RECLAMATION

Managing Water in the West

Hood River Basin Study

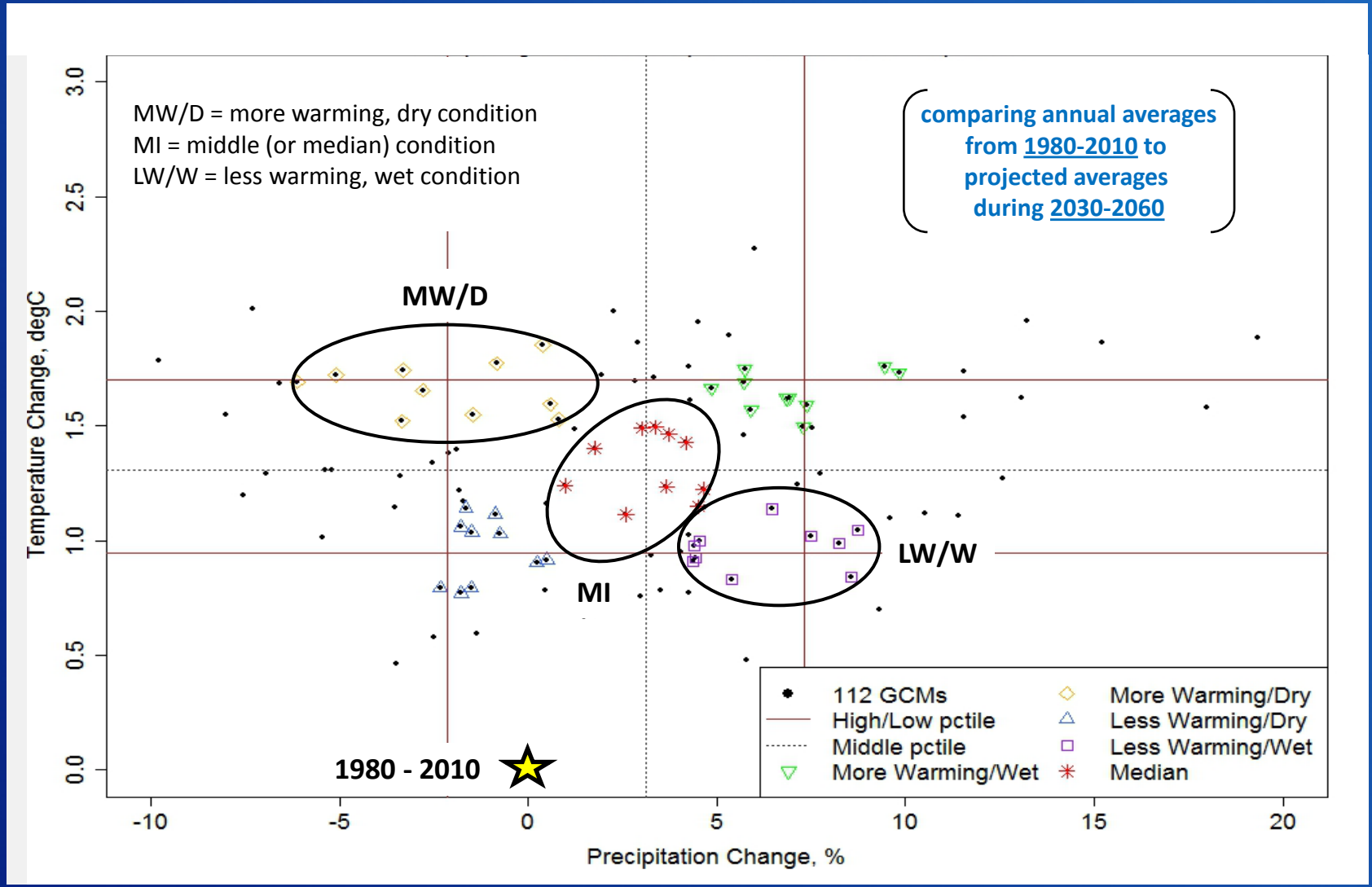
Water Resources Modeling (MODSIM)

Taylor Dixon, Hydrologist

February 12, 2014

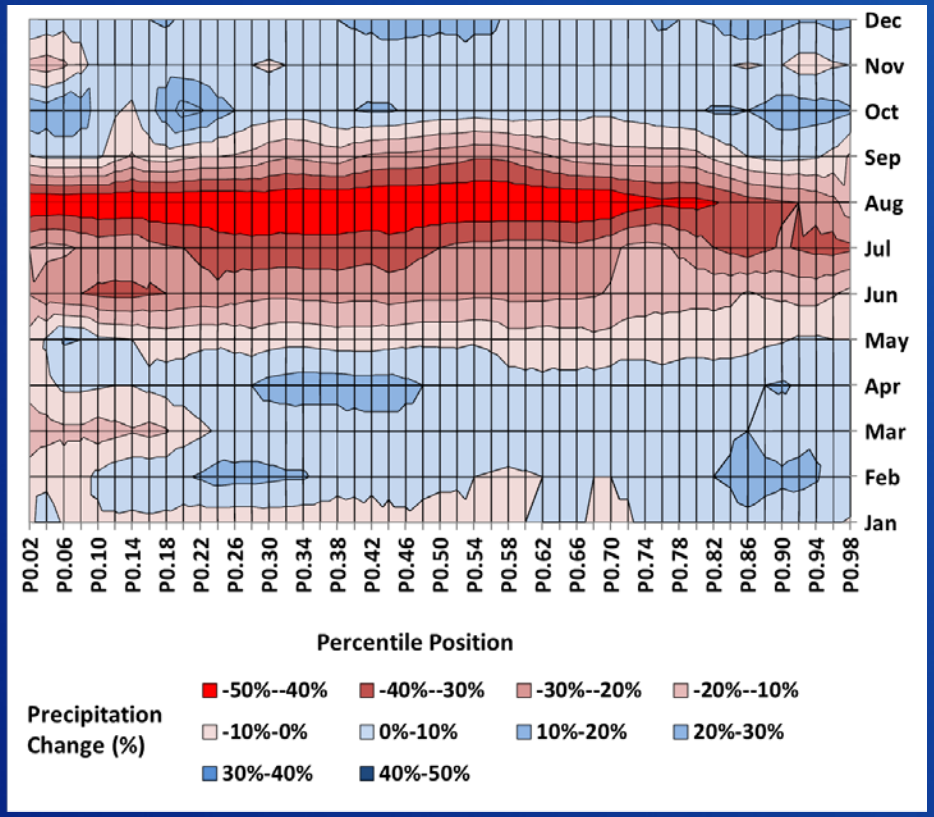
U.S. Department of the Interior
Bureau of Reclamation

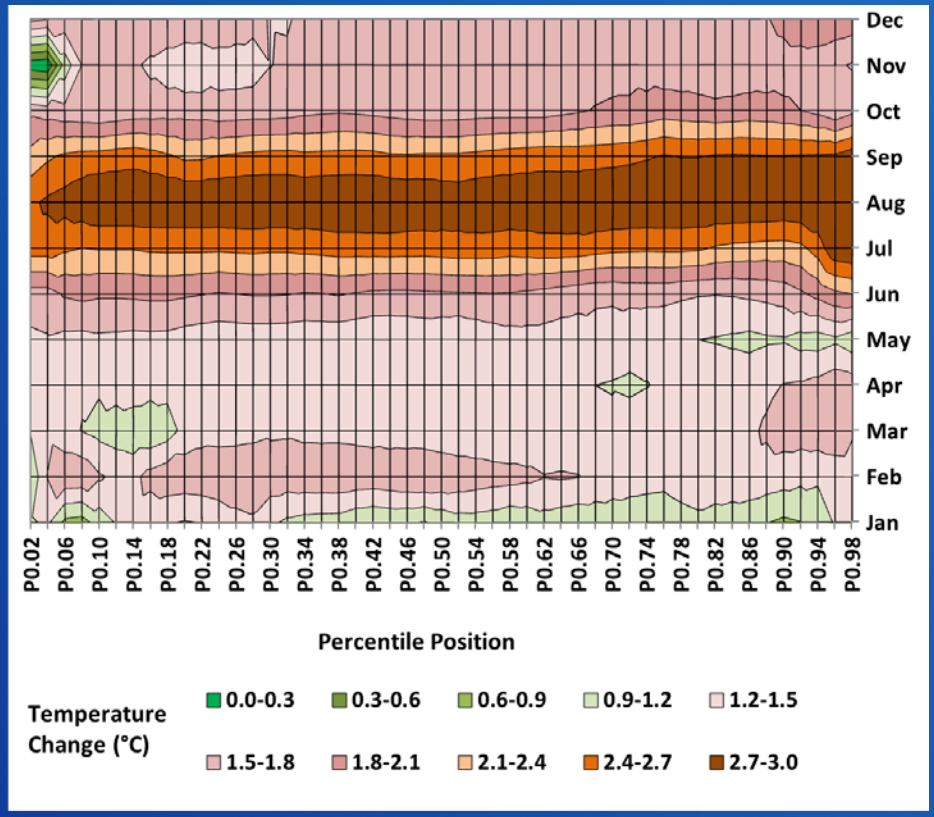
Water Resources Modeling: Climate Scenarios



RECLAMATION

Water Resources Modeling: Climate Scenarios



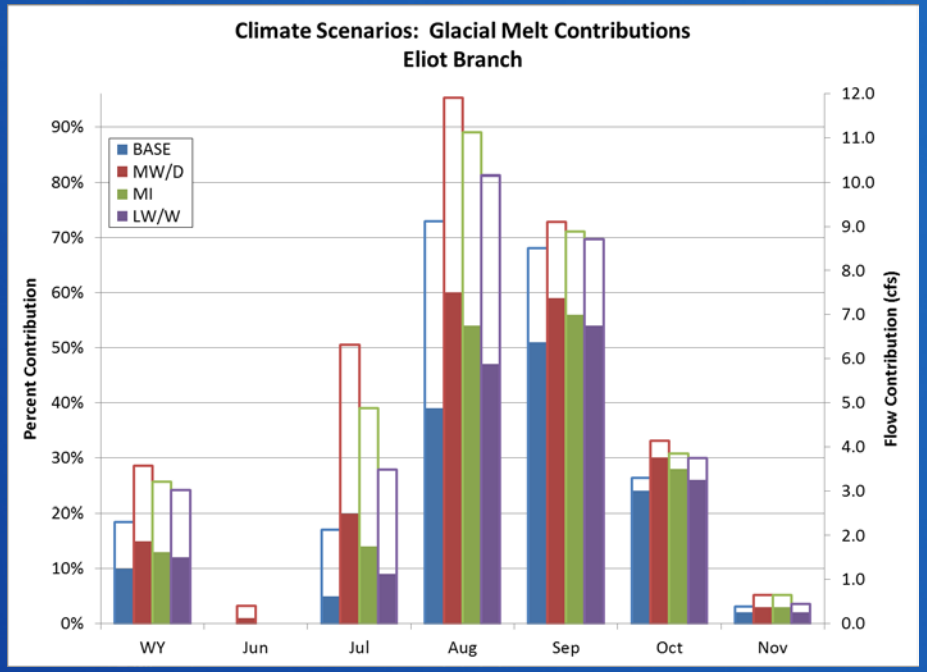


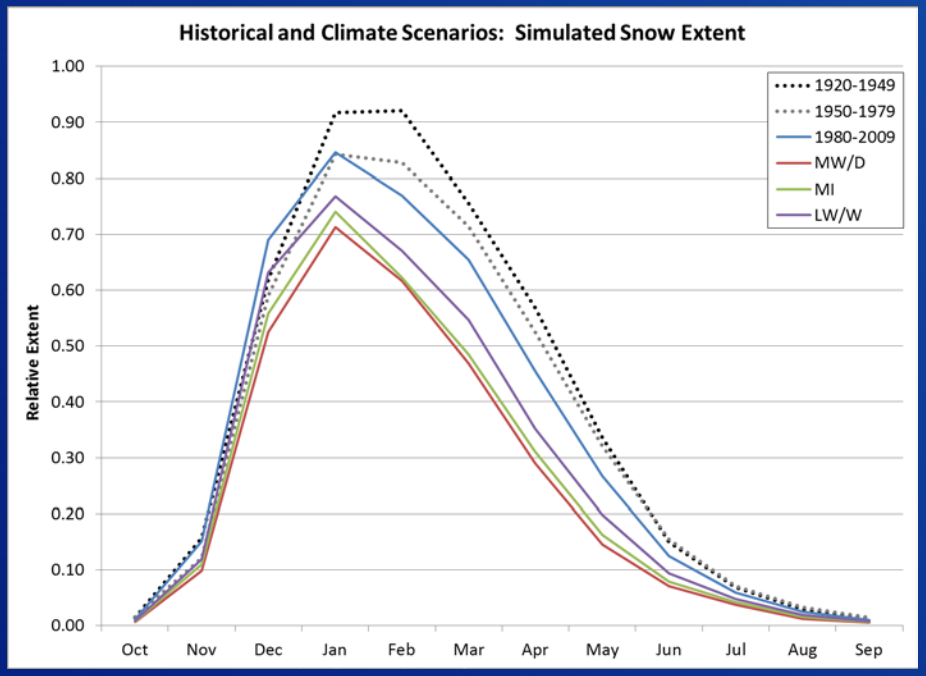
- **Historical precipitation and temperatures adjusted to generate "future" conditions**
  - **For each month, the adjustments made by "rank"**
    - **i.e. Where a given value sits with respect to all historical values for that month**

RECLAMATION

Water Resources Modeling: Climate Scenarios

- Warmer temperatures expected to increase glacial melt contributions to stream flows
  - During 30 year simulation period, not indefinitely





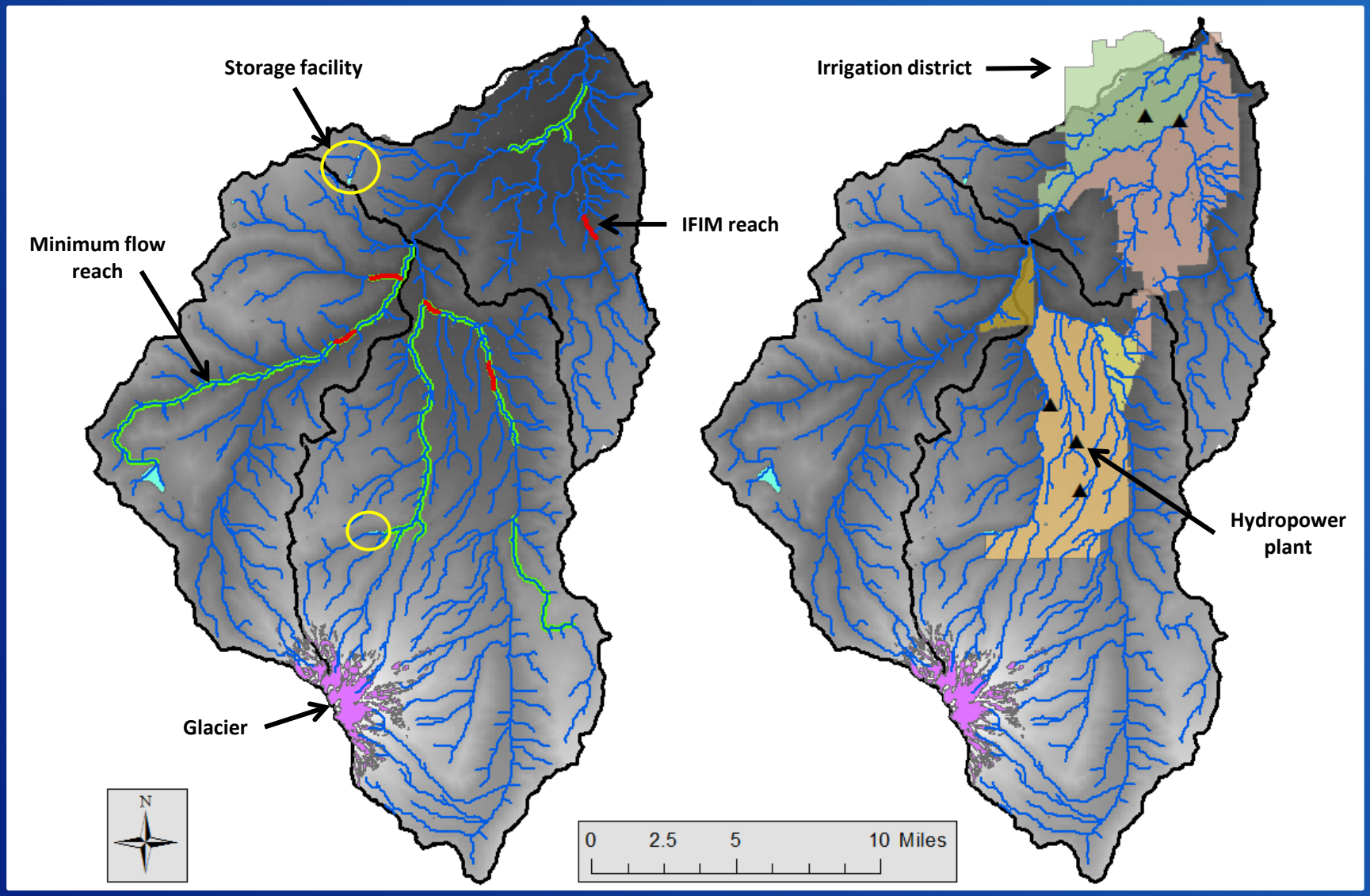
- Warmer temperatures (and potentially less precipitation) expected to decrease snow melt contributions to stream flows

RECLAMATION

Water Resources Modeling: Metrics

- **Investigate potential relative changes to:**
  - **Quantity and timing of runoff at key locations**
    - *Hood River at Tucker Bridge*
    - *West Fork near Dee*
    - *Middle Fork above East Fork*
    - *East Fork above Middle Fork*
    - *East Fork below Main Canal*
    - *Green Point Creek*
    - *Neal Creek*
  - **Reservoir storage**
    - *Laurance Lake*
    - *Green Point reservoirs*
  - **Hydropower production**
    - *Cumulative by district*
  - **Consumptive use**
    - *Cumulative by district*
  - **Minimum flows**
    - *Locations specified in Water Use Assessment*

Water Resources Modeling: Metrics



RECLAMATION

Water Resources Modeling: Alternatives

- **Baseline: historical flows, historical conditions**
  - 1980 – 2009 period
  - Current storage facilities
  - Average water demands
- **Alternative 2: future flows, historical conditions**
  - 2030 – 2059 period
  - Baseline storage facilities and demands
- **Alternative 3: future flows, increased demands**
  - 2030 – 2059 period
  - Baseline storage facilities
  - Municipal demands scaled according to population growth
  - Agricultural demands scaled according to temperature (ET)

Water Resources Modeling: Alternatives

- **Alternative 4: future flows, increased demands, water conservation**
  - 2030 – 2059 period
  - Baseline storage facilities
  - Alternative 3 municipal demands
  - Alternative 3 agricultural demands scaled according to projected conservation practices

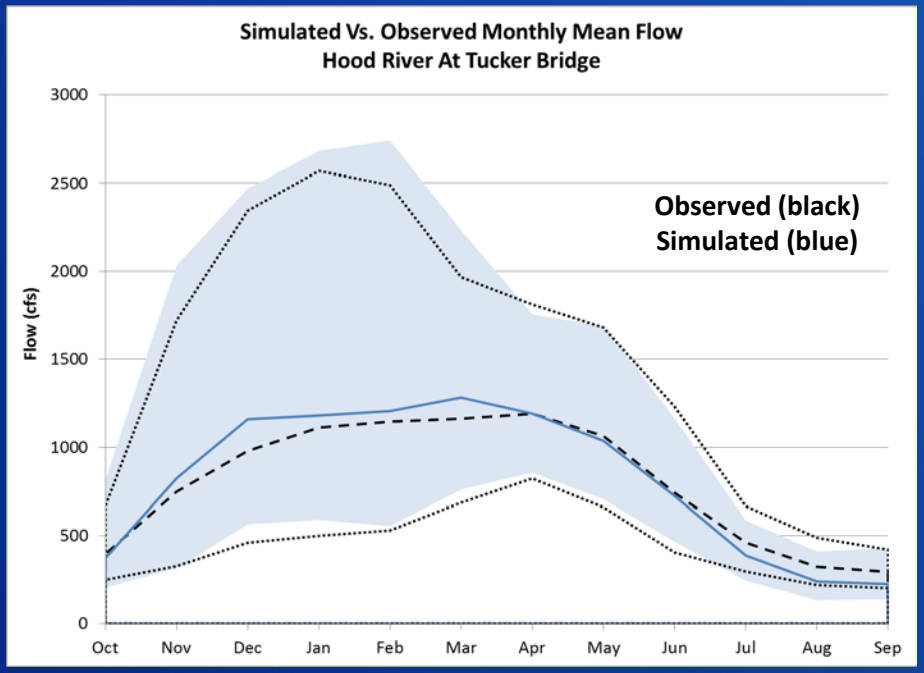
- **Alternative 5: future flows, increased demands, water conservation, new storage**
  - 2030 – 2059 period
  - Alternative 4 demands
  - Increased storage at existing facility or new facility

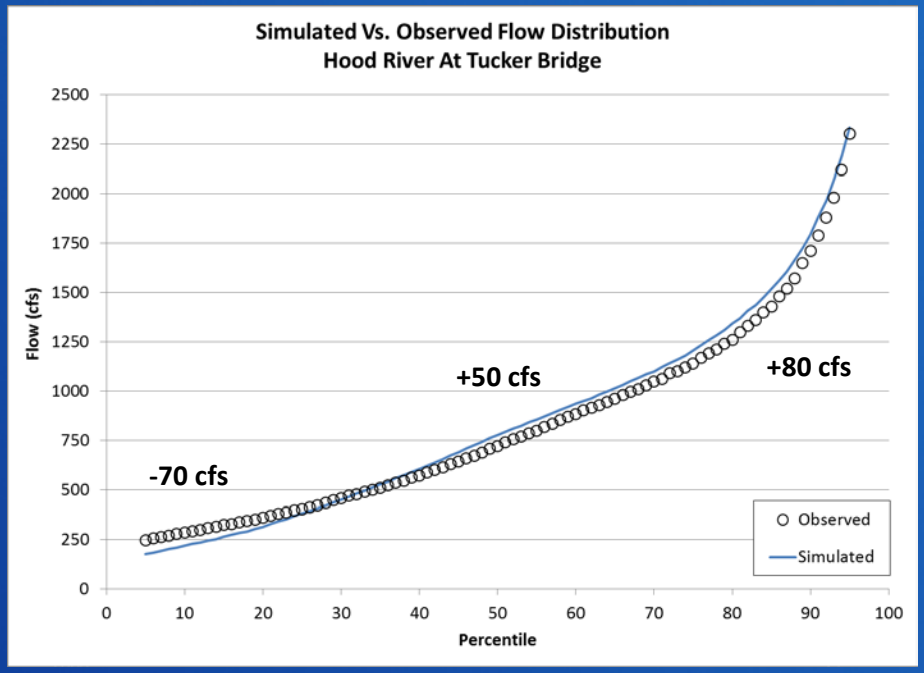
RECLAMATION

Results: Baseline Conditions

RECLAMATION

Hood River At Tucker Bridge



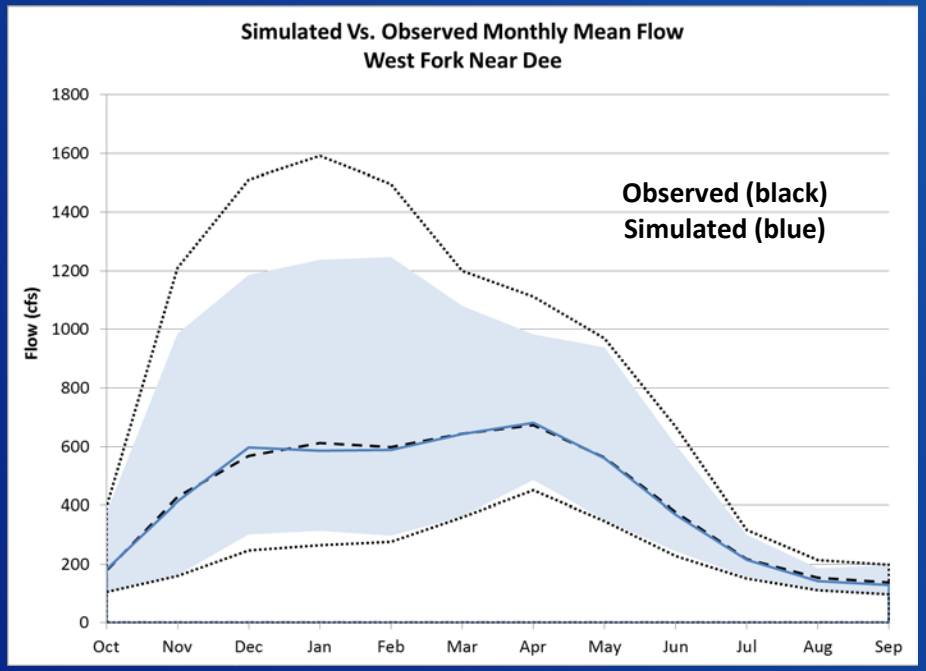


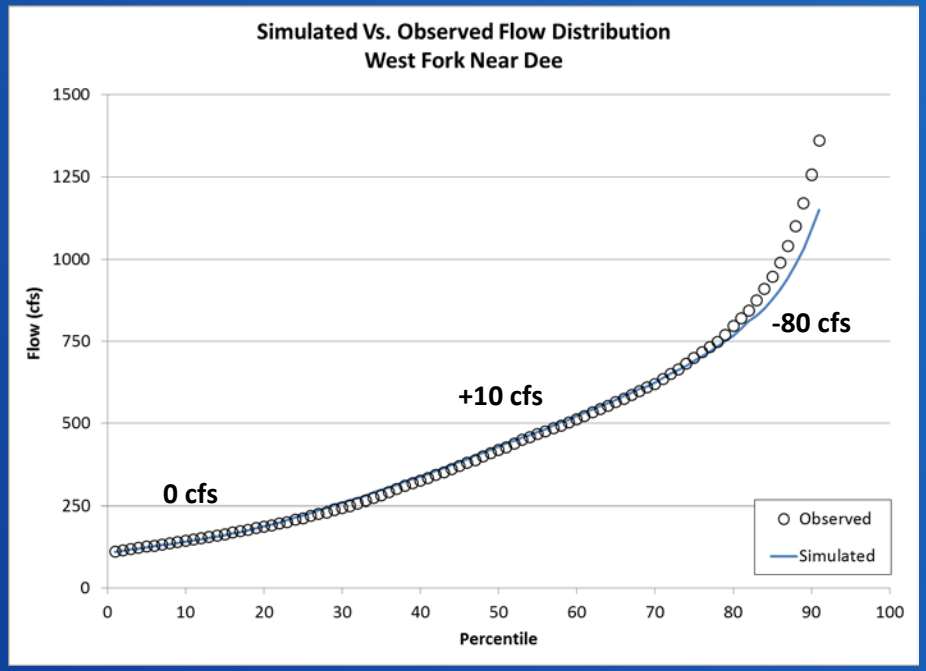
- Winter averages: simulated slightly higher than observed
- Summer averages: simulated slightly lower than observed
  - Using average demands across the basin (recent 5 – 10 years)

- Overall: < 5% error

RECLAMATION

West Fork Near Dee





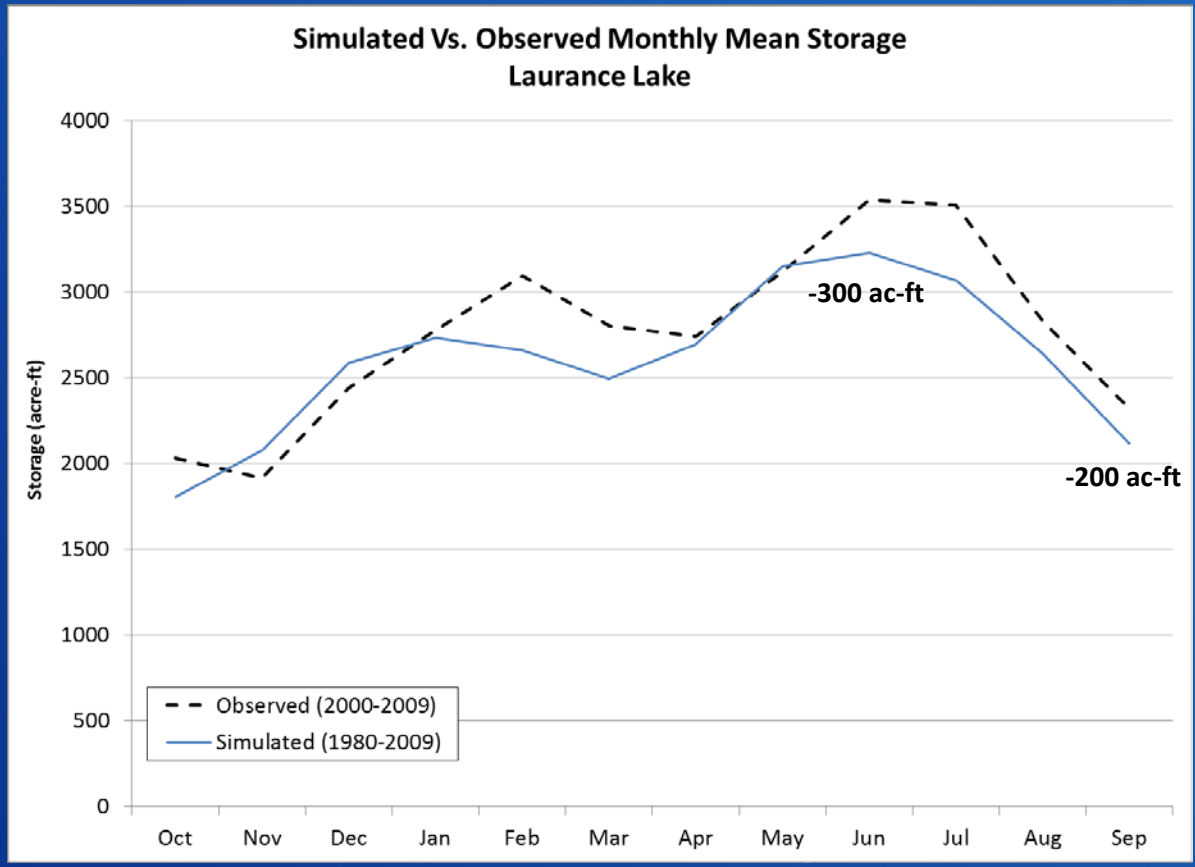
- Simulated averages match observed very well
- Simulated peaks slightly lower than observed peaks (winter months)
  - Insignificant implications

- Overall: < 5% error

RECLAMATION

Laurance Lake

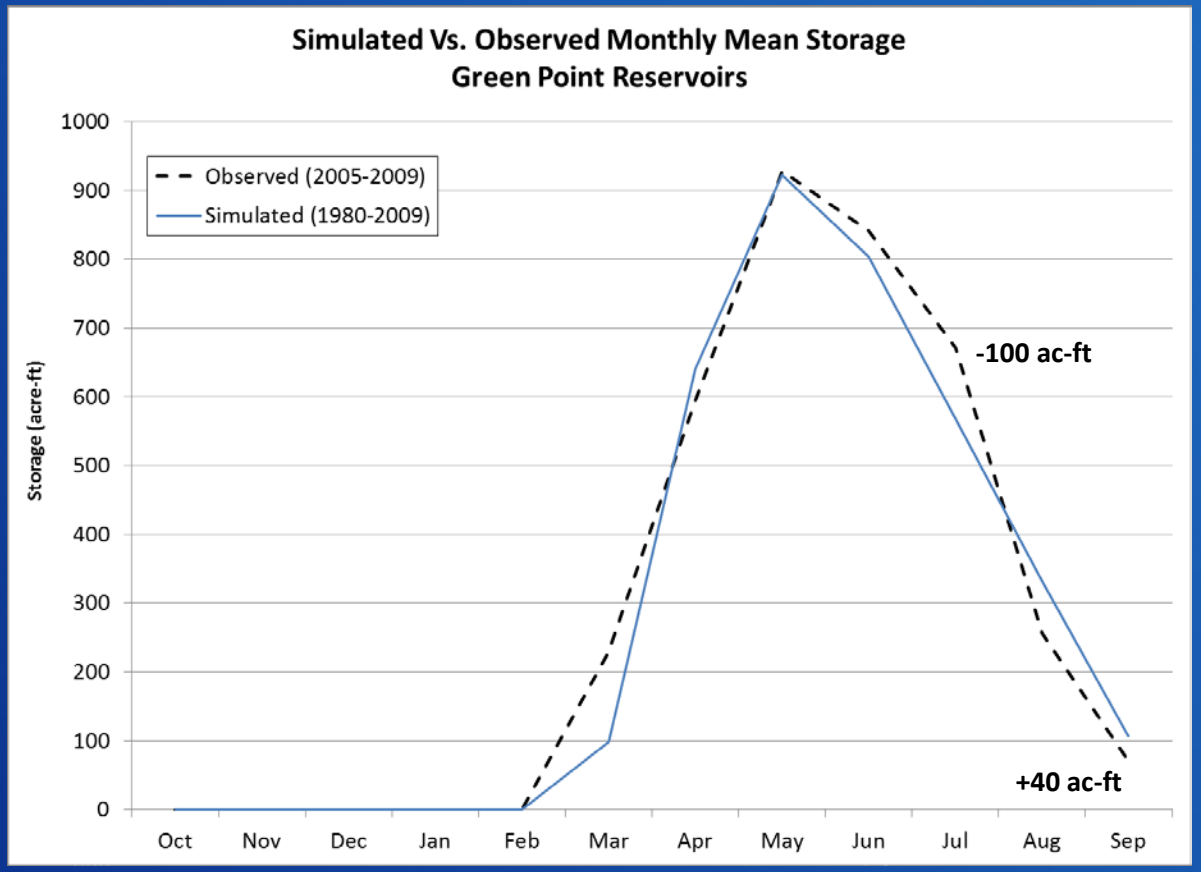
- General monthly pattern captured
- Average storage volumes slightly lower than observed (2000 – 2009)
  - Using average reservoir releases (2008 – 2012)
- Overall: ~ 5% error



RECLAMATION

Upper & Lower Green Point Reservoirs

- General monthly pattern captured
- Assumes:
  - Filling mid-March through May
  - Releasing June through September
  - Constant release rate
- Overall: < 5% error

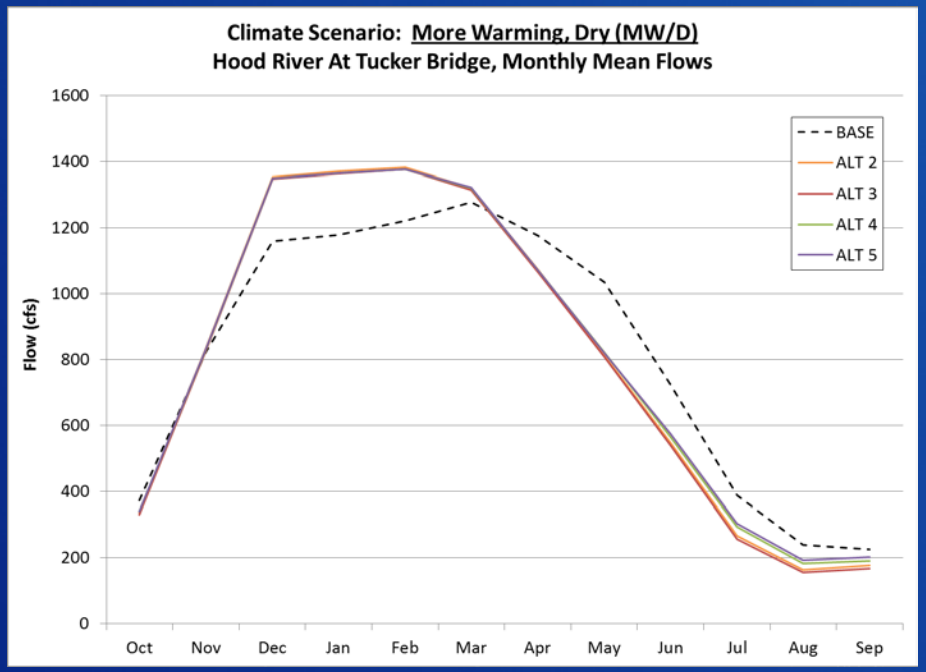


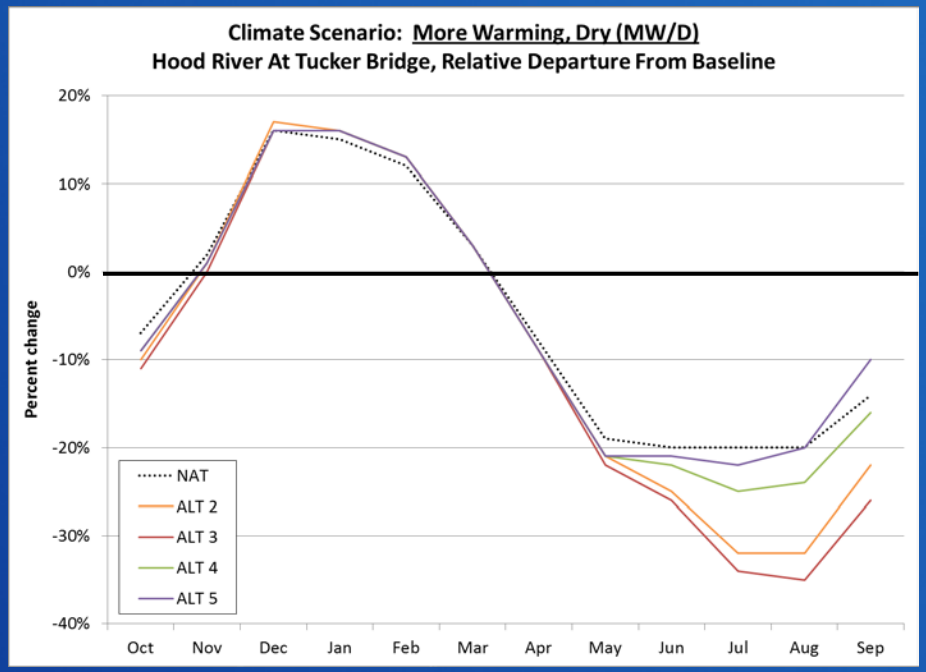
RECLAMATION

Results: More Warming, Dry (MW/D) Scenario

RECLAMATION

Flow Comparisons Across Alternatives

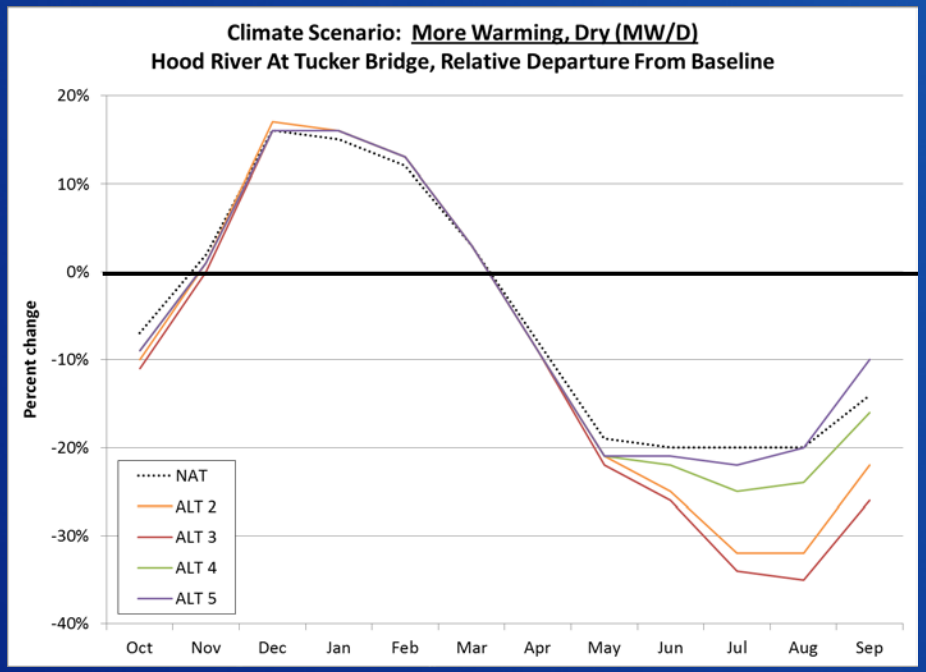


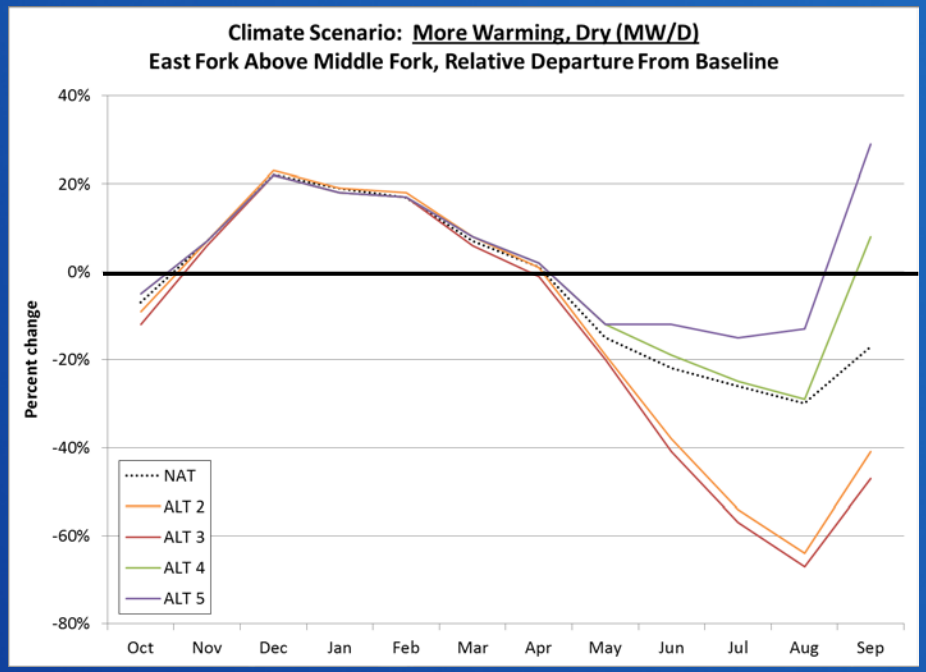


- **Projected future climate change expected to:**
  - **"Compress" high flows**
    - **Potentially earlier in time and greater in magnitude**
  - **"Skew" low flows**
    - **Likely earlier in time and lower in magnitude**

RECLAMATION

Flow Comparisons Across Alternatives

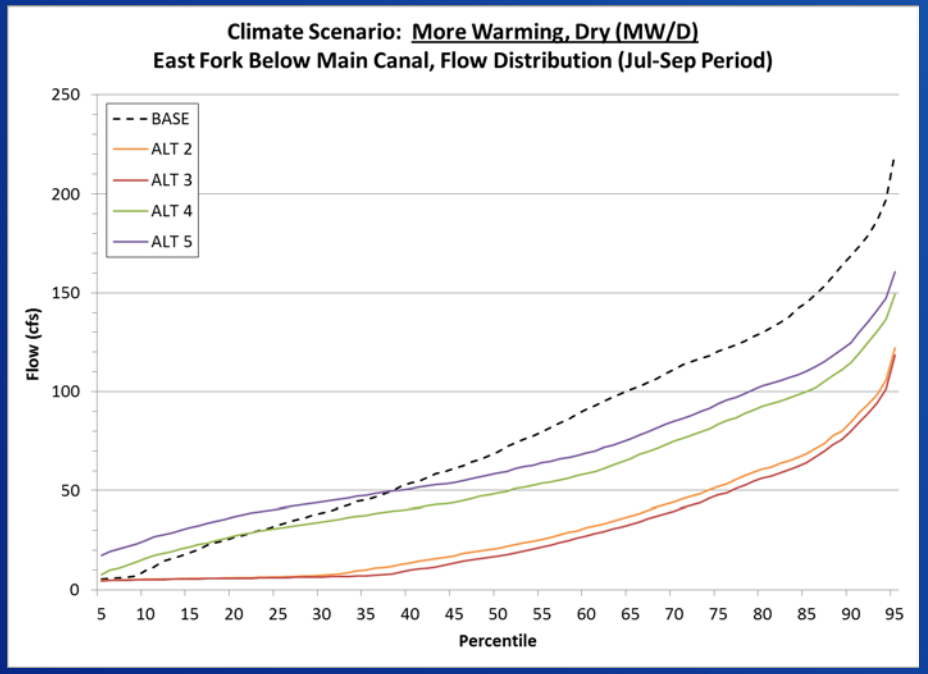


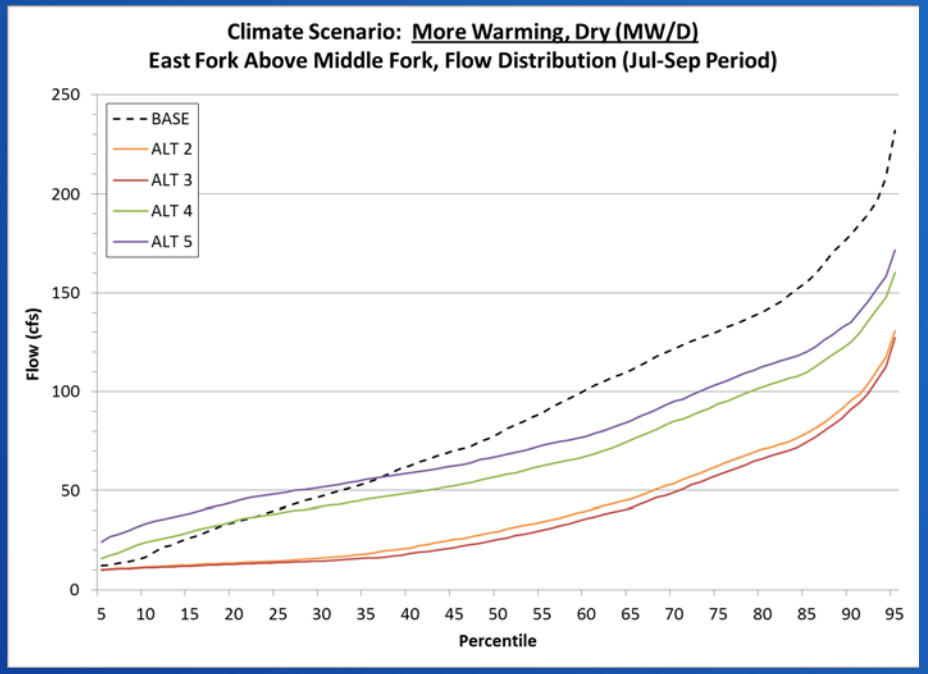


- Water resource alternatives modeled to primarily impact summer flows
  - Increased demands
    - Further decrease flows
  - Conservation measures, additional storage
    - Mitigate, or potentially eliminate, decreases

RECLAMATION

Flow Comparisons Across Alternatives

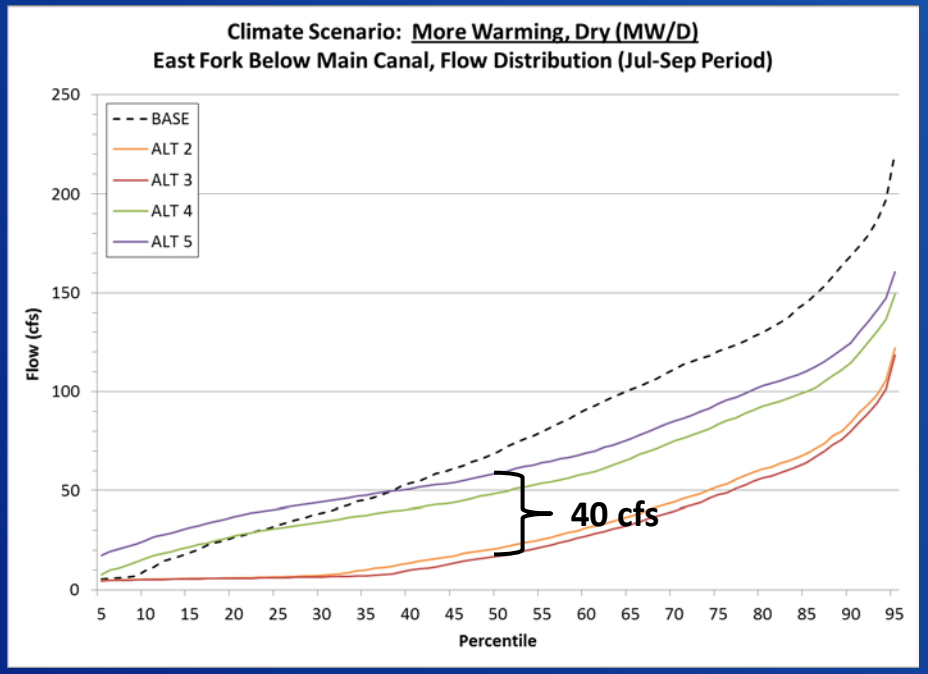


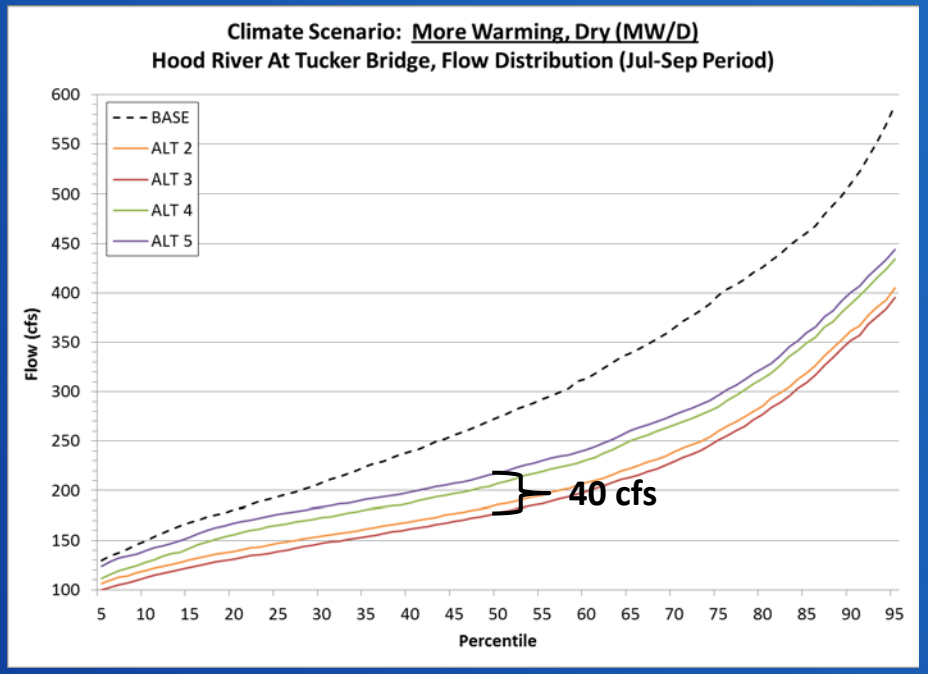


- **Most significant improvements along:**
  - East Fork
  - Greatest downstream impact (i.e. Hood River At Tucker Bridge)

RECLAMATION

Flow Comparisons Across Alternatives

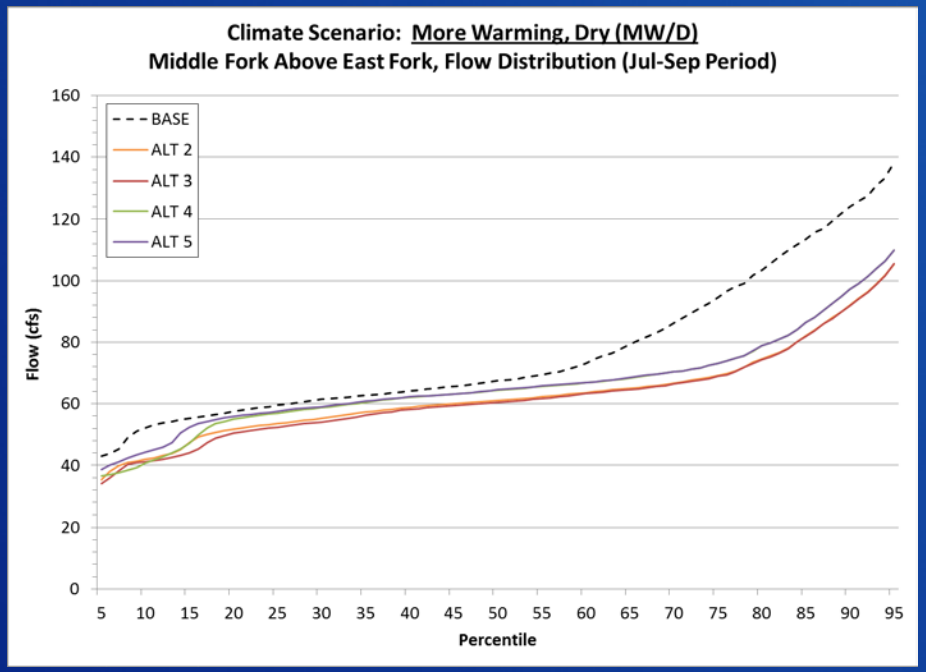


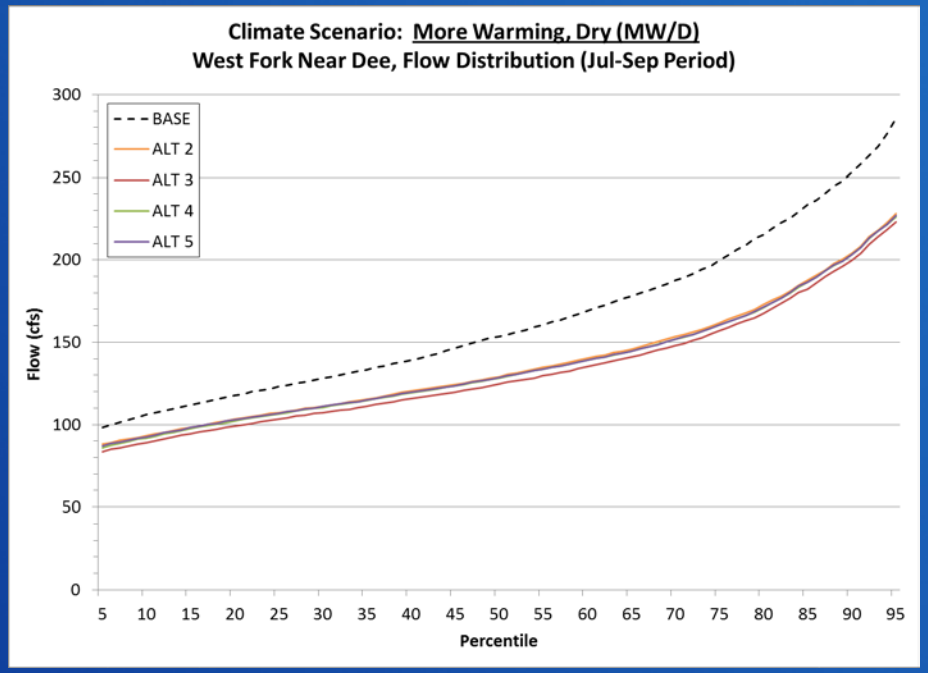


- **Most significant improvements along:**
  - East Fork
  - Greatest downstream impact (i.e. Hood River At Tucker Bridge)

RECLAMATION

Flow Comparisons Across Alternatives

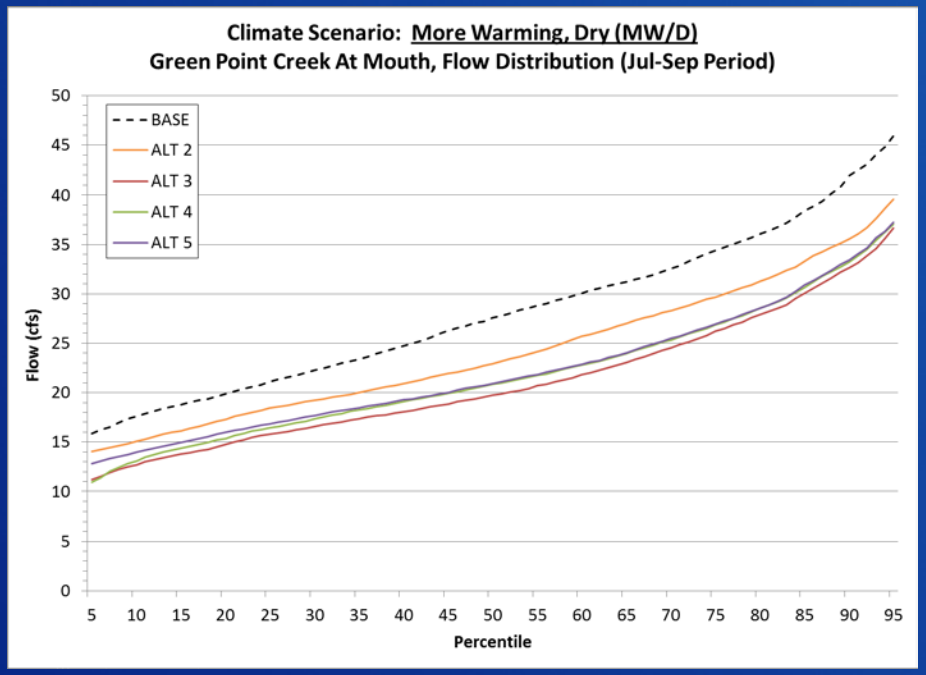


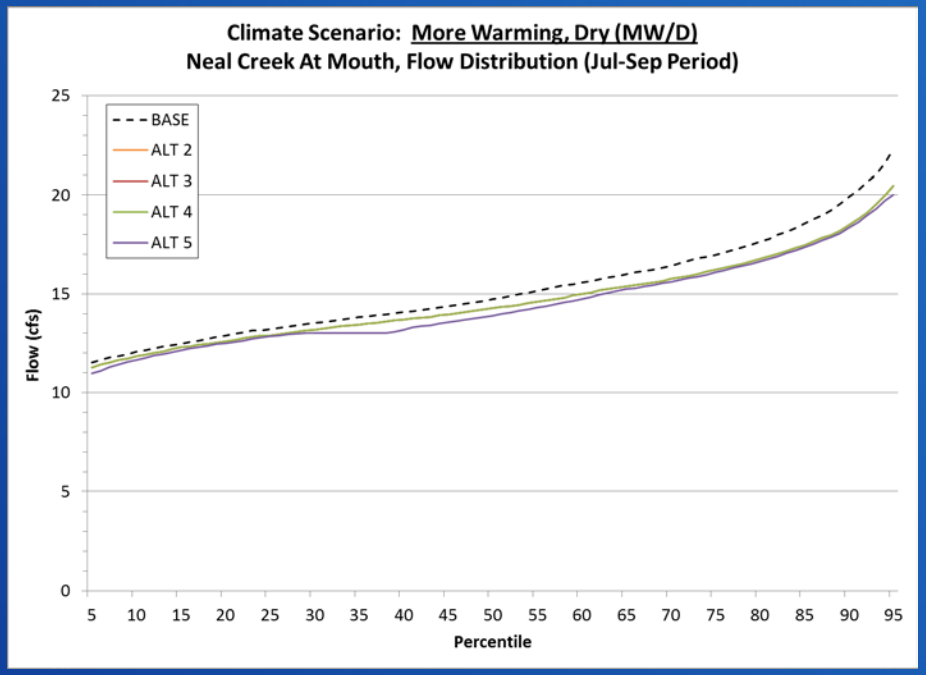


- **Less notable improvements along:**
  - **Middle Fork**
  - **West Fork**

RECLAMATION

Flow Comparisons Across Alternatives

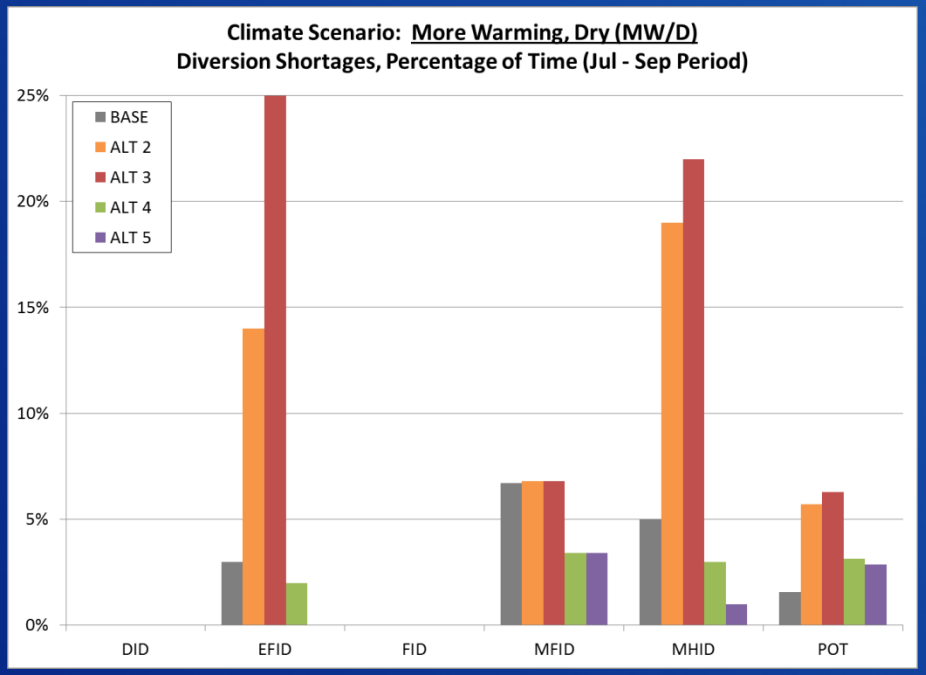


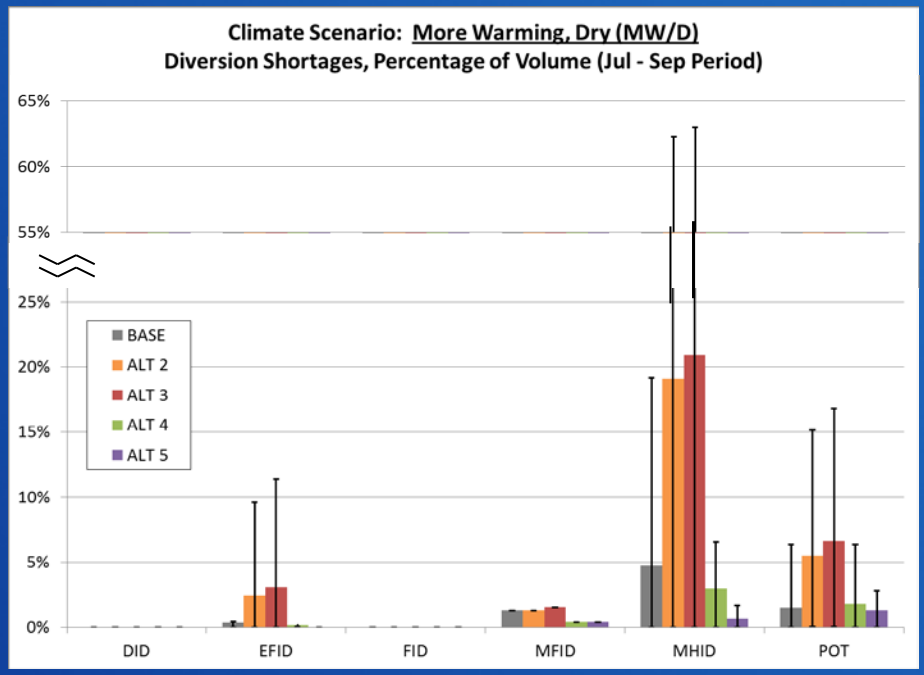


- **Less notable improvements along:**
  - **Green Point Creek**
  - **Neal Creek**

RECLAMATION

Consumptive Use Comparisons Across Alternatives

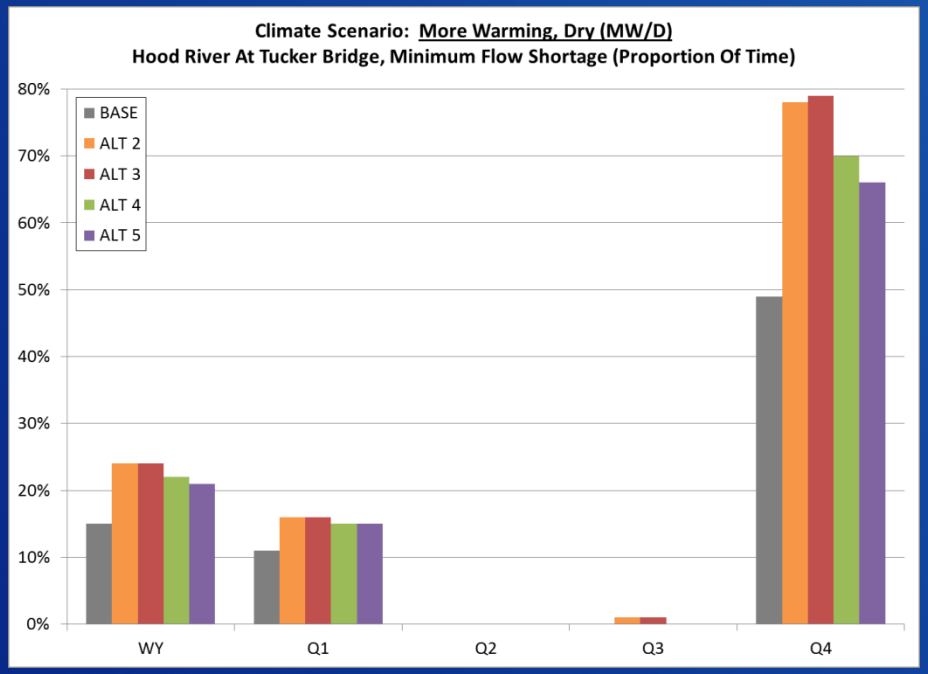


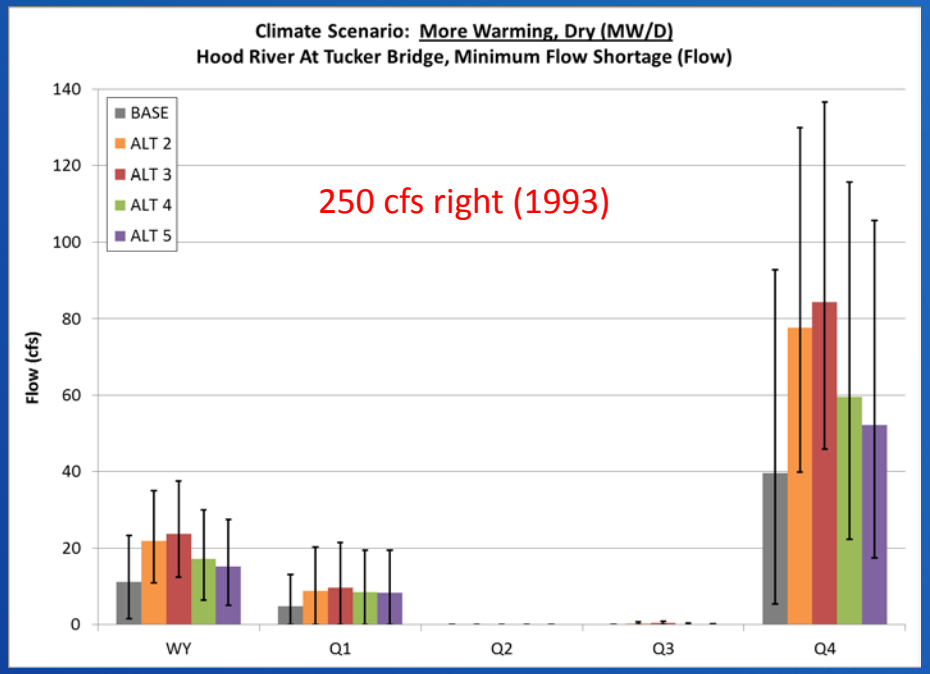


- **Projected future climate change may affect MHID and EFID***
  - Other districts not modeled to have water availability issues
  - *Dependent on 2 cfs minimum flow requirement downstream of Main Canal POD
    - Same priority date as MHID and EFID senior rights
- **Shortages sensitive to water resource alternatives**
  - Increased demands likely to amplify shortages
  - Conservation measures, additional storage may mitigate, or eliminate, shortages

RECLAMATION

Minimum Flow Comparisons Across Alternatives



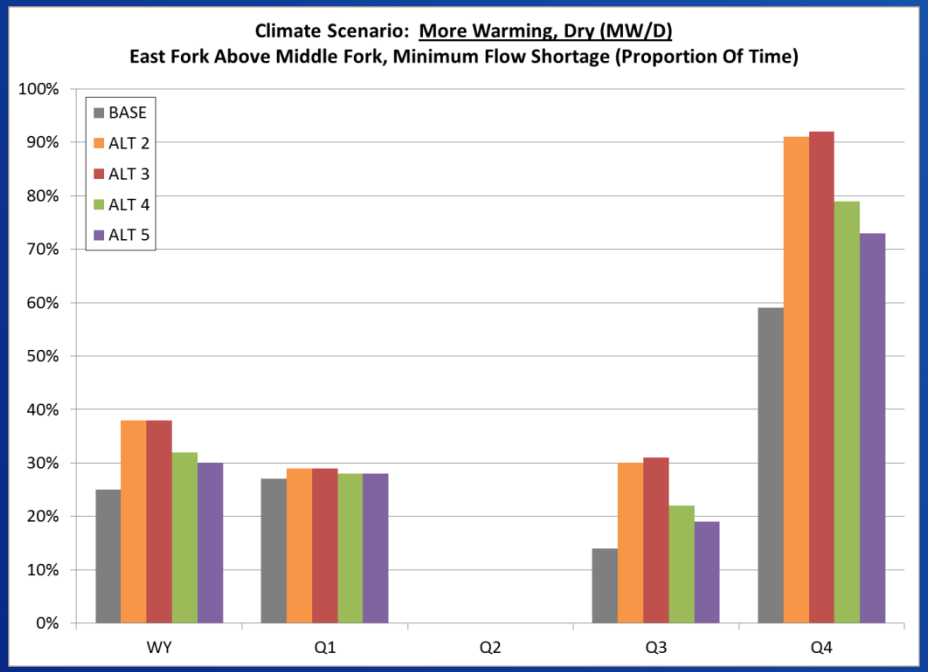


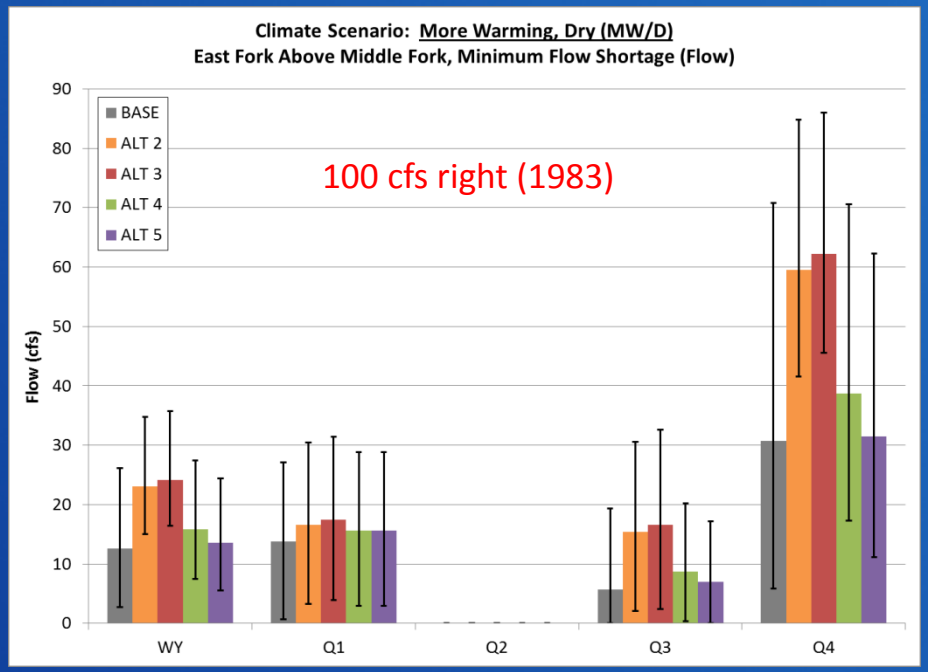
- **Similar story for minimum flows . . .**

- **Projected future climate change expected to affect:**
  - Mainstem, East Fork, and Middle Fork headwaters
- **Shortages sensitive to water resource alternatives**
  - Increased demands likely to amplify shortages
  - Conservation measures, additional storage may mitigate, but not eliminate, shortages

RECLAMATION

Minimum Flow Comparisons Across Alternatives

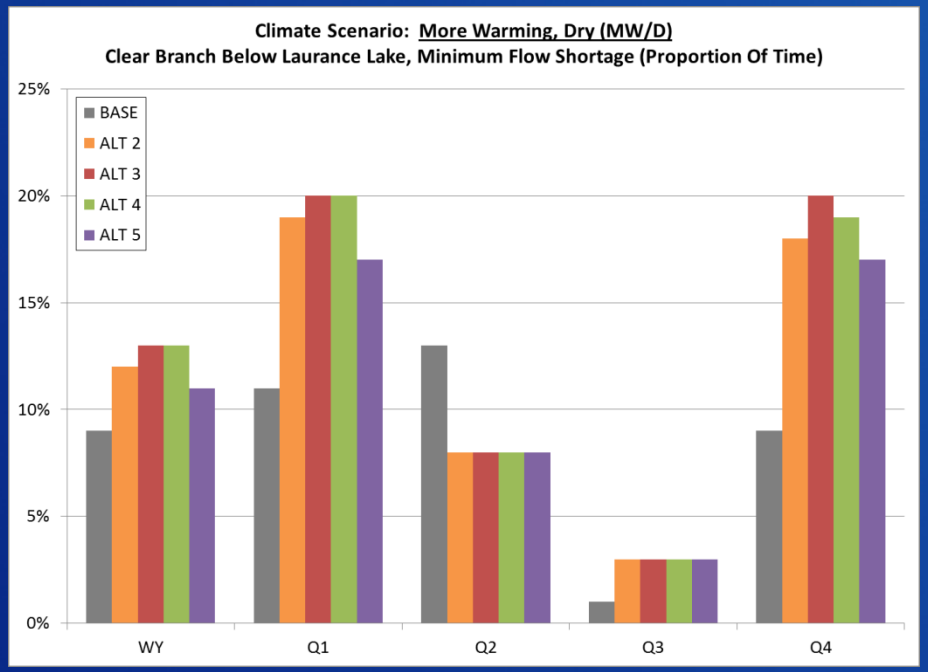


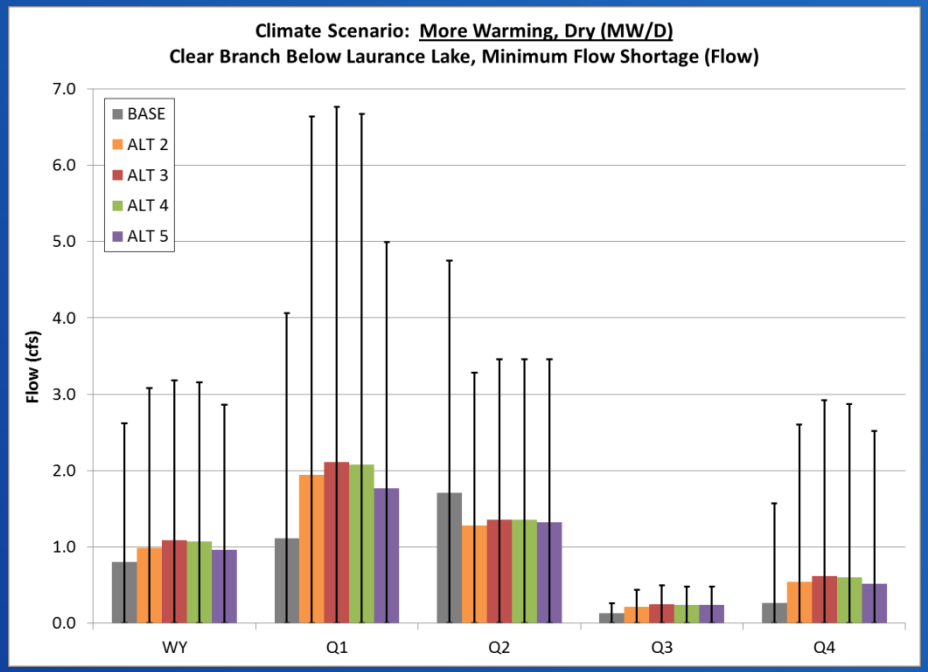


- **Similar story for minimum flows . . .**
- **Projected future climate change expected to affect:**
  - Mainstem, East Fork, and Middle Fork headwaters
- **Shortages sensitive to water resource alternatives**
  - Increased demands likely to amplify shortages
  - Conservation measures, additional storage may mitigate, but not eliminate, shortages

RECLAMATION

Minimum Flow Comparisons Across Alternatives



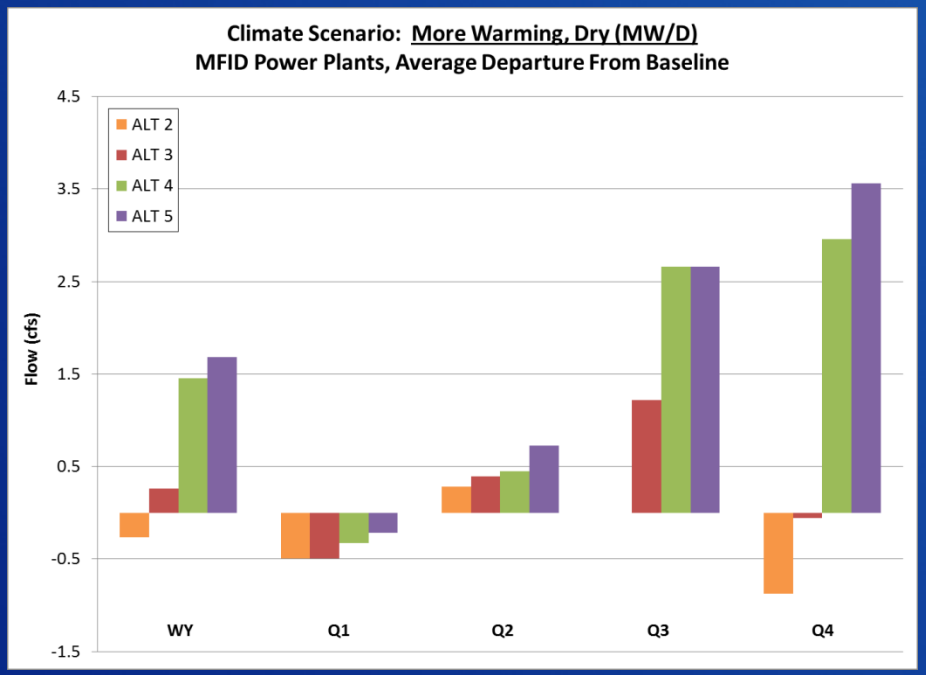


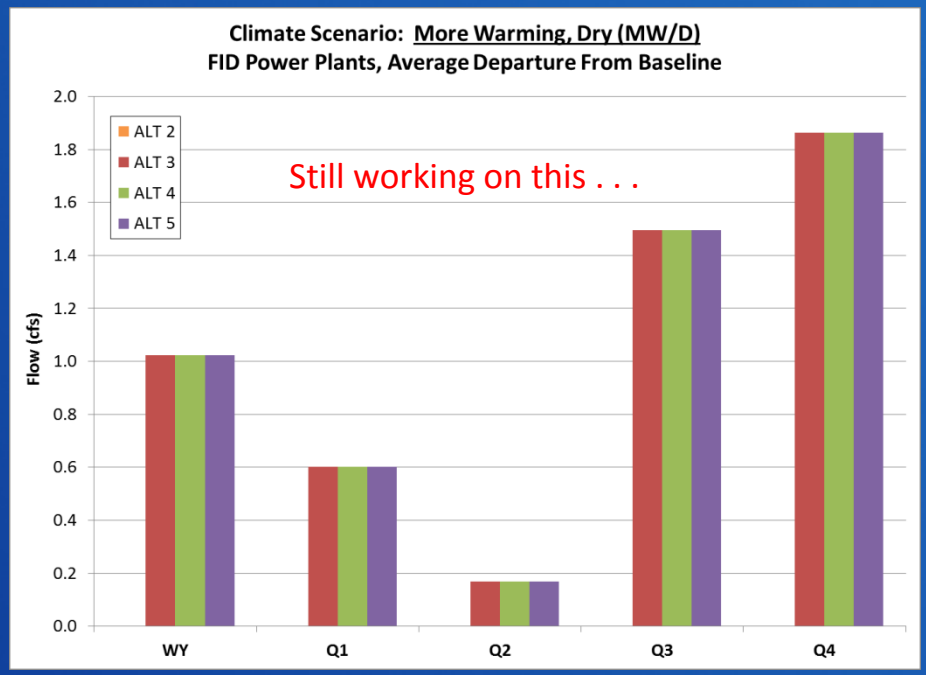
- **Similar story for minimum flows . . .**

- **Projected future climate change expected to affect:**
  - Mainstem, East Fork, and Middle Fork headwaters
- **Shortages sensitive to water resource alternatives**
  - Increased demands likely to amplify shortages
  - Conservation measures, additional storage may mitigate, but not eliminate, shortages

RECLAMATION

Hydropower Comparisons Across Alternatives

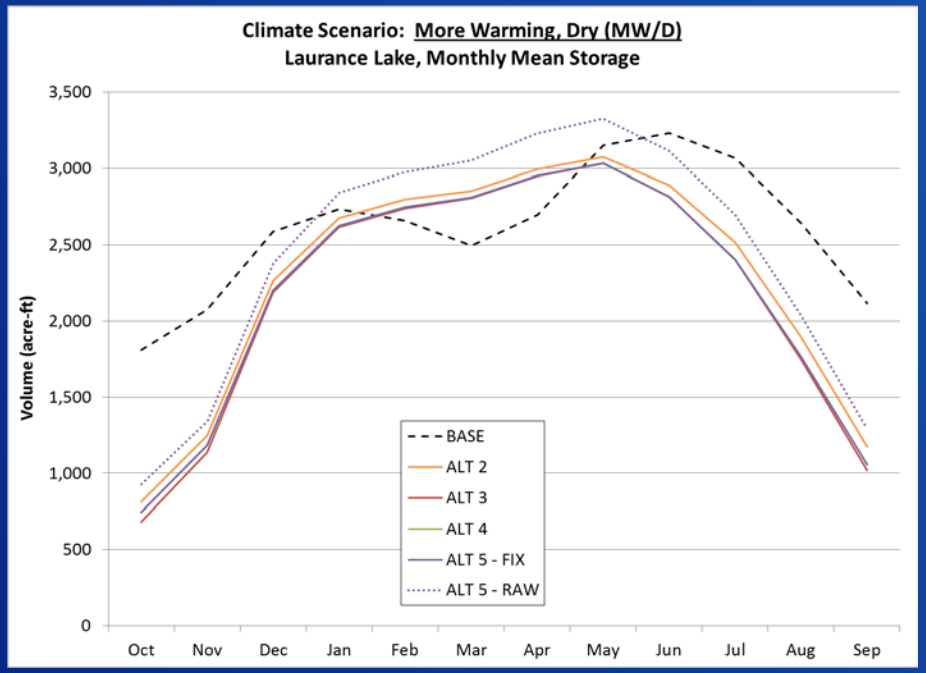


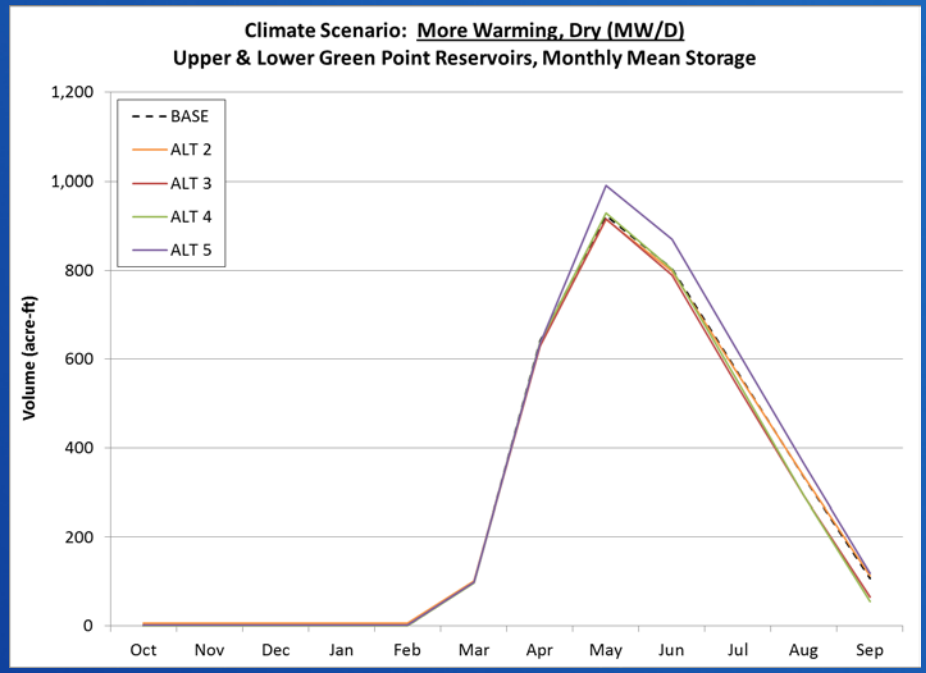


- **Power production may increase, generally by less than 5%**
  - Increased consumptive demands (3 – 8%) may be carried through power plants
  - Water conservation decreases consumptive demands, but flows through plants maintained
  - Additional storage not much of a factor

RECLAMATION

Storage Comparisons Across Alternatives

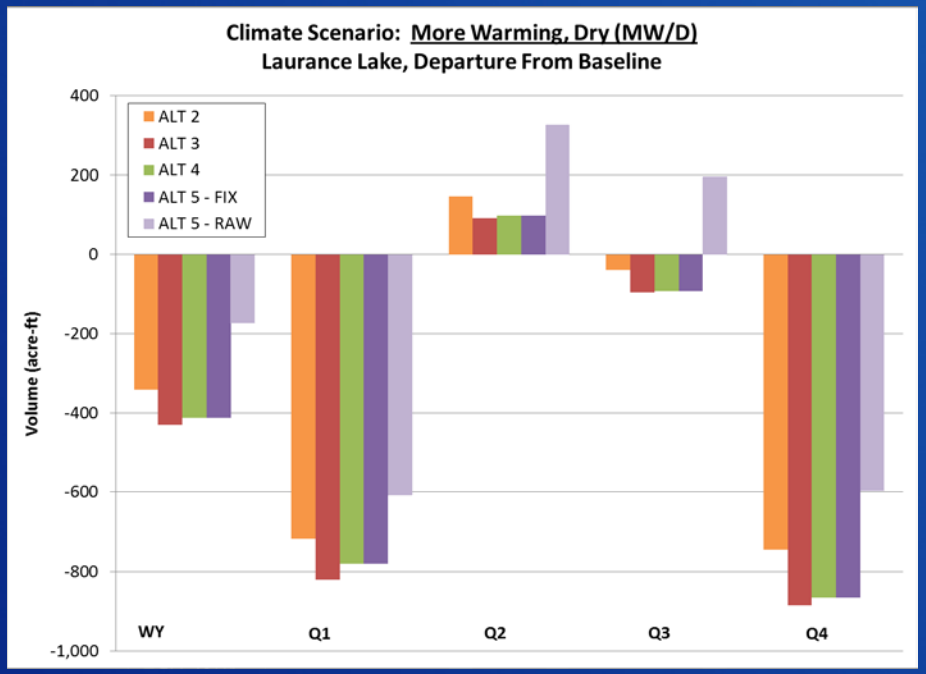


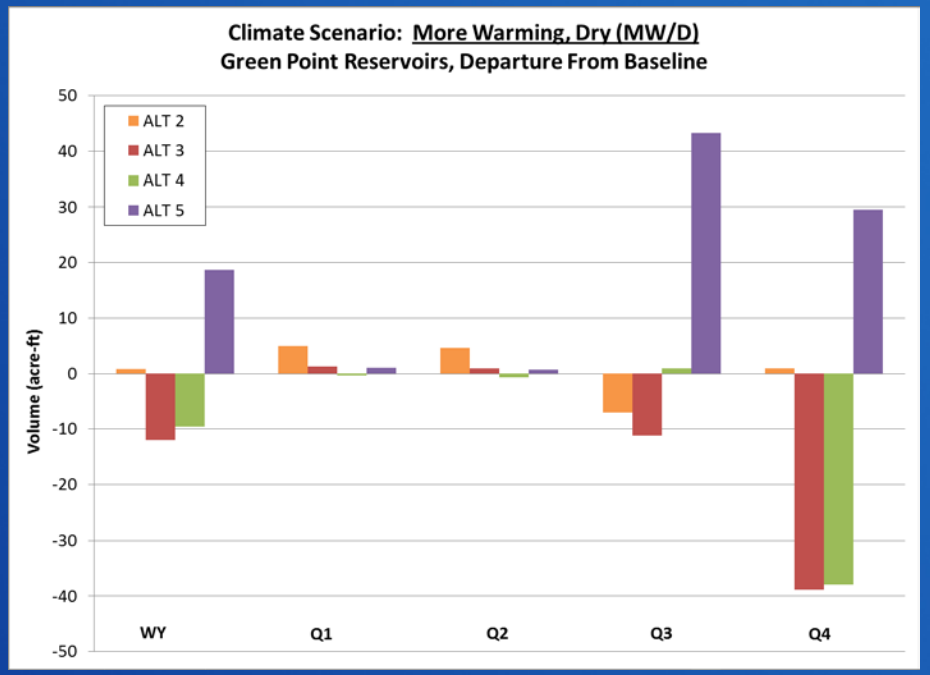


- **Projected future climate change expected to:**
  - Decrease storage during irrigation season → Potentially by more than 50%
  - Increase storage during off-season → Potentially by more than 20%

RECLAMATION

Storage Comparisons Across Alternatives

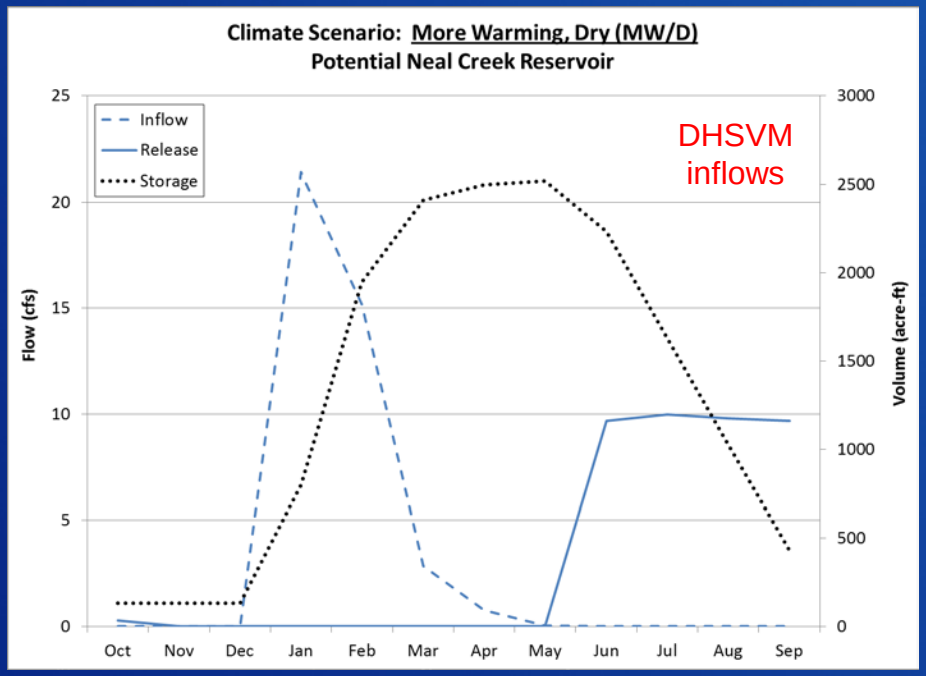


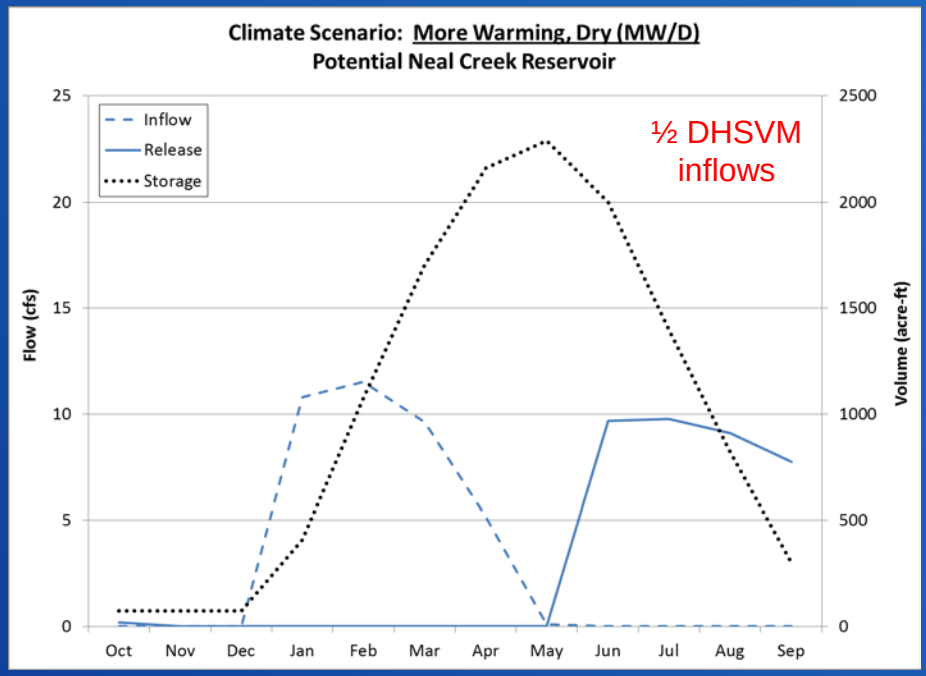


- **Changing demands not modeled to significantly impact existing storage facilities**
  - However, additional capacity may provide increased water availability for acute low flow periods
- **Laurance Lake:**
  - Slight improvement in downstream shortages with expansion → ~ 1 cfs extra flow
  - Additional capacity (+ 370 acre-ft) may provide 10+ cfs for critical two week window
- **Upper Green Point Reservoir:**
  - No downstream shortages to alleviate
  - Additional capacity (+ 560 acre-ft) may provide 15+ cfs for critical two week window

RECLAMATION

Storage Comparisons Across Alternatives





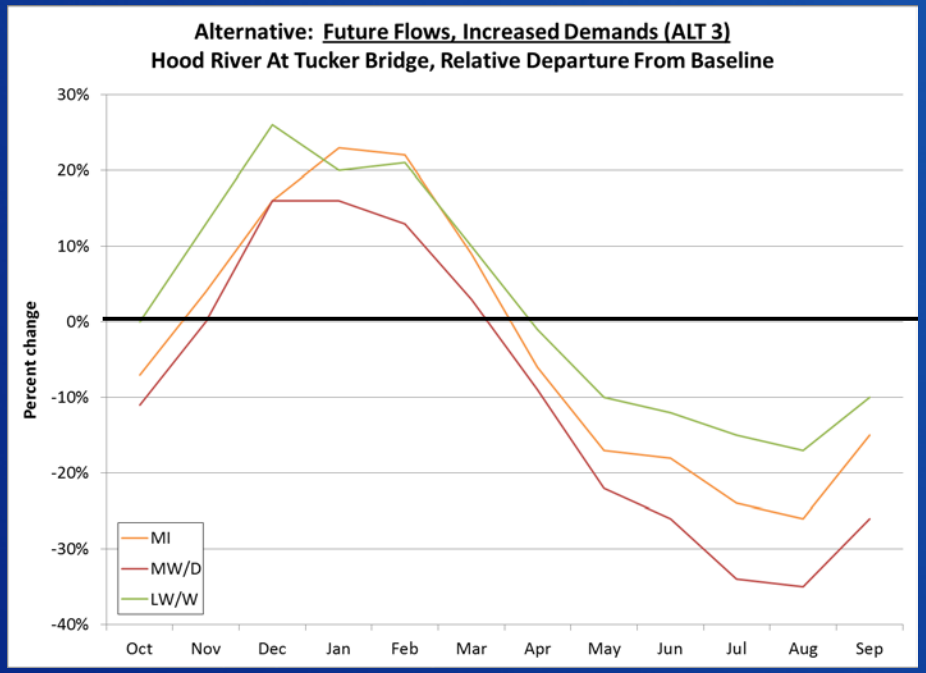
- **Proposed Neal Creek Reservoir may serve significant role**
  - **Fill during Jan – Apr**
  - **Release during Jun – Sep**
  - **May provide up to 10 cfs to EFID during irrigation season**
    - **Allow more water to remain in East Fork and mainstem**

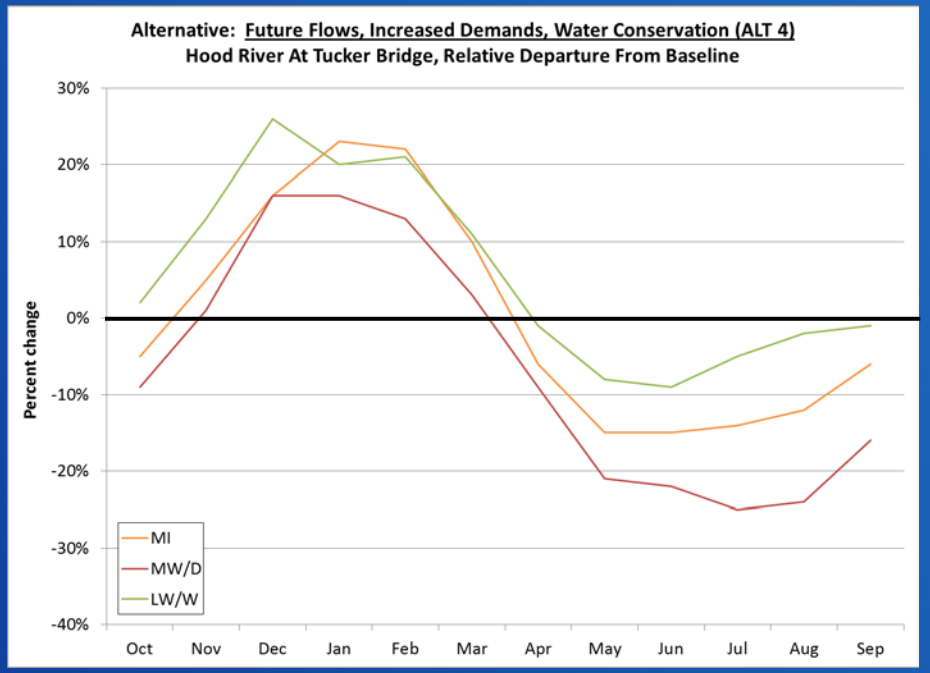
RECLAMATION

Results: All Scenarios

RECLAMATION

Flow Comparisons Across Scenarios

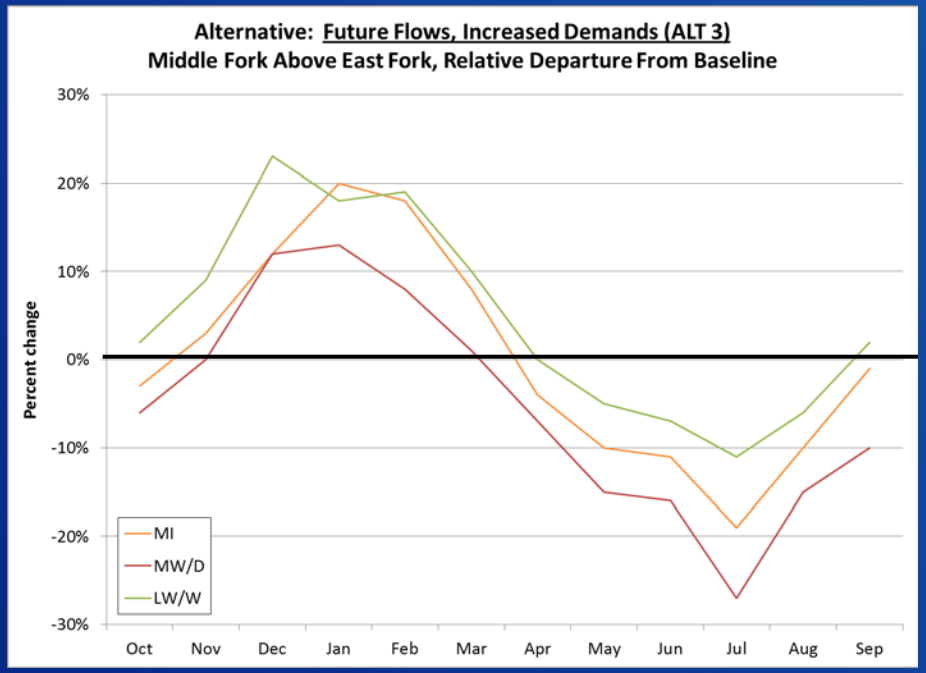


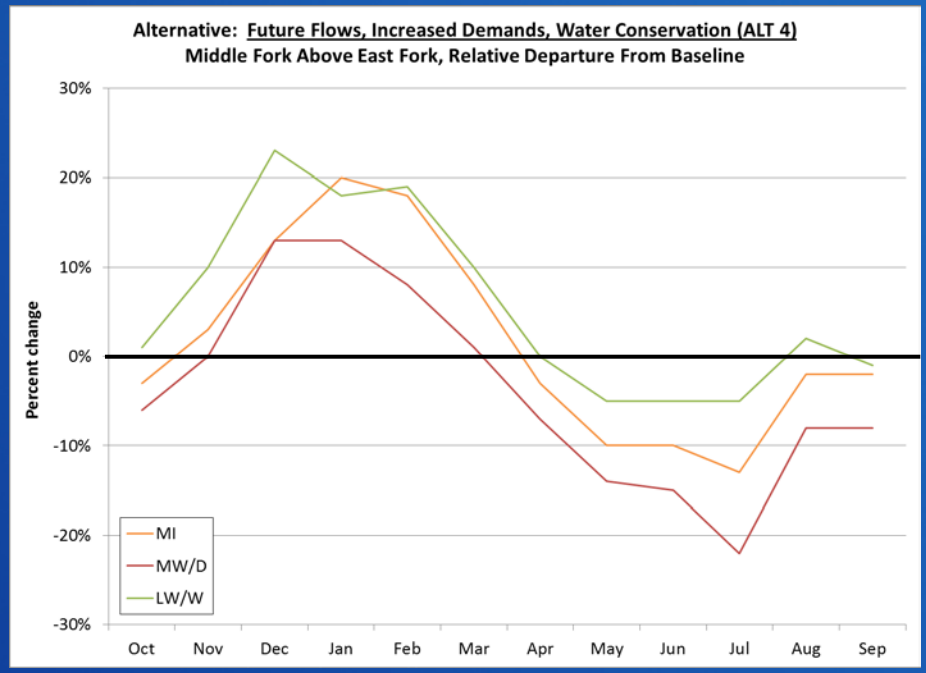


- **Water conservation may increase flows 10 – 15% along mainstem during Jul – Sep period**
  - **Approximately 20 – 40 cfs**

RECLAMATION

Flow Comparisons Across Scenarios

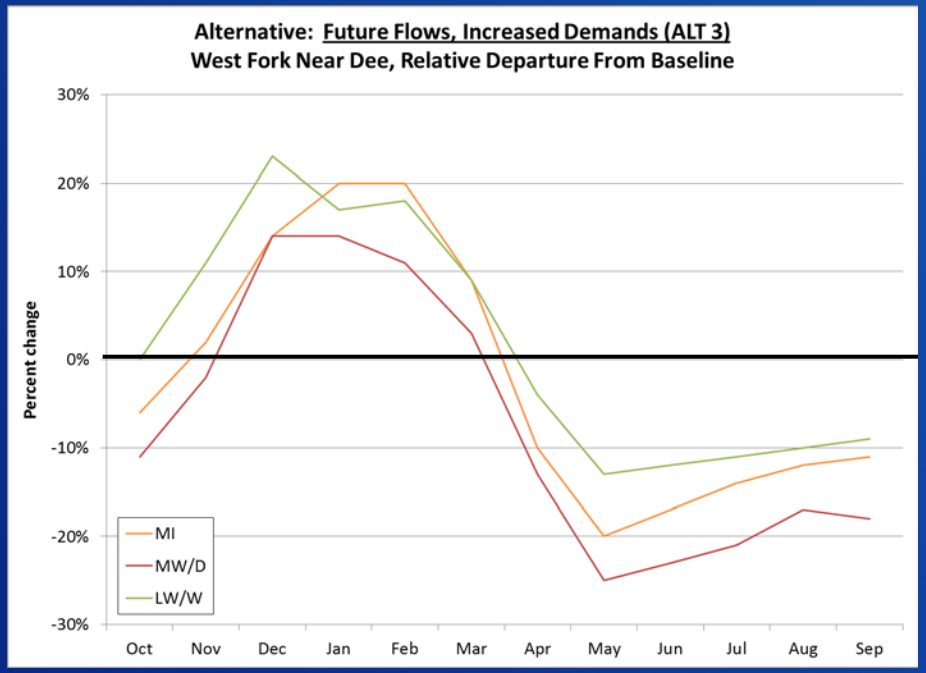


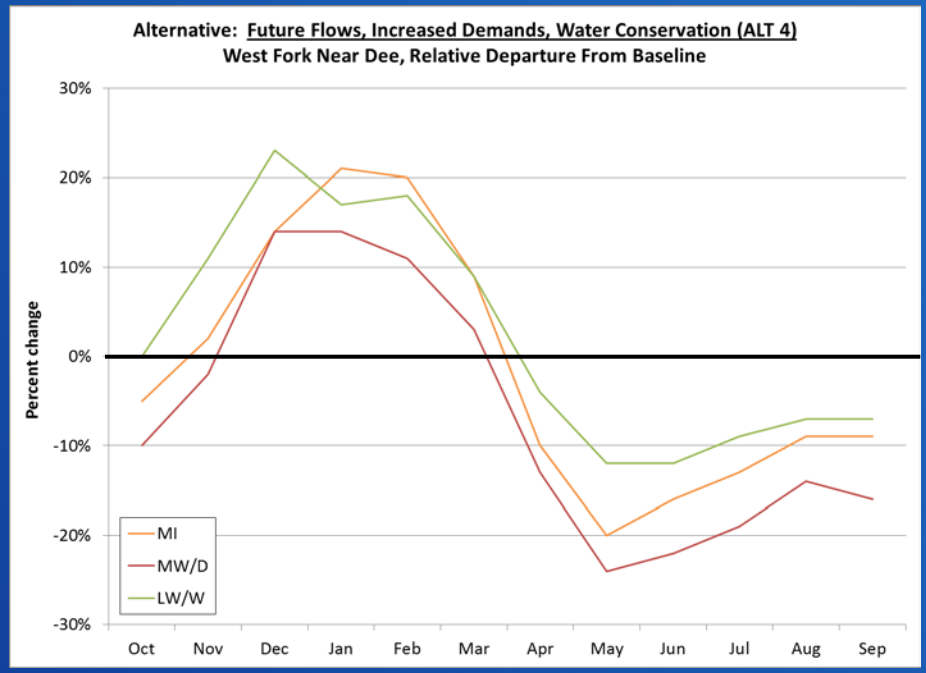


- **Water conservation may increase flows < 10% along Middle Fork during Jul – Sep period**
  - **Less than 5 cfs**

RECLAMATION

Flow Comparisons Across Scenarios

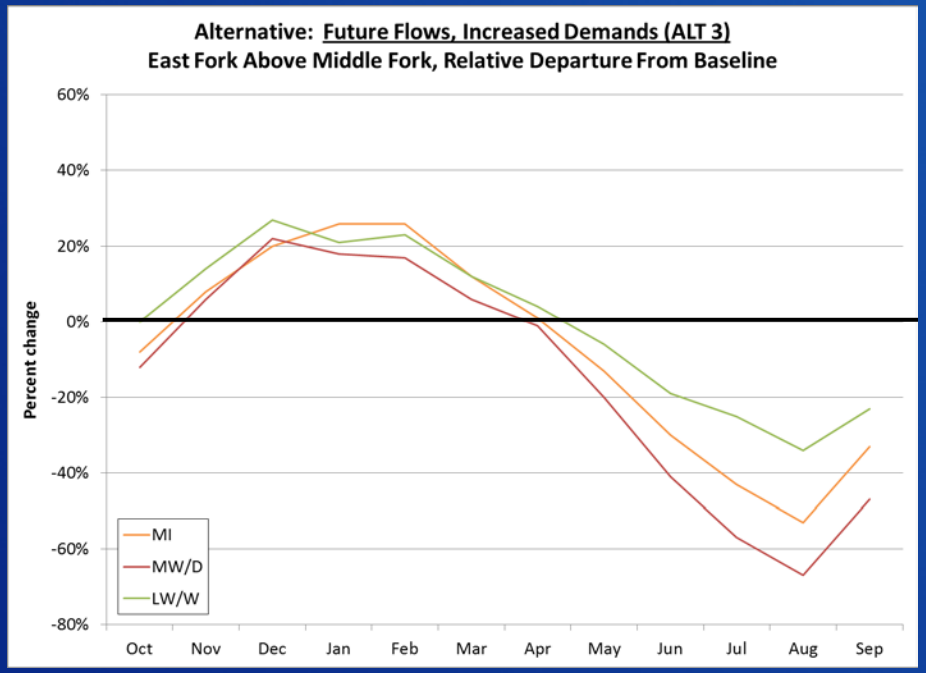


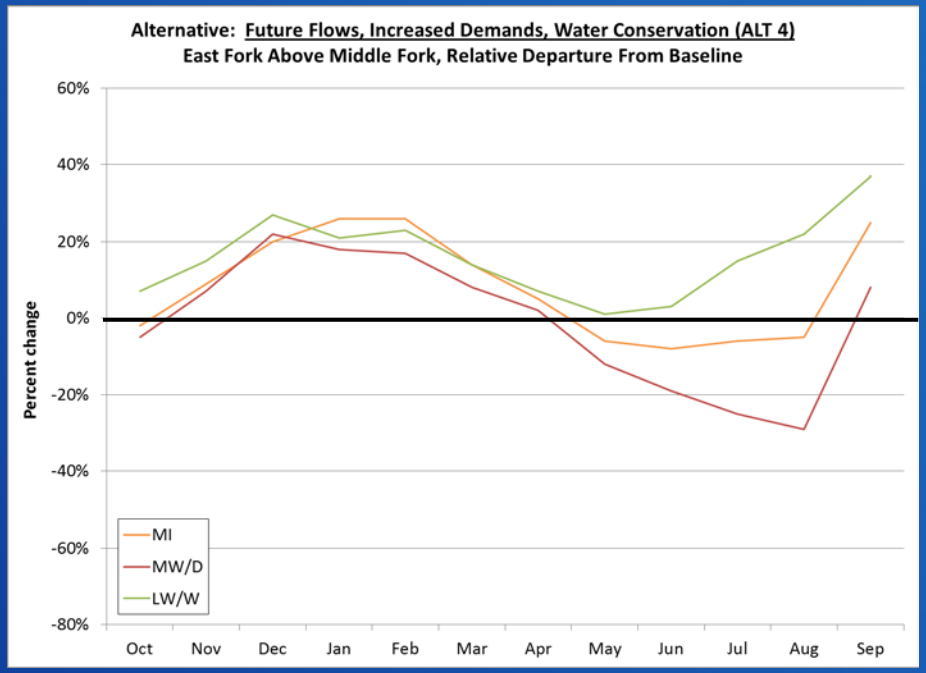


- **Water conservation may increase flows < 5% along West Fork during Jul – Sep period**
  - **Less than 5 cfs**

RECLAMATION

Flow Comparisons Across Scenarios





- **Water conservation may increase flows 30 – 60% along East Fork during Jul – Sep period**
  - **Approximately 20 – 40 cfs**

RECLAMATION

Summary

- Projected climate change expected to alter runoff timing and character
  - Potentially higher flows during the winter (+10 – 20%) and lower flows during the summer (-20 – 30%)
  - Water shortages, namely along East Fork and mainstem, are enhanced
  - Storage in existing facilities likely to decrease during irrigation season
- Projected increase in demands likely to exacerbate water availability issues
- Proposed conservation practices may mitigate, or eliminate, some demand issues
  - Namely along East Fork and mainstem
- Additional storage in existing facilities may provide buffer to acute low flow periods
  - Expansion of Laurance Lake and Upper Green Point Reservoir could yield + 30 cfs for two weeks
- New storage facility along Neal Creek may provide most notable benefit to flows and shortages
  - Could serve district(s) modeled to have biggest water availability issues
  - Could keep more East Fork flow in-channel and allow to pass down

Biggest Unknowns

- **Low elevation tributary flows**
  - Green Point Creek, Dead Point Creek, Pine Creek, Ditch Creek, Neal Creek
  - Flow observations not available for model calibration
- **Farmers Irrigation District (FID)**
  - Uncertainty in inflows translates to uncertainty in water availability for storage, consumptive use, hydropower, and minimum flows
  - Fine-tuning PODs, POUs, and the timing and quantity of demanded water may yield more expected results
- **Potential Neal Creek Reservoir**
  - Uncertainty in inflows translates to uncertainty in water availability for storage and augmenting EFID
  - However, even half of projected inflows may provide water to EFID and keep water in-channel

Acknowledgements

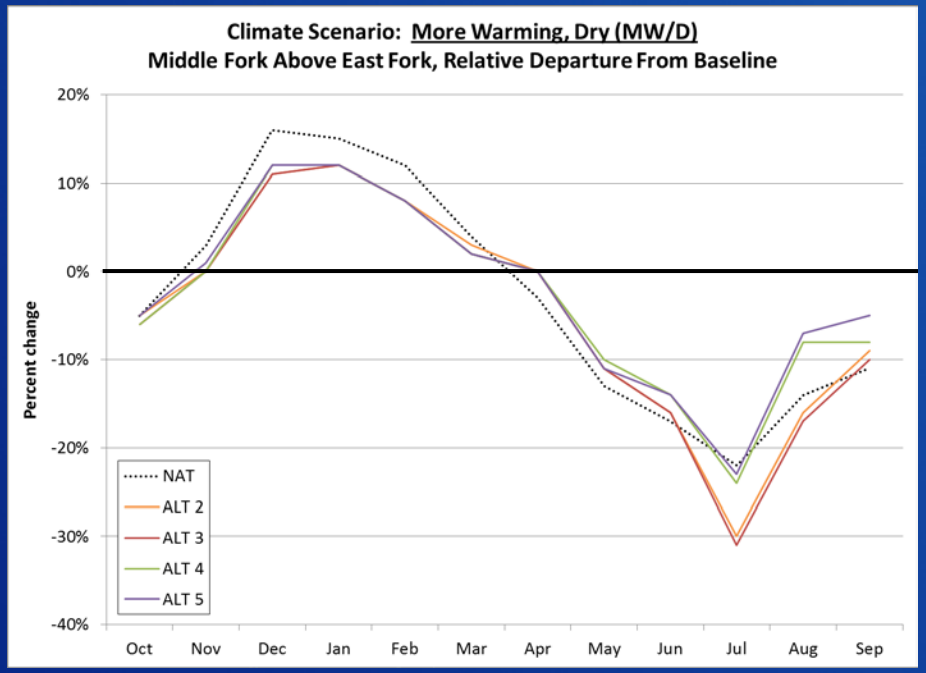
- Reclamation would like to thank everyone involved for helpful guidance and feedback

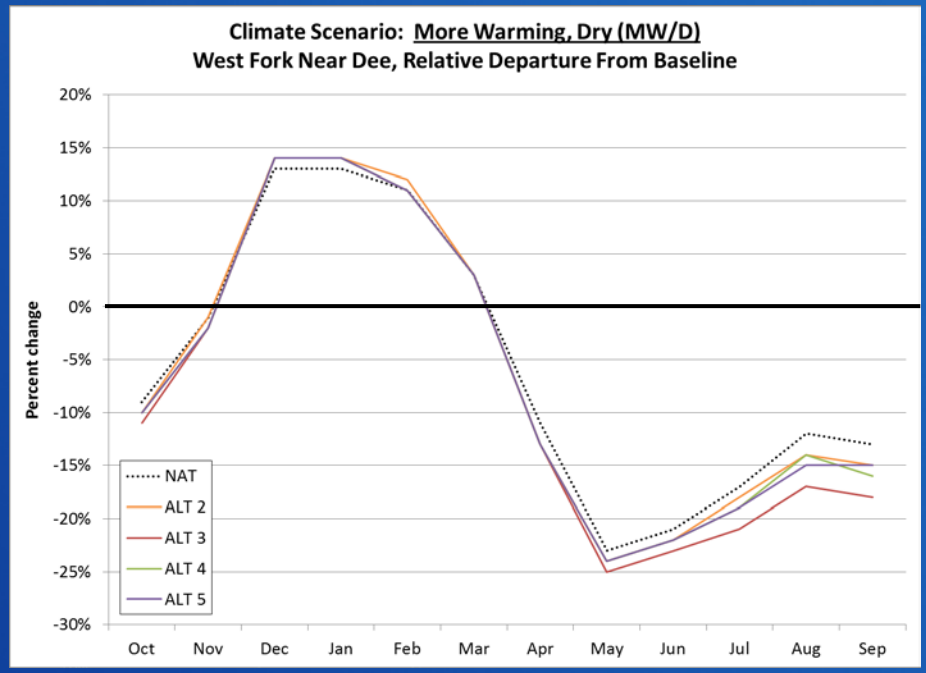
- Specifically, for their extensive efforts:
  - Niklas Christensen, Watershed Professionals Network
  - Mattie Bossler, Hood River County
  - University of Washington Dept. of Civil and Environmental Engineering

Questions???

RECLAMATION

Flow Comparisons Across Alternatives

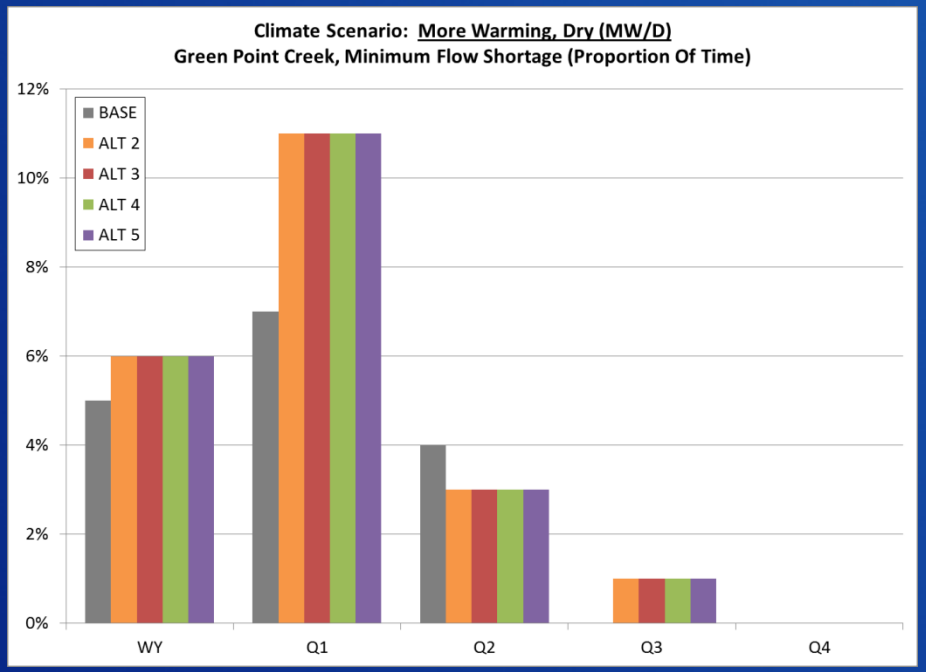


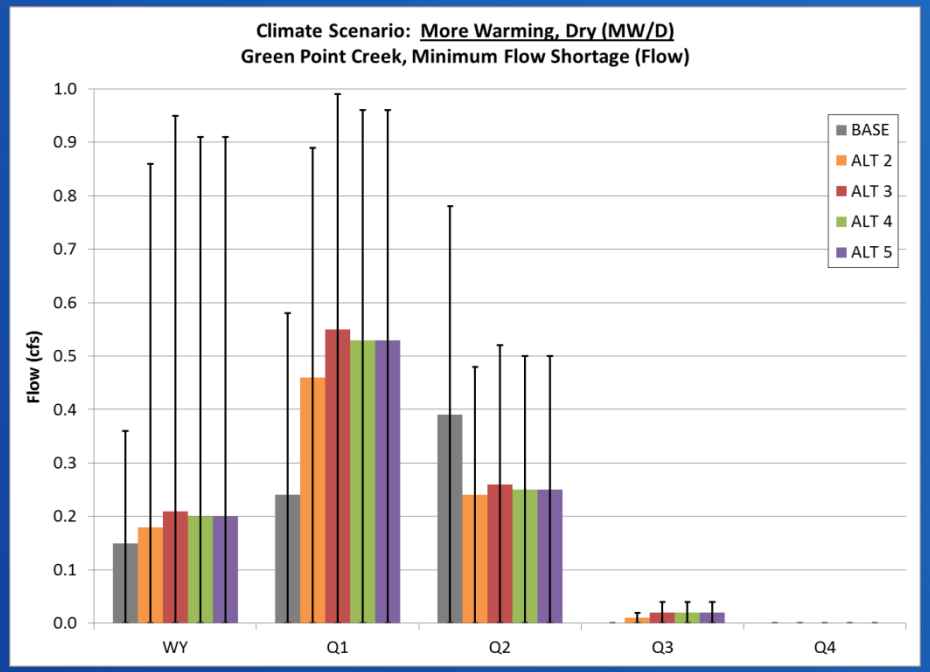


- Water resource alternatives modeled to primarily impact summer flows
  - Increased demands
    - Further decrease flows
  - Conservation measures, additional storage
    - Mitigate, or potentially eliminate, decreases

RECLAMATION

Minimum Flow Comparisons Across Alternatives

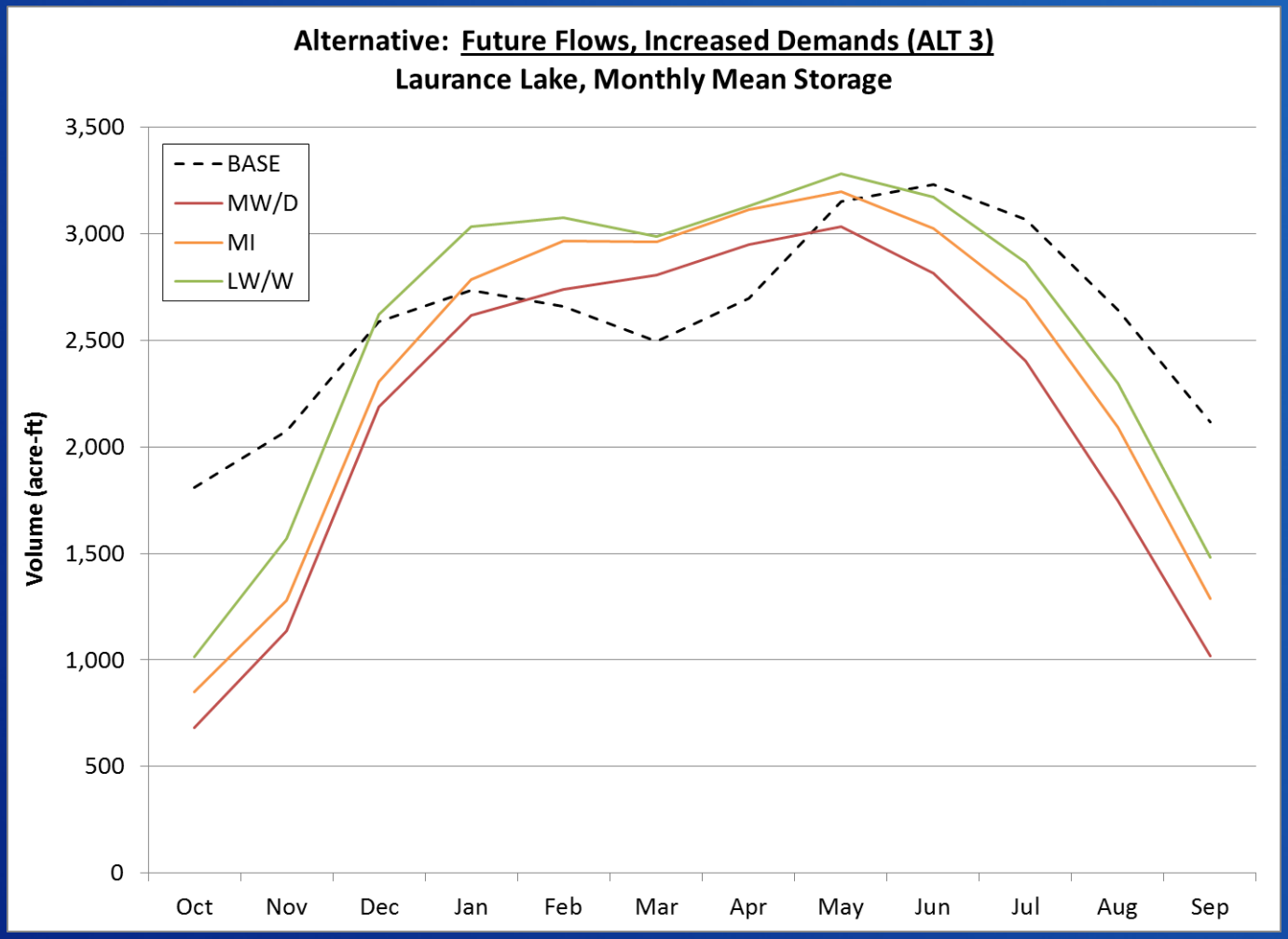




- **Projected future climate change expected to affect:**
  - Mainstem, East Fork, and Middle Fork headwaters
  - Other flow targets not modeled to have water availability issues
- **Shortages sensitive to water resource alternatives**
  - Increased demands likely to amplify shortages
  - Conservation measures, additional storage may mitigate, but not eliminate, shortages

RECLAMATION

Storage Comparison Across Scenarios



RECLAMATION