow required at Bassano and is not allowed to refill from August 1 to October 15. This option could provide about 30,800 dam^3 (25,000 acre feet) of water but would result in extended draw-down at Barrier. It includes stabilization of Lower Kananaskis Lake and Kananaskis River, and the water would contribute to meeting the WCO at Bassano. This scenario would minimize infrastructure changes compared to the restored Spray scenario.

D: Water Bank

This scenario includes stabilization of Lower Kananaskis Lake and Kananaskis River, but instead of using Spray or Barrier for additional storage, it involves taking up to 49,300 dam^3 (40,000 acre feet) of water proportionately from every TransAlta reservoir above Ghost Dam. This water would also contribute to meeting the WCO at Bassano. This volume would minimize infrastructure changes compared to the restored Spray scenario..

3.2.2 FINAL SCENARIOS

As results of each model run were reviewed and examined, the Consortium fine-tuned the parameters it considered most important in meeting the overall goals of the project, and the model runs were adjusted accordingly. Four scenarios, in addition to the base case, then emerged and are described in more detail in Appendix C.

All scenarios except for the base case include a doubling of storage in the WID's Langdon reservoir, from 8,340 to 16,700 dam^3 (6,750 to 13,500 acre feet), which significantly reduces WID shortages in the BROM. This expansion has financing in place and is in the final design stage so it was regarded as a certain development that should be included in the model. As well, in all scenarios except the base case, Lower Kananaskis Lake and Kananaskis River are stabilized.

Scenario 1: Stabilized Lower Kananaskis Lake and Kananaskis River

- In this scenario, Lower Kananaskis Lake is stabilized at 1663.5 metres—3.5 metres below the current 1667-metre full supply level (FSL)—with a fluctuation of ± 0.5 metre; this is a significant change from current annual fluctuation of up to 13.5 metres. This reservoir is not allowed to use its spillway unless elevation rises above the FSL of 1667 metres. Stabilizing Lower Kananaskis Lake was modelled based on the operating parameters proposed by FREWG (2001).
- Discharge flows into the Kananaskis River from the Pocaterra power plant are held steadier, with the objective of ensuring that within-day instantaneous flows vary by no more than a factor of three, maximum day-to-day instantaneous flows vary by no more than a factor of two, and minimum day-to-day instantaneous flows vary by no more than a factor of 0.5.
- Langdon reservoir capacity is doubled.

Scenario 2: Stabilized Lower Kananaskis Lake and Kananaskis River + Water Bank of 49,339 dam^3 (40,000 acre feet)

- This scenario includes all the conditions described in #1, plus access to 49,300 dam^3 (40,000 acre feet) using the "water bank" approach.

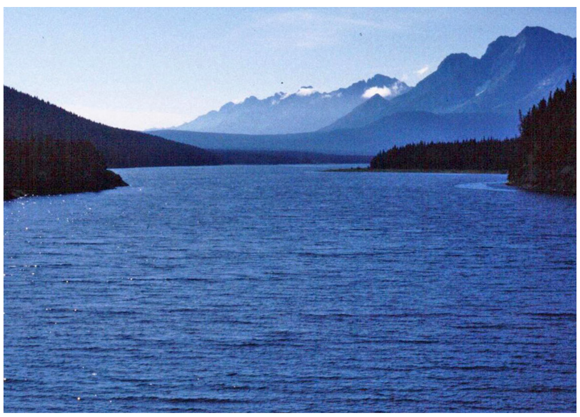
Scenario 3: Stabilized Lower Kananaskis Lake and Kananaskis River + Water Bank of 74,000 dam^3 (60,000 acre feet)

- This scenario includes all the conditions described in #1, plus access to 74,000 dam^3 (60,000 acre feet) using the "water bank" approach.

Scenario 4: Stabilized Lower Kananaskis Lake and Kananaskis River + Water Bank of 74,000 dam³ (60,000 acre feet) + Restored Spray at 75,200 dam³ (61,000 acre feet) (the Integrated Scenario)

» This scenario includes all the conditions described in #1, plus access to 74,000 dam³ (60,000 acre feet) using the "water bank" approach.
» It also includes restoring the capacity of Spray to its original design specifications, thus increasing storage by 75,200 dam³ (61,000 acre feet).

In the water bank scenarios, downstream needs are met by taking water from each of the upstream reservoirs in approximate proportion to their water storage capacity or their current (given time of travel) storage levels. This tends to lower several reservoirs proportionately rather than draining a single reservoir. The integrated scenario with a restored Spray reservoir (scenario 4) also includes a water bank. The additional storage in Spray is drained down to generate additional power and is used in combination with the other reservoirs. This results in higher water levels in the other reservoirs for a longer period, likely creating environmental, recreational, aesthetic and other benefits. More refined analysis is needed to understand all the implications of the water bank approach.



Note the difference in water levels in these two photos of Lower Kananaskis Lake taken four months apart {l: Lower Kananaskis Lake in September (full); r: Lower Kananaskis Lake in May (empty).} This extreme annual fluctuation, caused by hydro power generation, reduces productivity and the invertebrates that fish feed on.

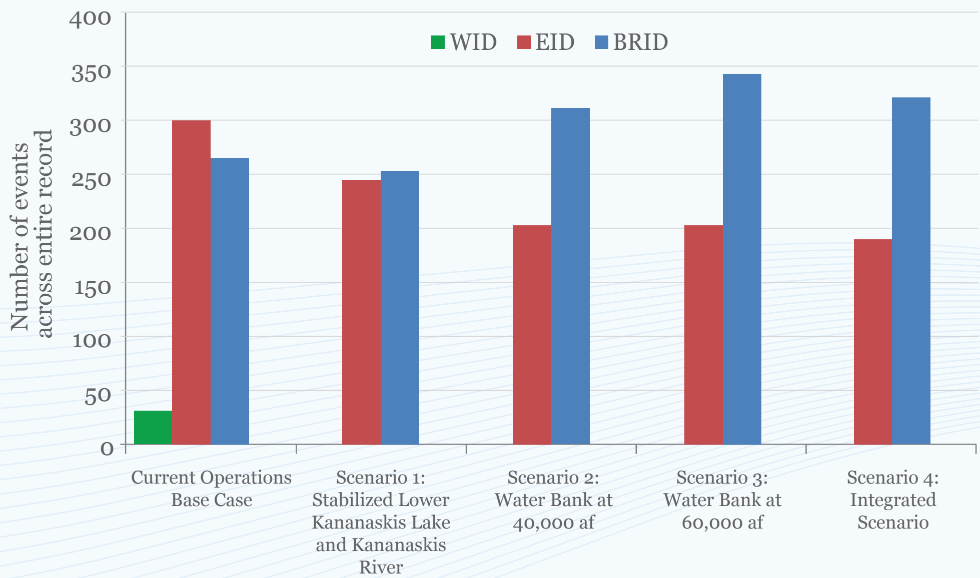
3.3 COMPARISON OF SCENARIOS WITH THE BASE CASE

All four alternate scenarios were run in the BROM; the impacts on performance measures are shown in Appendix D.

Figure 7 compares days with shortages (PM 13); a shortage is defined as one day in the historical record when the user could not divert the full amount of water required. The BROM modelled 68 years (1928 to 1995, inclusively), which means that the entire historical record reflected in the chart covers 24,820 days.

Figure 7 shows that all the alternate scenarios reduce the number of days of shortages for WID and EID. Calgary demands are always met.

FIGURE 7. Comparison of Shortages (PM 13) under the Base Case and the Alternate Scenarios



In the water bank scenarios, the BRID experiences some additional shortages; as an example, in scenario 2, this increase amounts to about 50 days over the 68 years of the record. Because the water bank scenarios intend to supplement low Bassano flows, they change the timing of water in the river from the current base scenario. In some years, this changes the ability of the irrigation districts to capture water. In dry years, this equates to additional draw-down in McGregor reservoir. Since demand 341 in the BROM (BRID Irrigation block, McGregor reservoir) is unable to draw water when McGregor reservoir drops below 871.74 metres, this causes a small increase in the number of days with some shortage for BRID. Further refinement of the release rules for the water bank storage could likely ameliorate many of these new shortages.

FIGURE 8. Comparison of Average Annual Power Revenue (PM 30) under the Base Case and the Alternate Scenarios

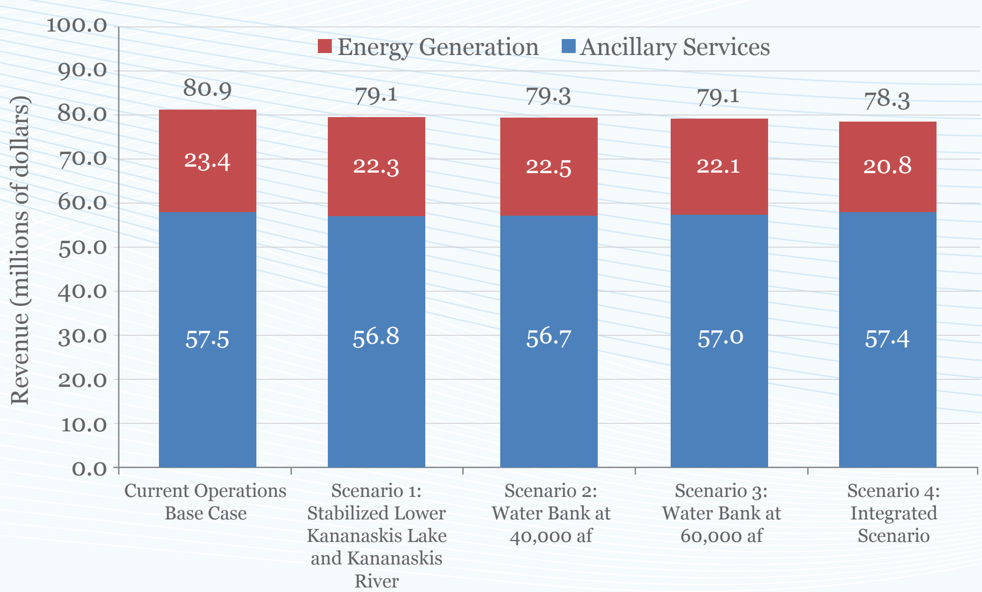
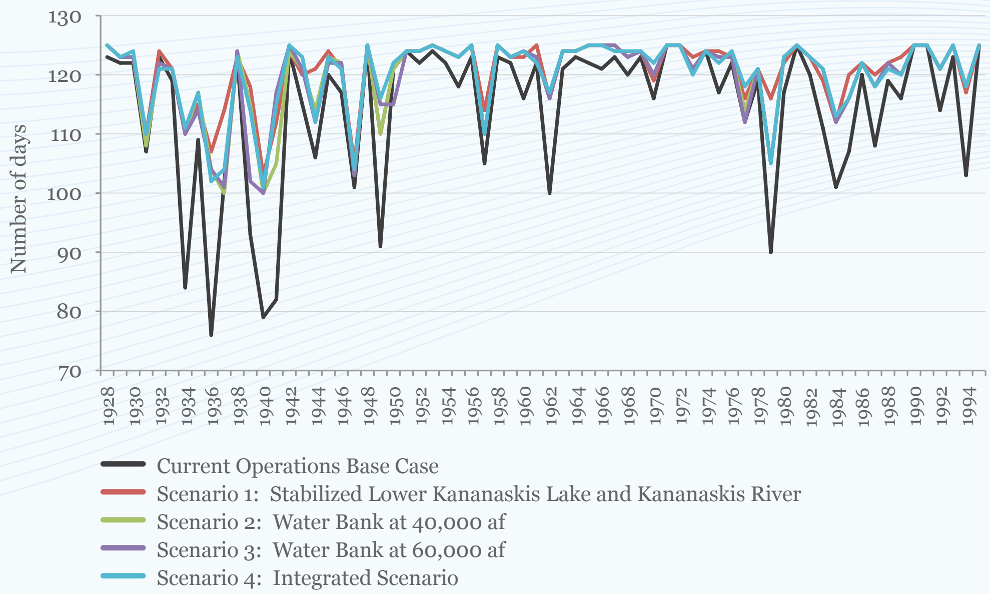
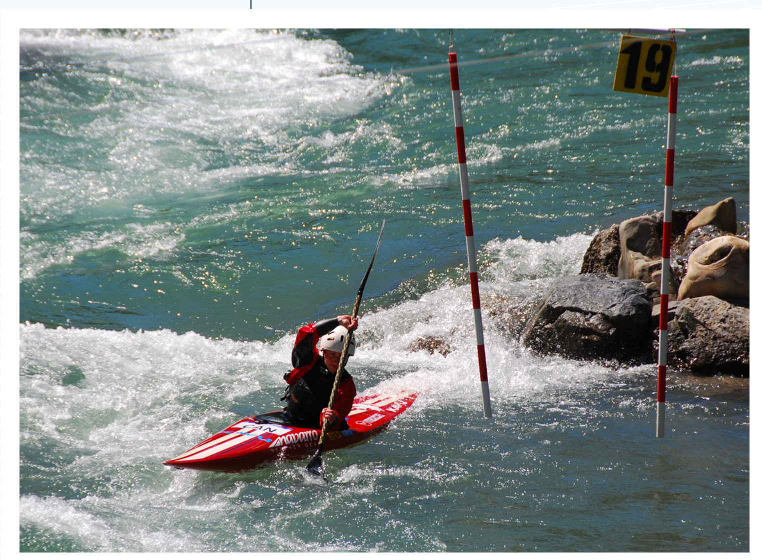


Figure 8 illustrates the relatively small impact on average annual power generation revenue (PM 30); most of the lost revenue is related to ancillary services. Revenue is reduced under Scenario 1 but some is recovered when a water bank is implemented. The difference from highest to lowest revenue is about $2.6-million, or about 3% of the base case revenue. Without restoring Spray capacity, the revenue difference between the base case and water bank scenario 3 is less than $2-million.

FIGURE 9. Comparison of Annual Rafting Days (PM 56b) Below Barrier Lake under the Base Case and the Alternate Scenarios

(days with a minimum of three consecutive hours with flow >= 30 cms)





Kayaking at Canoe Meadows on the Kananaskis River below Barrier Dam

Figure 9 illustrates the impact on a major recreation activity on the Kananaskis River—kayaking and rafting (PM 56b). Compared to current operations, all of the alternate scenarios produce substantial improvements in the annual number of rafting days below Barrier Lake. “Rafting days” is just one example of how recreation in the Kananaskis region would be improved. Improvements in fishing, day use of facilities, camping and other tourism and recreation activities would also be expected.

Figure 10 shows the significant improvement in stability of Lower Kananaskis Lake (PM 57) that occurs with all of the alternate scenarios.

The green bars reflect the positive desired outcome of stabilization; that is, for essentially 100% of the time, Lower Kananaskis Lake is within 0.5 metres of the target elevation with the alternate scenarios; for 60% of the time, it is 0 to 0.5 metres above the target elevation, and for about 40% of the time, it is 0 to 0.5 metres below the target elevation.

FIGURE 10. Comparison of Lower Kananaskis Lake Levels (PM 57) under the Base Case and the Alternate Scenarios

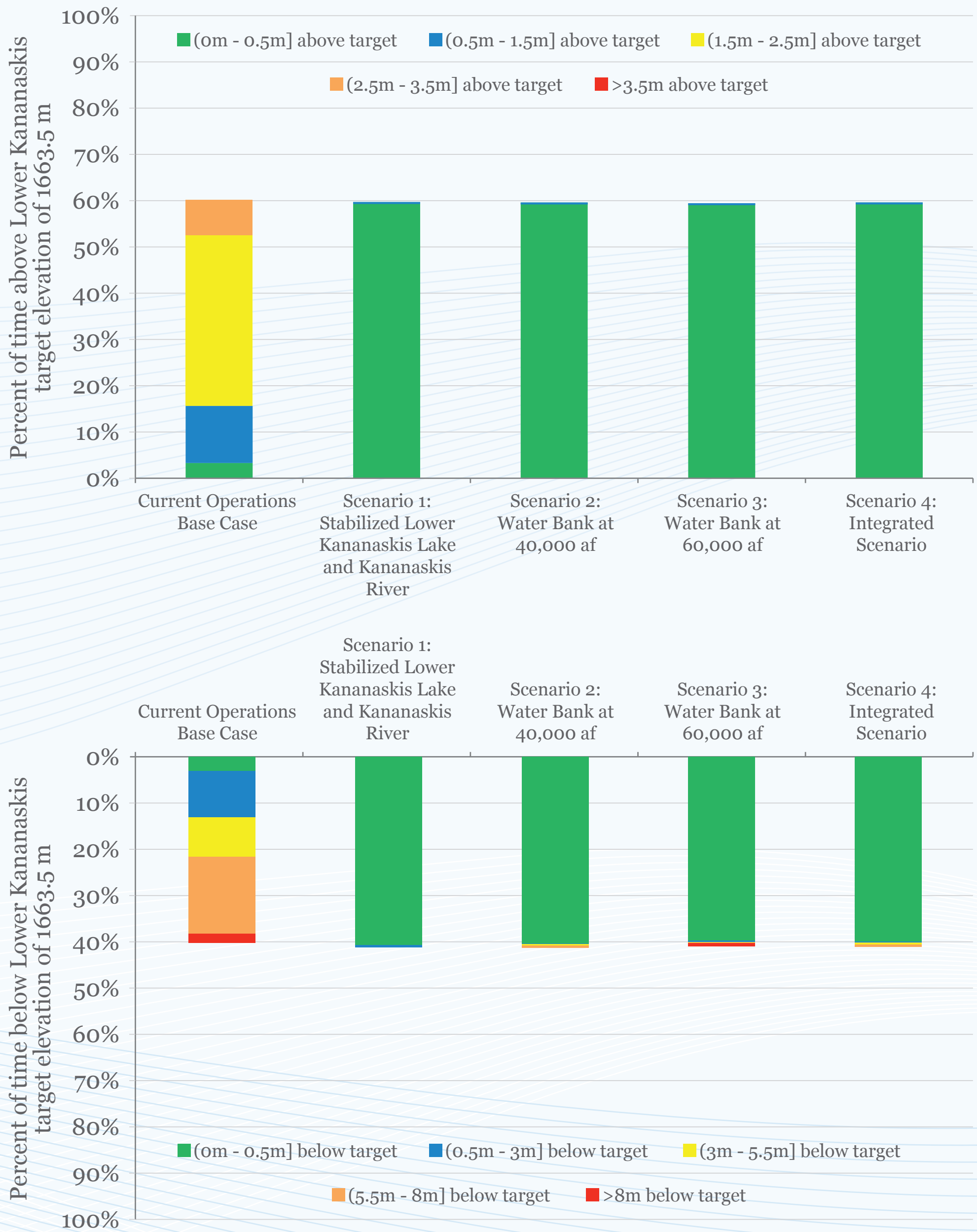


Figure 11 shows the annual stage range on Lower Kananaskis Lake (PM 58). For scenario 2, the lake level is nearly always within 0.5 metres of the target elevation (1663.5 metres), although in two years out of the 68 on record, it drops to meet Bassano flows. With the integrated scenario, the added water from Spray counteracts even that dip.

Figure 12 shows the impact on Bassano flows of the alternate scenarios over the 24,820 days in the 68-year simulation. The goal was to reduce the number of lower-flow days below Bassano; i.e., reduce the number of days in the 400-800 cfs column (orange and increase the number of days in the 800-1200 cfs column (green) or above 1200 cfs (purple).