TWG Assessment of the April 1 Allotment Model

This document addresses the AC request to:

"*Develop and evaluate the April 1 Allotment ("A1A") Model for Consumptive Use Allotment Estimations to determine if it can be the basis for a longer-term management plan.*"

Introduction

The proposed April 1 Allotment Model (A1A Model) concept uses historical data to develop correlations between water supply forecasts, flow in the Big and Little Wood rivers, and upstream groundwater consumptive use in the Galena and South Valley Groundwater Districts as the basis for a predictive model. Using April 1 forecasts of seasonal Big Wood River water supplies at the Big Wood River at Hailey gage (Hailey) and the Below Magic Dam near Richfield gage (below Magic), the model attempts to predict the volume of junior groundwater consumptive use that can occur, while still maintaining specified minimum monthly flows in the Little Wood River to meet the needs of senior surface water users later irrigation season.

In a departure from the current plan, the A1A proposes to use a flow target at the Little Wood River Station 54 (Station 54), instead of flow at the Little Wood River at Station 10 (Station 10). This change incorporates possible returns from Big Wood River diversions that discharge into the Little Wood River between Stations 10 and 54 as additional water supply available to senior surface water users.

The A1A Model was presented to the Technical Working Group as a proof of concept, and as such, was not conducive to technical evaluation. To better evaluate the concept and the uncertainty associated with the predictions, IDWR generated a simplified tool called the Skeleton A1A Tool (Skeleton A1A). The following discussion of the A1A concept is based on the Skeleton A1A Tool.

Summary of Skeleton A1A Calculations

The Skeleton A1A calculates an estimated groundwater pumping limit needed to achieve a target minimum monthly average flow in the Little Wood River at Station 54, based on forecast seasonal Big Wood River water supplies at Hailey and below Magic. Figure 1 provides a schematic illustration of the relationships used in the Skeleton A1A.

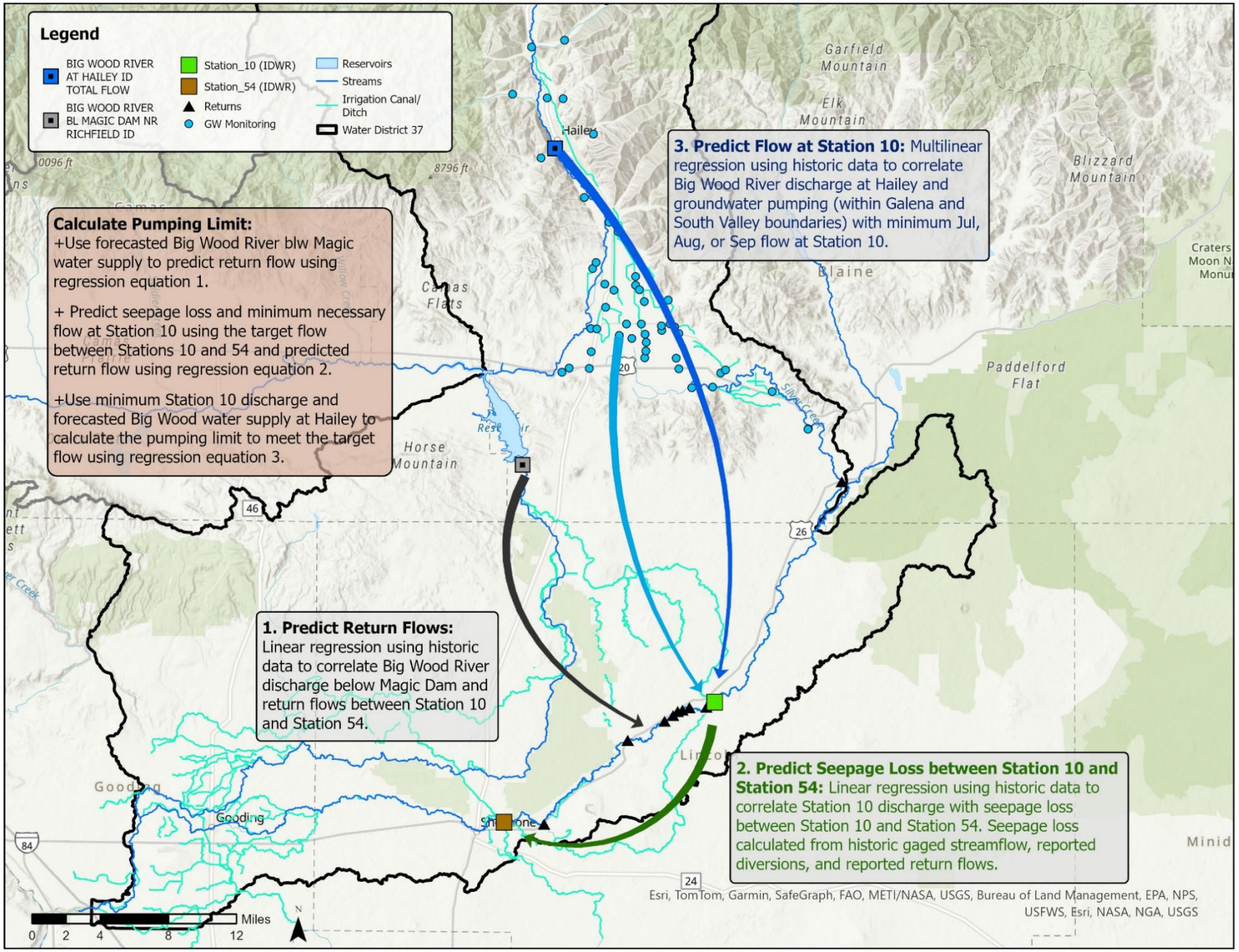

Figure 1. Schematic illustration of the Skeleton A1A tool process.

Correlations:

The Skeleton A1A uses historic data to develop correlations between seasonal water supply, flow in the Big and Little Wood rivers, and groundwater consumptive use that are used to calculate a pumping limit.

- RETURN FLOWS: A logarithmic regression was developed between seasonal (Apr-Sep) discharge below Magic and minimum monthly average (Jul, Aug, or Sep) irrigation return flows to the Little Wood River between Stations 10 and 54.
    - The regression used data from 1995-2023.
    - This regression equation is used with the April 1 seasonal water supply forecast below Magic to predict return flows into the Little Wood River that largely result from Big Wood River diversions.
    - The returns provide additional water supply to the Little Wood River between Stations 10 and 54 when water is being released from Magic Dam for diversion to the Richfield and Dietrich tracts.
    - The minimum monthly average return flow is predicted to be zero when the seasonal discharge below Magic is less than 150 KAF.
- SEEPAGE LOSS: A linear regression was developed between monthly average streamflow at Station 10 and calculated seepage losses between Stations 10 and 54.
    - The regression used data July – September data from 2021-2023.
    - This regression equation is used to predict seepage losses in the Little Wood River between Stations 10 and 54 during July through September.
- STATION 10 STREAMFLOW: A multilinear regression was developed between seasonal (Apr-Sep) discharge at Hailey, annual groundwater pumping within Galena and South Valley GWD boundaries, and minimum monthly average (Jul, Aug, or Sep) streamflow at Station 10.
    - The regression used data from 2003-2024.
    - This regression equation is used with the April 1 seasonal water supply forecast at Hailey and the desired streamflow at Station 10 (after accounting for return flows and seepage losses below Station 10) to predict a pumping limit.

Quantifying uncertainty:

Irrigation season weather variations, water management, groundwater use, surface-water use, and other factors contribute to the uncertainty of the predictions.

Skeleton A1A Uncertainty:

- Prediction residuals were used to estimate 95% confidence intervals for each of the three regression equations.
    - +/- 23.4 cfs for predicted flow at Station 10
    - +/- 18.5 cfs for predicted return flow
    - +/- 8.0 cfs for seepage loss
- The combined uncertainty was computed by propagation of error to estimate 95% confidence intervals for the predicted flow at Station 54.
    - +/- 30.9 cfs for predicted flow at Station 54
- These uncertainty values assume the actual season flow is equal to the forecasted season flow at both the below Magic and Hailey gages and do not include the uncertainty inherent in the seasonal flow forecasts.

Forecast Uncertainty:

During evaluation of the A1A, the TWG began discussing the uncertainties associated with the April 1 water supply forecasts and how they increase the uncertainty in the A1A predictions. TWG members have begun a statistical analysis of forecast uncertainty, but the analysis is not complete. Figures 2 and 3 are presented to illustrate forecast uncertainty.

Conclusions:

Based on the TWG's review, the A1A concept is best viewed as an exploratory exercise. The large uncertainties mean it cannot reliably determine pumping limits to predict specific streamflows. As such, the A1A is not recommended as a forecasting or management tool in its current form.

- The effects of factors that cannot be predicted by April 1 (e.g., irrigation season weather, water management, and water use) contribute to significant variability in the correlations applied in the A1A concept and are expected to result in significant differences between predicted and actual outcomes.
- Estimated uncertainties (95% confidence interval) are large in comparison to the current Little Wood River discharge target of 32 cfs (+/- 23.4 cfs) at Station 10.
- Due to the large uncertainties, the A1A concept currently lacks predictive confidence and is not suited to determine pumping limits that would produce specified streamflows.
- The uncertainties inherent in the April 1 water supply forecasts for the Big Wood River at Hailey and Below Magic Dam add additional uncertainty to the A1A concept.

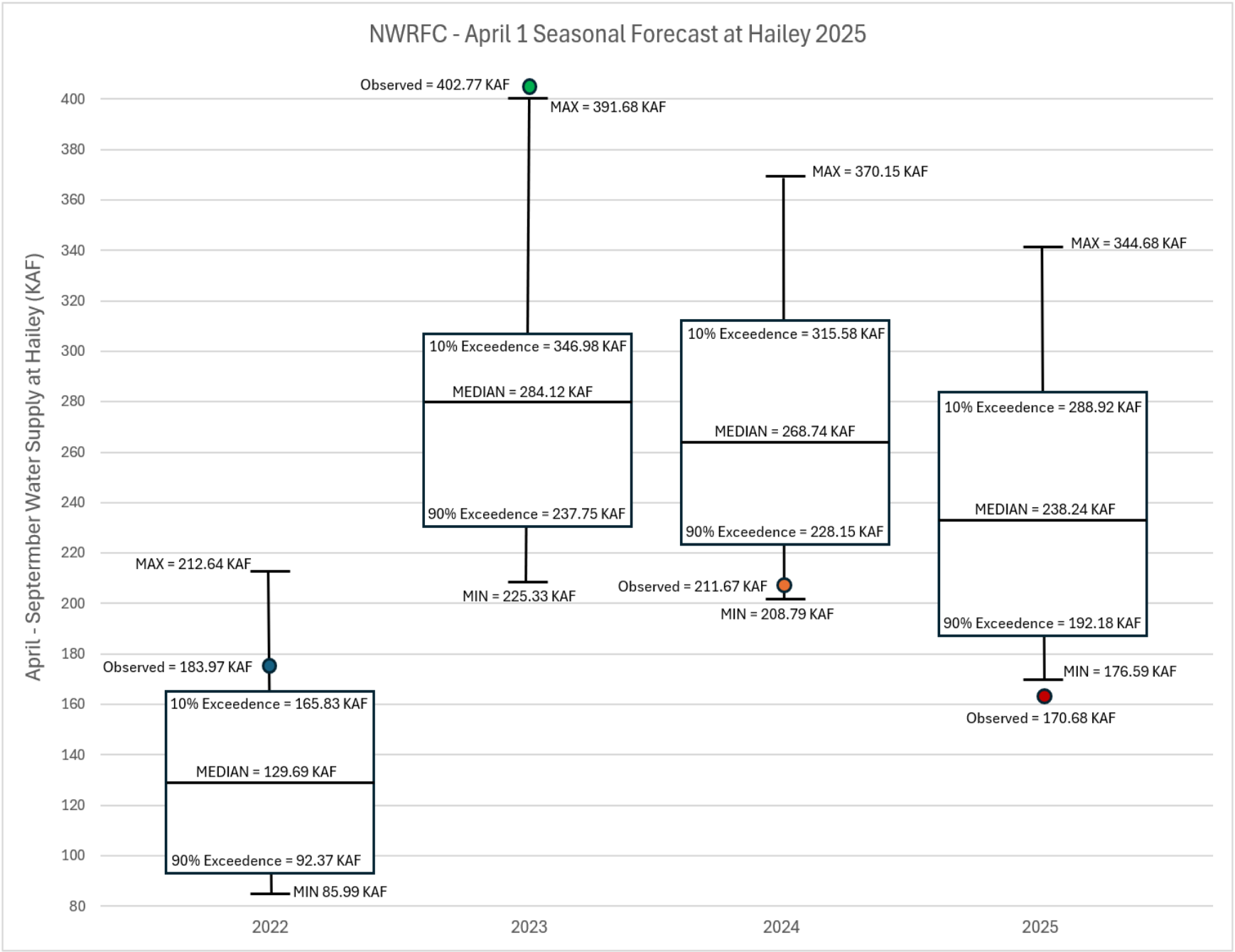

Figure 2. Box and Whisker Plot of NWRFC Forecasts vs. Observed Water Supply 2022 - 2025

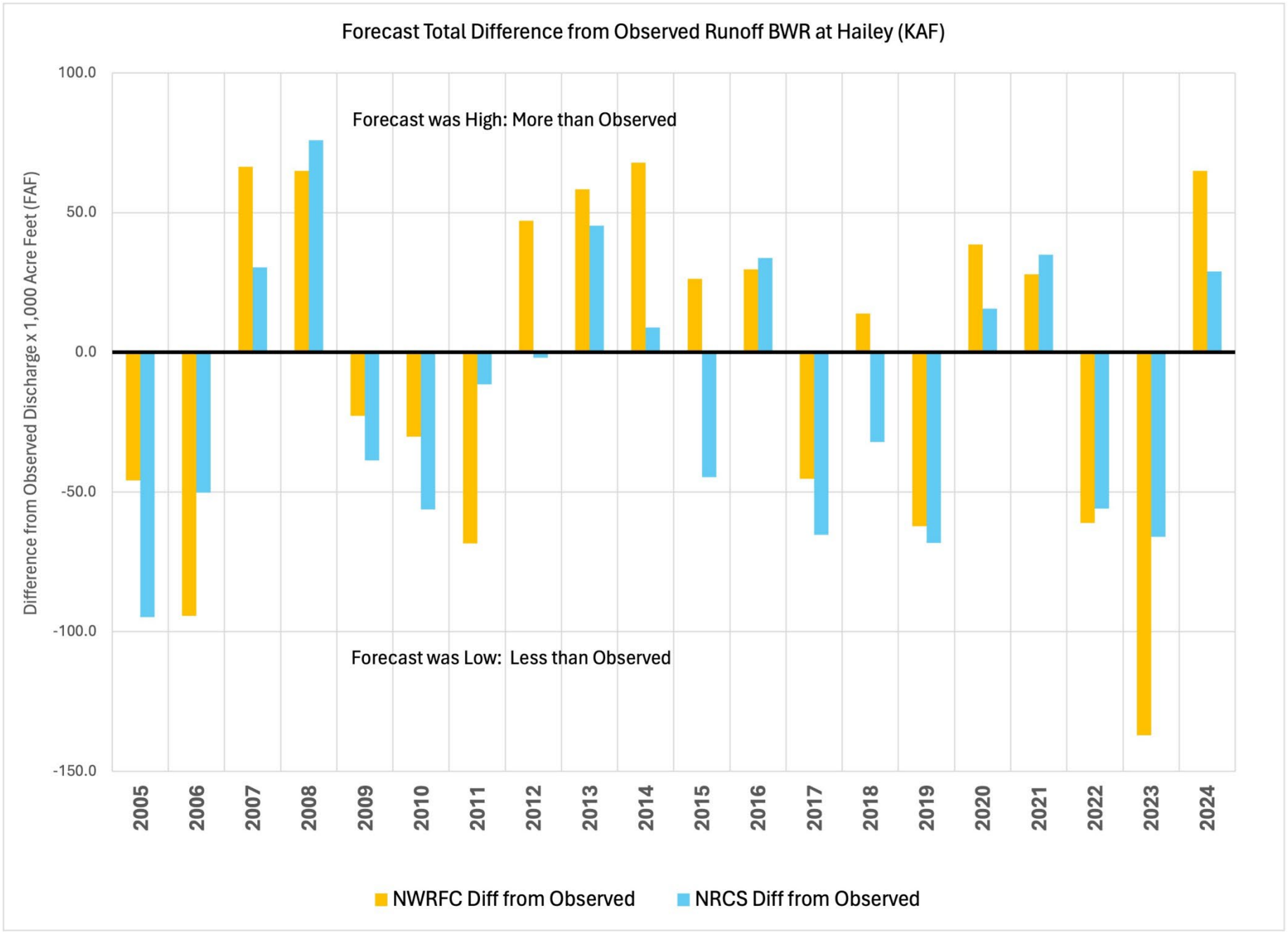

Figure 3. Graph of Differences Between Median NWRFC and NRCS Forecasts vs. Observed Water Supply