Linking Water Sources & Water Quality within the Jordan River, Utah

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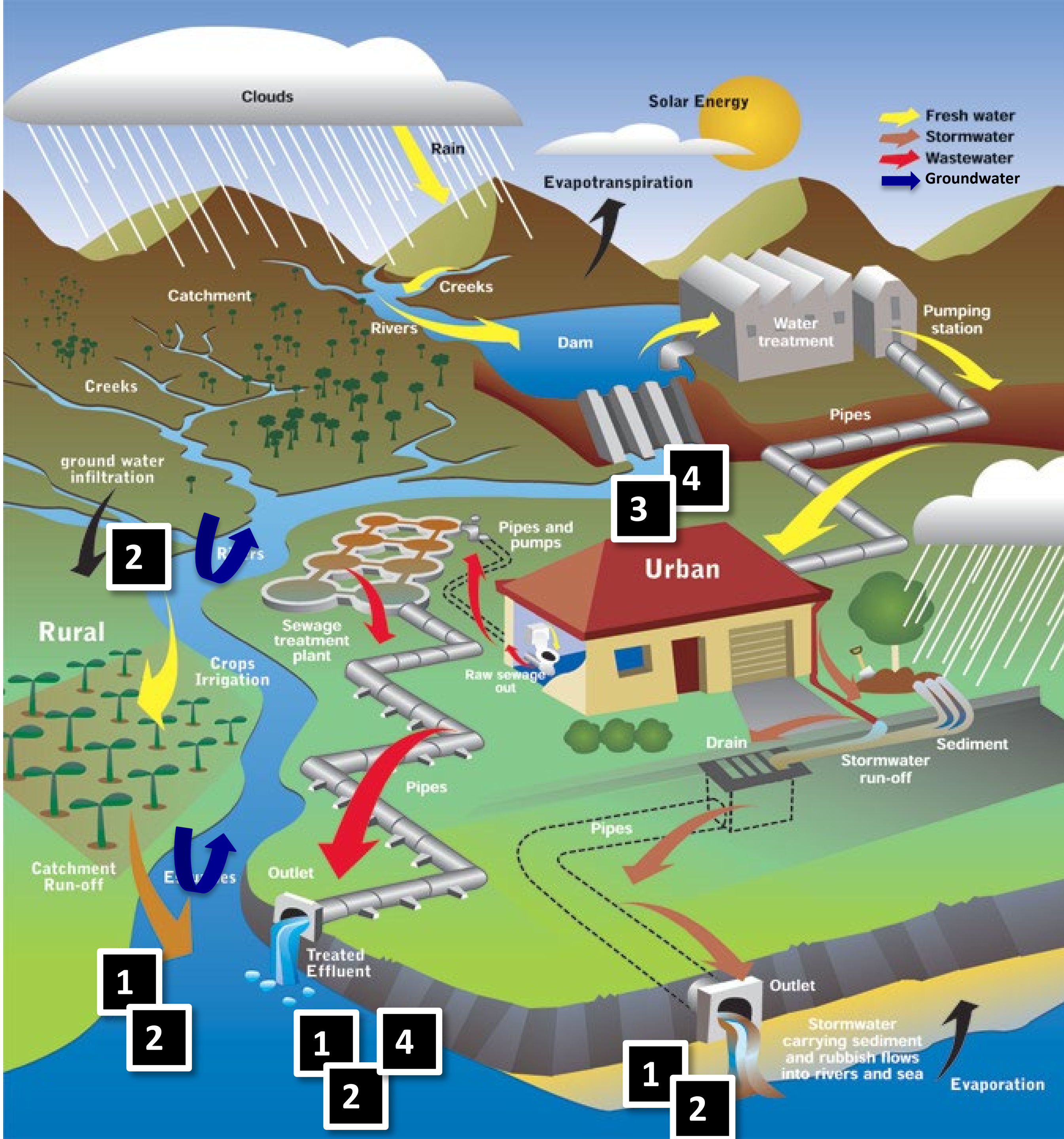
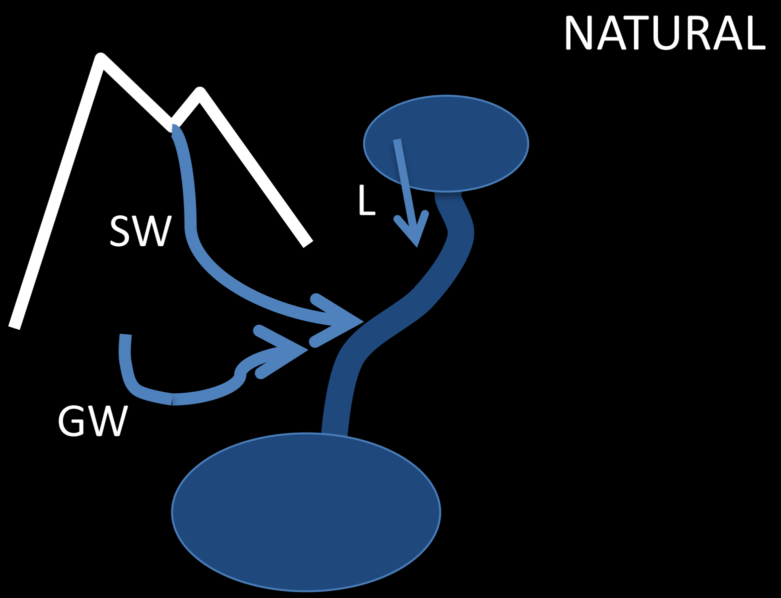
Outline

I. Linking patterns of discharge in the Jordan River to sources of water
II. Linking water quantity to water quality
III. Assessing nutrient processing capacity of the Jordan River

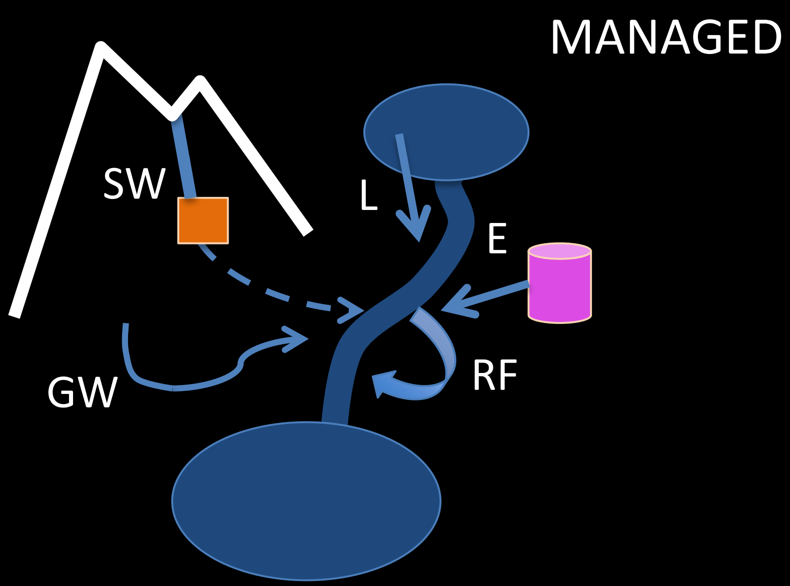
Urban Stream Syndrome

1	TSS, TDS pollution
2	Nutrient pollution
3	Altered temperature
4	Altered flow





Q1: How do the dominant sources of water to the river vary along the flowpath of an urban river and amongst seasons?



L – lake outlet
SW – surface water
GW – groundwater
E – effluent
RF – return flow

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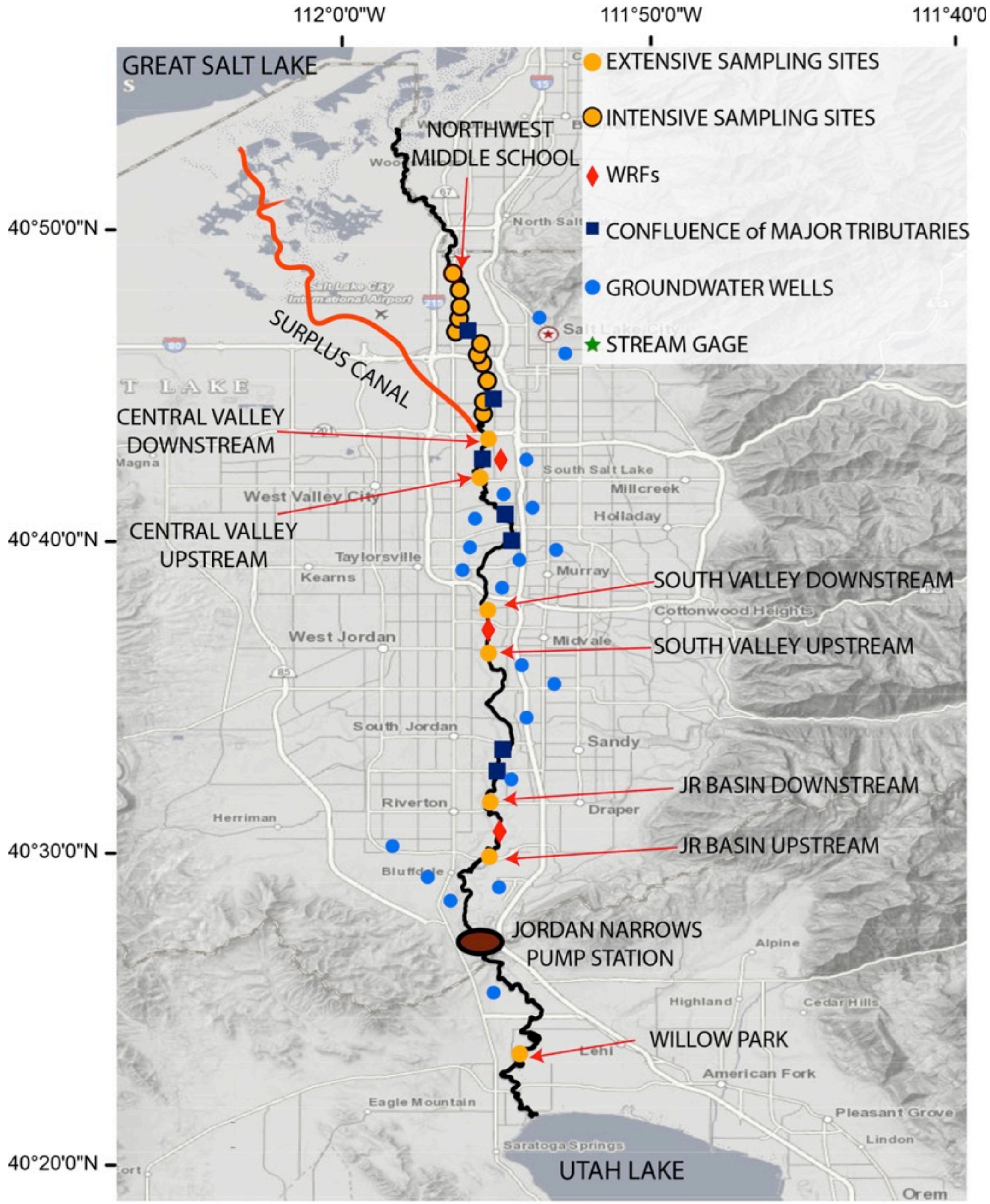

Data collected in May, August, November of 2016:

- Discharge
  - River
  - Inputs – Utah Lake, effluent, tributaries
  - Outputs – diversions
- Water isotopes (^{18}O, ^{2}H)
- Water temperature
- Water chemistry
  - DO
  - NO_3-N, TDN
  - PO_4-P, TDP
  - DOC

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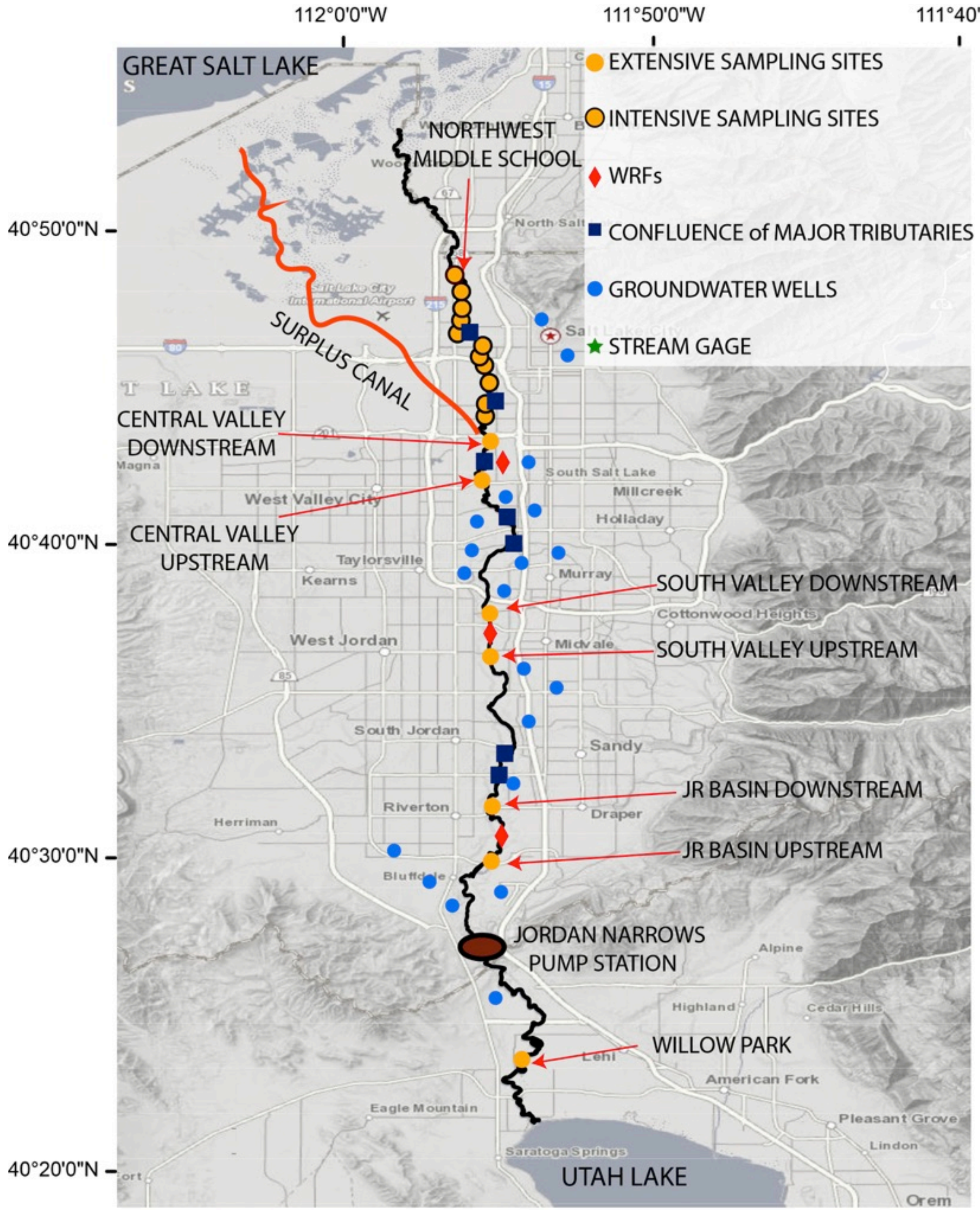

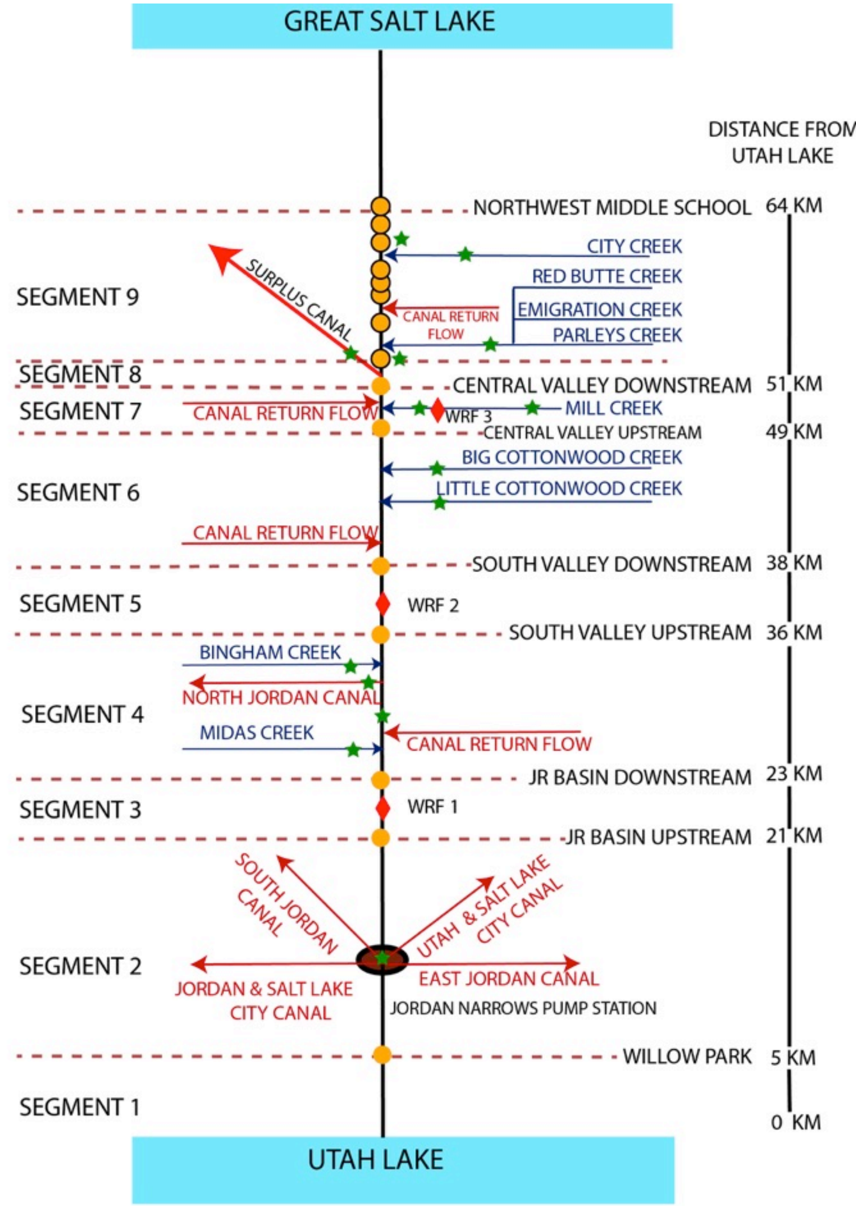

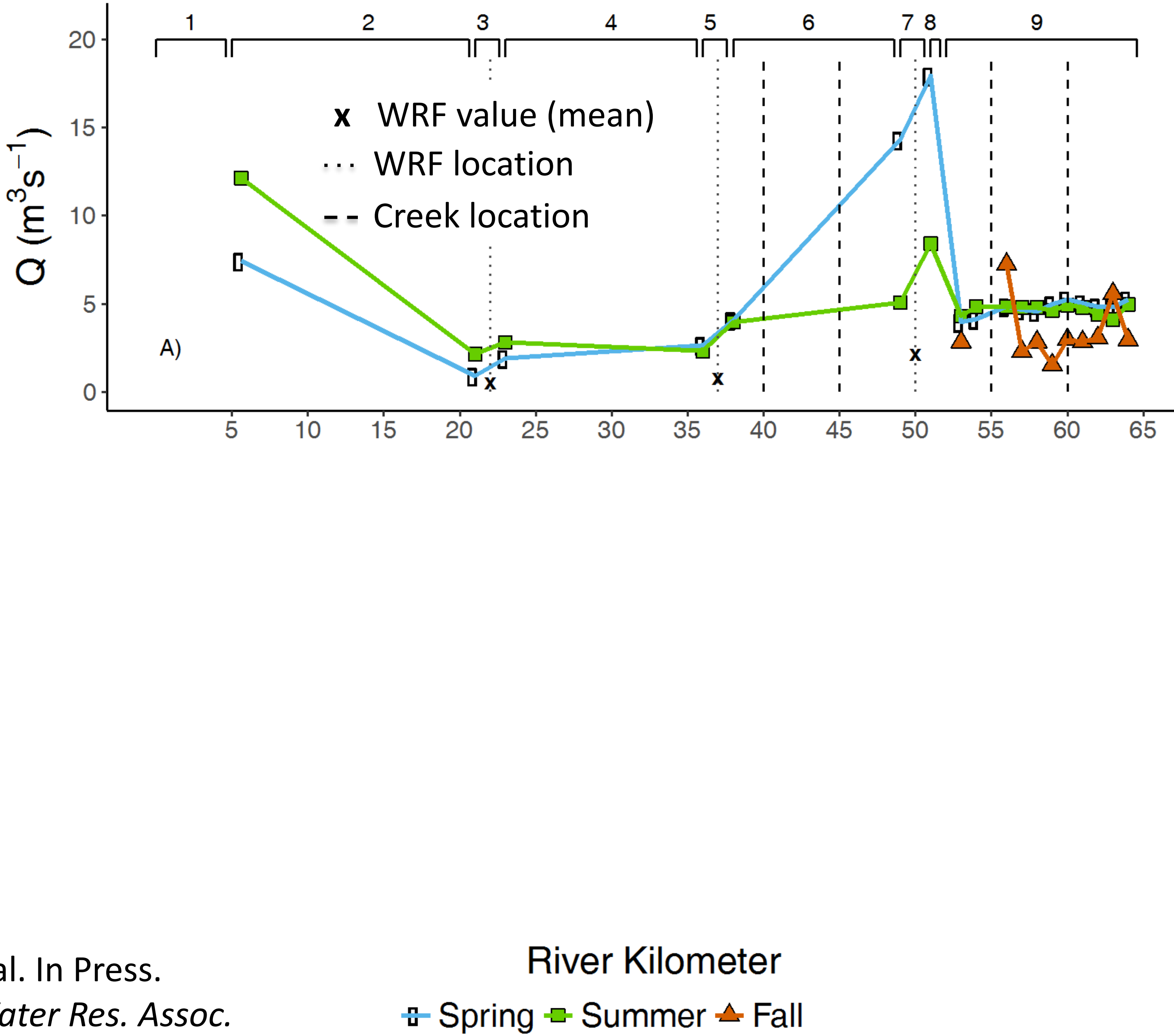

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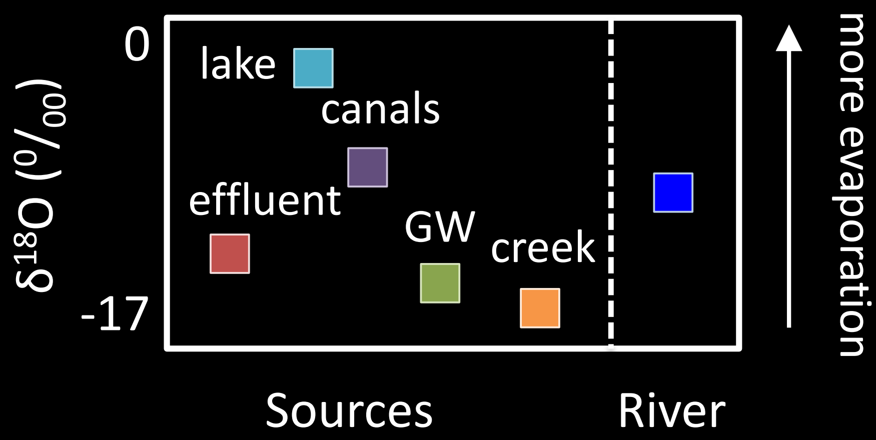
Calculation of Proportional Inputs of Water

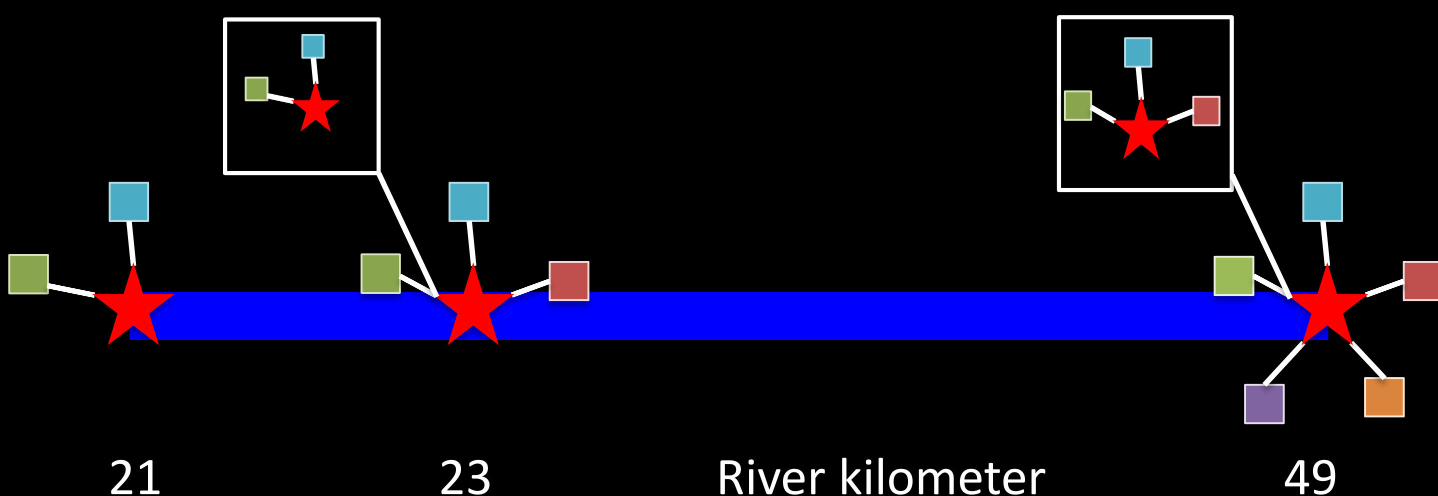
1. $\delta^{18}O$ (and $\delta^{2}H$) values of sources & river

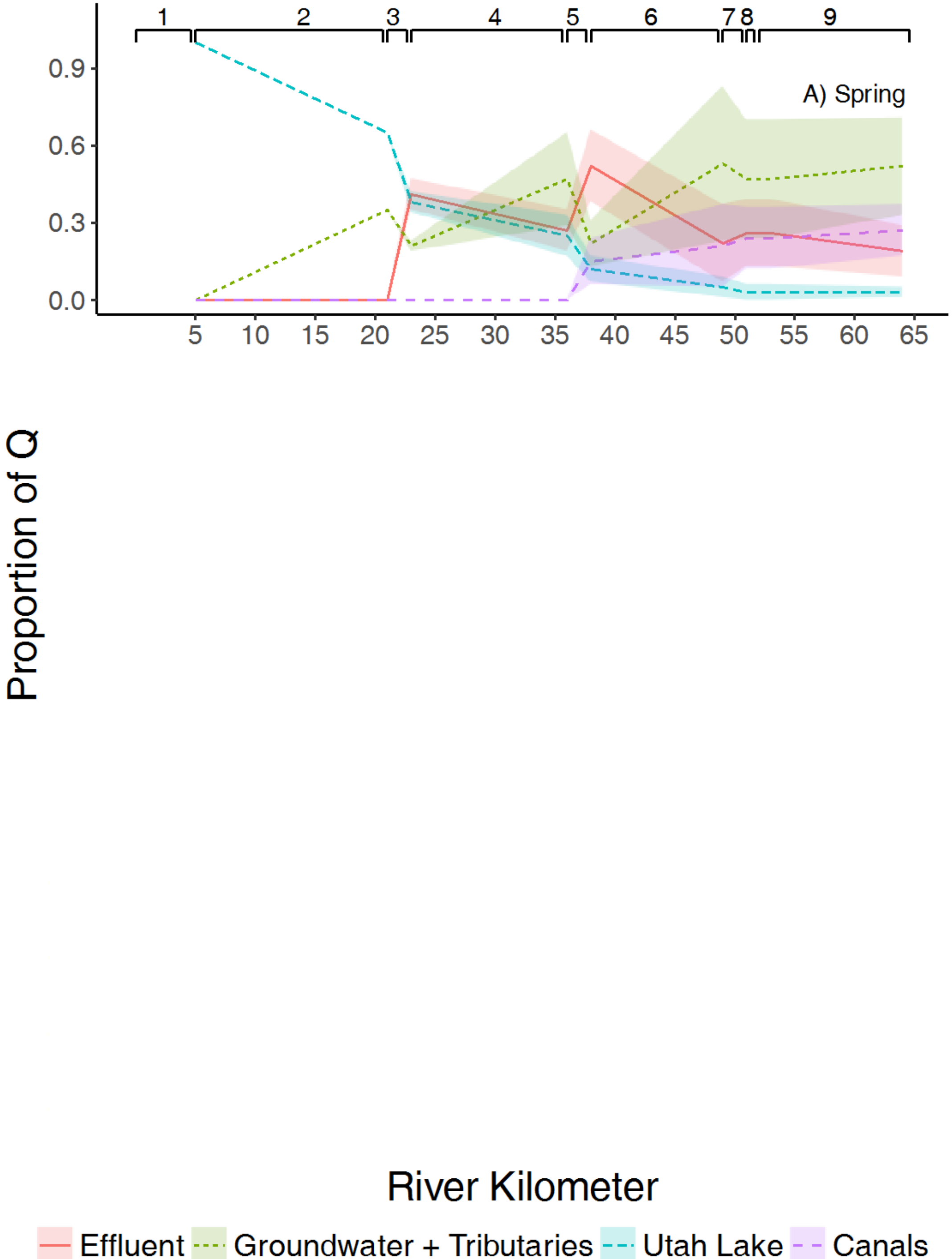


Field data:

- This study
- Thiros. 2003. USGS *Water Resources Investigations Report 03-4028*
- Ehleringer et al. 2016. *Isotopes in Env. & Health Studies*
- *Water Isotopes Database* (http://waterisotopes.org)

2. Bayesian mixing model analysis





Dominant Sources of Water

SPRING

Above km 36: Utah Lake

Below km 36: Tributaries

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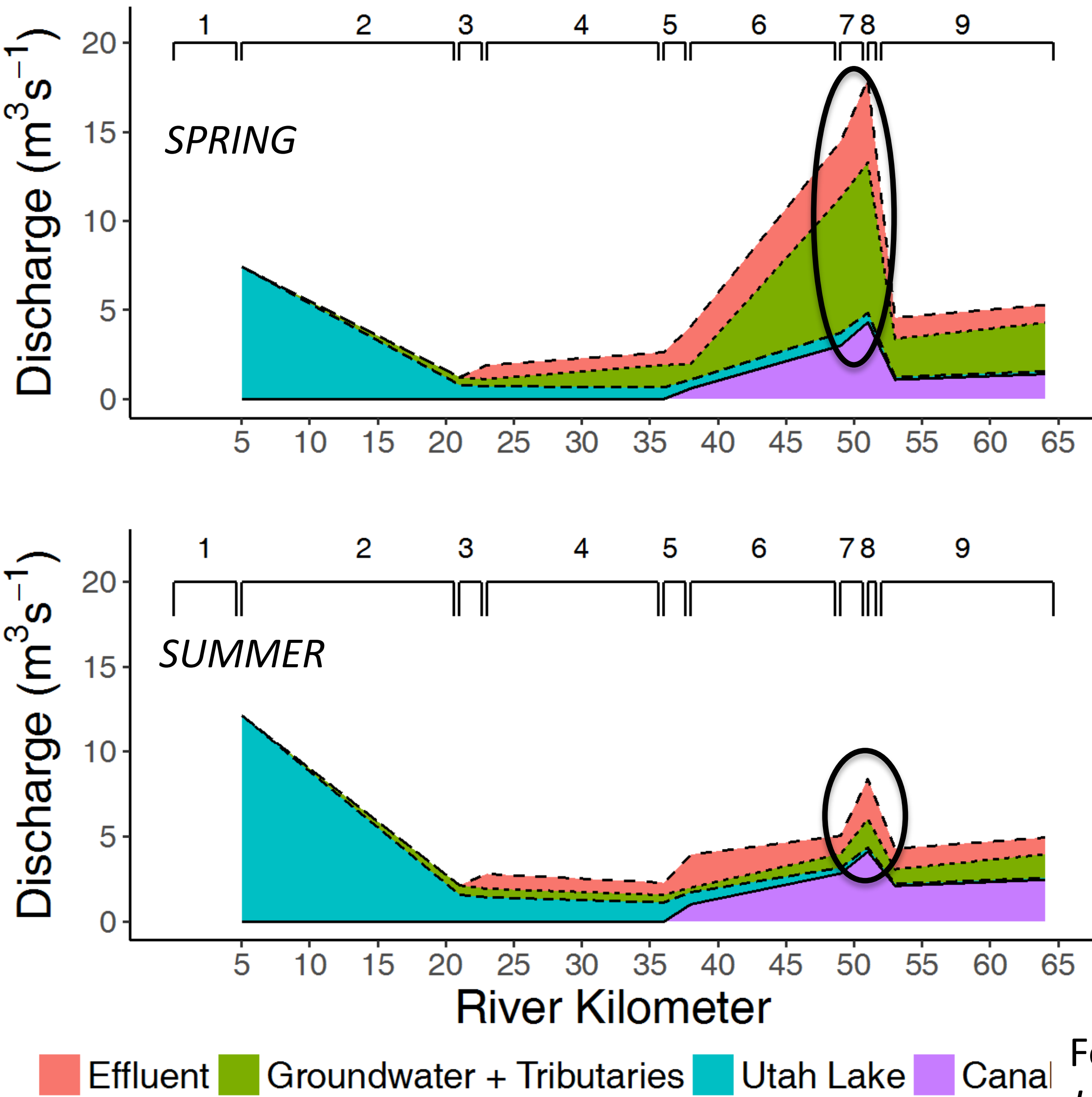
Discharge Associated with Source Inputs



Proportional inputs can be similar amongst seasons, but vary dramatically in Q

EXAMPLE: km 51

Proportional inputs

Utah Lake (3%)

Effluent (26%)

Spring

Utah Lake: 0.54 m^3 s^{-1}

Effluent: 4.66 m^3 s^{-1}

Summer

Utah Lake: 0.25 m^3 s^{-1}

Effluent: 2.35 m^3 s^{-1}

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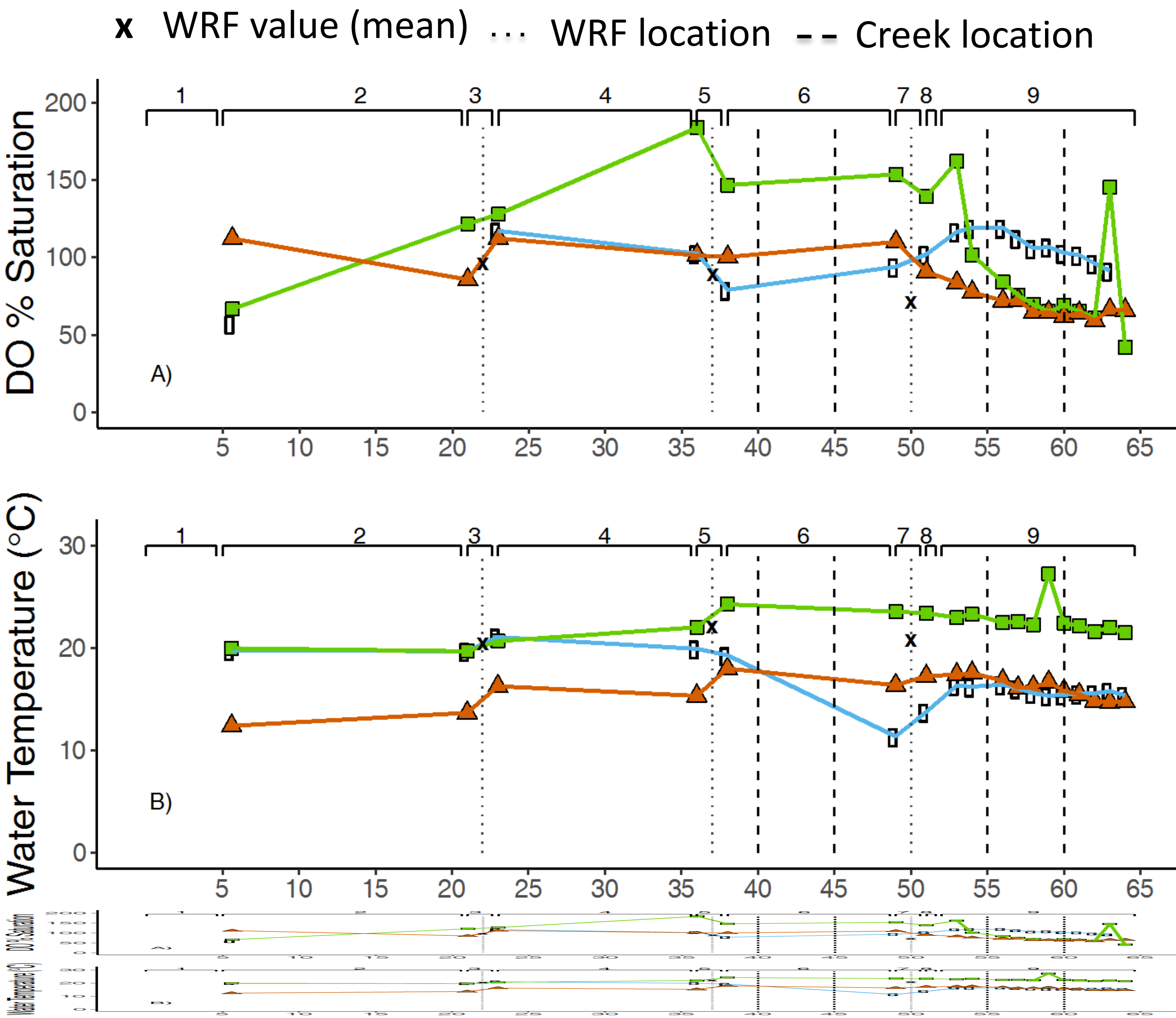
Q2: How does spatial and temporal variation in dominant sources of water inputs affect physical & chemical characteristics of the river?



30% decline from summer to fall, on average

Differences in water inputs are reflected in spatial and seasonal variation in water chemistry

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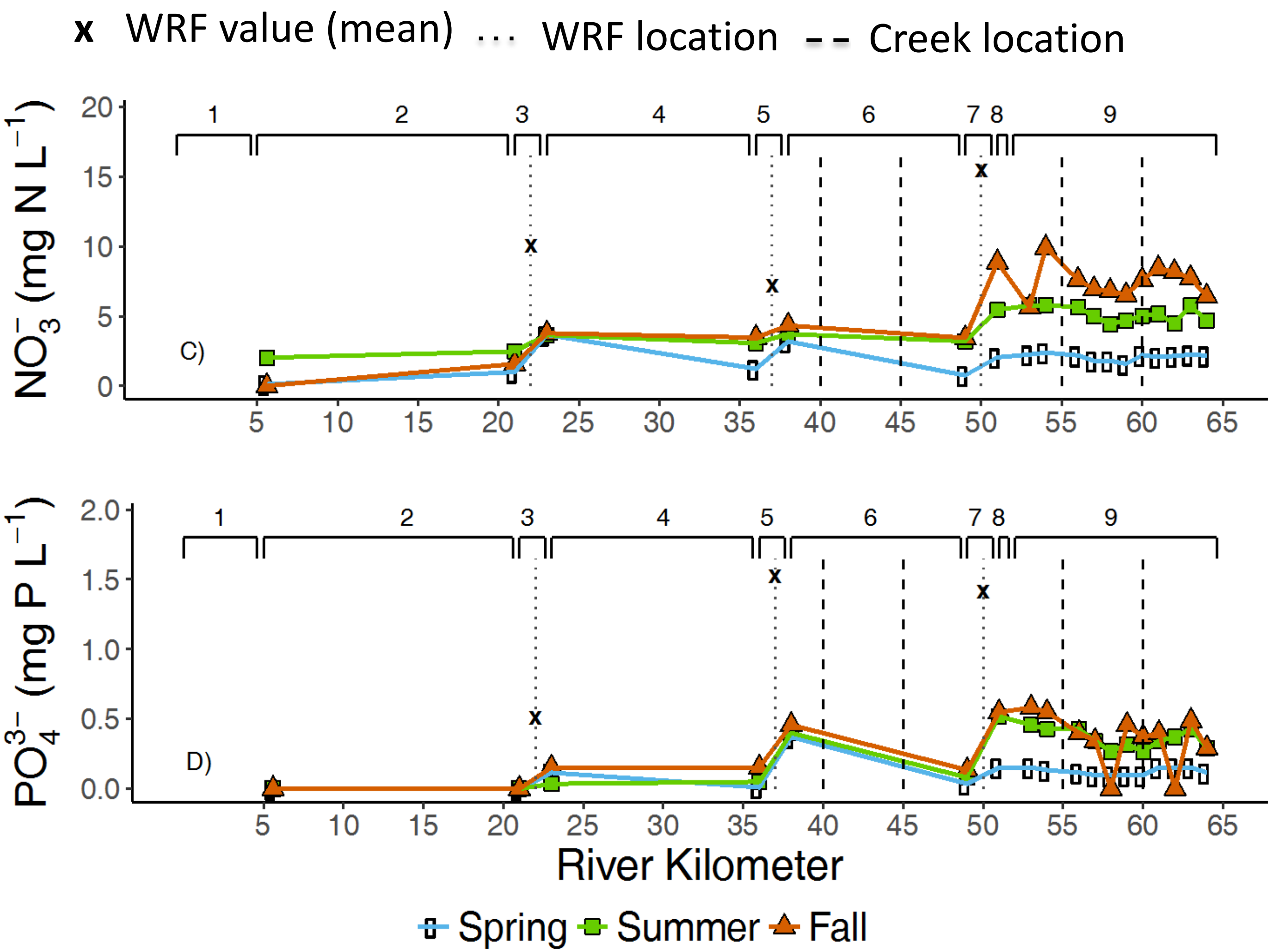

Differences in water inputs are reflected in spatial and seasonal variation in water chemistry

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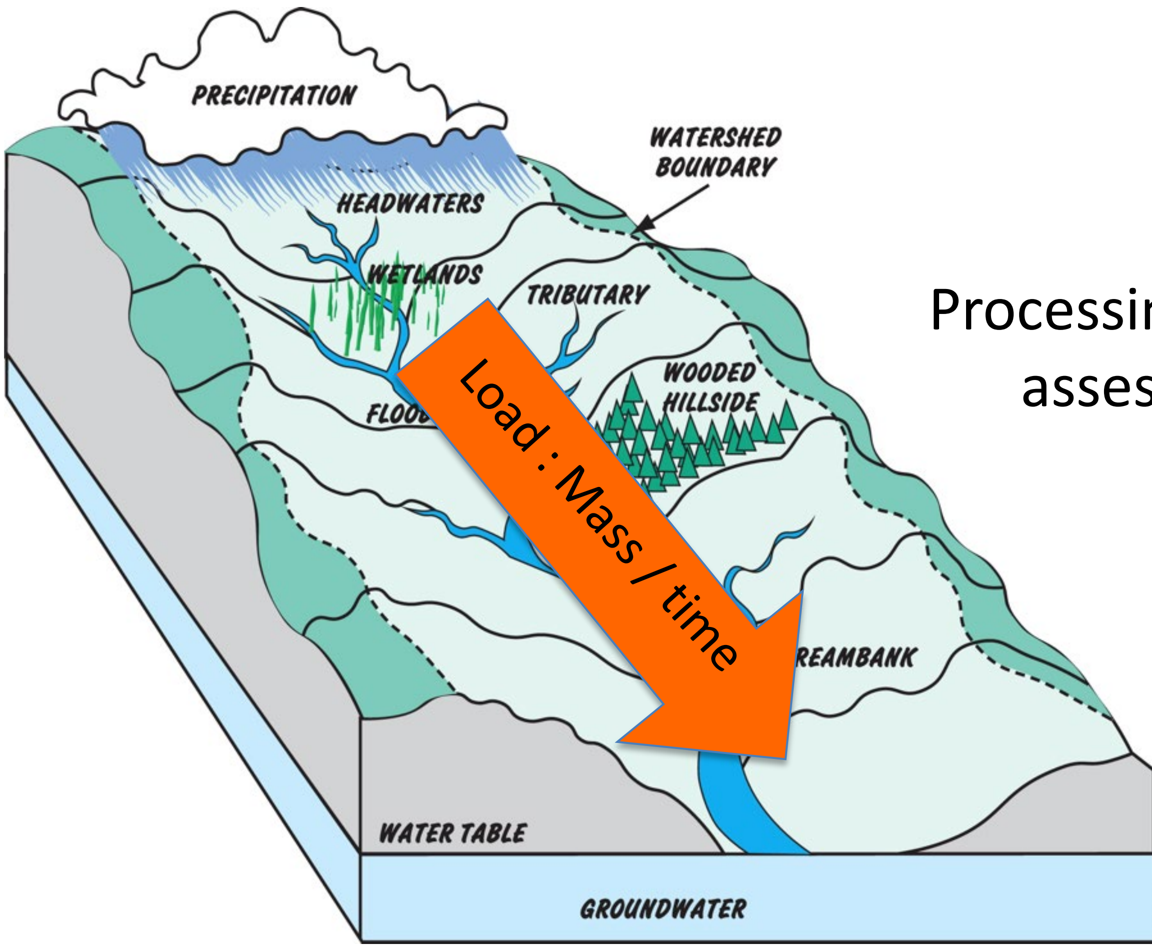
Q3: Do in-stream transformations play a role in the load of nutrients transported downstream?



Processing capacity can be assessed through mass balance analyses

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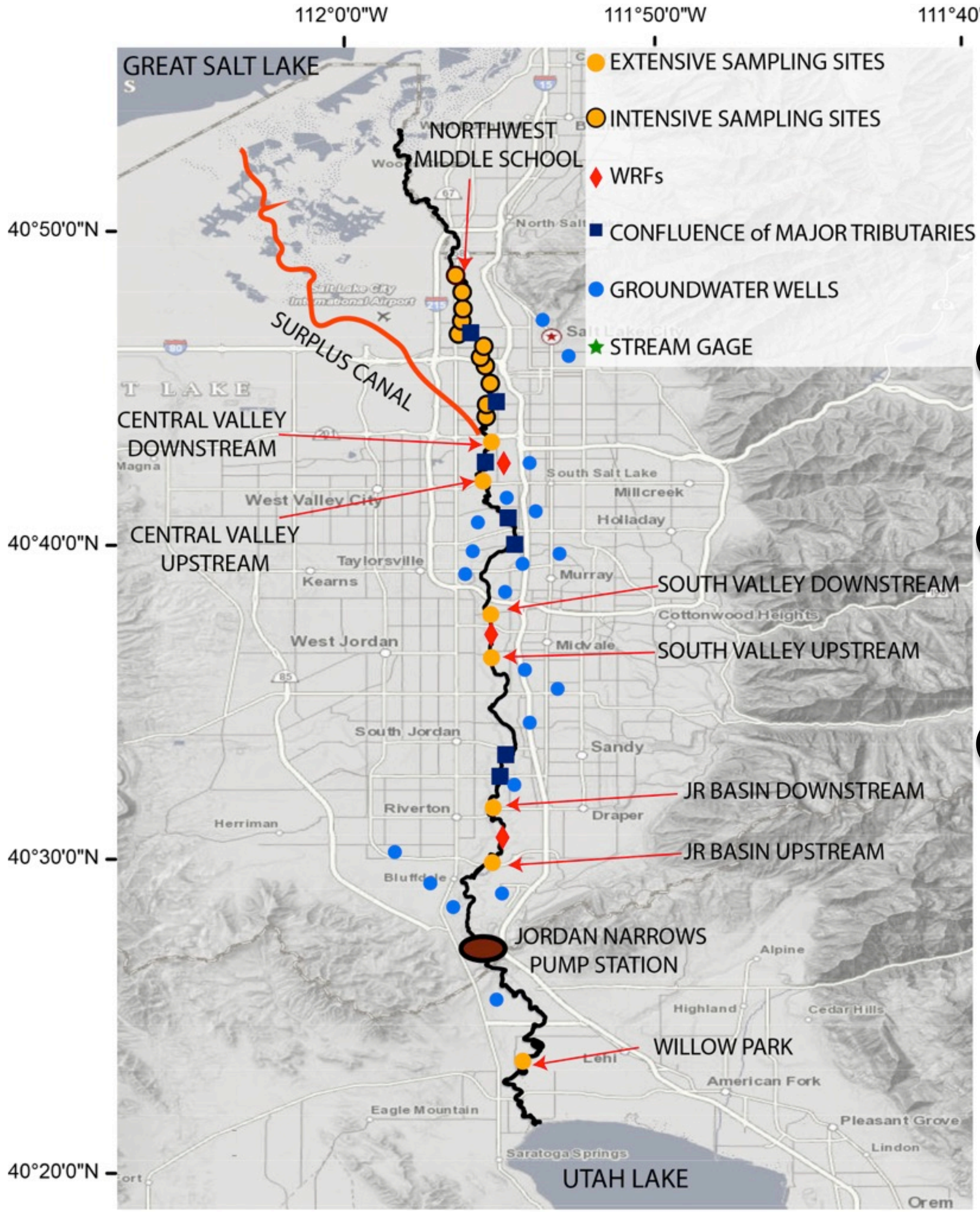

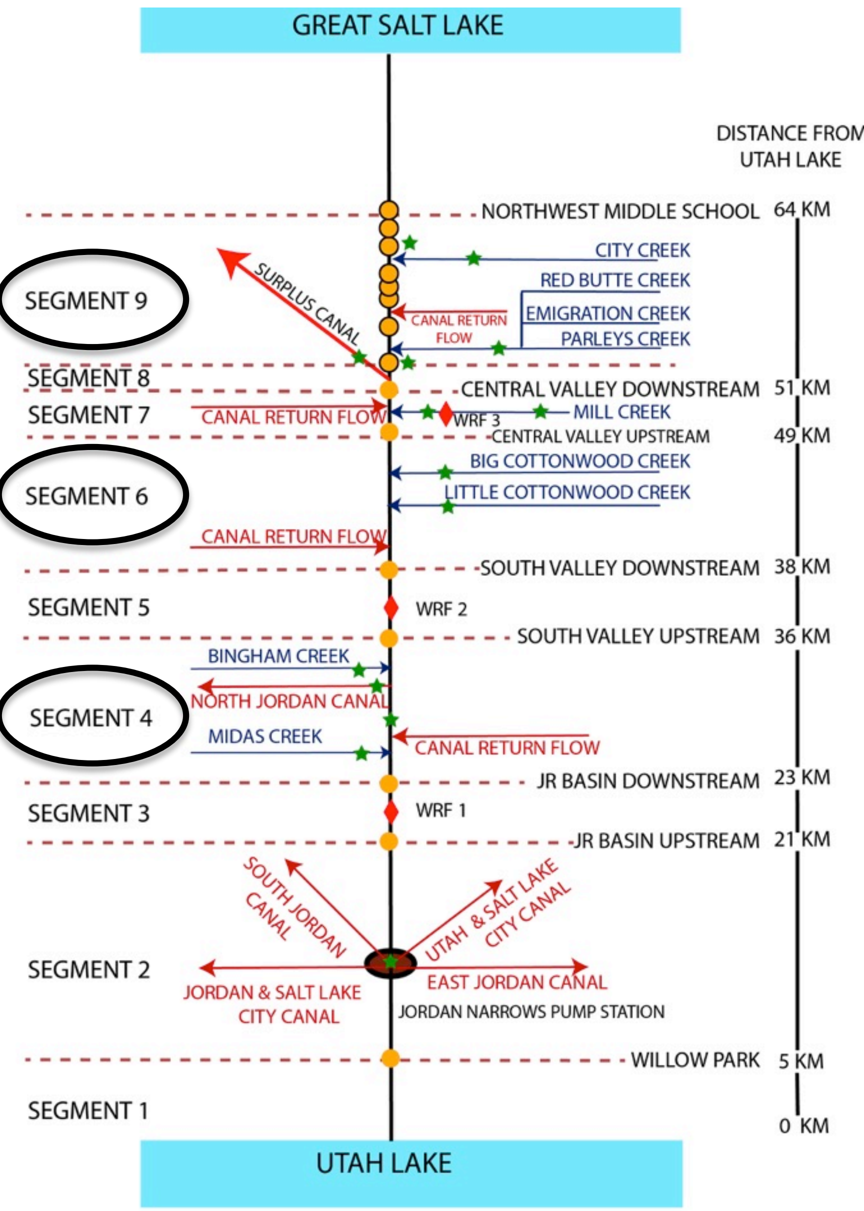

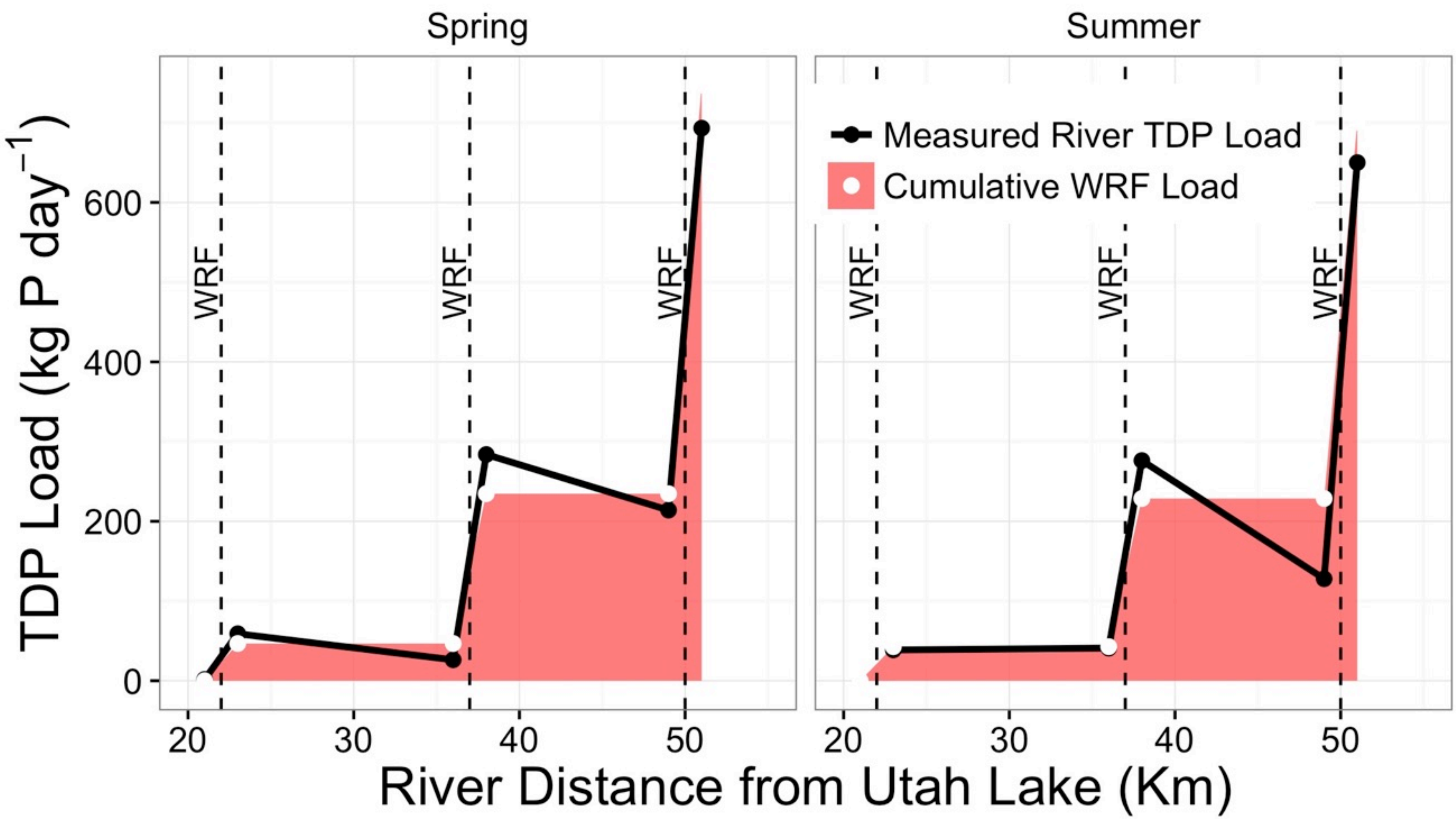

- TDP loads increase downstream
- Effluent is a major source of P
- Evidence of some processing between km 40-50 (segment 6)

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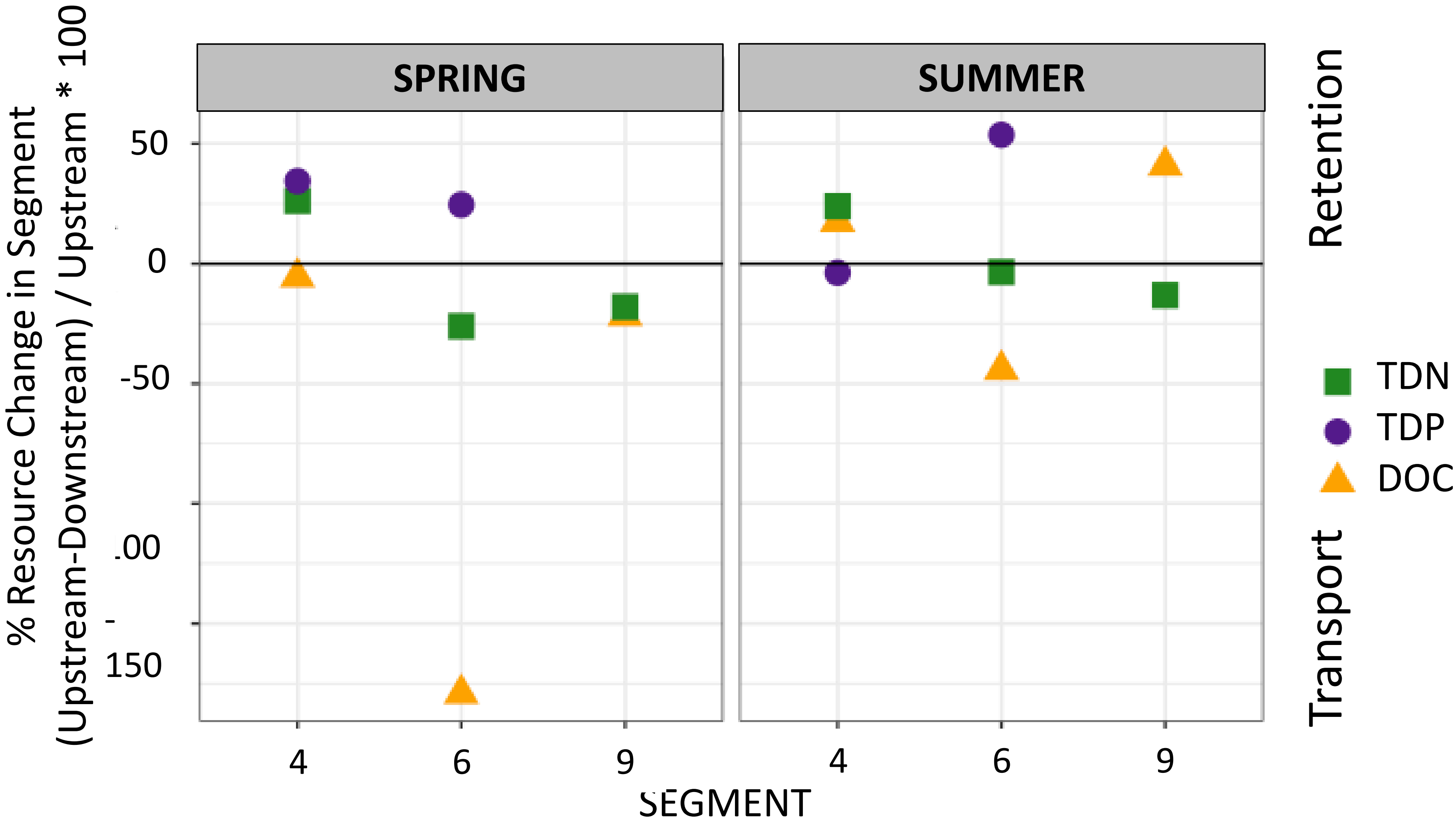

- 15-55% reduction in loads possible, with greatest reduction for P

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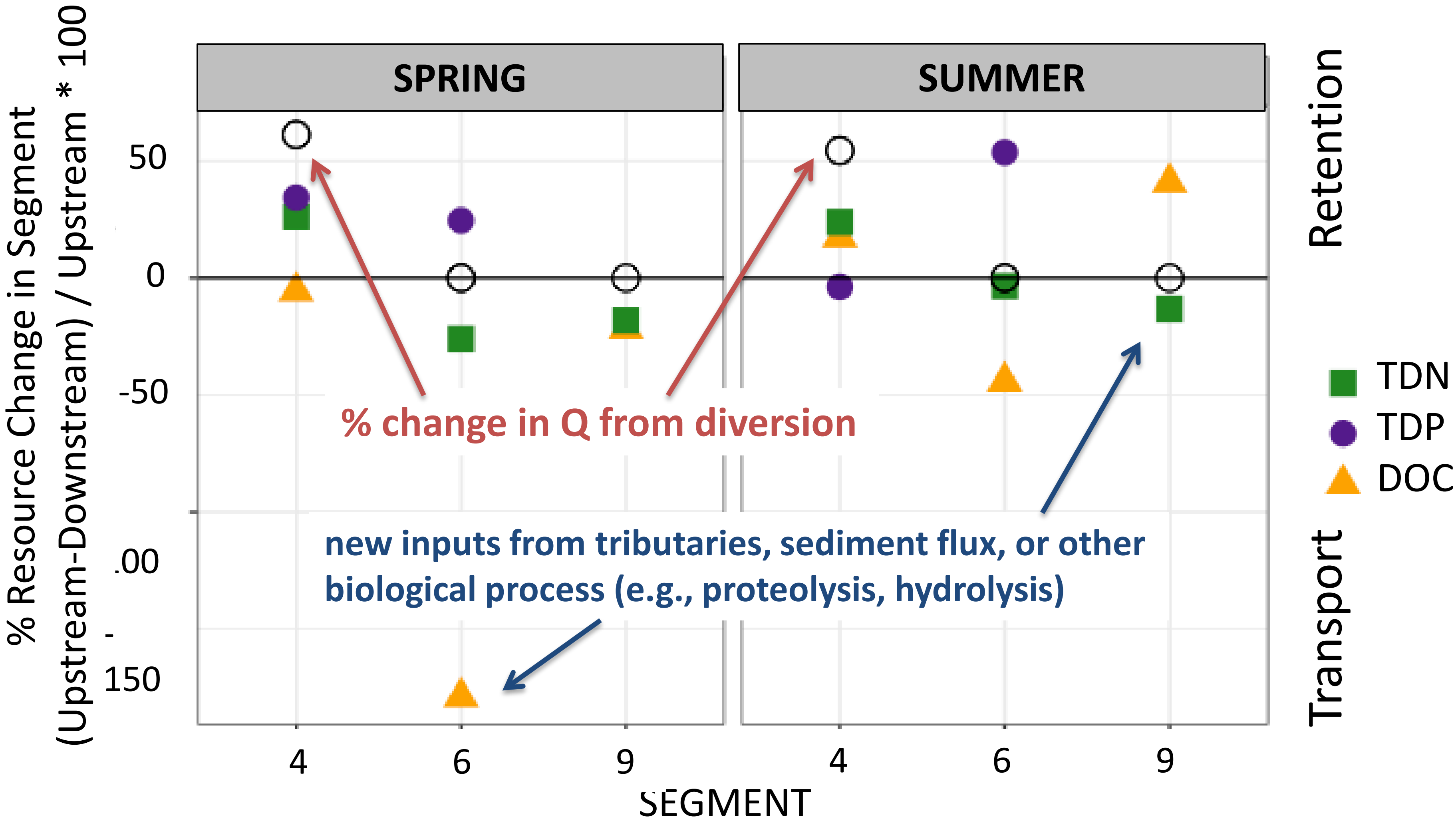

- 15-55% reduction in loads possible, with greatest reduction for P
- But retention in segment 4 can be explained by water diversion

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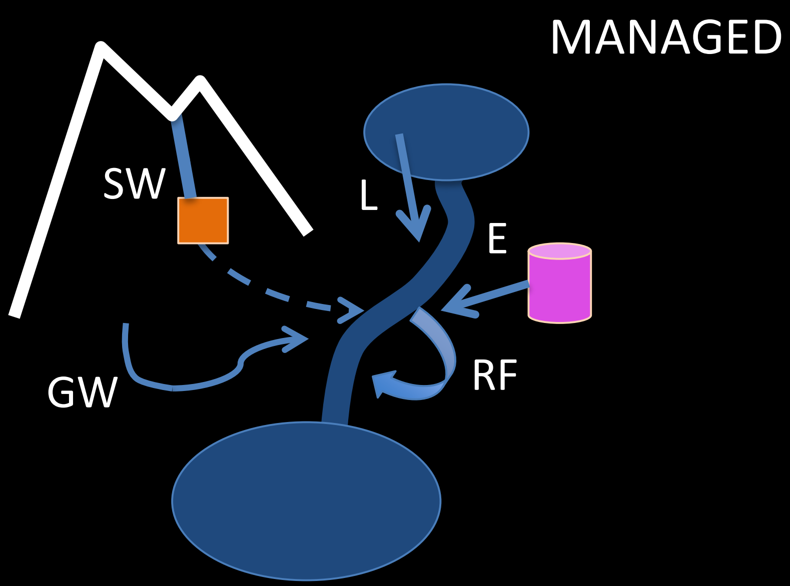
Conclusions

1. River management must take into consideration both natural and urban sources as influences upon river hydrology, while recognizing the spatial and temporal variation associated with these water sources.



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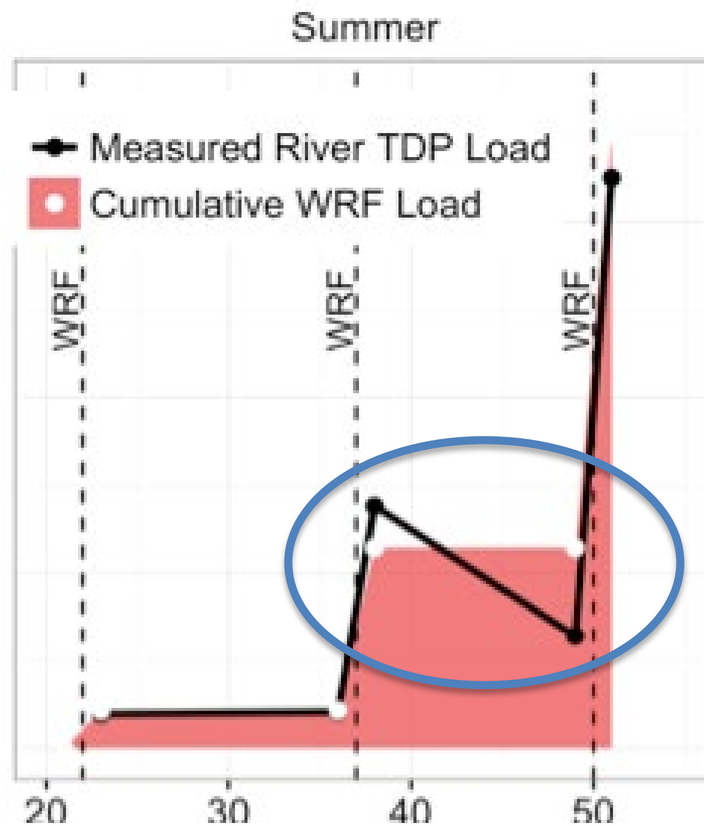
2. It is important to assess the relative magnitude of flows from various sources in addition to relative proportions, since variable loads of constituents within water (*e.g.,* pollutants) can be transported to the river from these different sources.

3. The river is still capable of processing nutrient loads.

How can this capacity be maximized?

- Flow augmentation is most critical in fall, when water levels are lowest and nutrient concentrations are high.
- Nutrient reduction efforts may have the greatest effect on riverine nutrient loads in summer and fall.



Questions?

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