Question 5 update

Presented to the Swan Falls Implementation Group Section by Sean Vincent
March 17, 2023

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Background

- Original Question 5:

    Analysis of the necessary ESPA levels, storage volumes, ~~and discharge~~ required to maintain minimum flows at the Murphy Gage

- Revised:

    Analysis of the necessary ESPA levels and/or cumulative storage change required to maintain the minimum flow rate at the Murphy Gage during the low flow period

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Summary of Preliminary Analysis

- Started by evaluating relationships between cumulative storage change vs discharge and ESPA water levels vs discharge

- Discovered several database errors and a formula error in forecast tool

- With errors fixed, linear relationship fails to explain most of the variability using data from 2002 to 2022

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Kimberly to King Hill Reach Gain from ESPA
(2002-2022)
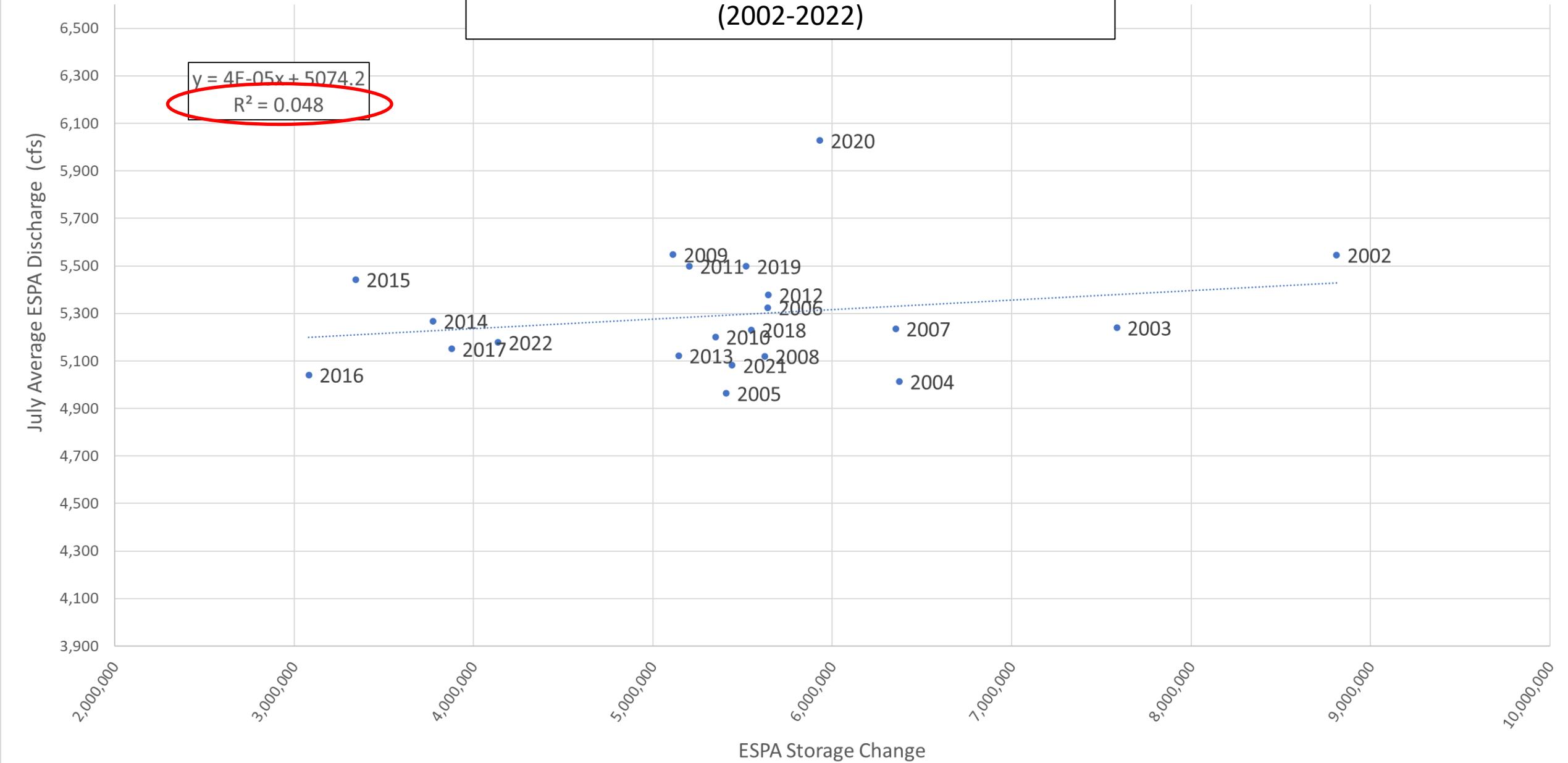
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- Coefficient of determination higher when using data back to 1980

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Kimberly to King Hill Reach Gain from ESPA
(1980-2022)
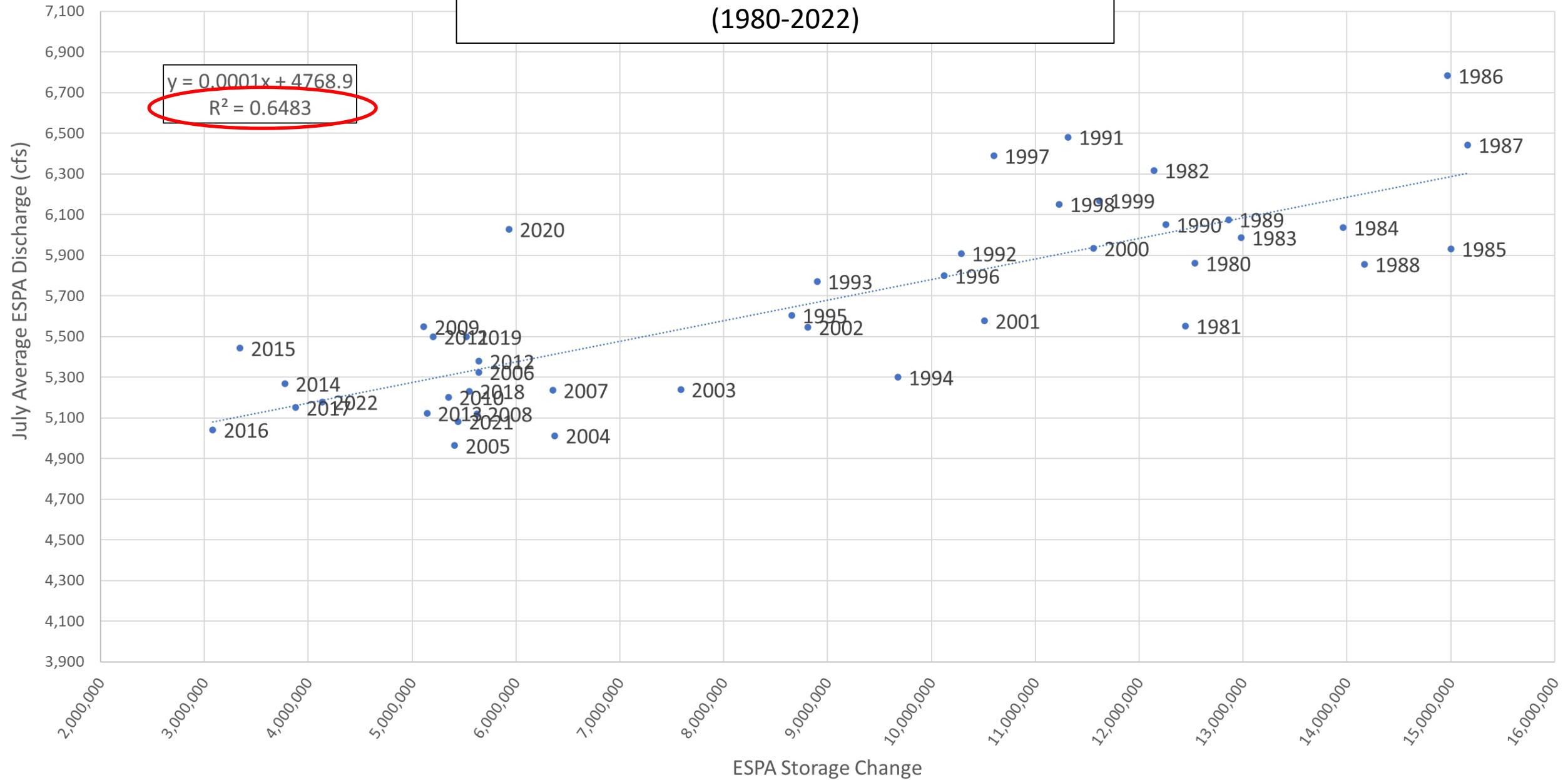
Summary of Preliminary Analysis

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- Discovered several database errors and a spreadsheet formula error

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- Decided to move ahead using cumulative storage change vs discharge relationship because simpler than looking at ESPA water levels
  - ✓ Attractive concept because straightforward, easy to explain, and intuitive

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ESPA Change in Volume of Water and Thousand Springs Discharge
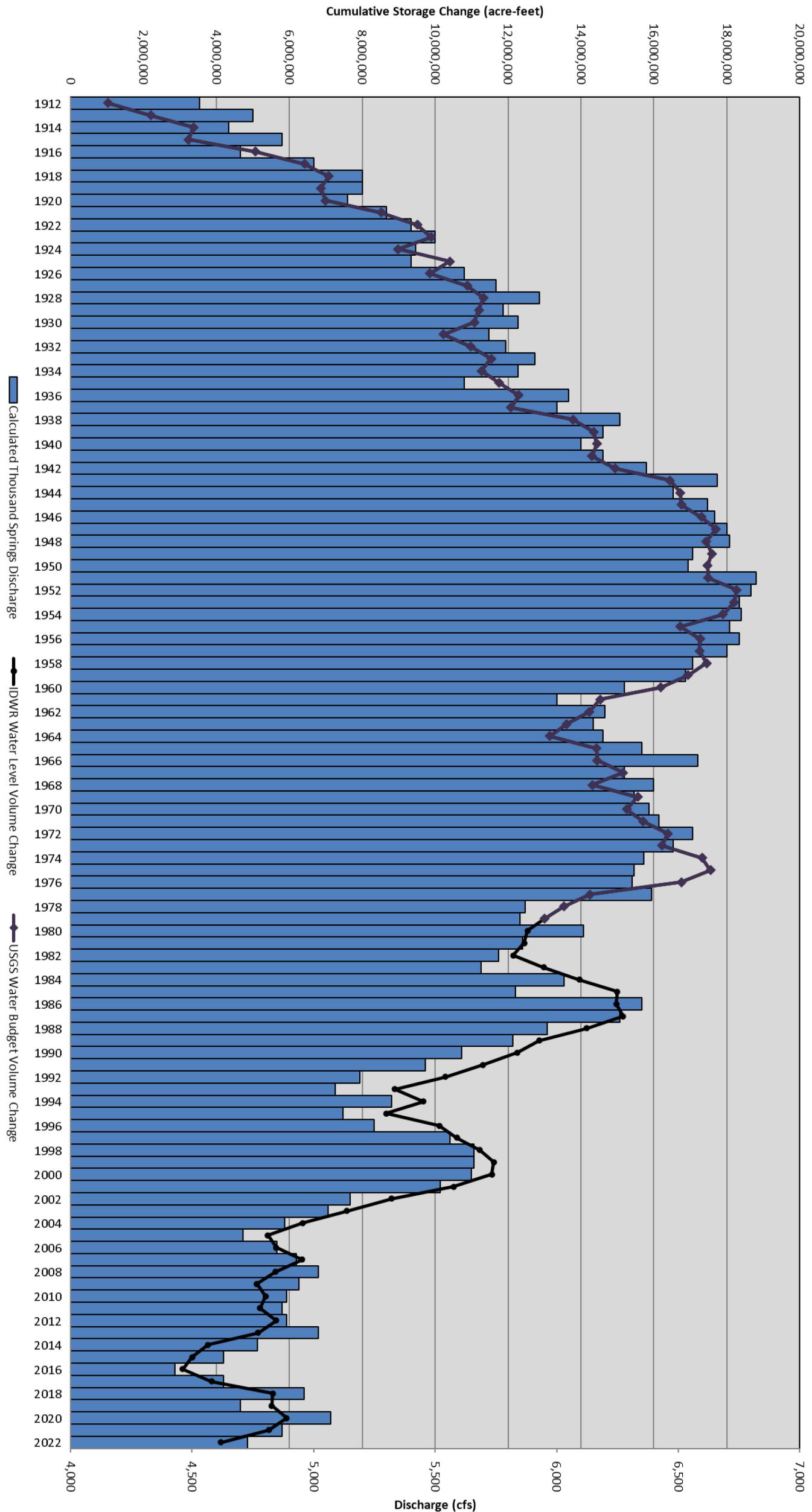
Initial Method

- Based on Swan Falls forecast tool algorithm
  - ✓ Use cumulative storage change vs discharge relationship for ESPA component
    - ➢ Cumulative storage change based on measured water level data
    - ➢ Discharge based on ESPAM reach gain calibration targets

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# Forecast Tool Inputs
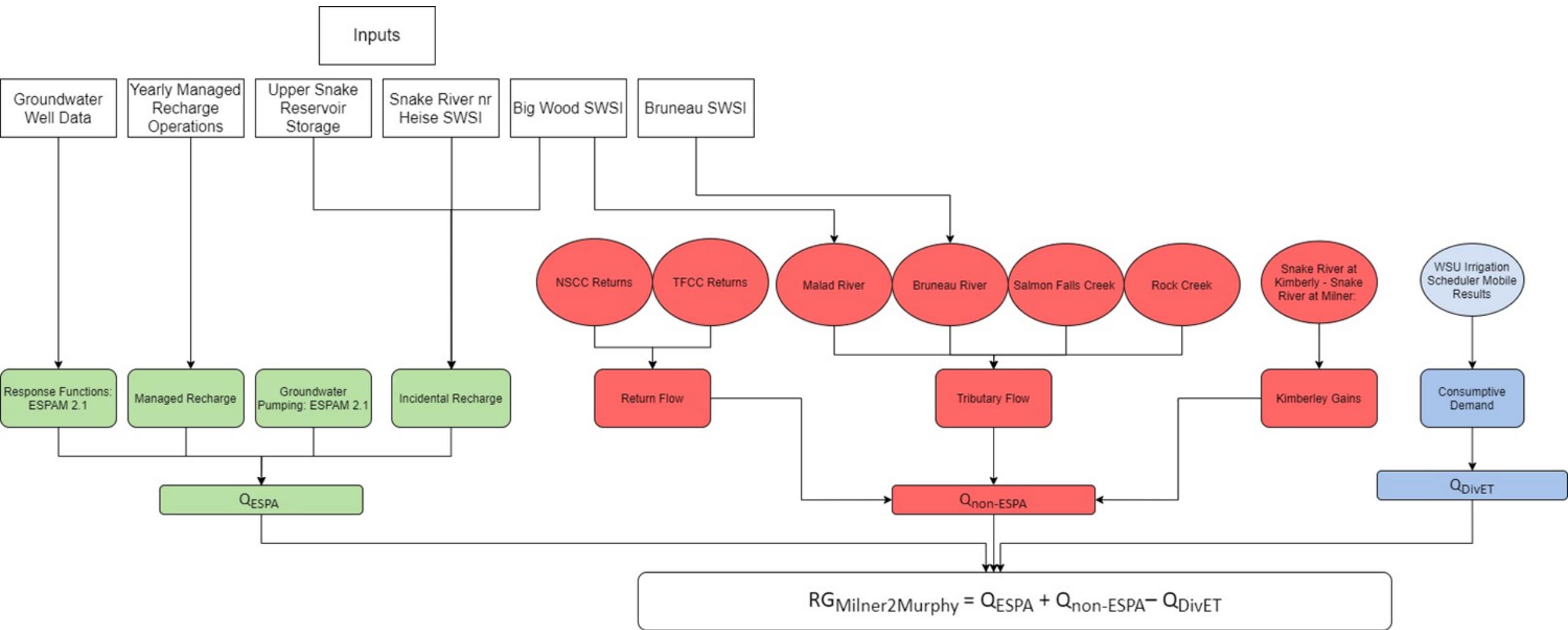
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- Based on Swan Falls forecast tool algorithm
  - ✓ Use cumulative storage change vs discharge relationship for ESPA component
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  - ✓ Apply forecast tool with increasingly conservative assumptions to estimate non-ESPA inflow terms and consumptive use below Milner and to quantify the impact of those assumptions
    - ➢ Medians of record
    - ➢ Water Year 2022
   - ➢ Extremes of record

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Forecast Tool Inputs
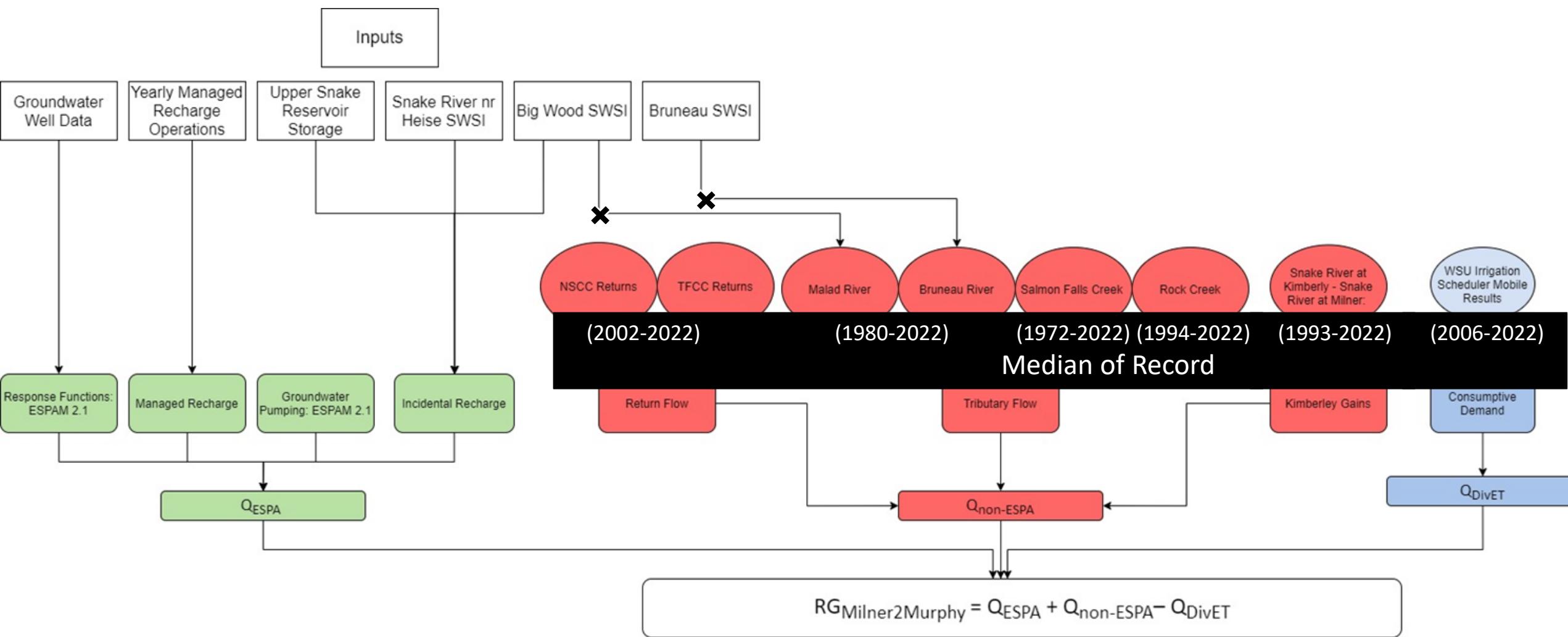
Forecast Tool Inputs
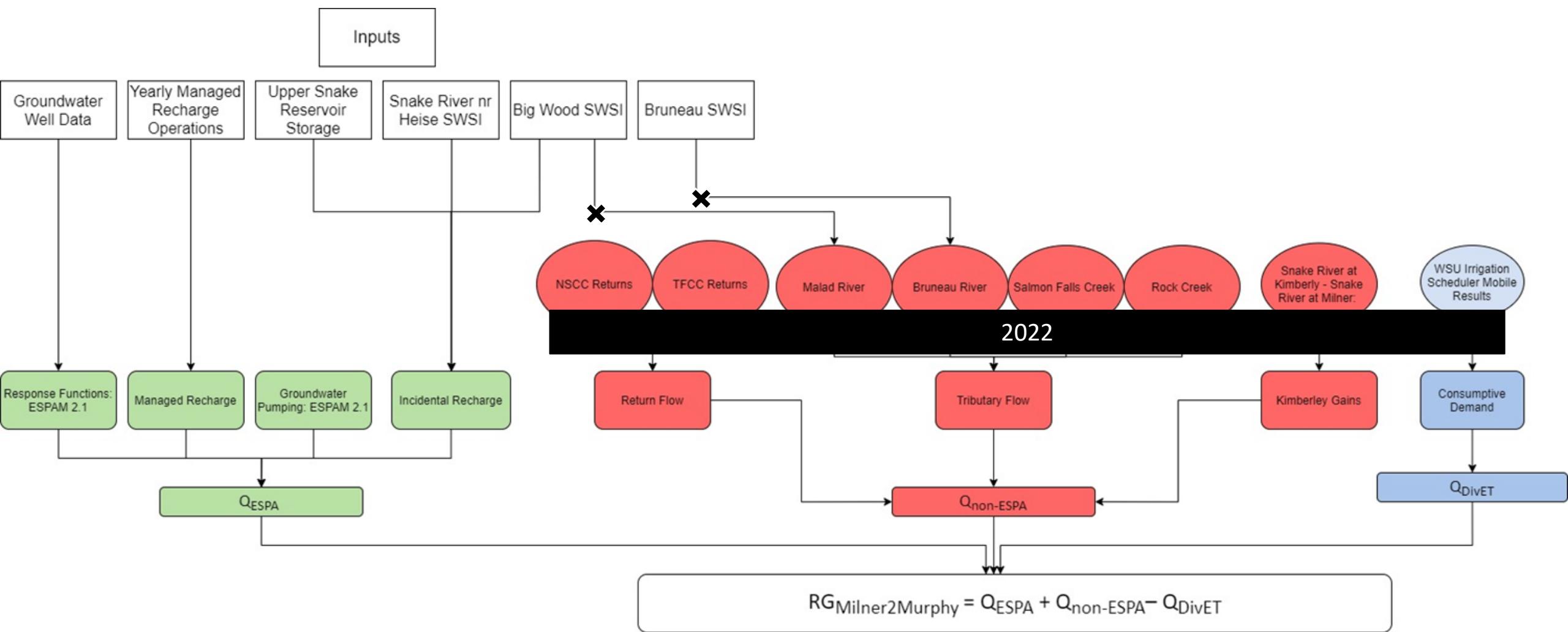
Forecast Tool Inputs
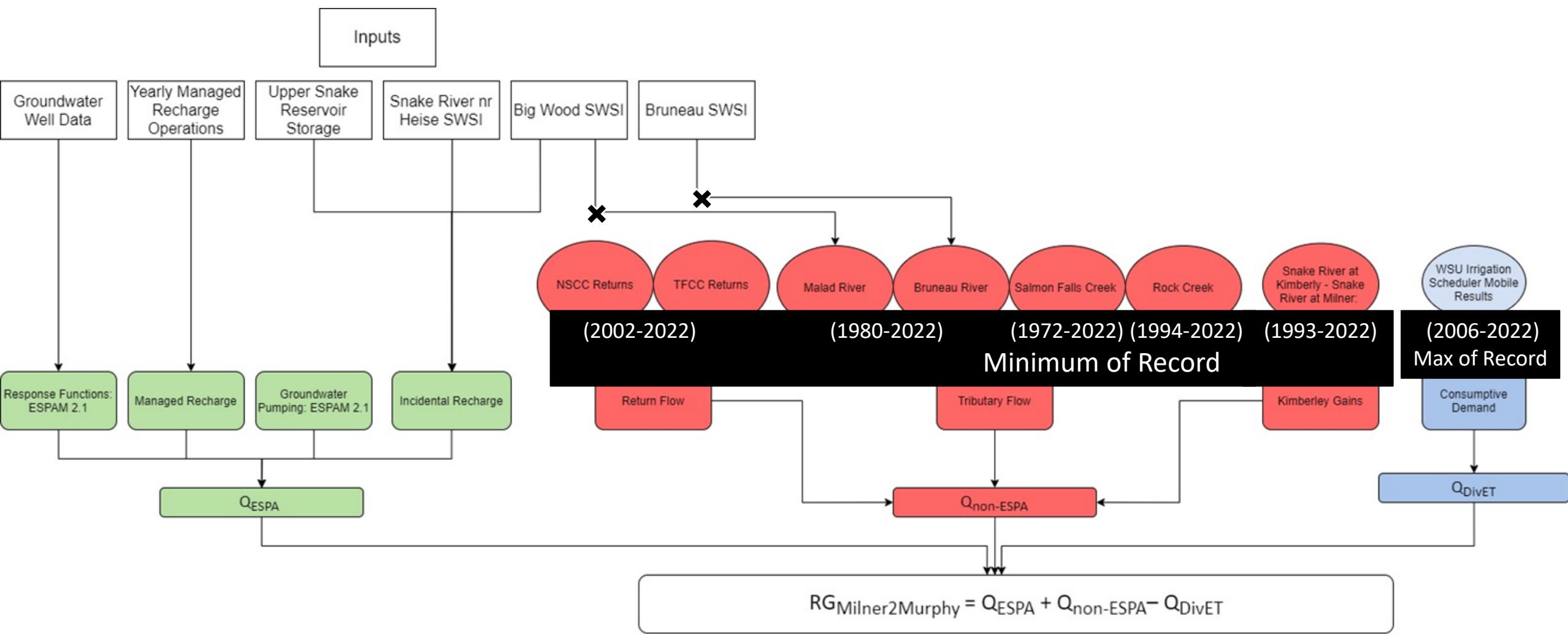
July Average Daily Flow (cfs)

July Average Daily Flow (cfs)

Legend: ■ Synthetic Min/Max ■ 2022 ■ Median Year

Consumptive Demand:
- Synthetic Min/Max: -1,871
- 2022: -1,642
- Median Year: -1,621

Sum of Non-ESPA:
- Synthetic Min/Max: 742
- 2022: 1,061
- Median Year: 1,252

Net:
- Synthetic Min/Max: -1,130
- 2022: -581
- Median Year: -369
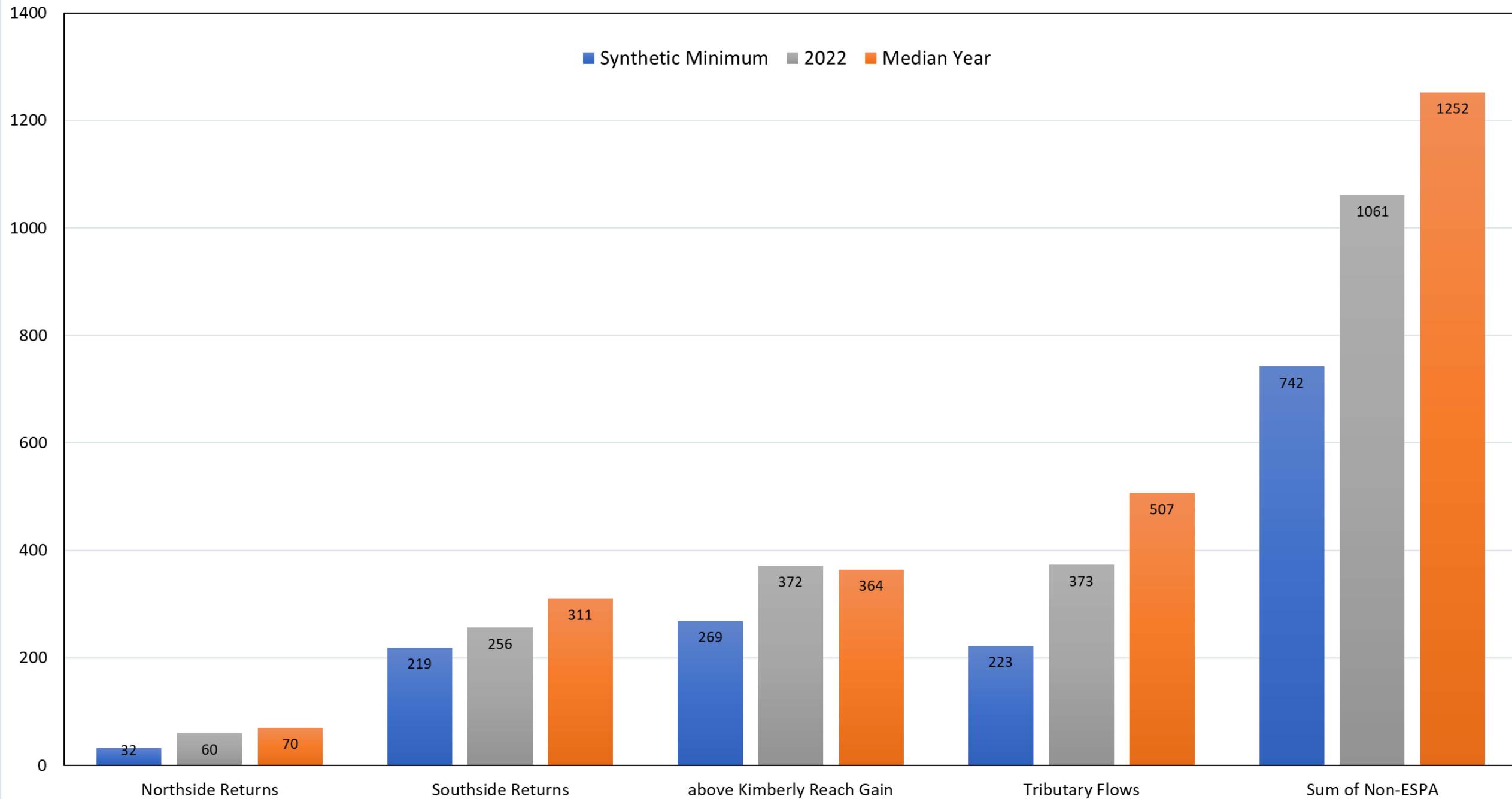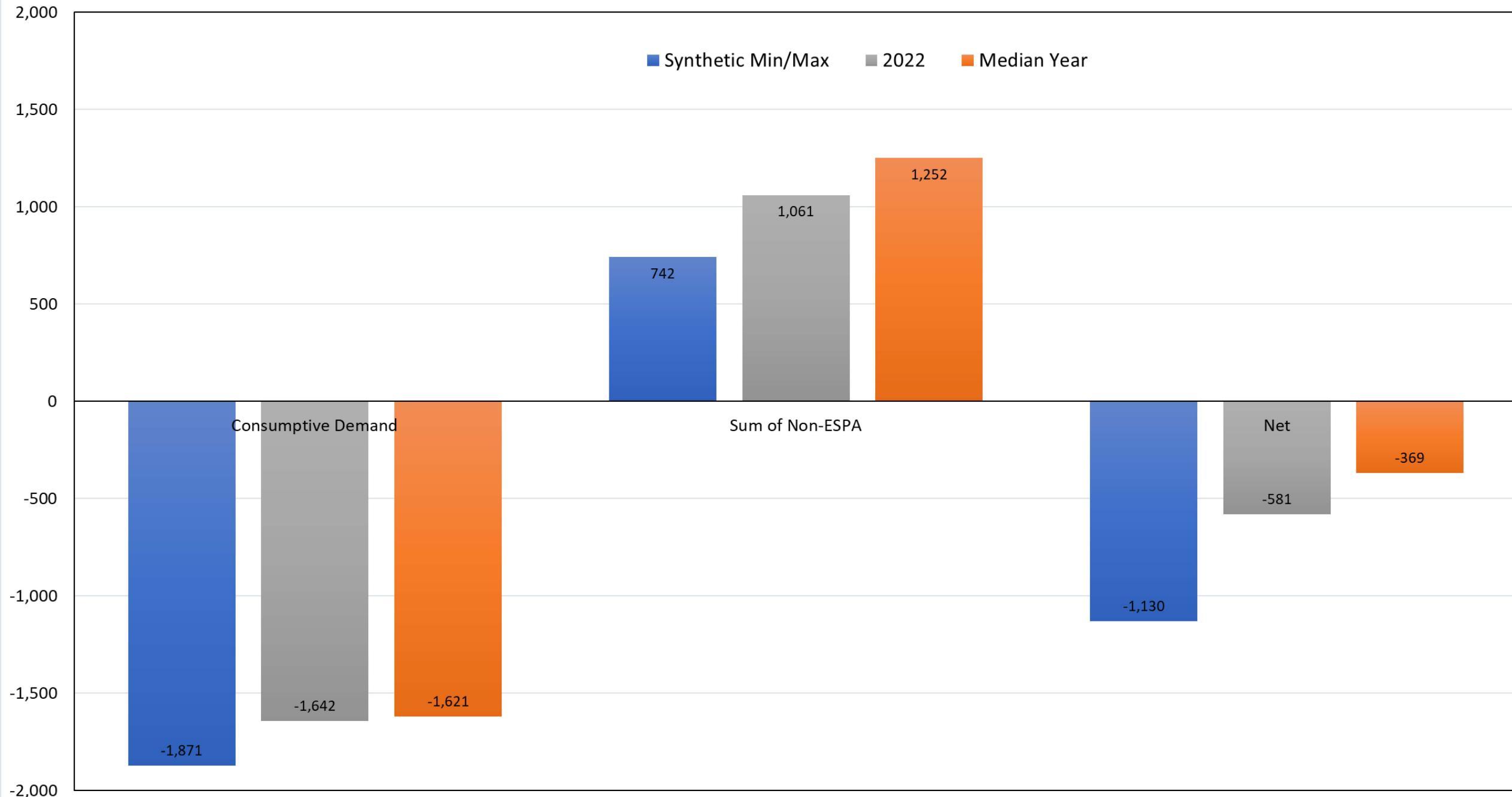
Kimberly to King Hill Reach Gain from ESPA + 2022 Non-ESPA conditions
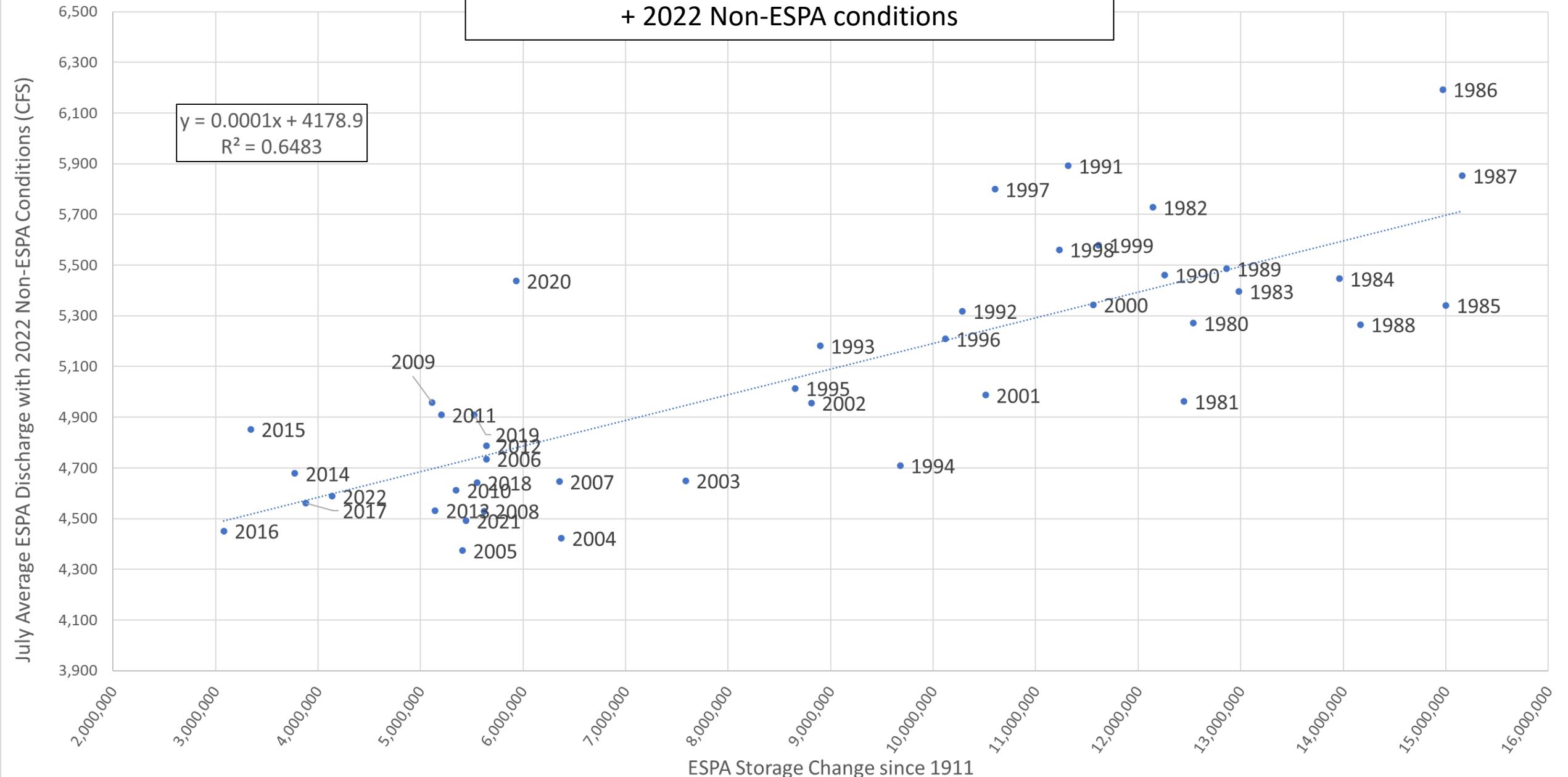
Kimberly to King Hill Reach Gain from ESPA + Min/Max Non-ESPA water conditions
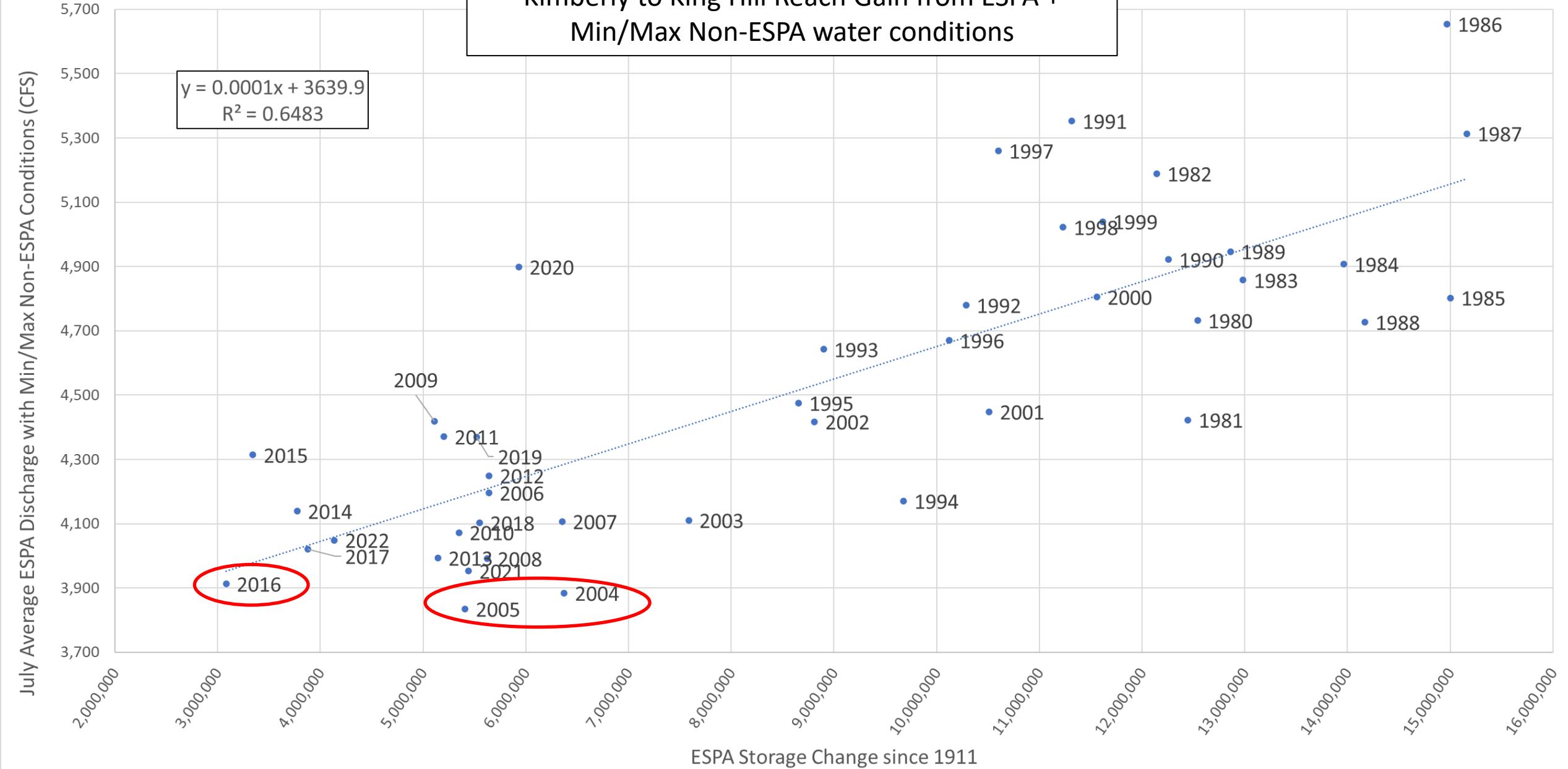
Summary

- ESPA discharge is the largest Murphy flow component during the low flow period

- ESPA discharge is correlated to cumulative aquifer storage change

- A linear regression model accounts for most of the variability in ESPA discharge
  - ✓ ESPA discharge estimates plot within ~ +/- 200 cfs of the trendline

- Non-ESPA and consumptive use components are also significant and variable

- Conservative assumptions could be used to address predictive uncertainty
  - ✓ Establishing an appropriate level of conservatism involves non-technical considerations

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Next Steps

- Continue evaluating whether a straightforward and defensible water level index could be used in lieu of cumulative aquifer storage change as predictor of ESPA discharge during the low flow period

- Evaluate impact of using July avgs. as proxies for minimum 3-day avgs.
    - ✓ In 2022, minimum 3-day avg. AADF was ~ 100 cfs less than the July avg. AADF

- Look at trends in non-ESPA components to determine whether hydrology of system is changing → change assumptions if indicated

Questions?