

# SUSITNA-WATANA HYDROELECTRIC PROJECT

## Technical Workgroup Meeting Instream Flow Studies

### *Geomorphology Presentation*

September 14, 2012

Prepared by: Tetra Tech and URS



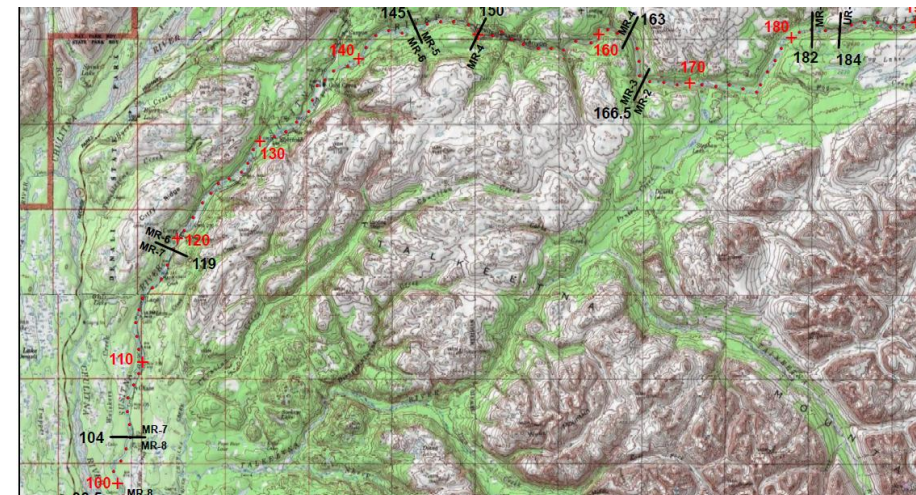
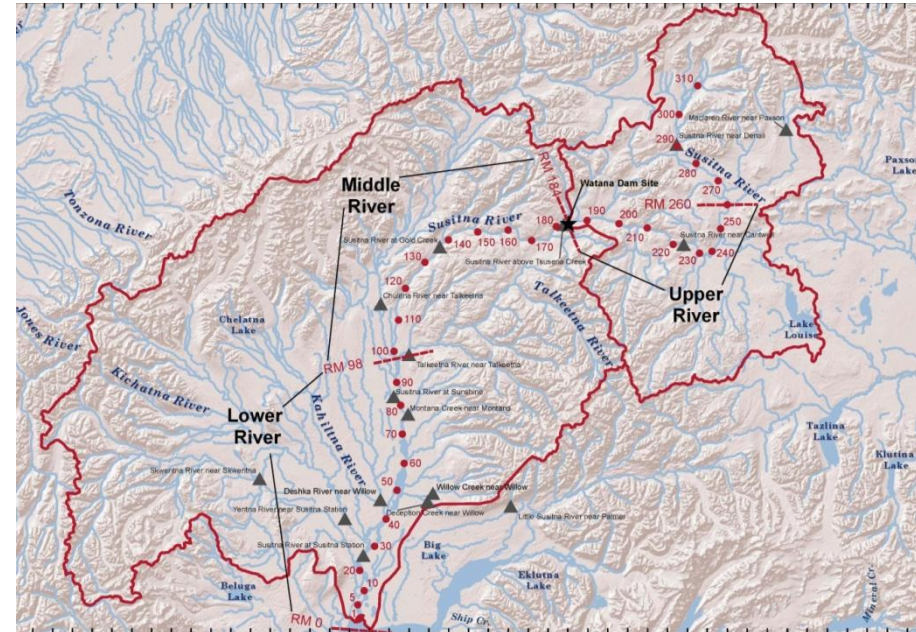
# Geomorphology Study

## Status of Reach Stratification

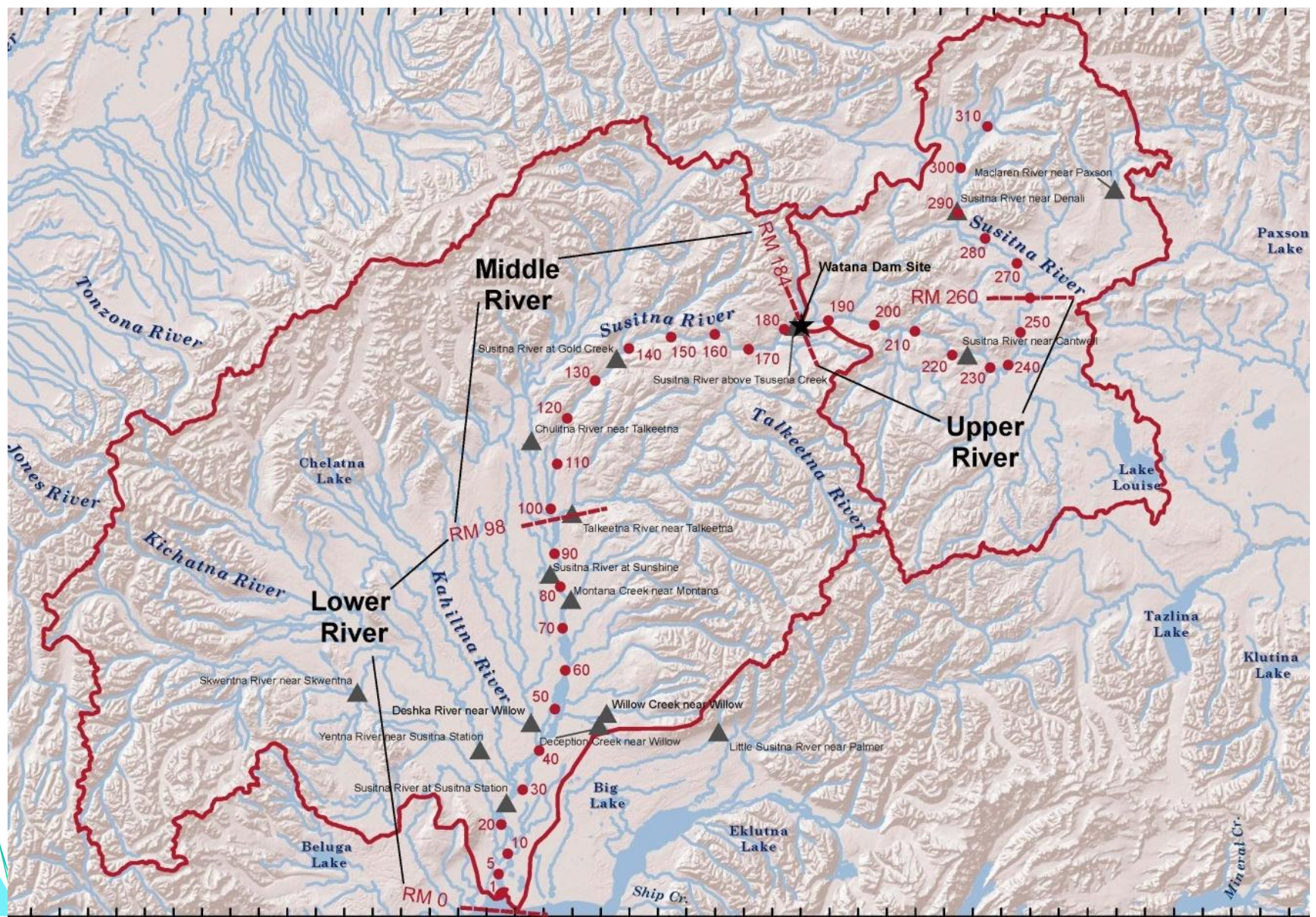
- Initial reach delineation/stratification performed and distributed to Project Team and Agencies
- Information initial reach delineation based on
  - USGS topographic maps
  - 1980s profiles
  - 1980s bed material
  - Description of river from 1980s reports
  - Current aerials and satellite imagery (2010 and 2011)
- Will be refined when additional information is available

# Levels / Hierarchy of Stratification

1. Segments / Sections
2. Geomorphic Reaches
3. Mainstem Habitats (Main Channel & Lateral)
4. Mesohabitat (Pool / Riffle / Run)
5. Microhabitats



# River Sections / Segments

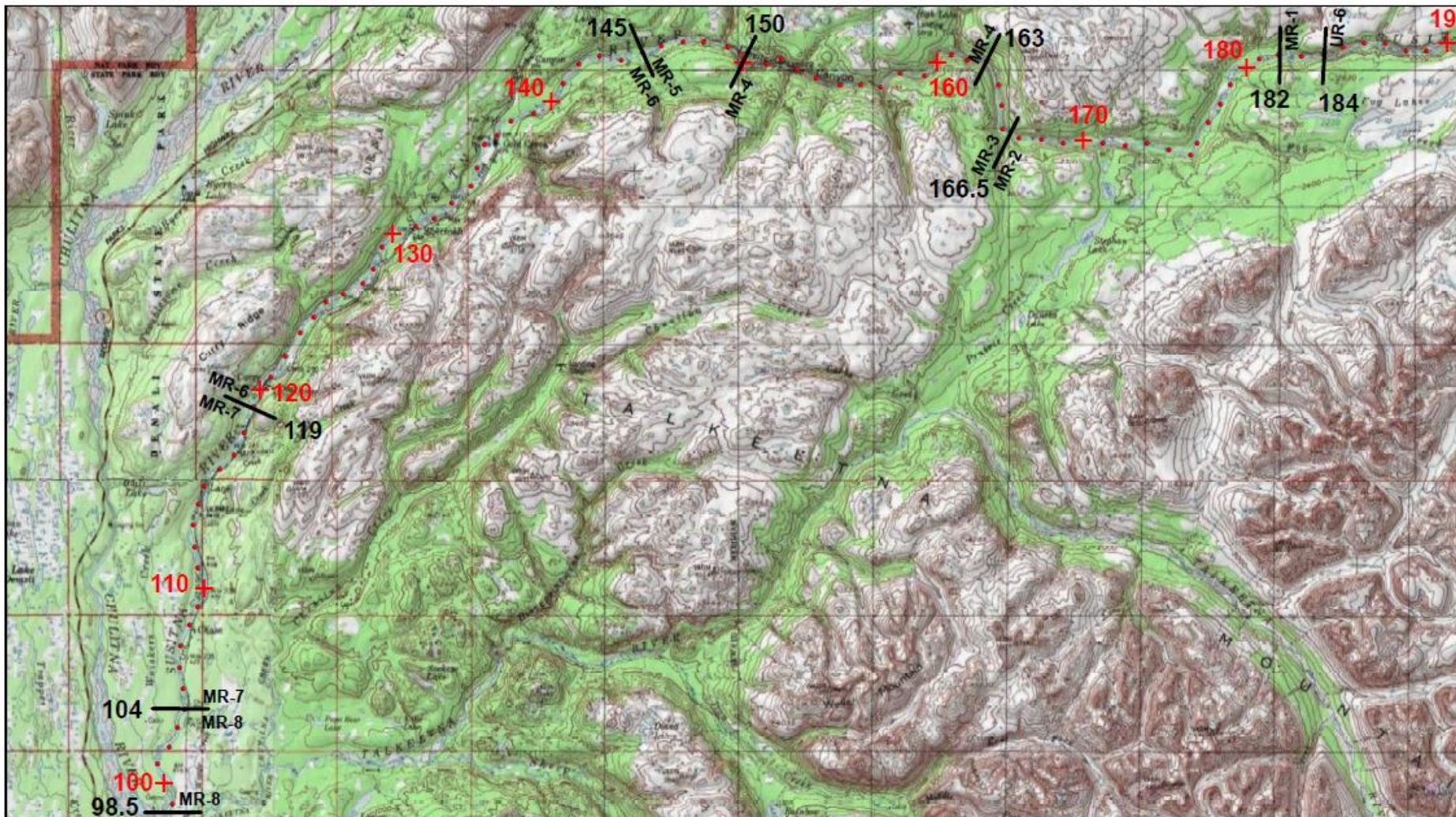


# Geomorphic Reach Stratification

- Primary factors initial geomorphic reach delineation based on:
  - Planform
    - Single channel
    - Multi-channel (island/side channel, braided)
  - Confinement (extent of floodplain, off channel features)
  - Gradient
  - Bed material / geology
  - Major tributary confluences

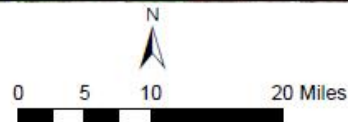


# Middle River Geomorphic Reaches



## LEGEND:

- + River Miles
- River Miles
- Reach Boundary

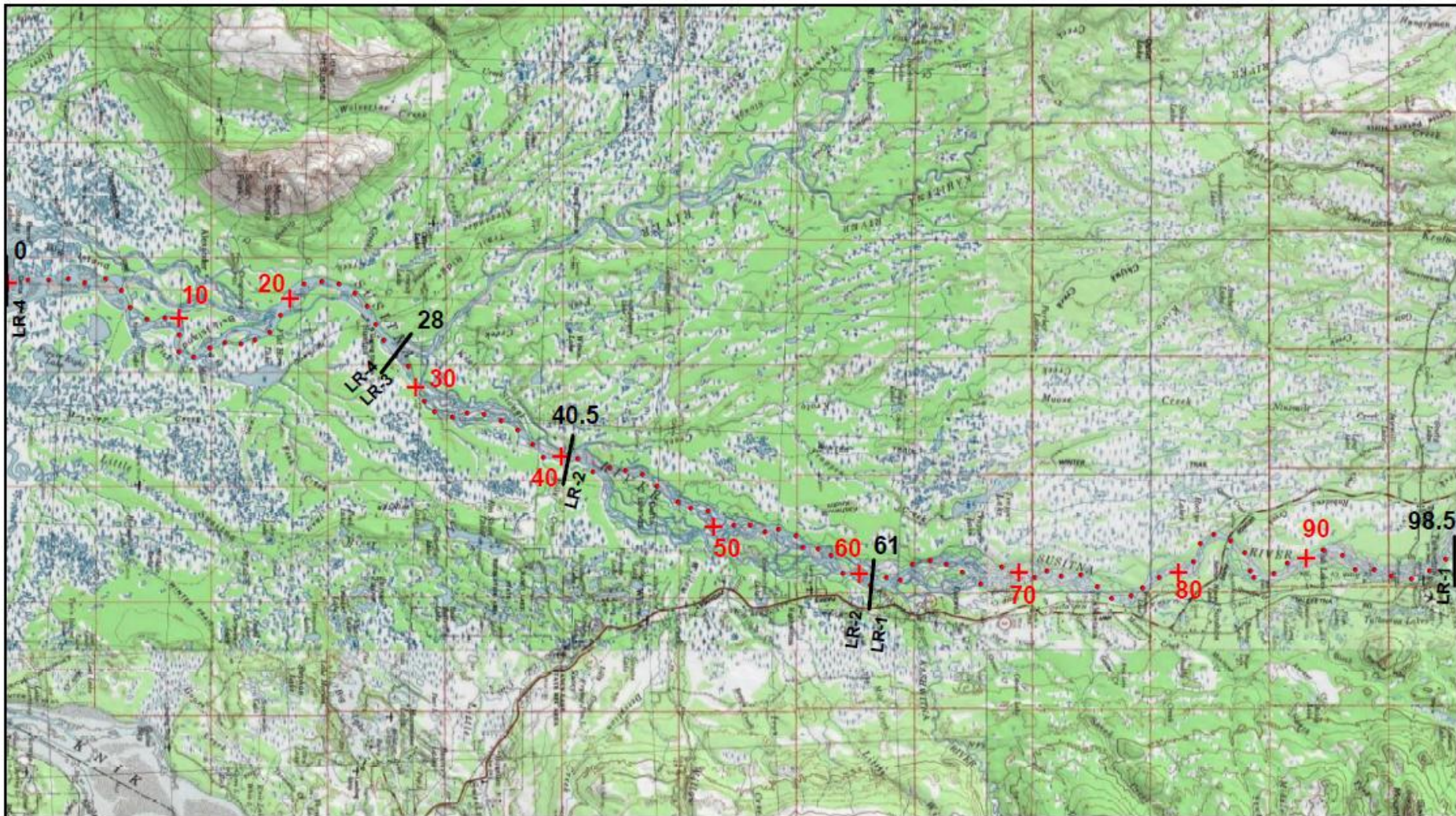


Susitna Middle River Preliminary Reaches and River Miles

# Geomorphic Reach Delineation Middle River

Reach	U/S RM	D/S RM	~Slope <sup>1</sup> (ft/mi)	General Description
<b>Middle River</b>				
MR-1	184	182	9	Short confined reach from Susitna-Watana Dam site downstream to Tsusena Creek. Continuation of UR-6 characteristics (only divided due to dam-site).
MR-2	182	166.5	10	Canyon walls pull back from the channel and floodplain exists (about 2 to 3 channel widths). Channel is straight with bars and a few vegetated islands. Near 90 degree bends likely associated with faults.
MR-3	166.5	163	17	Short transition straight reach as channel narrows and floodplain disappears. A few open bars and a couple of small vegetated islands exist. Reach is a transition to Devils Canyon.
MR-4	163	150	30	Very steep, narrow, bedrock controlled Devils Canyon reach. Only a few, narrow attached bars in the reach and no islands.
MR-5	150	145	12	This is a short transition reach below Devils Canyon. Single thread, narrow channel (1 vegetated island) without floodplain.
MR-6	145	119	10	Canyon walls pull back and the valley bottom widens. Frequent side channels, vegetated island and bars throughout this reach. Tributaries entering in this reach include Gold Creek, Indian Creek and 4 <sup>th</sup> of July Creek. The reach ends as the Susitna River canyon walls move back in and the valley bottom narrows.
MR-7	119	104	8	The channel is more constricted in this reach than the upstream reach and the side channels become less frequent. Vegetated islands occur in the less confined portions of the reach. The canyon walls gradually tapers between RM 110 and RM 104. Lone Creek enters in this reach.
MR-8	104	98.5	8	This reach is a transition between the canyon and the Three Rivers confluence. The channel becomes unconfined and then braided above the confluence with the Chulitna River.

# Lower River Geomorphic Reaches



## LEGEND:

- + River Miles
- River Miles
- Reach Boundary



Susitna Lower River Preliminary Reaches and River Miles

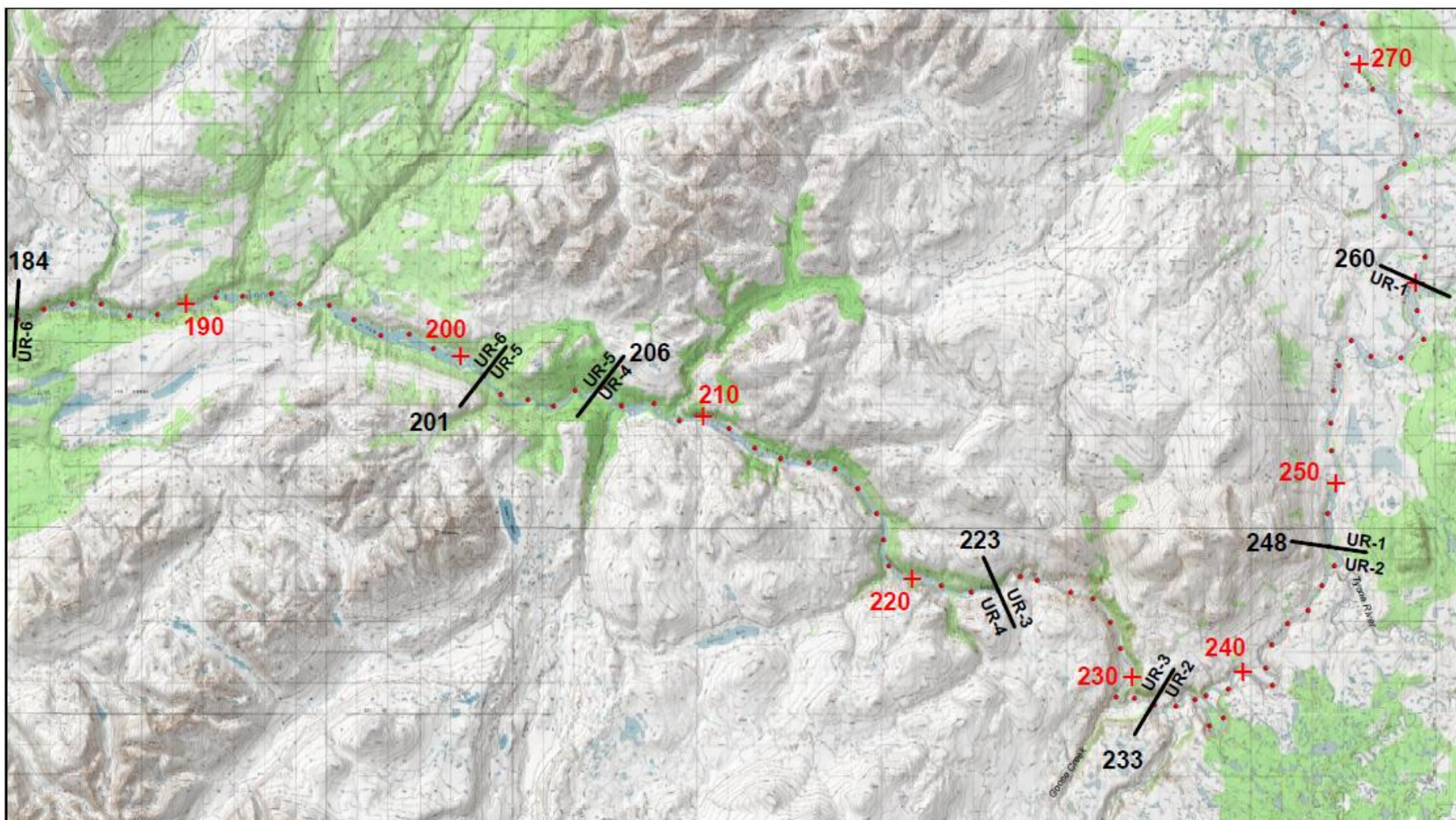


# Geomorphic Reach Delineation

## Lower River

Lower River				
LR-1	98.5	61	5	As a result of the heavy sediment load delivered by the Chulitna River as well as the reduction in slope, the Susitna becomes heavily braided in this reach. Terraces generally define the edges of the braidplain. Talkeetna also joins the Susitna at the U/S end of the reach. There is one constriction in the reach (RM 84 the location of the USGS Sunshine gage) where the channel is confined to a single thread. The downstream end of the reach is the confluence with the Kashwitna River.
LR-2	61	40.5	4	The Susitna branches into multiple channels in this reach. The channels occupy a 3-to-5-mile wide corridor. The downstream end of this reach is marked by the Kroto Creek (Deshka River) confluence and constriction by terraces just downstream of the confluence. The lower portion of the each is referred to as the Delta Islands.
LR-3	40.5	28	2	The gradient is reduced by 50% in this reach compared to LR-2. Below the constriction, the Susitna branches into 4 to 6 channels. The Kroto Slough splits off from the main river and flows across the western edge of the floodplain and joins the Yentna River about 0.5 miles above the Susitna confluence.
LR-4	28	0	1.4	The upper 2 miles of this reach is dominated by the Yentna River confluence and a constriction at RM 26 that forces the river into a single channel. The Susitna Station USGS gage is located at this constriction. The gradient flattens to a reach average of 1.4 ft/mi as the Susitna approaches Cook Inlet. Between RM 26 and RM 20, there are vegetated islands and a 3-mile-long side channel. At RM 20, the river branches into multiple channels at the start of the delta.

# Upper River Geomorphic Reaches



## LEGEND:

- + River Miles
- River Miles
- Reach Boundary



Susitna Upper River Preliminary Reaches and River Miles

# Geomorphic Reach Delineation

## Upper River

Reach	U/S RM	D/S RM	~Slope <sup>1</sup> (ft/mi)	General Description
<b>Upper River</b>				
UR-1	260	248	NA <sup>2</sup>	Island and bar braided, predominately straight, floodplain appears to be very limited. Maclaren River confluence at upstream end (U/S).
UR-2	248	233	NA	Sinuuous, single thread channel, appears to be incised, and meanders with very limited floodplain.
UR-3	233	223	NA	Channel progressively narrows in downstream (D/S) direction, canyon walls confine channel, single thread channel of varying sinuosity.
UR-4	223	206	NA	Channel widens but primarily single thread, low sinuosity, bars and a few vegetated islands present, confined with very limited floodplain.
UR-5	206	201	NA	Narrow, highly confined canyon reach, single thread channel with only a few bars.
UR-6	201	184	NA	Channel widens, more frequents bars than U/S and vegetated islands are present, channel is low sinuosity, floodplain is still very limited by canyon. Wide, straight section between RM 200 and RM 205. Watana Creek enters at RM 194. Deadman Creek enters at RM 186.5 and appears to have debris fan that severely constricts the channel. D/S limit of reach is the Susitna-Watana Dam site.

# Geomorphic Reach Delineation

## Middle River – Reach Types

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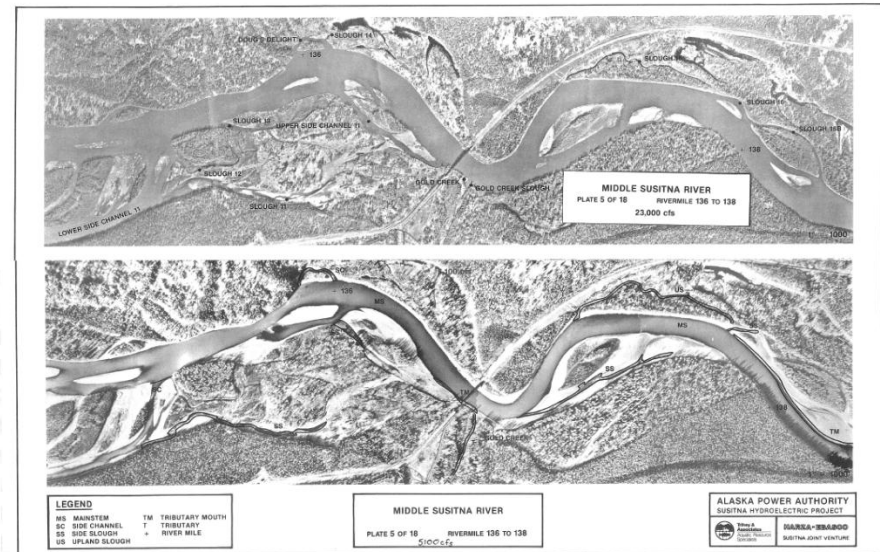
Note: Colors Represent Geomorphic Classifications



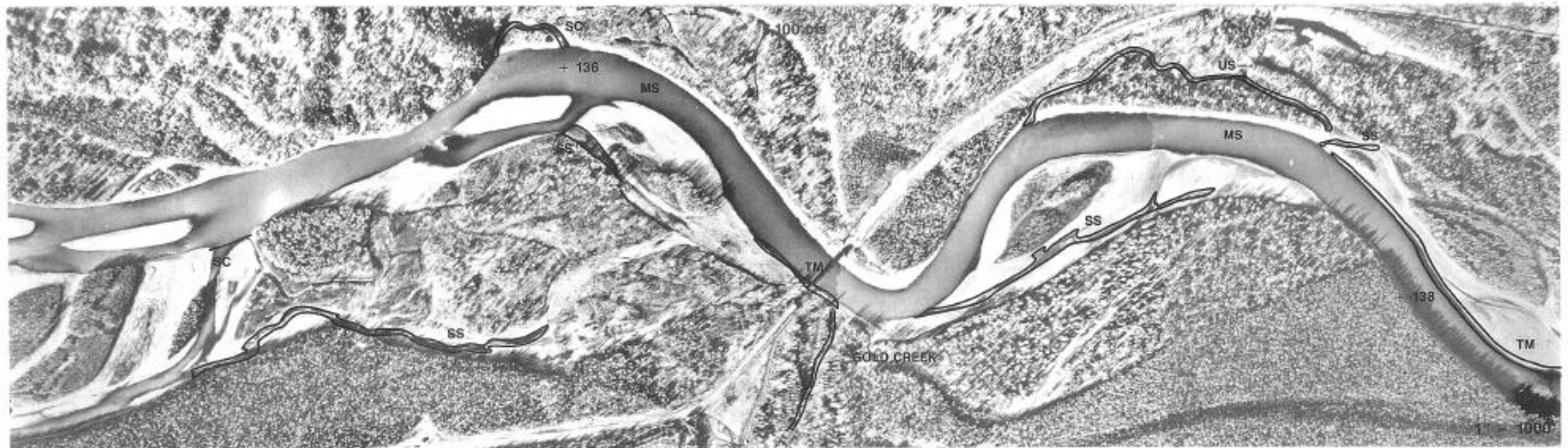
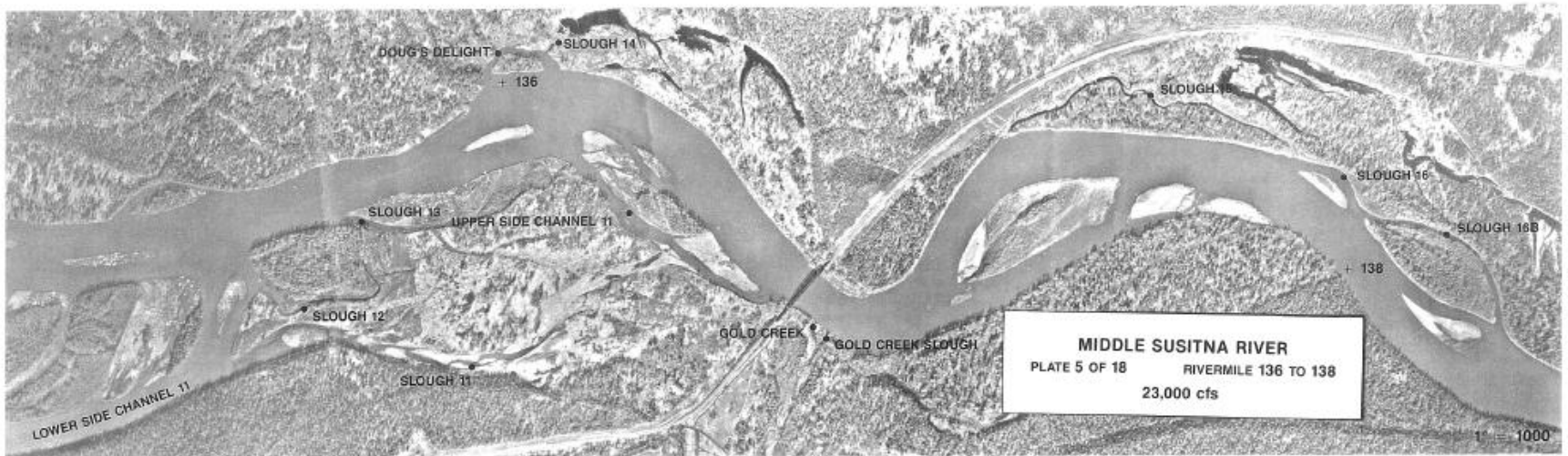
# Mainstem Aquatic Habitat Types 1980s Study

- 6 Mainstem Wetted Habitat Types
  - Main Channel
  - Side Channel
  - Side Slough
  - Upland Slough
  - Tributary Mouth
  - Tributary

- 2 Mainstem Non-Wetted Types
  - Vegetated Area
  - Bars



# Mainstem Aquatic Habitat Types 1983 Aerials



## LEGEND

MS	MAINSTEM	TM	TRIBUTARY MOUTH
SC	SIDE CHANNEL	T	TRIBUTARY
SS	SIDE SLOUGH	+	RIVER MILE
US	UPLAND SLOUGH		

## MIDDLE SUSITNA RIVER

PLATE 5 OF 18 RIVERMILE 136 TO 138  
 5100 cfs

ALASKA POWER AUTHORITY  
 SUSITNA HYDROELECTRIC PROJECT



HAZKA-TEASCO  
 SUSITNA JOINT VENTURE

# Mainstem Aquatic Habitats

## Initial Determination of Areas 1980s and 2012

- Digitize and create shape files from 1980s mapbooks for 5,100, 12,500 and 23,000 cfs
- Obtain 2012 aerials at similar flows and delineate aquatic habitat for three flows
- ~50% of Middle River in 2012, option for additional coverage in 2013
- Develop and compare 1980s vs. 2012 habitat area vs. flow relationships
- Overlay comparison of 1980s vs. 2012 aquatic habitat to identify changes/stability

# Mainstem Aquatic Habitats

## Determination of 1980s and 2012 Areas

- 2012 effort does **not** include:
  - Determination of breaching flows (current effort is aerial exercise at 3 flows, no hydraulic analysis or field work)
  - Identification / mapping of other aquatic habitat classification schemes such as: riffles, pools and runs
  - Limited to ~50% of Middle River in 2012, option for additional area in 2013
  - 1980s habitat types only available upstream of RM 149 (Portage Creek) since 1980s effort stopped below Devils Canyon. Will determine for 2102.



# Example of 2012 Aerials ~ RM 61 of Lower River



# Status of 2012 Mainstem Aquatic Habitat Mapping

- 2012 aerial acquisition & analysis (23k, 12.5k and 5.1k cfs)
  - Acquisition initiated for 23k and 12.5k cfs
  - Challenges – cloud cover / river flow target
- 1980s aerial
  - RM 98 to 155: 12,500 cfs orthorectified aerial developed 1983
  - RM 155 to 249: 30,000 cfs orthorectified aerial developed 1980
  - RM 249 to 260: 30,000 cfs orthorectified aerial CIR coverage 1981
- Complete 1980s main channel habitats MR: Nov.
- Complete 2012 main channel habitats MR: 23,000 cfs (Nov)  
/ 12,500 cfs (Nov) / 5,100 cfs (Dec)