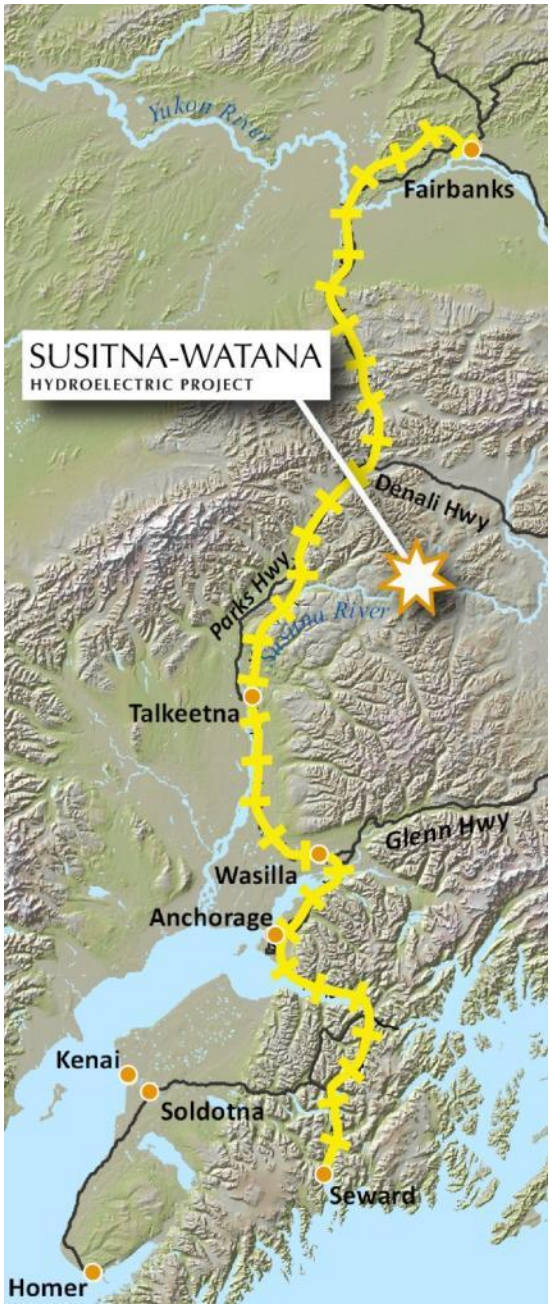

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Technical WorkGroup Meeting
Instream Flow-Riparian

September 14, 2012

Prepared by R2 Resource Consultants

ALASKA ENERGY AUTHORITY

Riparian Instream Flow Modeling Study

The overarching goal of the Riparian Instream Flow Study is to model riverine and riparian physical and vegetation processes to assess potential impacts of alternative Project operations to Susitna River floodplain vegetation.

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Riparian Process Domain Concept

(after Montgomery 1999)

- Riparian (or floodplain) process domains are distinct areas of the active valley within which similar suites of geomorphological processes govern floodplain habitat type, structure and dynamics.
- Use this approach to stratify the river network for sampling riparian variability and modeling
- Primary Susitna River geomorphic processes:
  - Hydroregime
  - Sediment transport
  - Channel migration (erosion and deposition)
  - Beaver dams (biogeomorphic process)
  - Ice processes: ice damming and associated flooding, sediment and vegetation disturbance (shear forces)

Riparian Modeling Approach

Steps:

1. Stratify the river project area into “riparian process domains,” river segments with distinct geomorphic process regimes
   a. Regime (type, magnitude, duration, timing)
   b. Similar floodplain vegetation disturbance regimes
2. Sub-sample a representative reach within each process domain and model.
3. Take results of reach-scale modeling and “scale-up” from reach to domain.

How to Stratify Process Domains & Select Study Reaches?

Formal statistical or subjective approach?

- Multivariate statistical analyses
  - Cluster analysis
  - Ordination techniques
- best professional judgement
  - Timing of necessary data availability
    - Channel slope, Lidar, Ice influence, flood routing definition of Project Area extent

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Channel & Floodplain Stratification Criteria

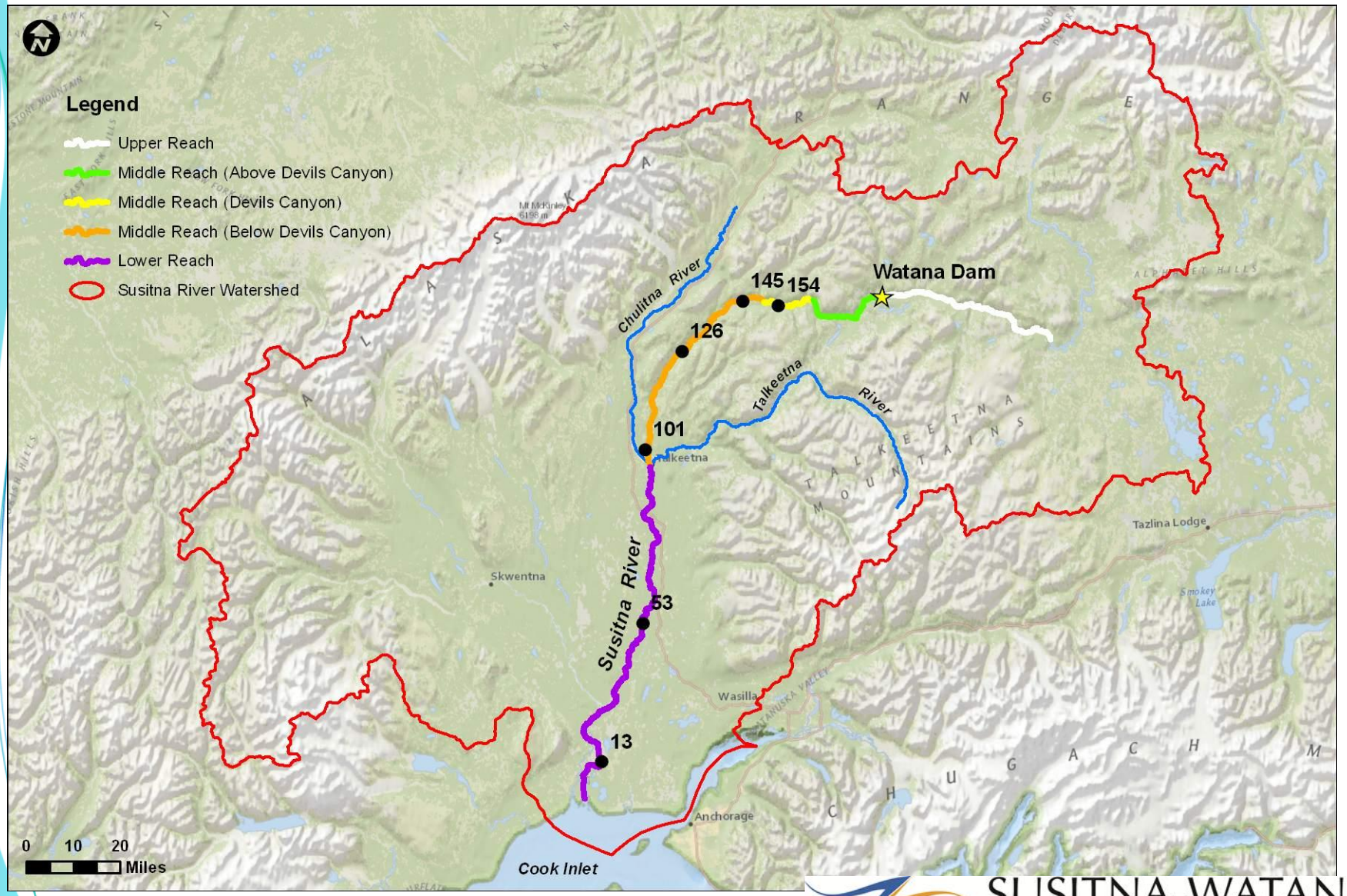
- Confinement-entrenchment ratio
  - $CR=W_{floodplain}: W_{channel}$
    - Strong (CR<2) vs. Moderate (2≤ CR ≤4) vs. Unconfined (CR > 4; WFPB 1995)
- General planform/channel aspect
  - Braided vs. Anastamosing vs. Transitional vs. Meandering vs. Straight
- Longitudinal slope breaks/Montgomery & Buffington (1993) channel type
- Ice process disturbance domains
  - Preliminary aerial photo mapping of apparent ice effected floodplains
  - DATA NEED: Field mapping of ice vegetation effects (tree ice scars)
- Major tributaries contributing flow, sediment
  - related to changes in channel size, type
- Beaver dam complex area
- Floodplain vegetation cross-sectional area
  - DATA NEED:
    - 2012 preliminary riparian botanical survey mapping

Susitna Instream Flow-Fish Site Selection Criteria

- All major habitat types sampled within each geomorphic reach
- At least one intensive site per geomorphic reach
- Replicate sampling strategy for habitat types
- Include biologically important salmon spawning/rearing sites in mainstem and lateral habitats
- Trib deltas included as habitat unit
- Incorporate multiple study elements

"NO SINGLE PREFERRED METHOD EXISTS FOR SELECTION OF STUDY SITES" (WADDLE 2001)

Intensive Study Reach Selection



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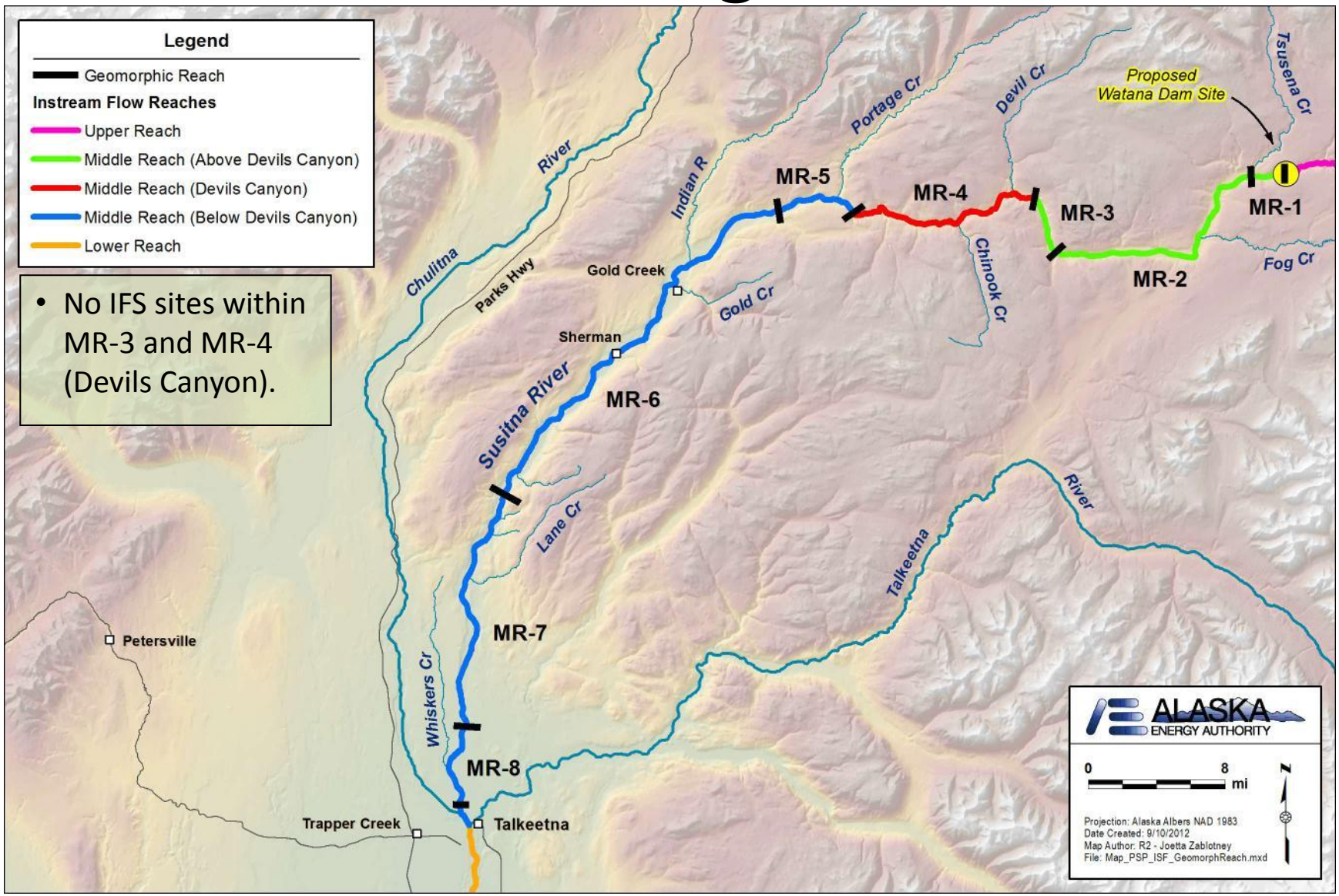
Reach Designations



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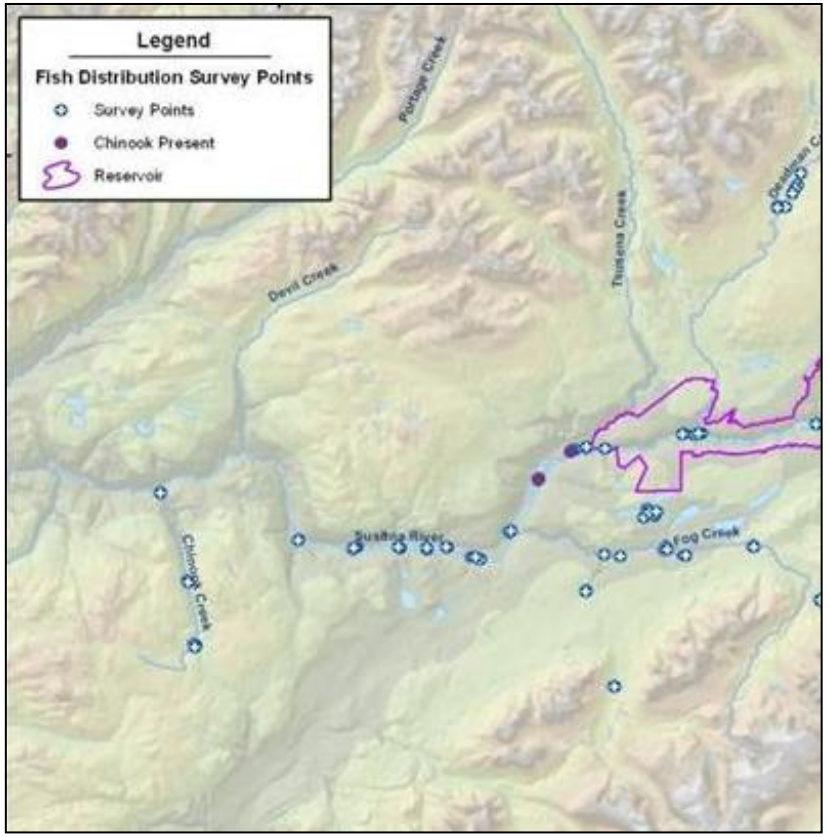
Susitna IFS Site Selection Process

- Identify potential intensive sites for planning purposes (Sept/Oct 2012)
- Use Riparian Botanical 2012 Survey and Mapping results to refine intensive sites and identify supplementary sites (Dec 2012)
- TWG confirmation of sites (Feb/Mar 2013)
- Collect data during summer 2013
- Collect additional data as needed summer 2014

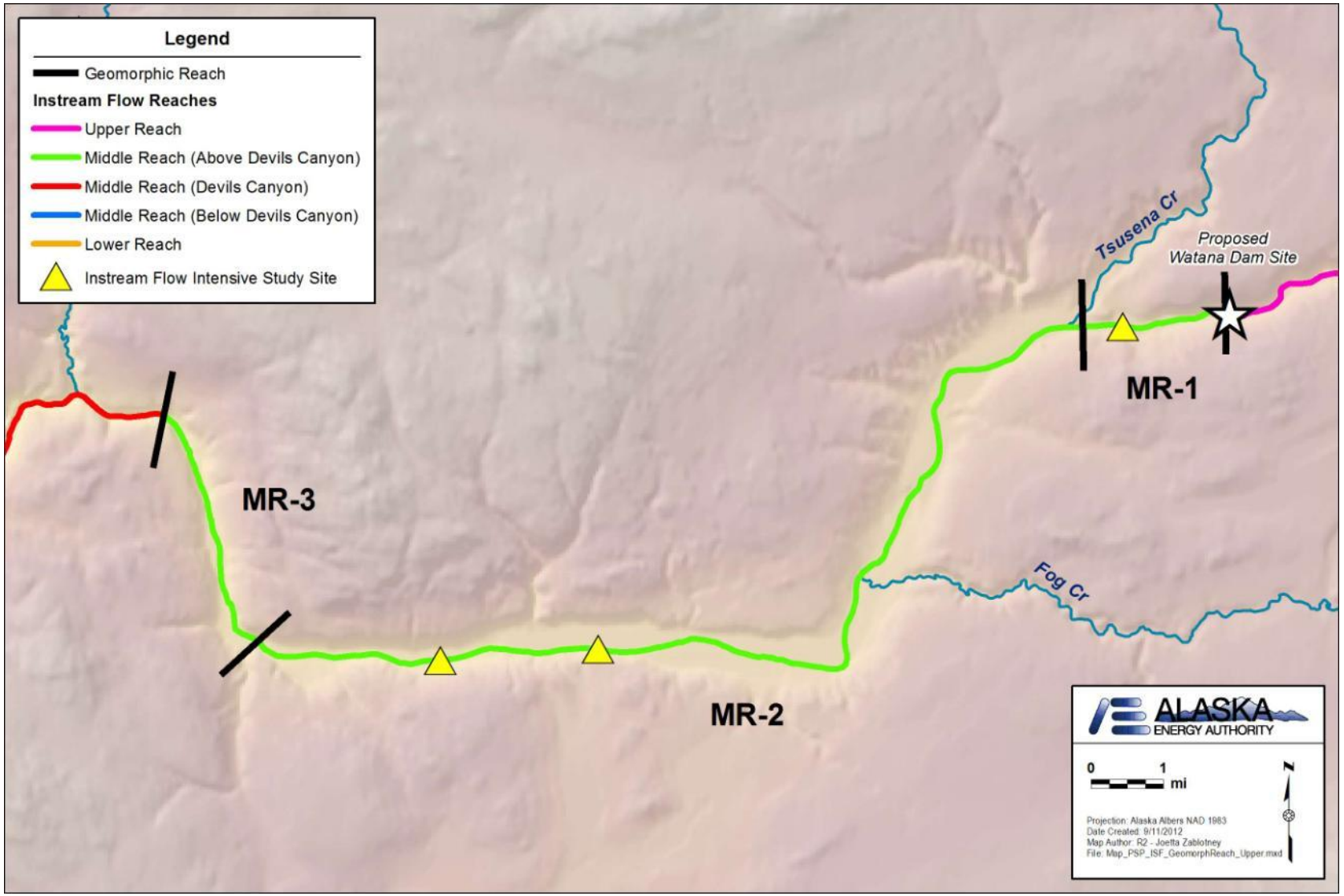
Site Selection

Watana Dam Site (RM 184) to Devils Canyon (RM 166.5)

- Potential intensive sites identified for planning purposes



Watana Dam Site (RM 184) to Devils Canyon (RM 166.5)



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Site Selection
Watana Dam Site (RM 184) to Devils Canyon (RM 166.5)

Use GIS platform to review potential sites

Highly Constrained Reach

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Moderately Confined Reach

(between Devil's Canyon & Three Rivers HRM 126)

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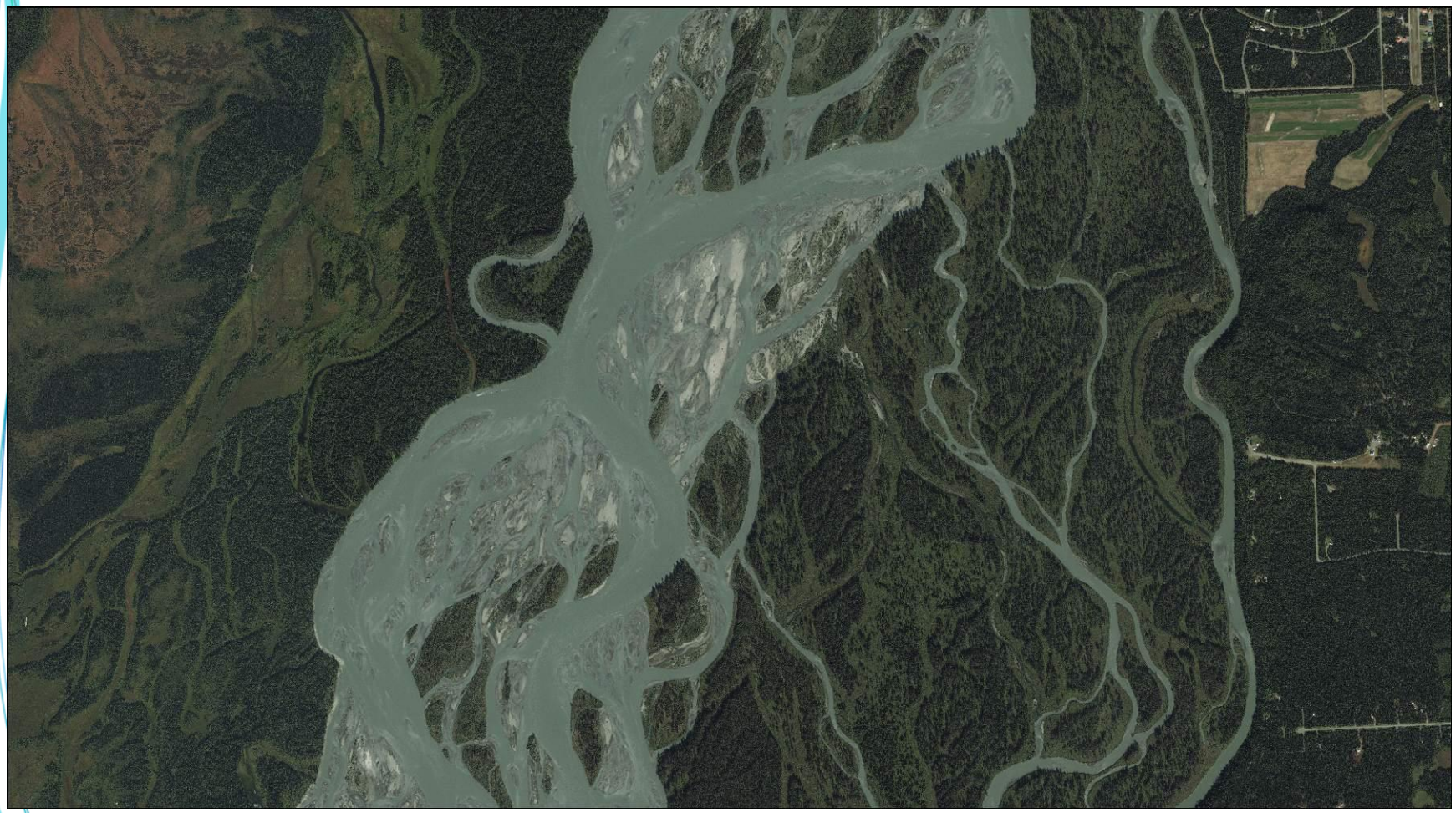
Unconfined Braided Reach

(HRM 53)



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Site Selection
Devils Canyon (RM 150) to Talkeetna (RM 98)

Use GIS platform to review

RM 150 to RM 98 and consider potential sites

Additional slides for discussion of Riparian Study Modeling and Methods

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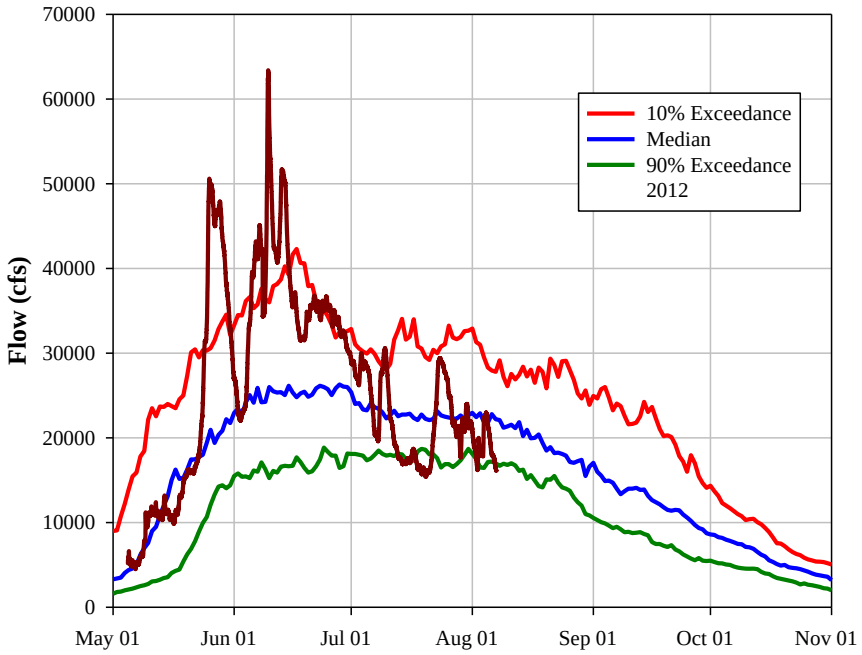
Riverine/Riparian Modeling Approach

- Intensive study reaches will be physically modeled
  - hydraulic (1-D, 2-D),
  - geomorphic reach analysis,
  - ice processes,
  - floodplain groundwater / surface water interaction
- Riparian plant community succession models
- Cottonwood, willow seed release phenology, flow regime and climate
- Vegetation-flow response guilds
- Intensive reach modeling results will be used to “scale-up” to the riverine/riparian process domain using ARC geospatial analyses

Synchrony of Cottonwood Seed Dispersal & Natural Flow Regime

2012 riparian botanical survey:
two year old cottonwood seedlings



Susitna River Gold Creek Gauge

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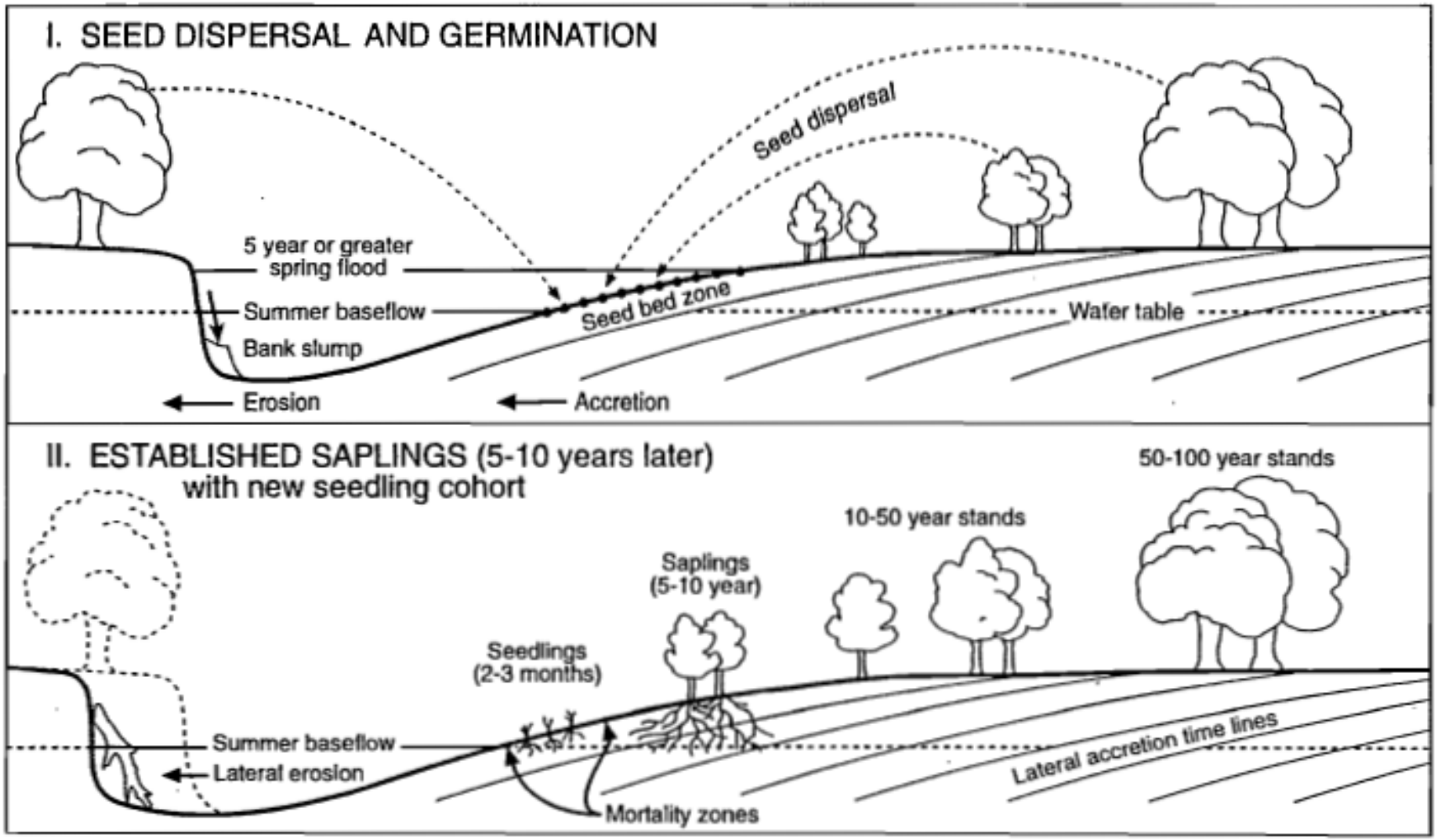
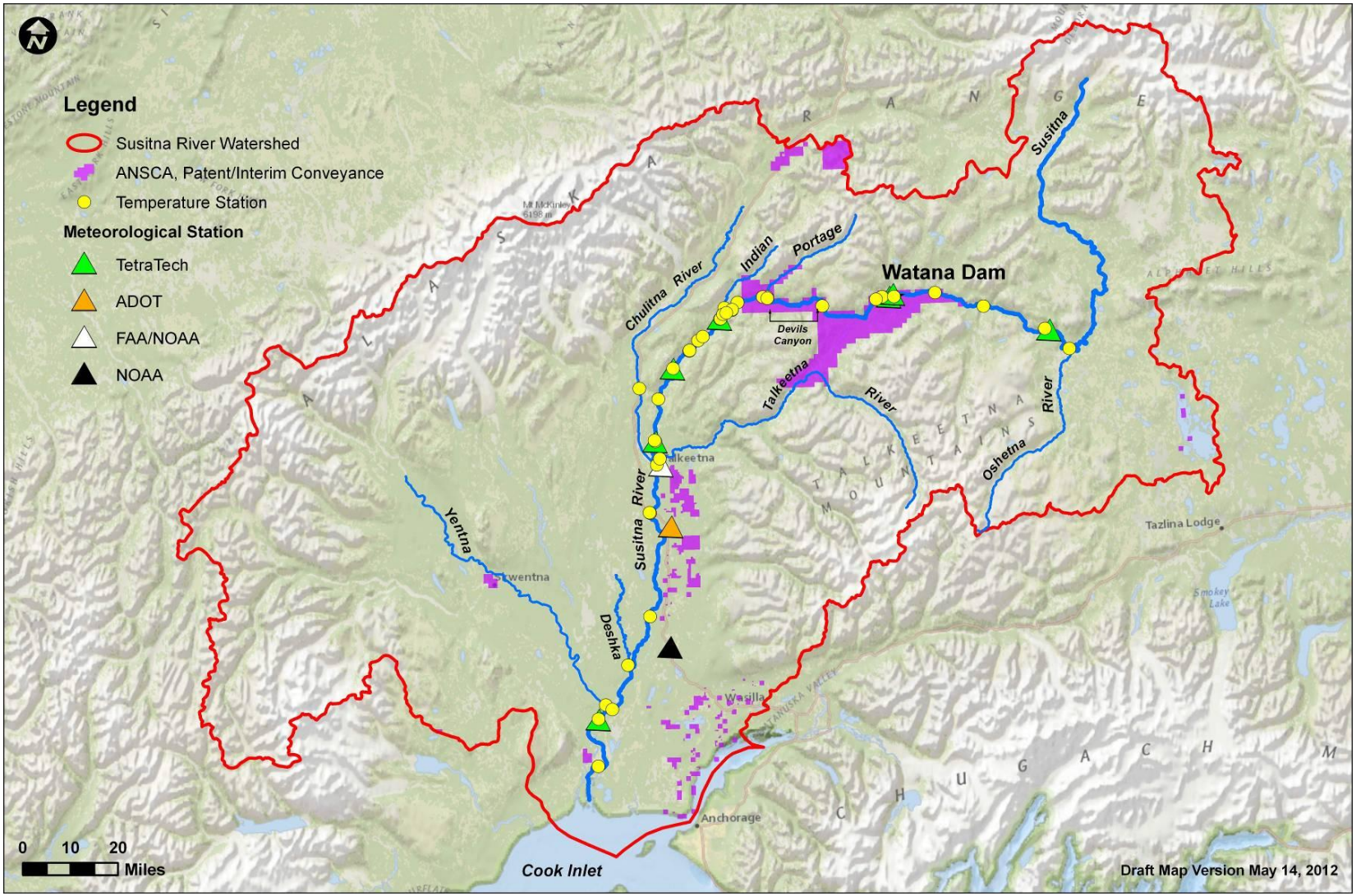
Cottonwood (*Populus* spp) Recruitment Life History Trait: Reproductive Strategy & Seedling Study



(Modified from Bradley and Smith 1986)

Susitna River Meteorological Stations



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Methods:
Riparian floodplain vegetation succession models

1. Build on 1980/90's succession model
2. Develop more comprehensive set of succession models, as necessary.
3. Focus on plant community recruitment conditions & conditions that will change under Project operational flows.

   a. sediment, flow-regime, groundwater, geomorphic terrain position

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Intensive Study Reach
Riparian Vegetation Elements

1. Detailed mapping of riparian plant communities.
   a. Vegetation composition, abundance, structure, forest age, and elevation
2. Balsam poplar /willow seed release phenology and local climatology
   a. Document seasonal timing of seed release relative to spring peak flows and valley climatic heat load
   b. Goal is to make recommendations for seasonal operational flow releases in support of generation and maintenance of cottonwood / willow riparian communites
3. Sampling design in support of riparian wildlife studies (browse, avian habitat)

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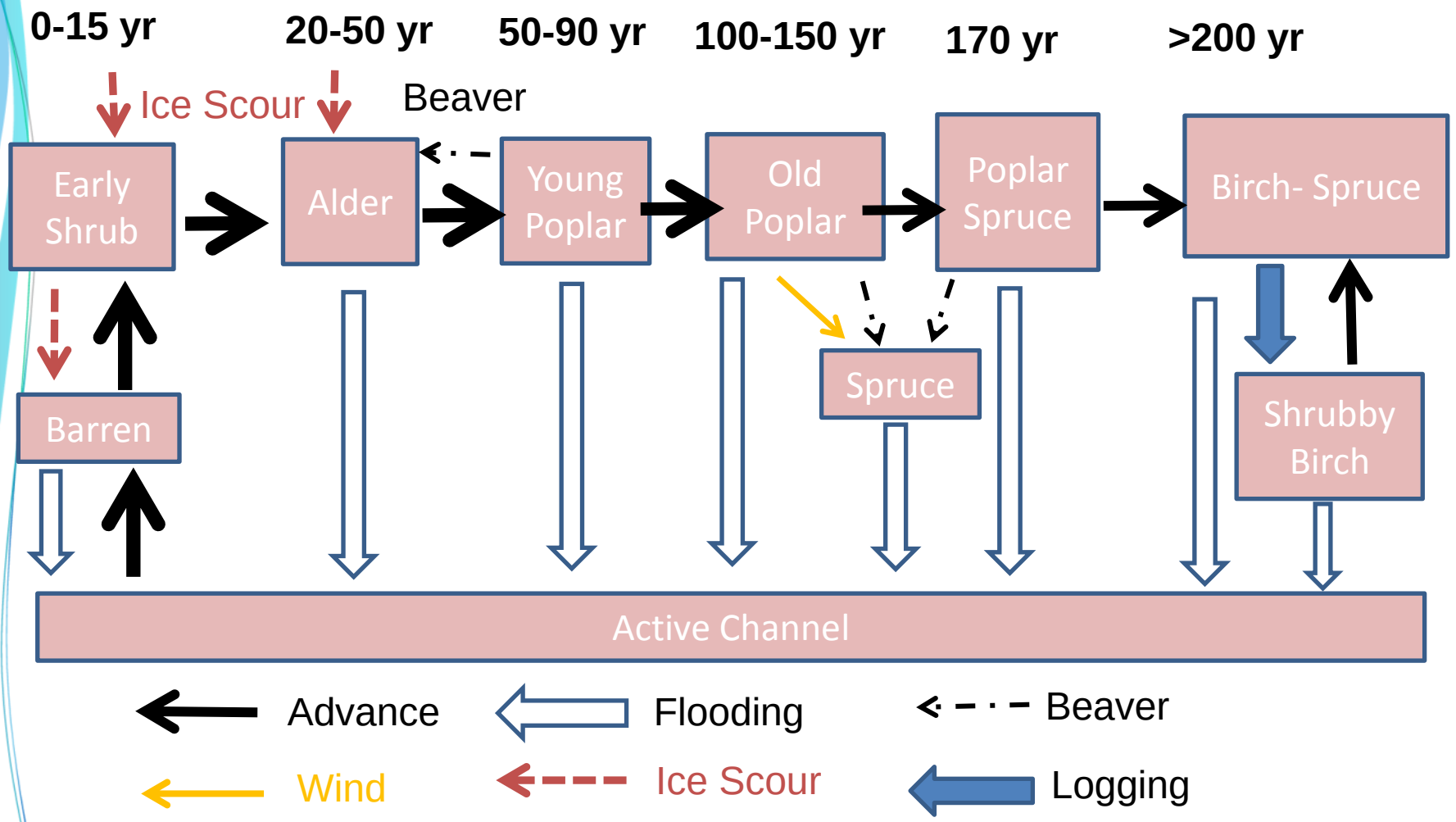
Susitna River Floodplain Forest Succession



(after Helm and Collins 1997)

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Methods: Riparian floodplain vegetation–flow response guilds

1. Group plant species into guilds with shared life history traits related to natural flow hydroregime:
   a. Reproductive strategy (Cottonwood & willow)
   b. Morphology (willow, alder, cottonwood)
   c. Disturbance adaptations (rhizomatous herbaceous species and ice shearing regime)
2. Develop probabilistic response curves for guilds and physical processes from empirical data and modeling:
   a. Flood regime
   b. Groundwater regime
   c. Ice shearing
   d. Sediment type

Riparian Guilds based on life history traits: sediment burial and shear resistance guild *(Salix / Populus / Alnus)*

Methods:
Physical and vegetation model scaling–intensive study reach to riparian process domain

1. ARCMAP GIS applications
2. Geospatial analyses
3. Projection of intensive study reach results to larger riparian process domain

Methods Application:
Whiskers Slough Intensive Study Reach

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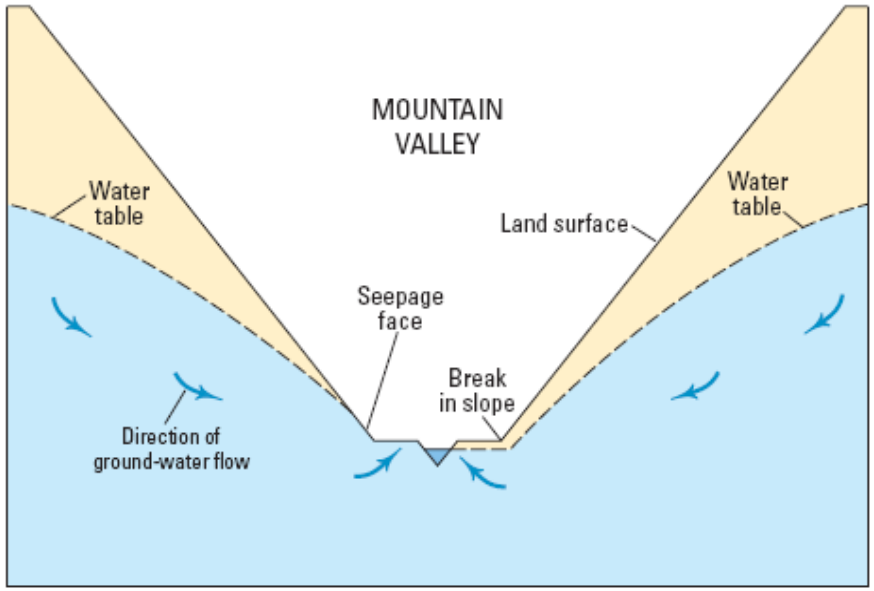
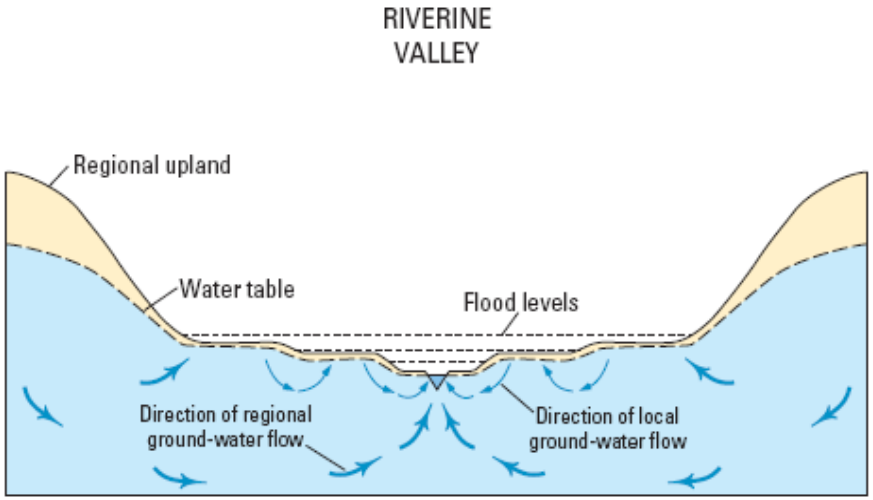
Whiskers Slough
Riverine Hydrologic Landscape (Winter 2001)





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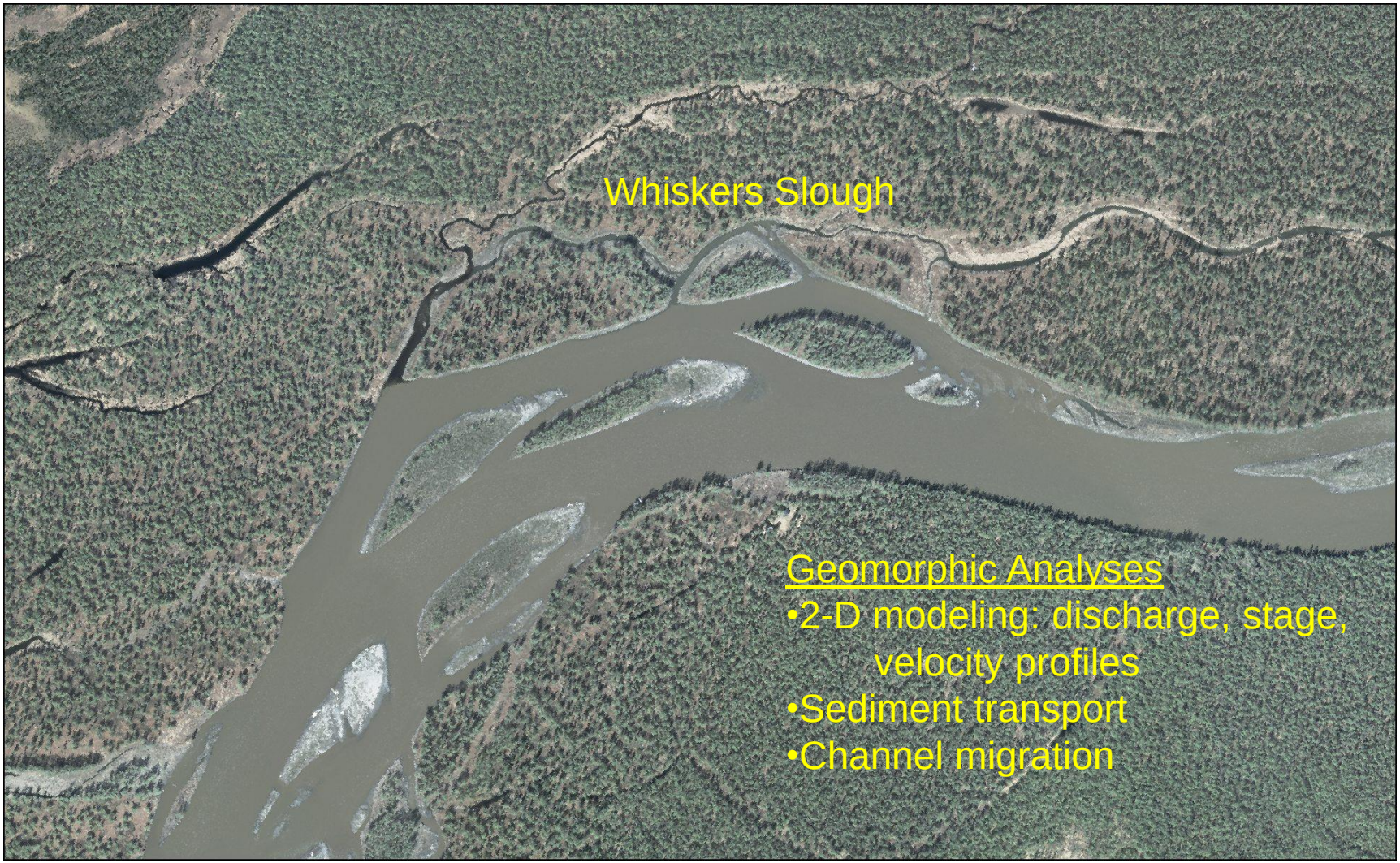
Geomorphic Reach Analysis Scale



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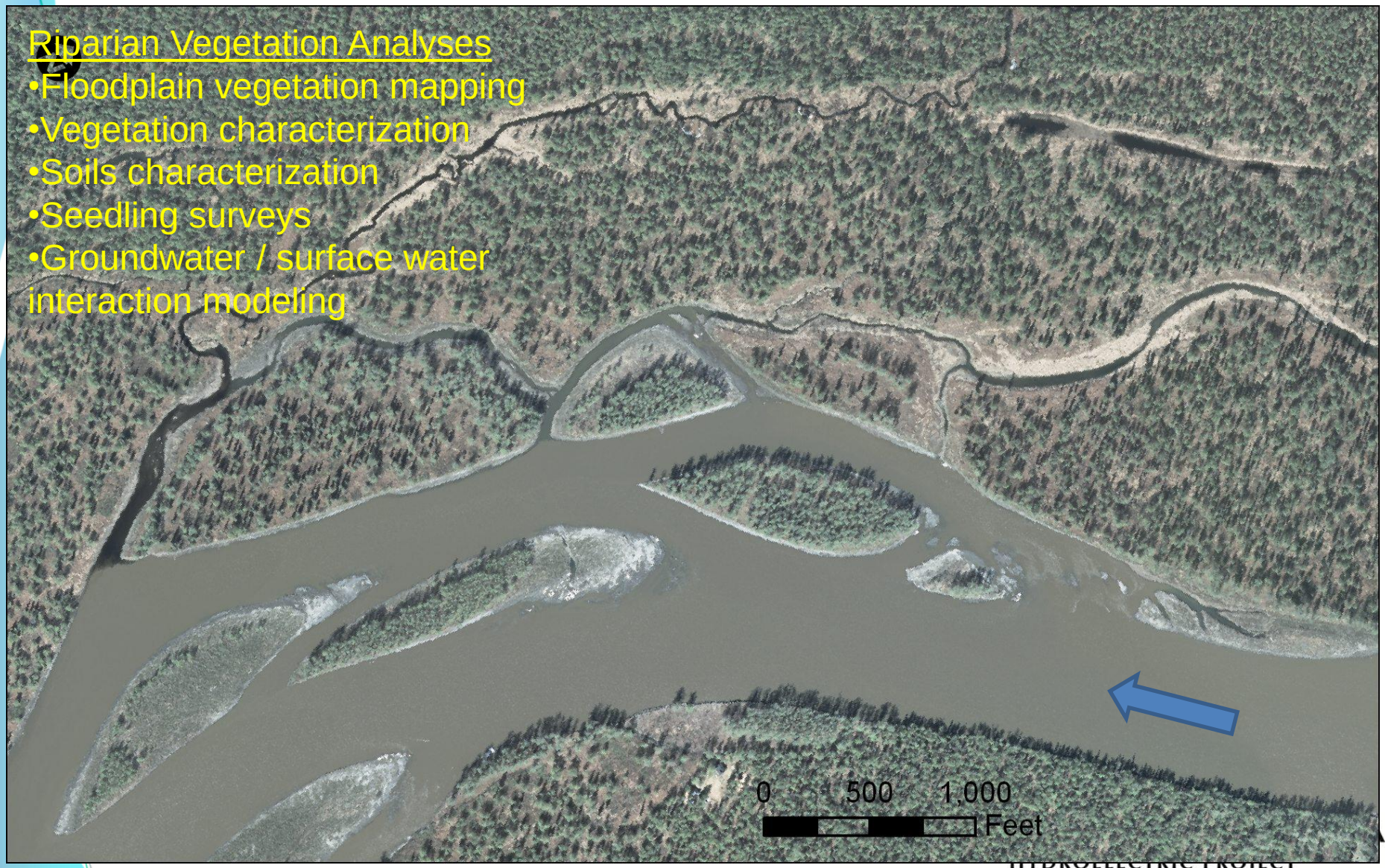
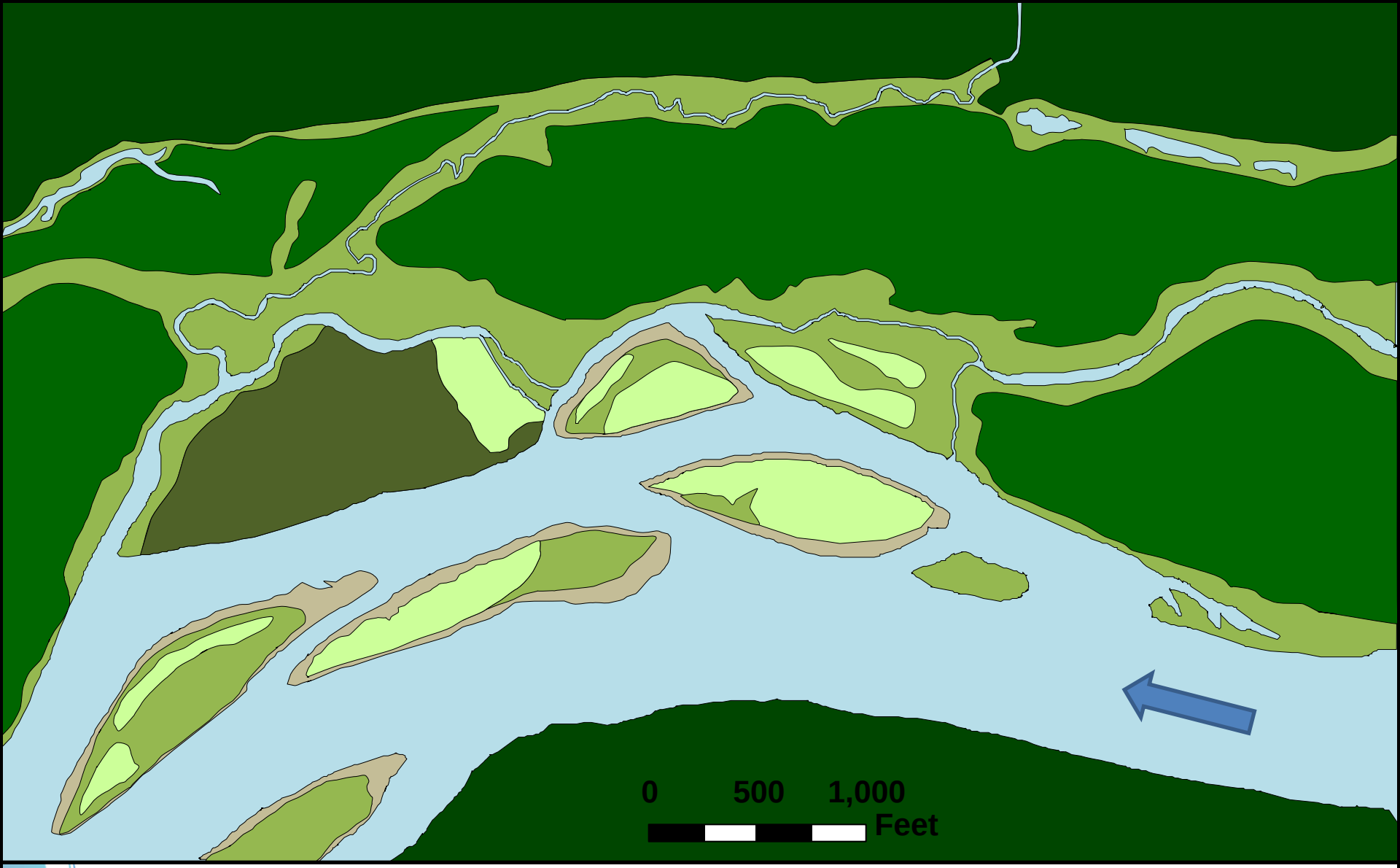
Whiskers Slough Riparian Study: GW/SW Interaction Scale



Whiskers Slough Wet Meadow Floodplain Vegetation

Whiskers Slough Sedge Meadow

Whiskers Slough



Spruce/Birch
Poplar/Spruce/Birch
Poplar/Spruce
Balsam Poplar
Willow/Alder
Alder/Wet Meadow

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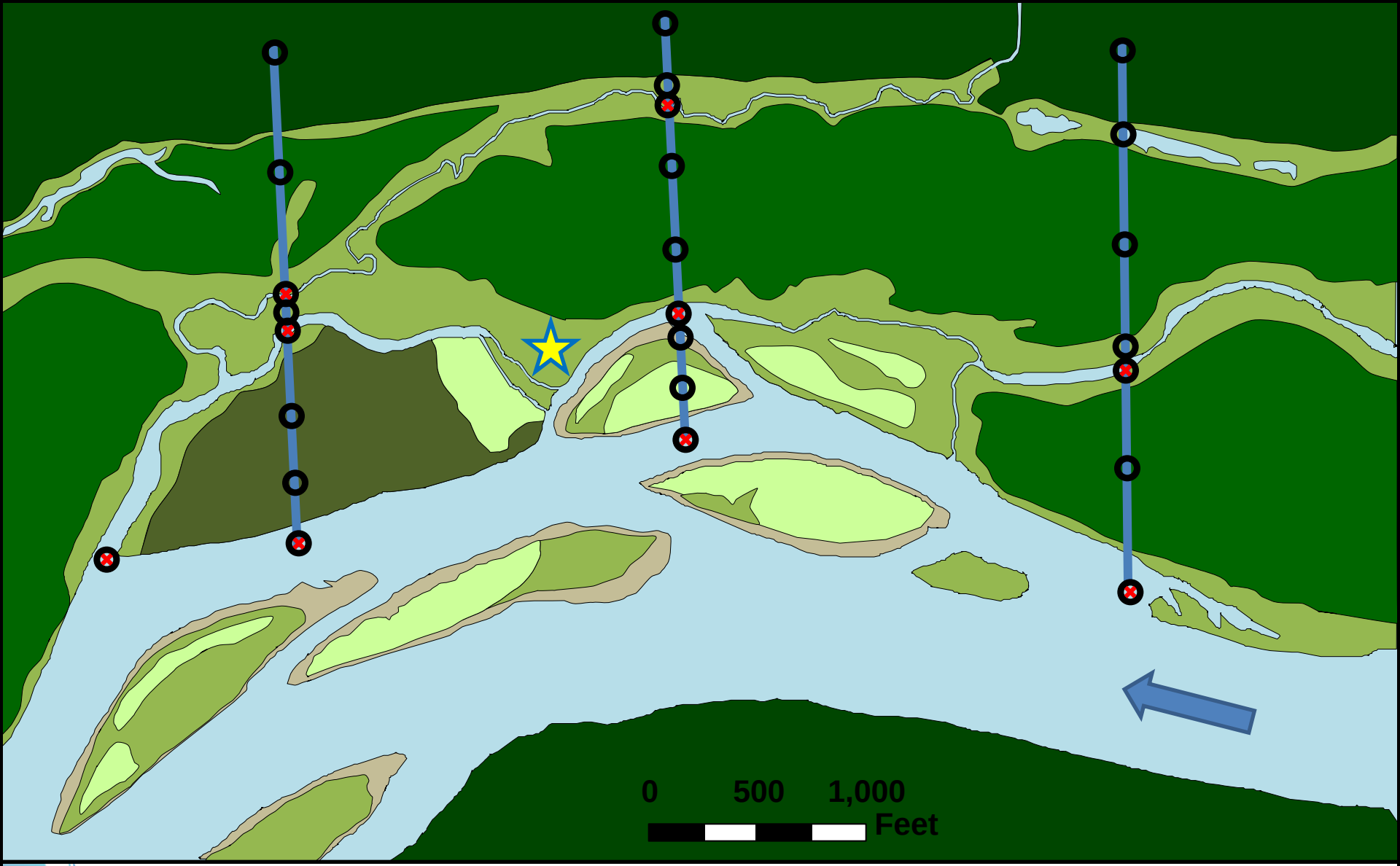
Methods:
Floodplain vegetation groundwater / surface water interaction modeling

- Investigation to quantify groundwater / surface water interactions within floodplain shallow aquifers.
- Vegetation modeling linkage with hydraulic model and groundwater models
- Develop empirical model of riparian plant community / groundwater associations to assess potential changes due to hydroregulation.
- Design with Michael Lilly, GW Scientific


0
500
1,000
Feet
Spruce/Birch
Poplar/Spruce/Birch
Poplar/Spruce
Sampling Transects
Balsam Poplar
Willow/Alder/Wet Meadow
Willow/Wet Meadow
Meteorology Station (ET)
Monitoring Wells
Soil Temperature
Soil Moisture
Stage Recorders
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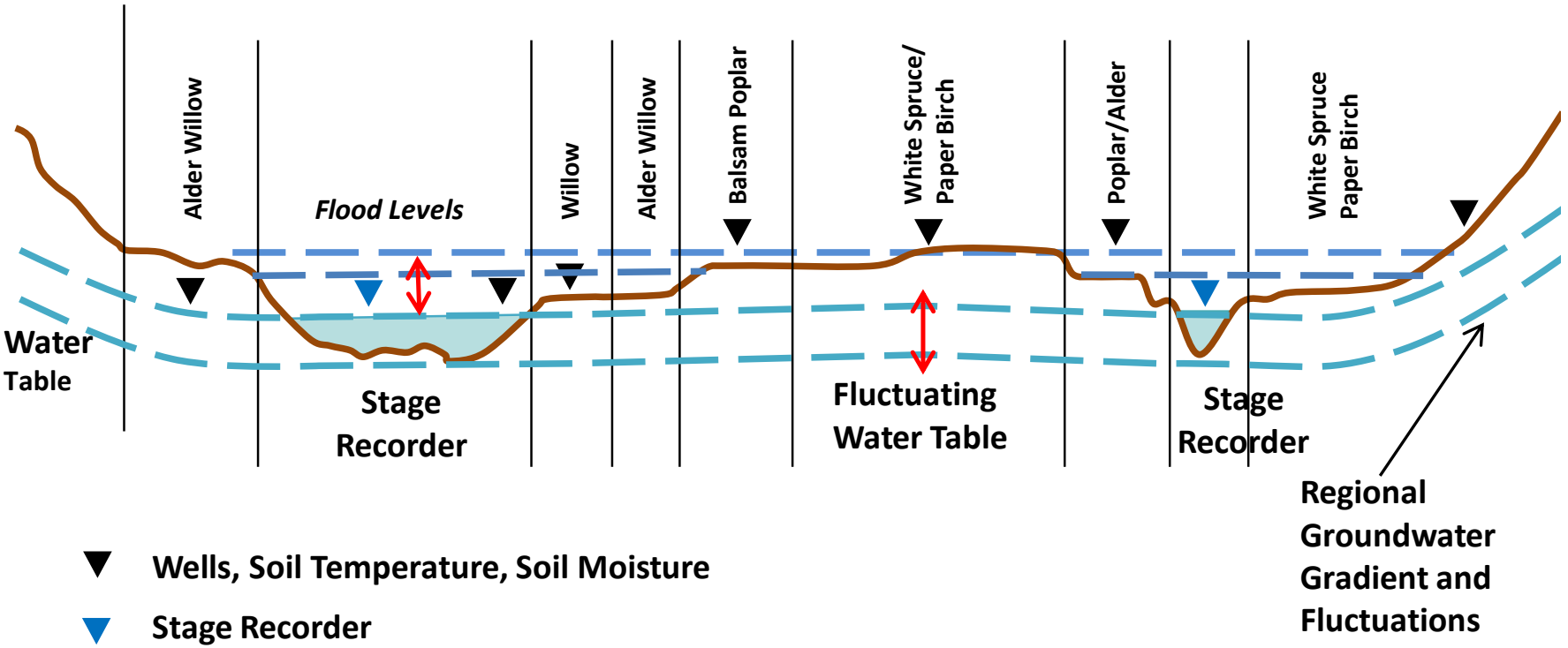
Study Site Cross-Section



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