

# SUSITNA-WATANA HYDROELECTRIC PROJECT

## Groundwater-Related Aquatic Habitat Study Plan Review

August 16, 2012

Prepared by GW Scientific



# Goals and Objectives

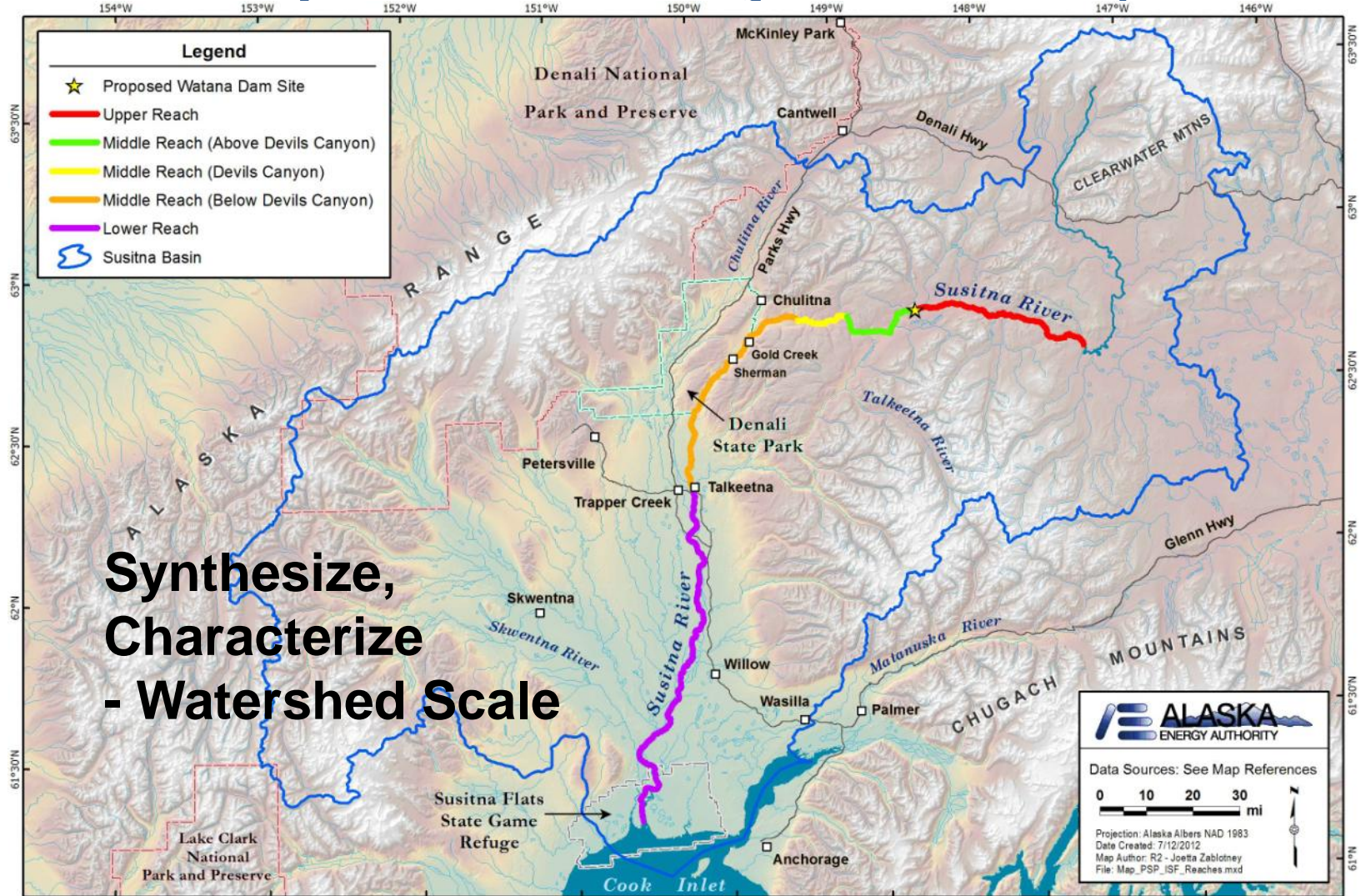
1. Synthesis Historical Data Related to Groundwater and Surface-Water (GW/SW) Interactions
2. Characterize Watershed-Scale Geohydrology and Geohydrologic Process Domains/Terrain
3. Assess Watana Dam/Reservoir Effects on Groundwater and Groundwater Related Habitat in Dam Vicinity
4. Map Groundwater Influenced Aquatic Habitat
5. Determine GW/SW Interactions in Riparian Study Sites



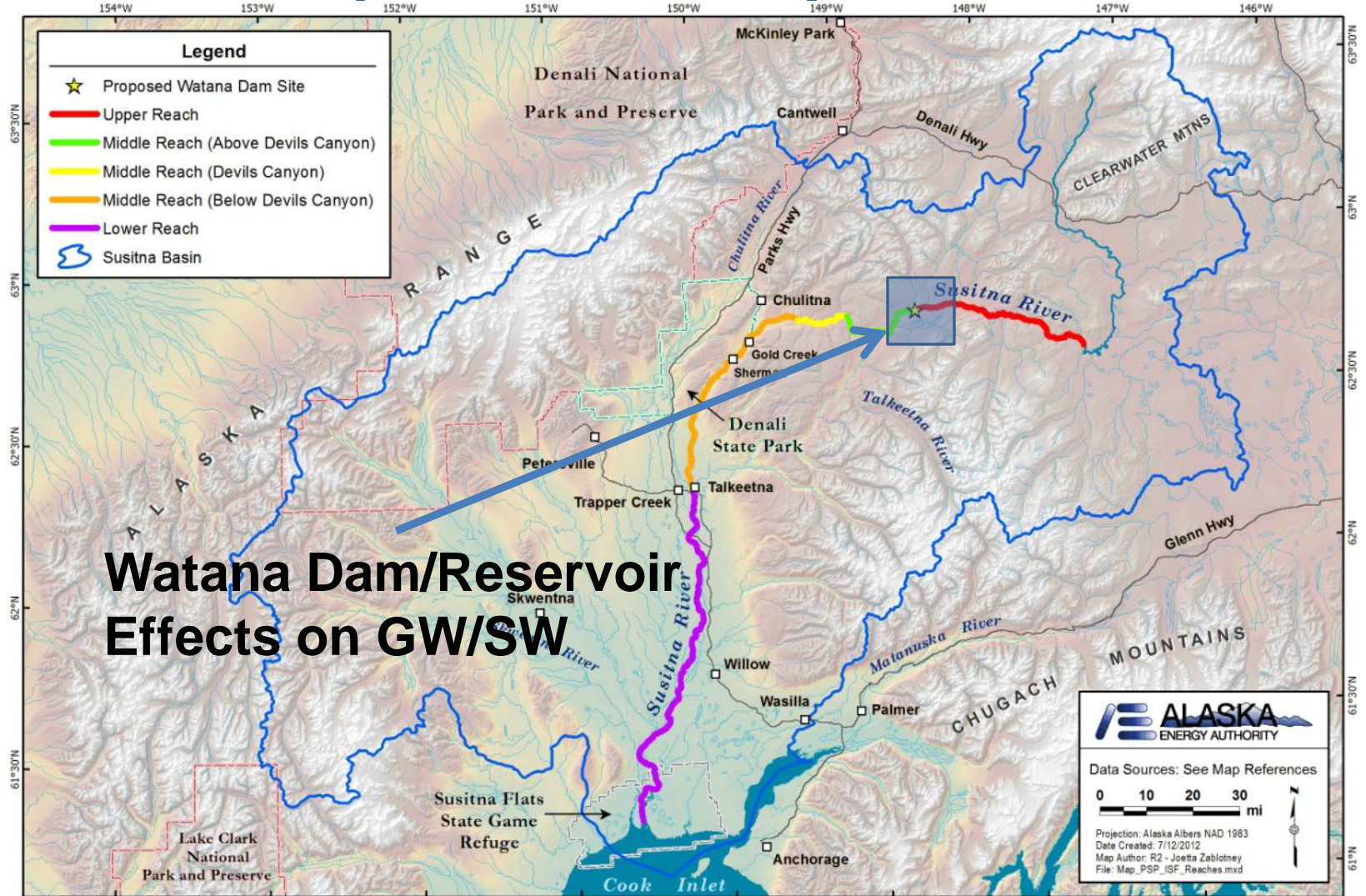
# Goals and Objectives

6. Determine GW/SW Interactions in Instream Study Sites
7. Characterize Water Quality of Selected Productive/Non-Productive Aquatic Areas
8. Characterize Winter Flow in Susitna River and GW/SW Interactions
9. Characterize Relationships Between Susitna River Flow Characteristics and Shallow Groundwater Users

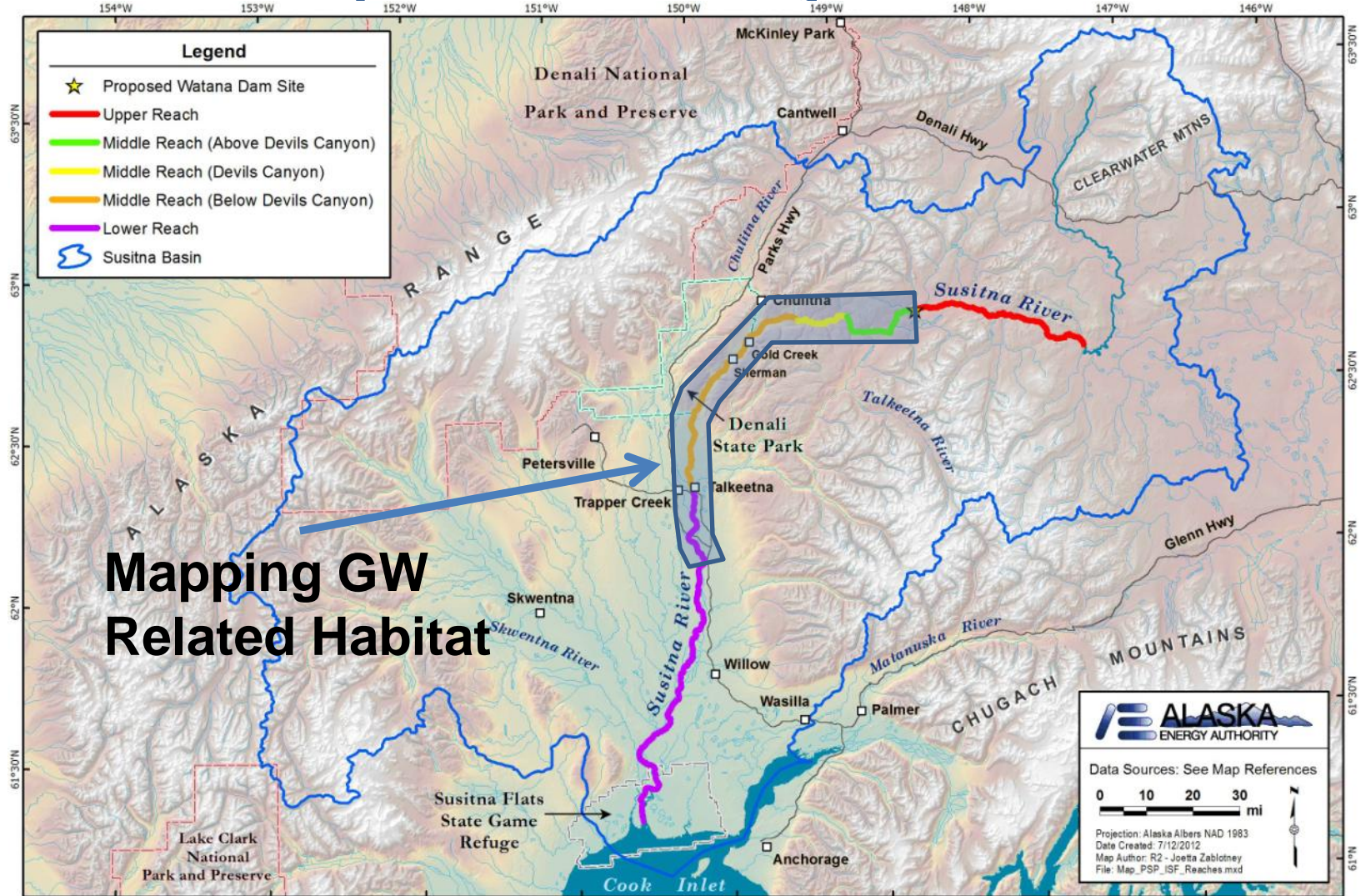
# Study Area – Objectives 1,2



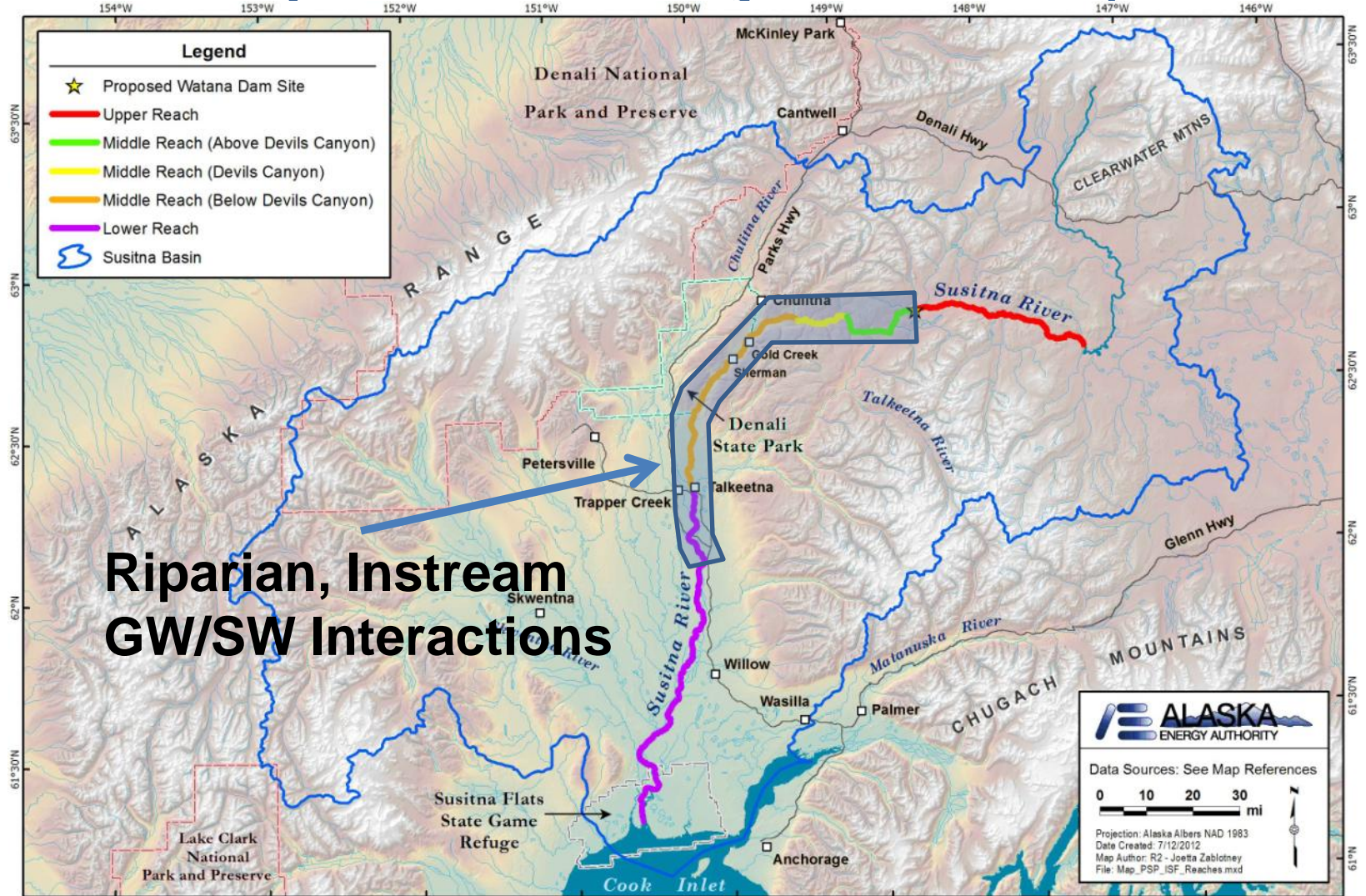
# Study Area – Objective 3



# Study Area – Objective 4



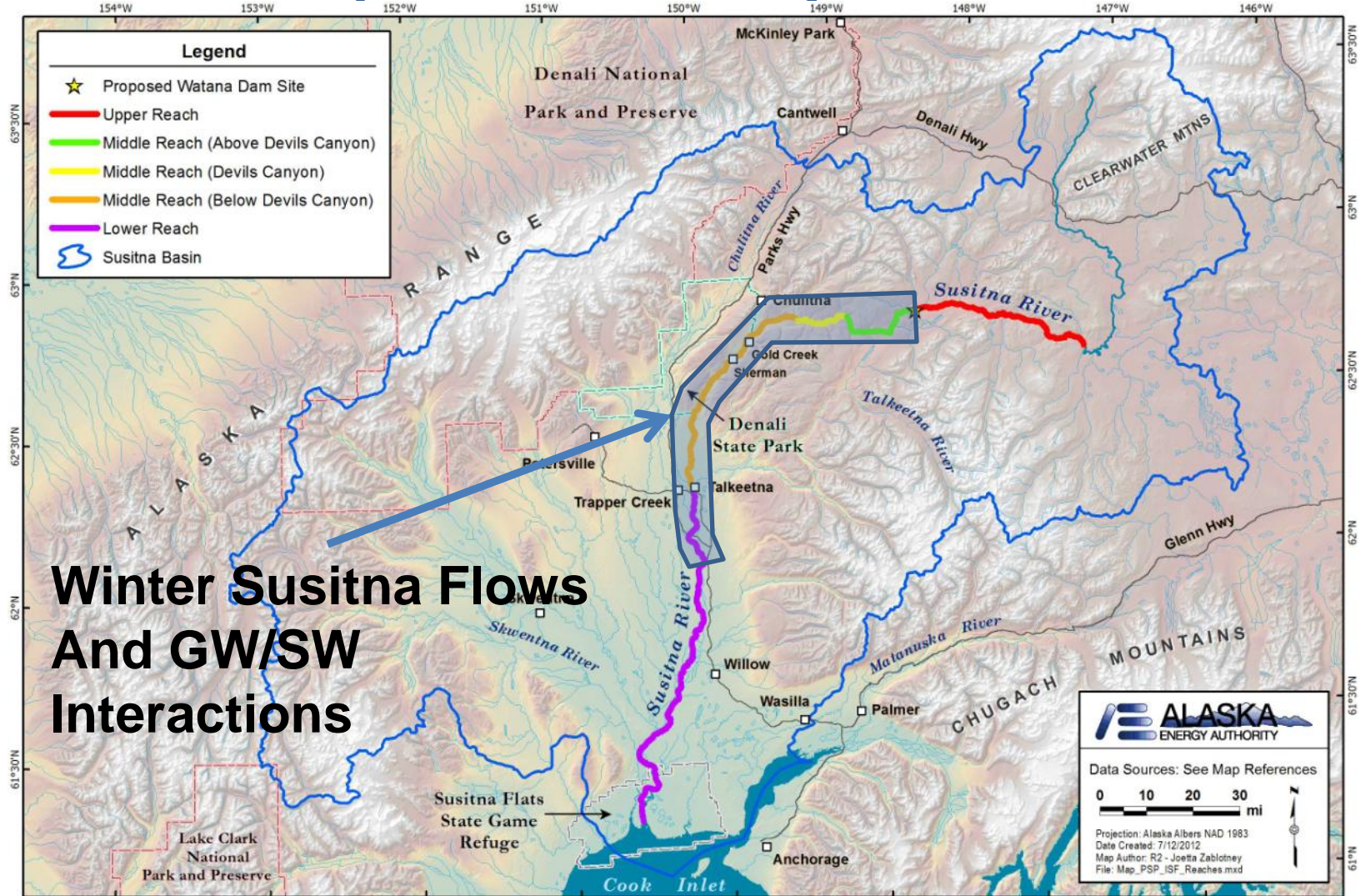
# Study Area – Objectives 5, 6



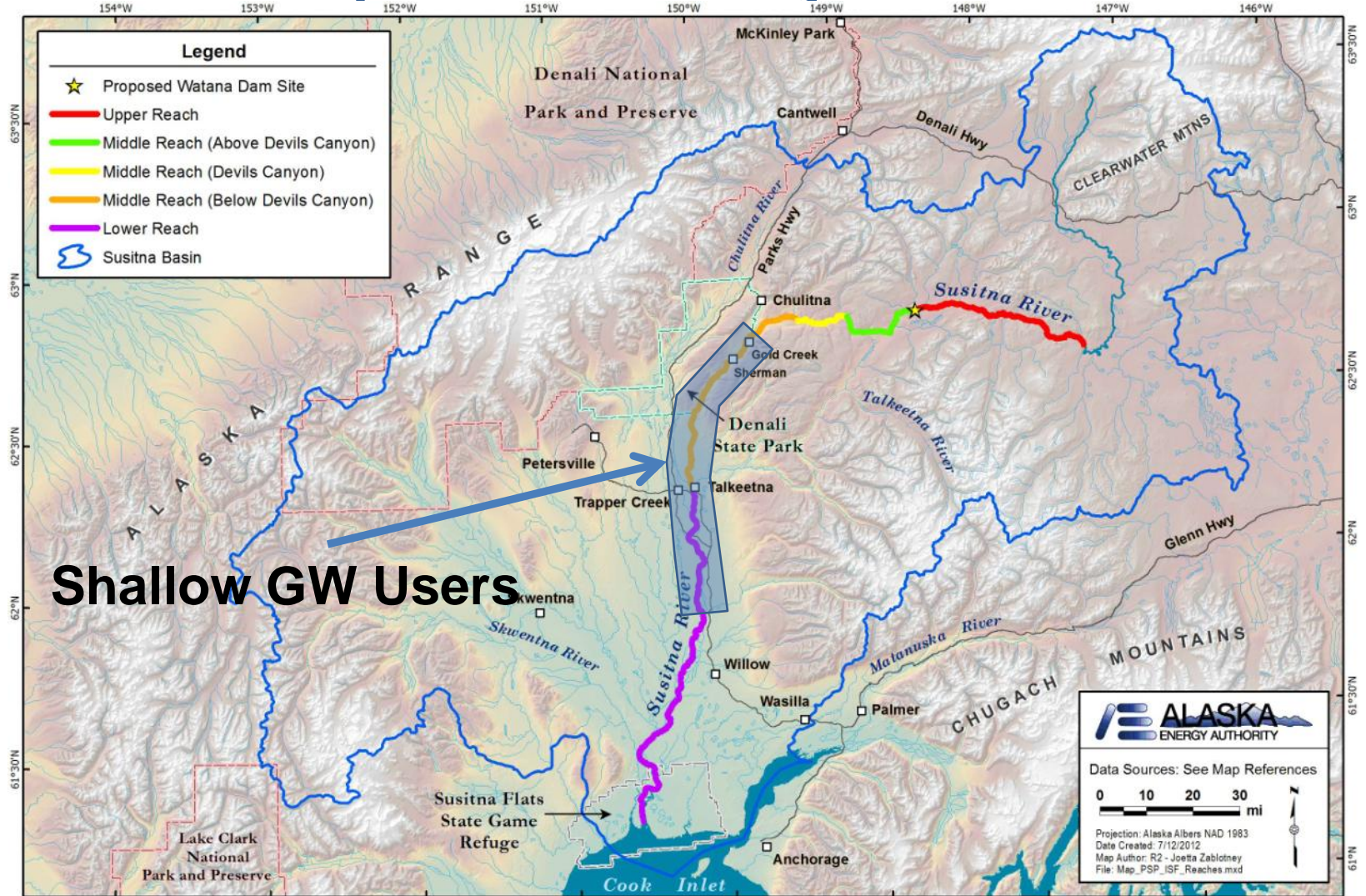




# Study Area – Objective 8



# Study Area – Objective 9



# Methods

1. Synthesis Historical Data Related to Groundwater and Surface-Water (GW/SW) Interactions
  - a. Identify and summarize 80s and other historical project information
  - b. Summarize information collected by Geology (4.5.4), Water Quality (5.6), Instream (6) studies
  - c. Searchable and annotated bibliography
  - d. Synthesize collected information related to potential impacts on GW/SW interactions and associated aquatic habitat

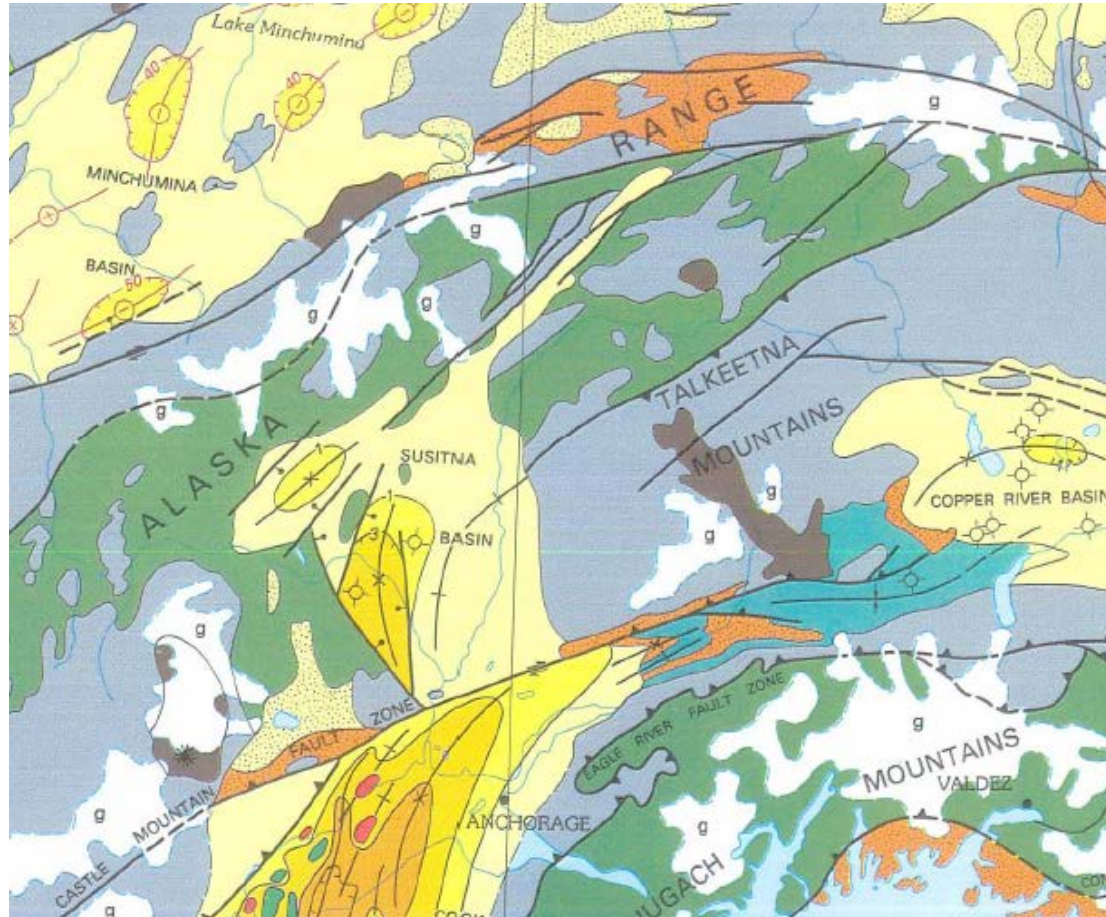


# Methods

2. Characterize Watershed-Scale Geohydrology and Geohydrologic Process Domains/Terrain
  - a. Characterize major geohydrologic units in Susitna Watershed
  - b. ASMT D5979 – Standard Guide for Conceptualization and Characterization of Groundwater Systems
  - c. Relate geohydrologic units to geomorphologic and riparian mapping units (process-domain river segments)
  - d. Define regional to local groundwater flow systems and the relationship to the process-domain river segments
  - e. Use ASTM D6106 Standard Guide for Establishing Nomenclature of Groundwater Aquifers to help characterize aquifers relevant to Project proposed operations
  - f. Identify the relationships and scaling issues between GW/SW interactions for process-domain river segments and the planned intensive study areas

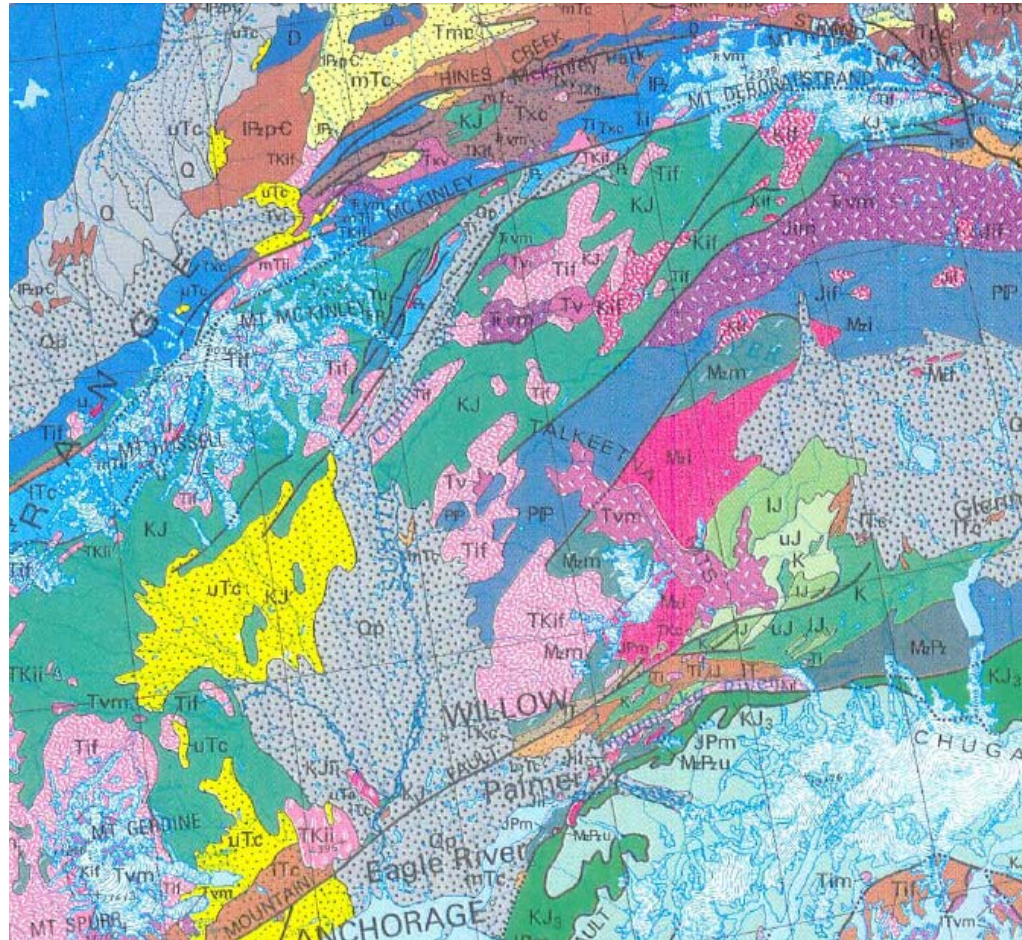


# Methods



Sedimentary basins and geologic structures,  
Kirschner, 1994

# Methods



Geologic units in the Sustina Watershed, modified from Beikman, 1994



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# Methods

3. Assess Watana Dam/Reservoir Effects on Groundwater and Groundwater Related Habitat in Dam Vicinity
  - a. Evaluate engineering geology information collected by Geology and Soils Studies (4.5) and past geotechnical studies of the proposed dam area
  - b. Coordinate with geomorphology and fluvial geomorphology studies (5.8, 5.9) to utilize existing data collection programs
  - c. Describe pre-project conditions
  - d. Characterize known permafrost and groundwater conditions
  - e. Develop conceptual GW/SW models of pre-project and proposed post-project conditions
  - f. Identify key groundwater pathways in dam location and how dam construction and operations will impact GW/SW interactions

# Methods

## 4. Map Groundwater Influenced Aquatic Habitat

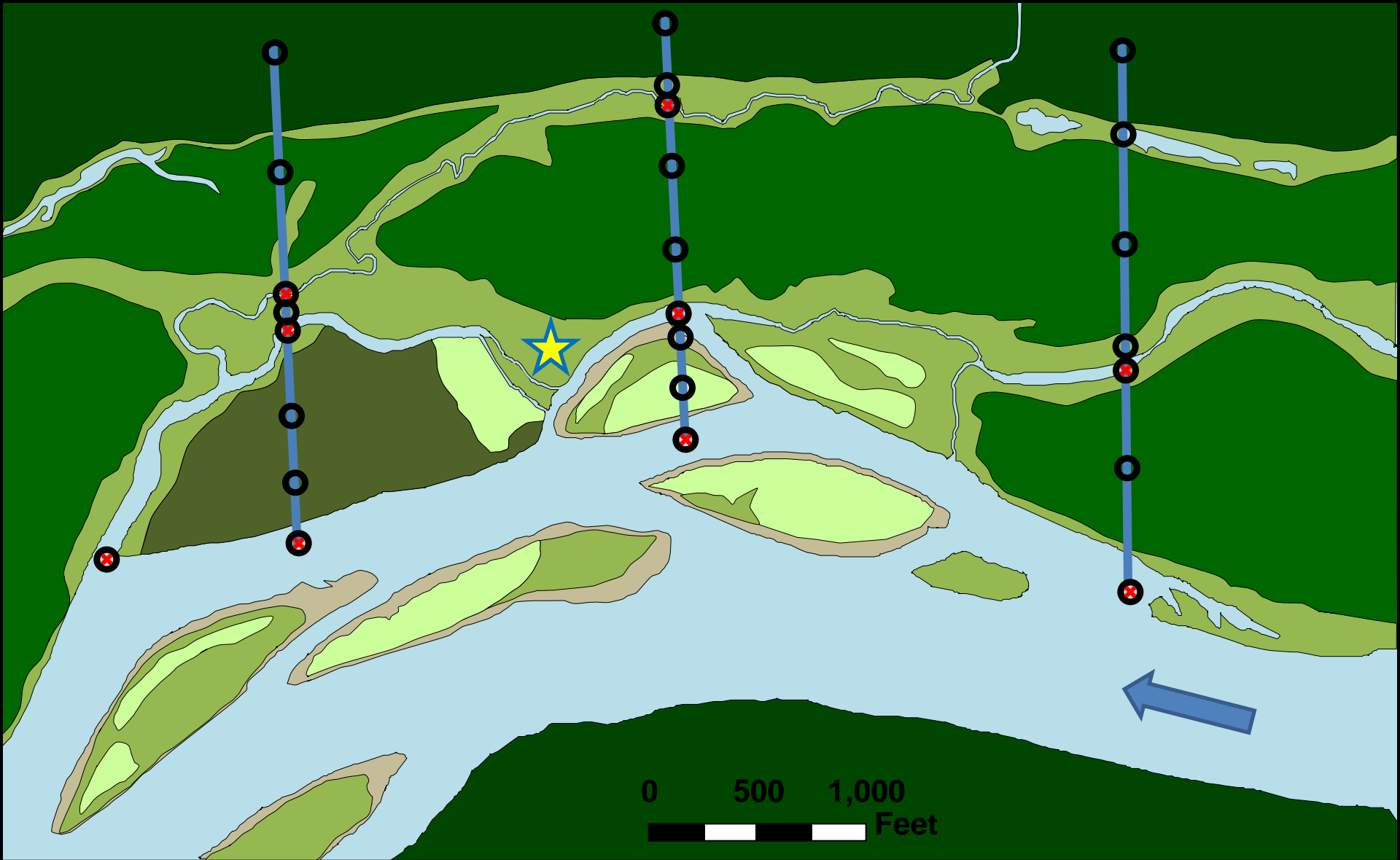
- a. Ice Processes (5.10) will map open leads through aerial and GPS mapping (RM 0 to RM 250), the general focus of the GW/Sw studies will be from RM 84 to RM184
- b. Aerial photography during ice –free periods will help show turbid and clear water sections by Instream Studies (6.5)
- c. Coordinate with Water Quality studies (5.5) on the pilot thermal imaging assessment of a test section of the Susitna River. In conjunction with Instream and Fish studies evaluate the thermal imaging methods for detecting groundwater upwelling
- d. Identify potential GW/SW interactions areas based on spawning of fish in coordination with fish population studies (7)
- e. Characterize at a recon level GW/SW interactions and whether or not they are dependant on mainstem stage, regional groundwater, or mixed















# Methods

5. Determine GW/SW Interactions in Riparian Study Sites
  - a. Field Work under this objective will be accomplished by the Riparian Instream Flow Study (6.6)
  - b. Coordinate efforts Ice Processes (5.10), Geomorphology (5.9), Instream (6)
  - c. Select intensive study sites, coordinate GW/SW data collection objectives, methods, data analysis with Riparian GW study (6.6)
  - d. Develop groundwater simulation models using USGS MODFLOW models to characterize GW/SW interactions
  - e. ASTM D6170 Standard Guide for Selecting a Groundwater Modeling Code and ASTM D5981 Standard Guide for Calibrating a Groundwater Flow Model Application will be used as guidelines for GW/SW modeling efforts
  - f. Coordinate with Riparian and Botanical studies in data collection and analysis for GW/SW interactions



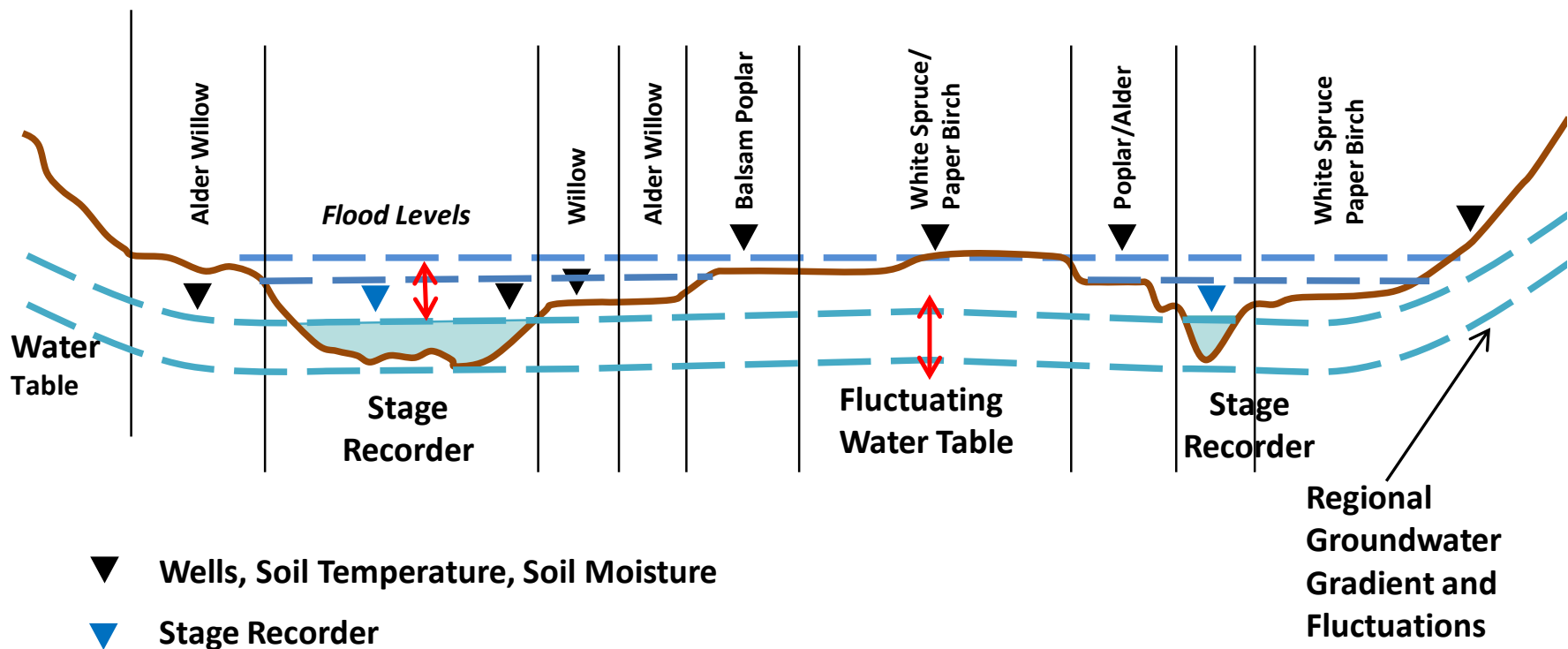


- |  |  |  |
|--|--|--|
|  Spruce/Birch        |  Balsam Poplar            |  Monitoring Wells |
|  Poplar/Spruce/Birch |  Willow/Alder/Wet Meadow  |  Soil Temperature |
|  Poplar/Spruce       |  Willow/Wet Meadow        |  Soil Moisture    |
|  Sampling Transects  |  Meteorology Station (ET) |  Stage Recorders  |



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# Study Site Cross-Section



# Methods

6. Determine GW/SW Interactions in Instream Study Sites
  - a. Field Work under this objective will be accomplished by the Instream Flow Study (6)
  - b. Develop in coordination with Riparian (6.6), and Geomorphology (5.8) intensive study sites to help characterize instream flow processes and related GW/SW interactions
  - c. Through Instream study field activities, collect groundwater and surface-water levels, water temperature profiles, discharge measurements, and other hydrologic parameters to describe and model the 3-D transient GW/SW hydrologic systems in main stem, side channel, and slough habitats
  - d. Coordinate with the hydraulic modeling efforts of the mainstem by the Instream Study (6) and associated data collection network on the mainstem to use the simulated flows from proposed project operations on GW/SW interactions



# Methods

7. Characterize Water Quality of Selected Productive/Non-Productive Aquatic Areas
  - a. Coordinate with Water Quality (5.5) and other related studies on the collection of data that will help improve the understanding of GW/SW interactions
  - b. At selected Instream Flow (6) study sites collect field water quality data to characterize GW/SW interactions and associated upwelling and aquatic habitat areas
  - c. Characterize the key water-quality differences between productive and non-productive slough sites

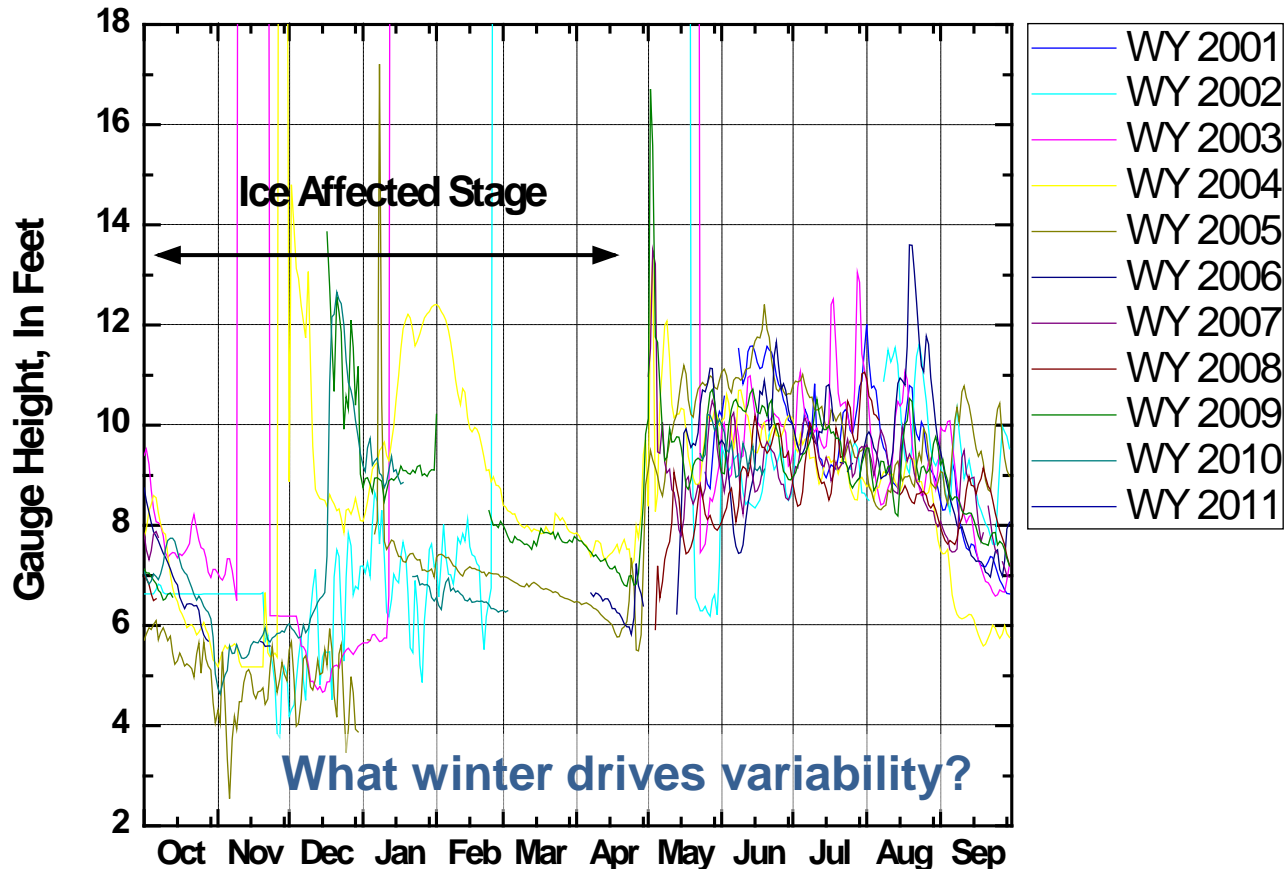
# Methods

8. Characterize Winter Flow in Susitna River and GW/SW Interactions
  - a. Coordinate with Ice Processes, Instream, and other studies on winter hydrology data collection activities
  - b. Though Instream (6) studies measure winter water levels and temperature at mainstem gaging stations and also at selected data collection sites in the intensive study areas
  - c. Measure winter flows (discharge measurements) in coordination with USGS activities to characterize the variation in winter flows from RM 184 downstream to approximately RM84 in coordination with Instream (6). Ice thickness, water temperature, conductivity, water levels and discharge measurement are key data collection objectives
  - d. Measure vertical transects (temperature, conductivity, water level) in key mainstem sections



# Methods

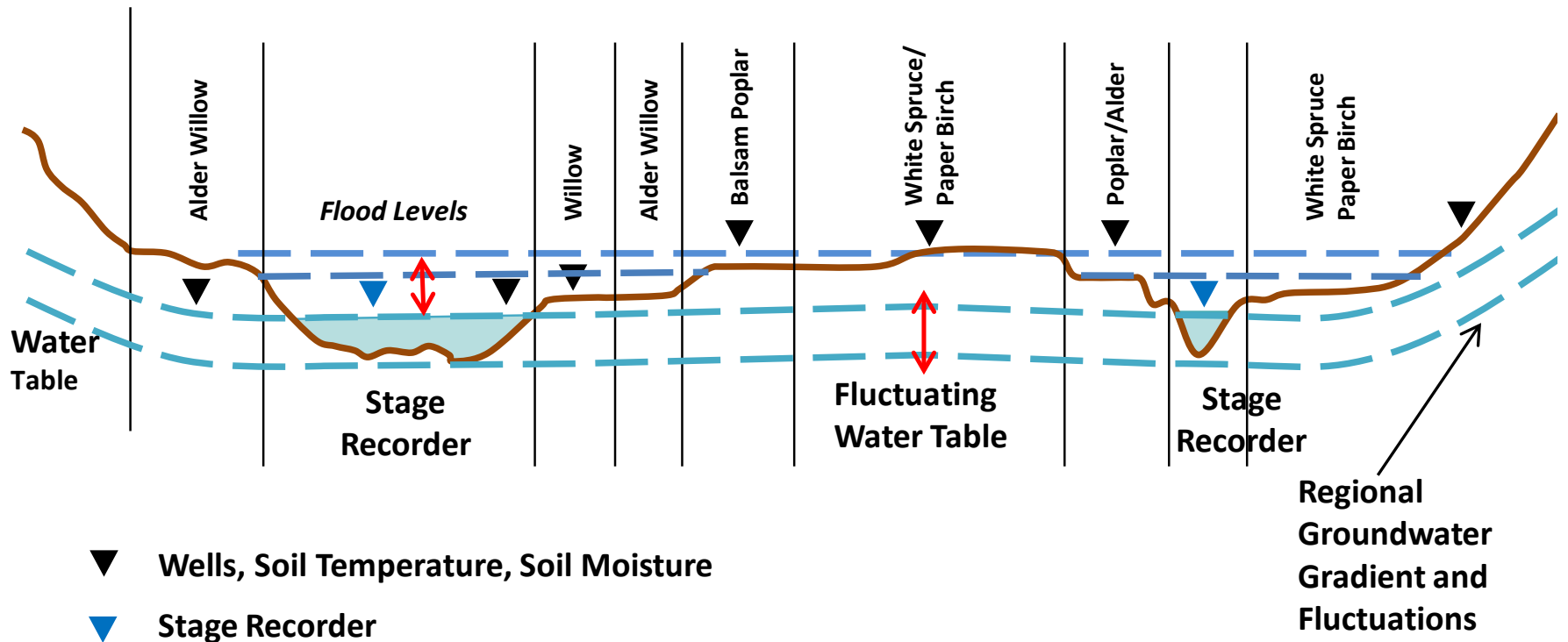
USGS Susitna River at Gold Creek Gauging Station, 15292000



Variability in mainstem river stage at Gold Creek, winter and summer



# Methods



How does winter variability affect GW levels?



# Methods

9. Characterize Relationships Between Susitna River Flow Characteristics and Shallow Groundwater Users
  - a. Identify existing shallow well users in the mainstem region between RM184 and RM84 with shallow groundwater wells. Effectively, the potential for residential wells only exists from Gold Creek downstream past RM 84.
  - b. ADNR Well Log Tracking System (WELTS) and USGS Groundwater Site inventory System (GWSI) data will be searched for additional information
  - c. Characterize the wells and rank them as to potential to be impacted by potential project operations based on factor such as well depth, geologic unit, distance from river
  - d. Select a small number of wells to monitor the interactions between groundwater and nearby mainstem surface-water levels

# Expected Results

- Improved understanding of the regional groundwater system and interaction with local scale groundwater systems in the mainstem of the Susitna River
- Improved understanding of the potential GW/SW interactions and potential changes in the vicinity of the Dam and reservoir operations
- Objectives 1 and 2 will be completed early (Year 1) to help guide other efforts on other study objectives
- Recon level observations in 2012 will be used to help develop 2013 studies, identify key intensive study site locations

# Expected Results

- The data, analysis, modeling tools and improved understand will be used in conjunction with the development of the hydraulic river-routing models to simulate potential impacts from Project operations on aquatic habitat processes

# Relationship to other Studies

- This study leverages data collection activities from the previously mentioned studies to help provide a foundation of data to address the groundwater aquatic study objectives
- Input from the groundwater study team to other studies will help improve the cumulative data resources produced by the project

# Summary of 2012 Activities

- This study is not part of the 2012 activities, but current Instream Studies (Task1 Planning, Task2 XSection, Task5 Network) are allowing recon-level data observations
- Selected Observations
  - Timing of field studies to stage conditions in the mainstem
  - Restrictions related to land ownership and permitting
  - Access issues related to boat versus helicopter access, landing zones
  - Visible observations from key sites – turbid mainstem, versus groundwater recharged side channels and tributaries

# Questions

- Study Objectives?
- Study Methods?
- Coordination with other Studies?
- Next Steps?

