# Chehalis Basin Strategy Geomorphology and Sediment Transport

Technical Workshop

May 7, 2014

Geomorphology Considerations

- Project operation could affect:
    - Peak flows (sediment transport)
    - Sediment input (reservoir storage, change in bank erosion)
    - Large woody debris input/transport
- Potential Key Geomorphology/Habitat Effects
    - Substrate (spawning gravel, interstitial rearing, etc.)
    - Channel forming processes (meander rate, LWD input, holding pools, etc.)
   - Floodplain and off-channel connectivity

Effects of 2007 Flood

- Extreme storm/flood event – 500 yr return flow at Doty gage
- Rainfall resulted in more than 1,000 landslides in Chehalis basin (sediment/wood)
  - 5.7 – 8.7 million cubic yards of sediment delivered from slides; deposition in channel/floodplain
 - Over 200 acres of woody debris accumulated in floodplain

Effects of 2007 Flood

- Gravel-sized material stored upstream of RM 104, currently providing excellent spawning habitat
- Gravel will be gradually transported downstream
  - Substrate will coarsen through time (eventually return to pre-flood conditions, less spawning gravel)
  - Likely take several decades based on bedload transport rates
- Channel avulsion at RM 105

Geomorphic Reaches and Sub-Reaches

Geomorphic Reaches and Sub-Reaches
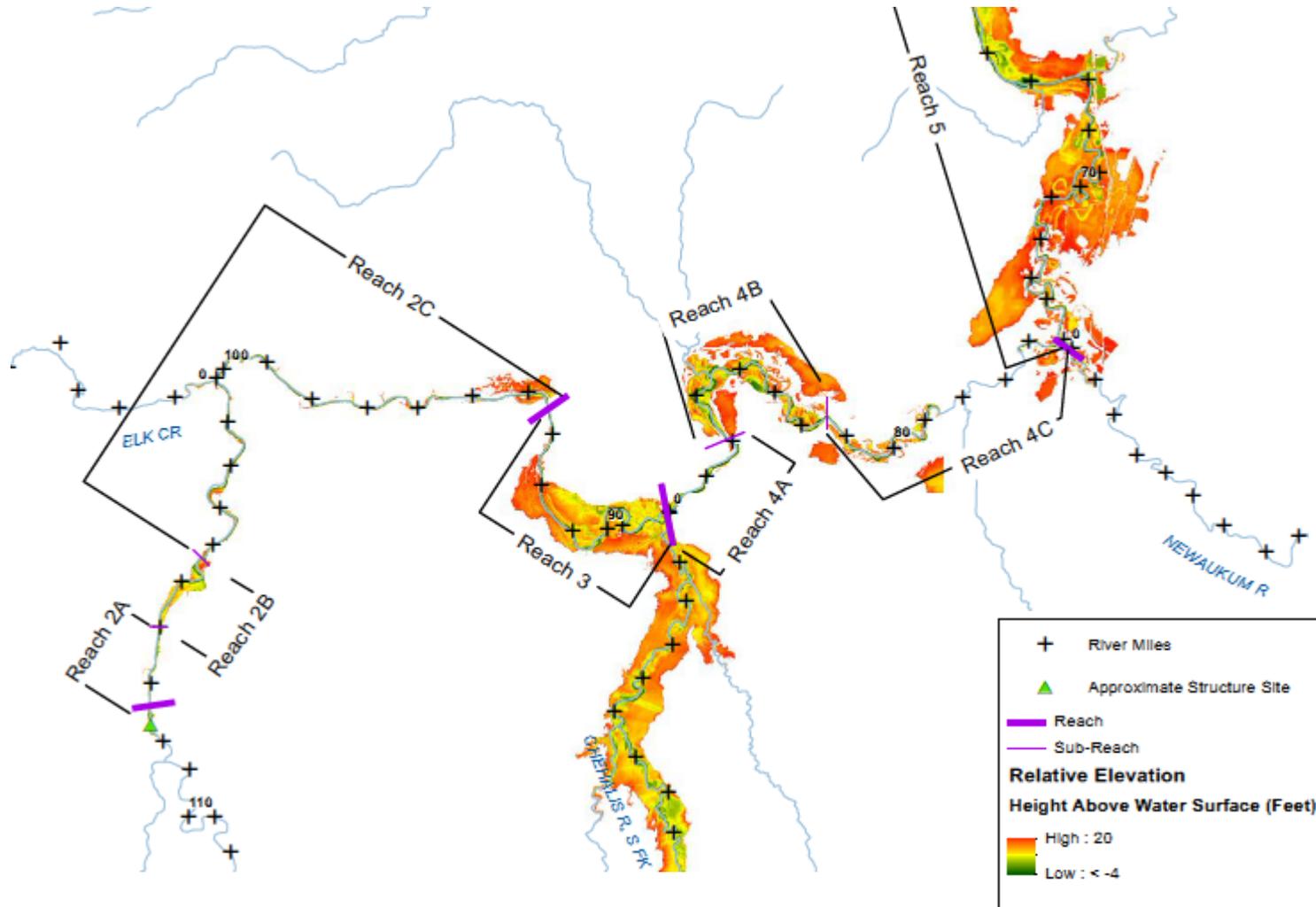
Substrate Characteristics
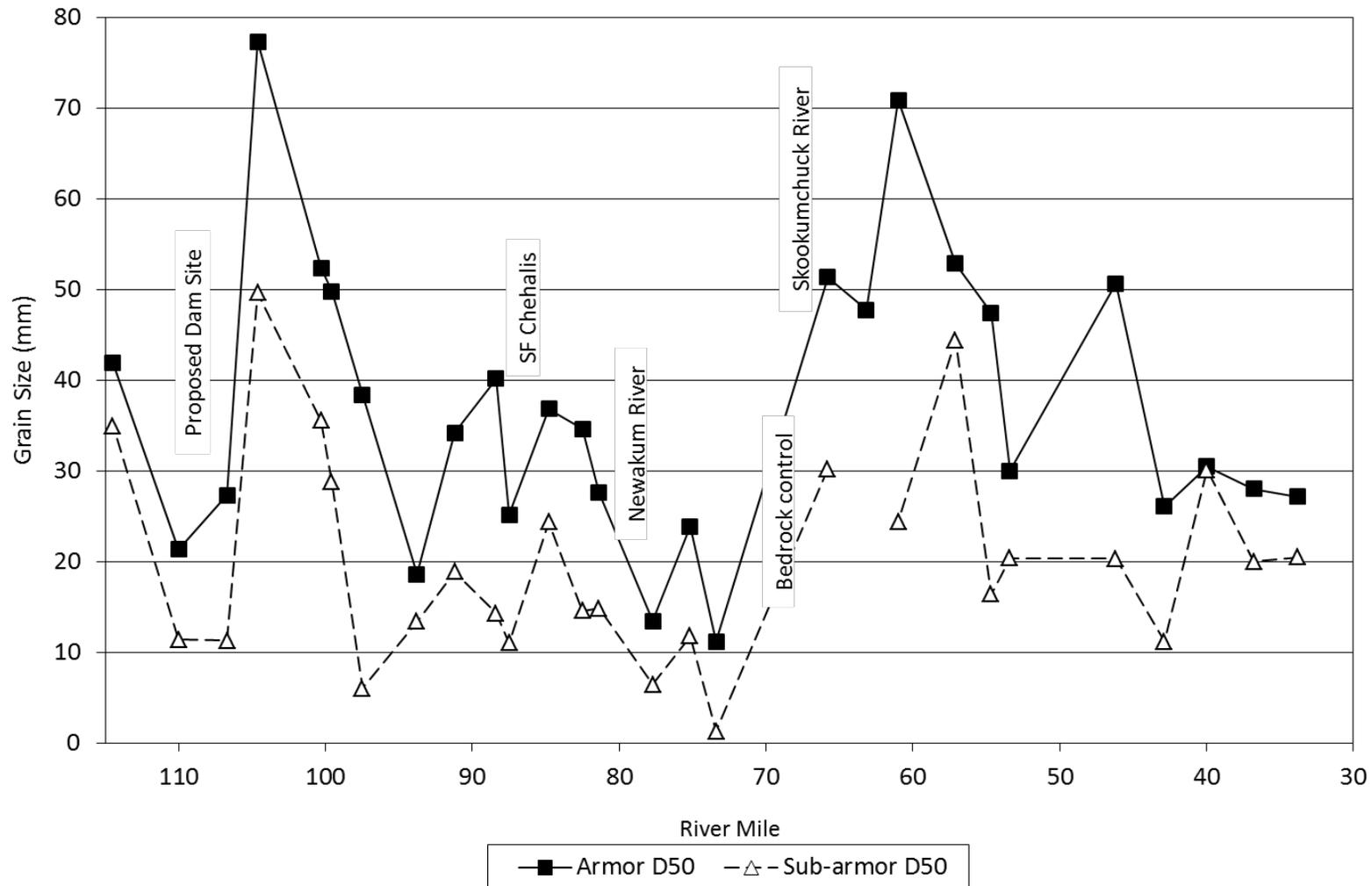
Bedload Transport Modeling

- Used HEC-RAS unsteady flow model to determine shear stress (main channel) for 20 years of existing and with-project flow scenarios

- Used bedload transport calculations to determine daily bedload transport under Flood Retention Only and Multi Purpose scenarios, compared to existing conditions

Bedload Transport – Existing Conditions

Average Annual Bedload Transport Capacity, Existing Conditions

RM 34.216	RM 50.002	RM 69.52	RM 74.95	RM 82.58	RM 85.05	RM 90.1	RM 99.77	RM 100.43	RM 104.49	RM 106.31	RM 107.62
18,877	38,834	7	720	1,373	1,777	140	2,745	3,878	1,093	66,645	1,798,835
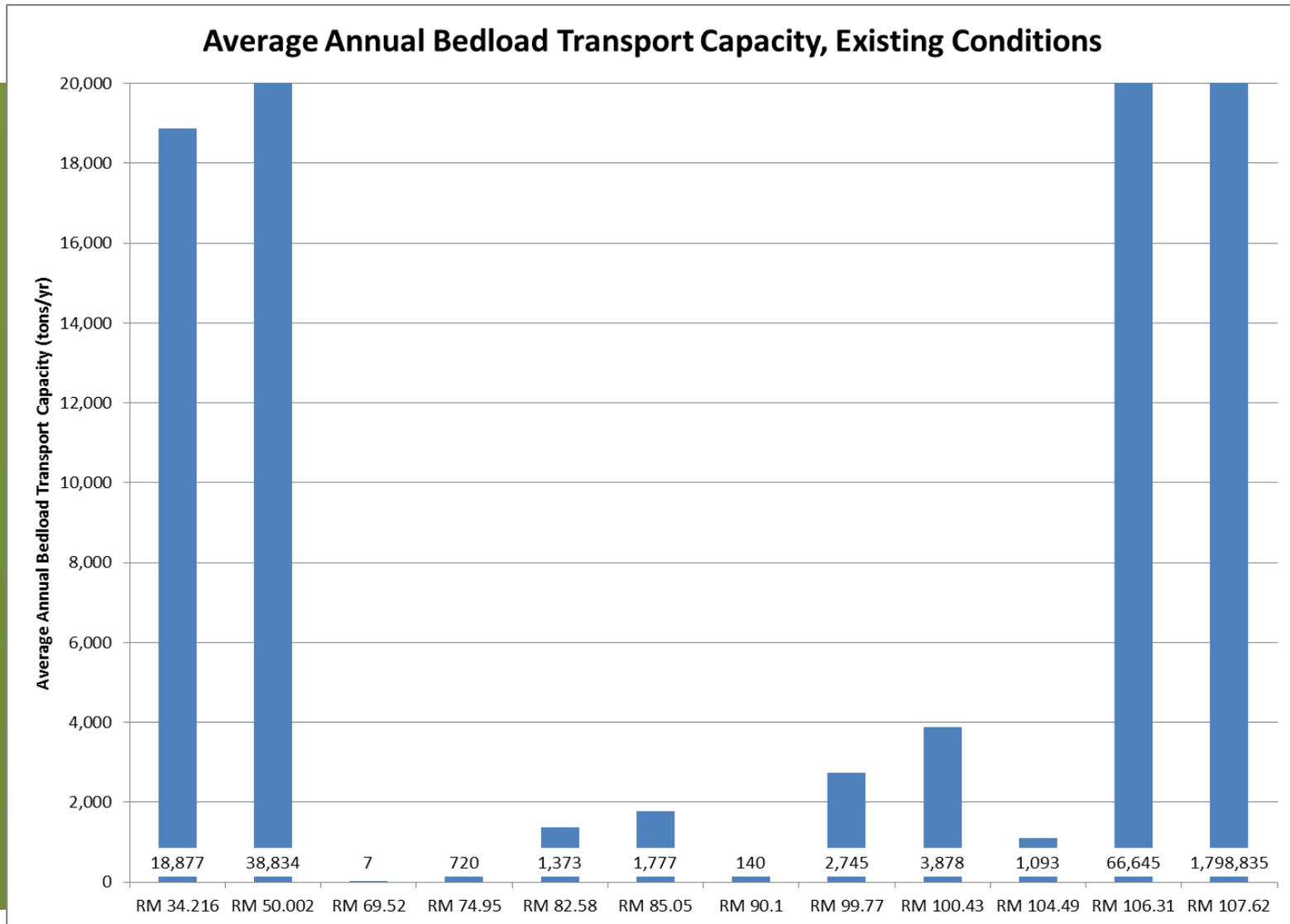
Balance of Changed Input/Transport – Flood Retention Only

Change to Bedload Supply and Transport Capacity
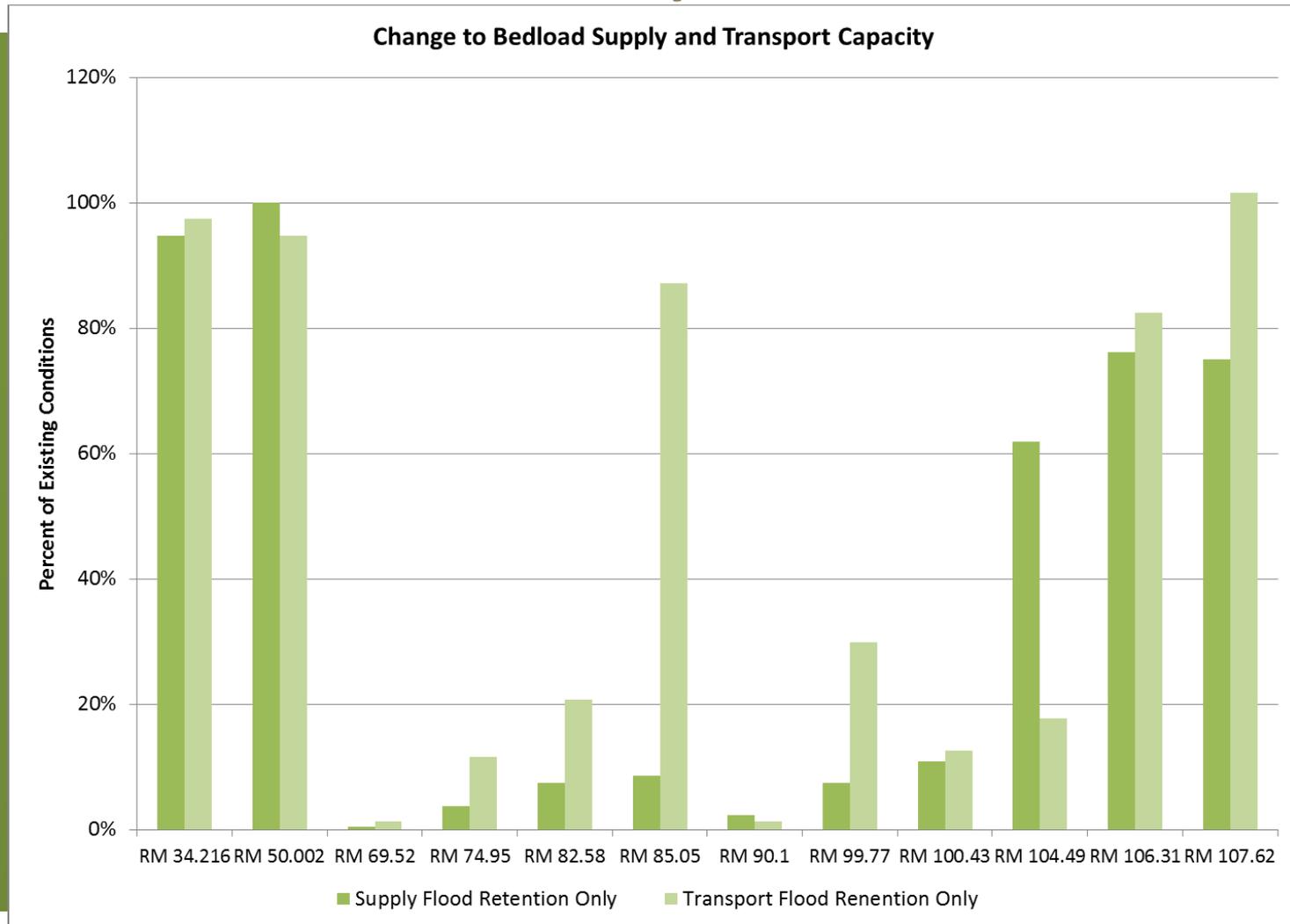
Balance of Changed Input/Transport – Multi Purpose

Change to Bedload Supply and Transport Capacity

Vertical axis: Percent of Existing Conditions (0% to 120%)

Horizontal axis categories: RM 34.216, RM 50.002, RM 69.52, RM 74.95, RM 82.58, RM 85.05, RM 90.1, RM 99.77, RM 100.43, RM 104.49, RM 106.31, RM 107.62

Legend: ■ Supply Multi Purpose   ■ Transport Multi Purpose
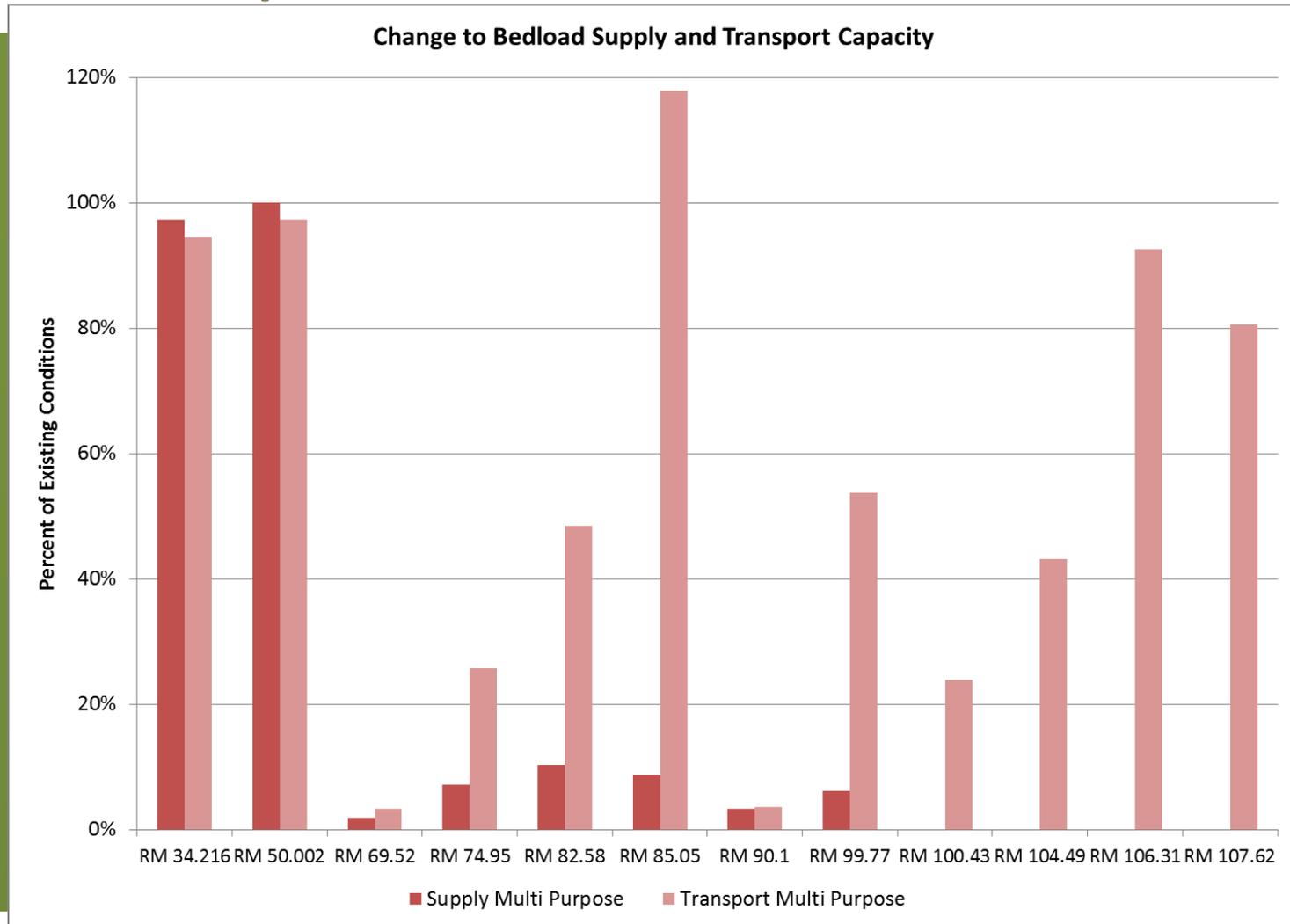
Channel Migration Analysis
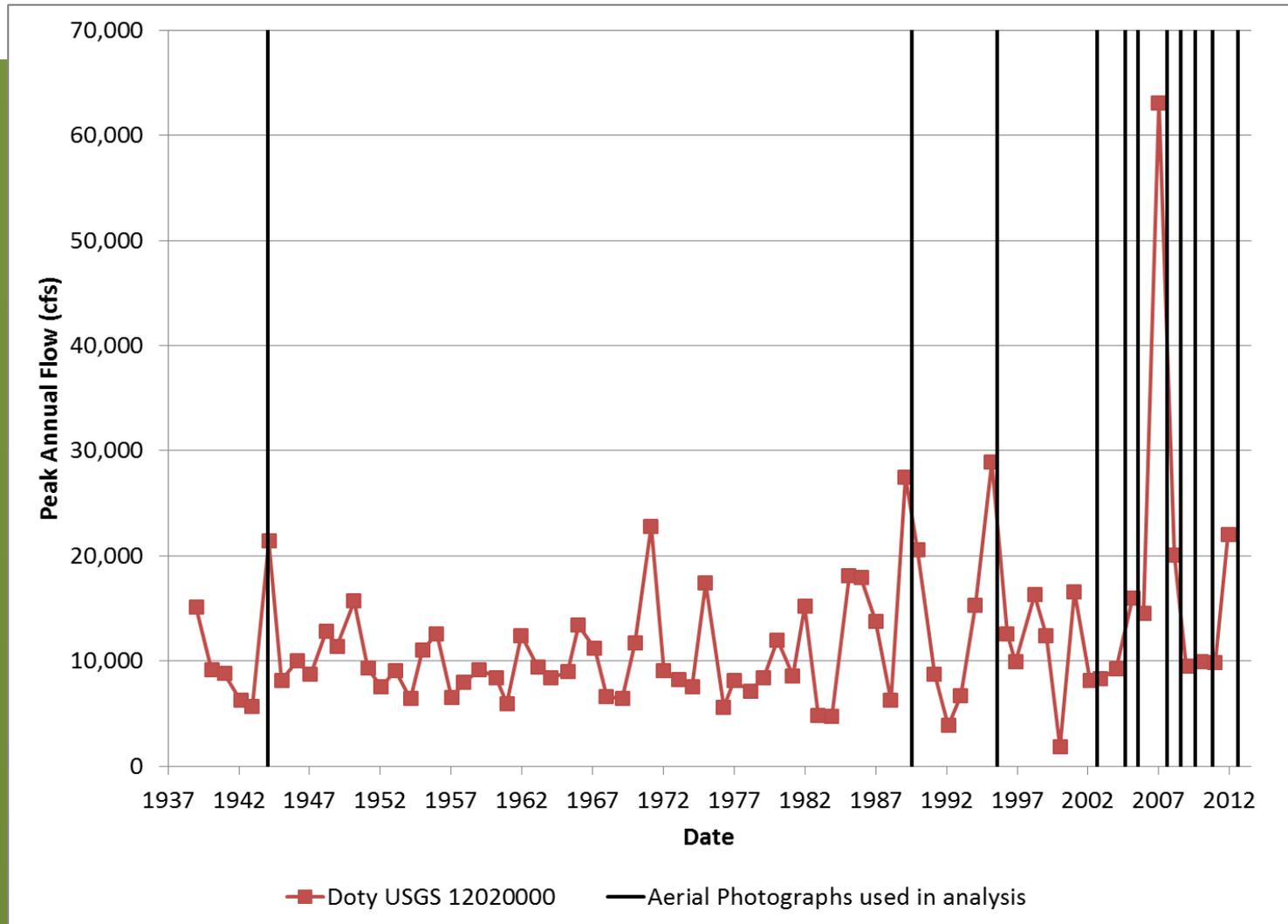
Channel migration – RM 104-105

Channel migration RM 88-91

Legend
2013
2011
2010
2009
2008
2006
2005 Channel
1996 Channel
1990 Channel
1990 Bars
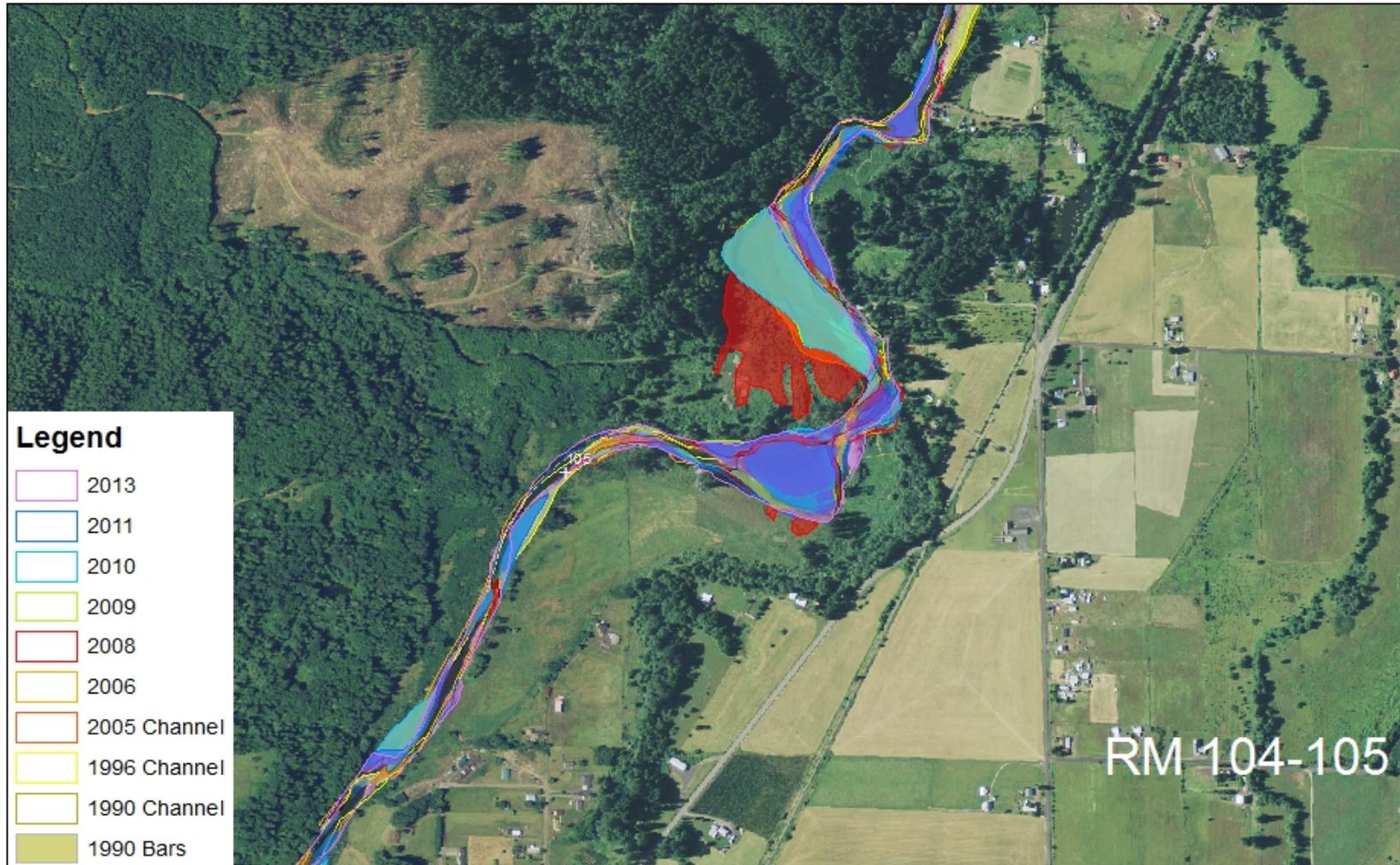
RM 88-91

Channel migration RM 82-86

Legend
- 2013
- 2011
- 2010
- 2009
- 2008
- 2006
- 2005 Channel
- 1996 Channel
- 1990 Channel
- 1990 Bars
- 1945
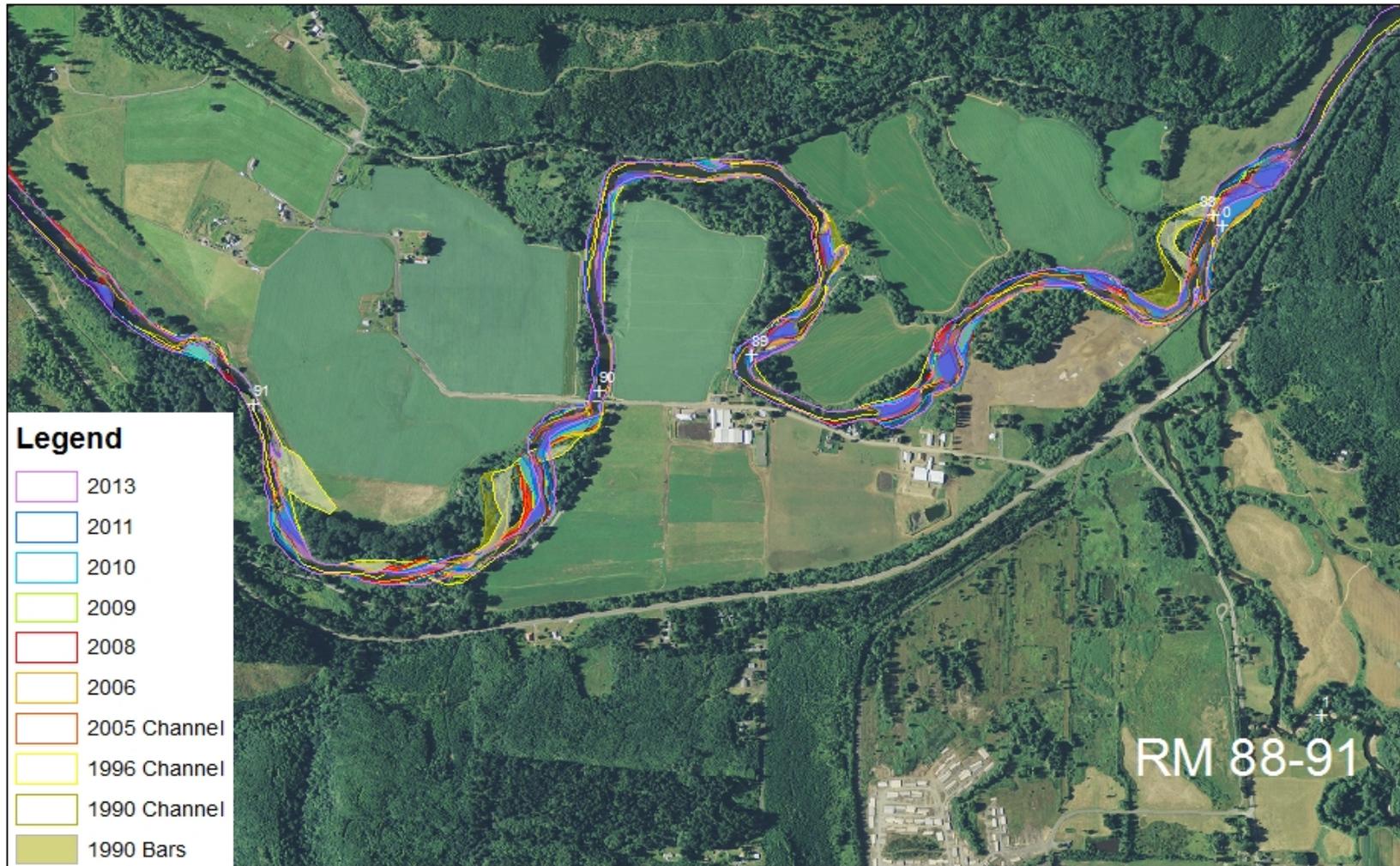
RM 82-86
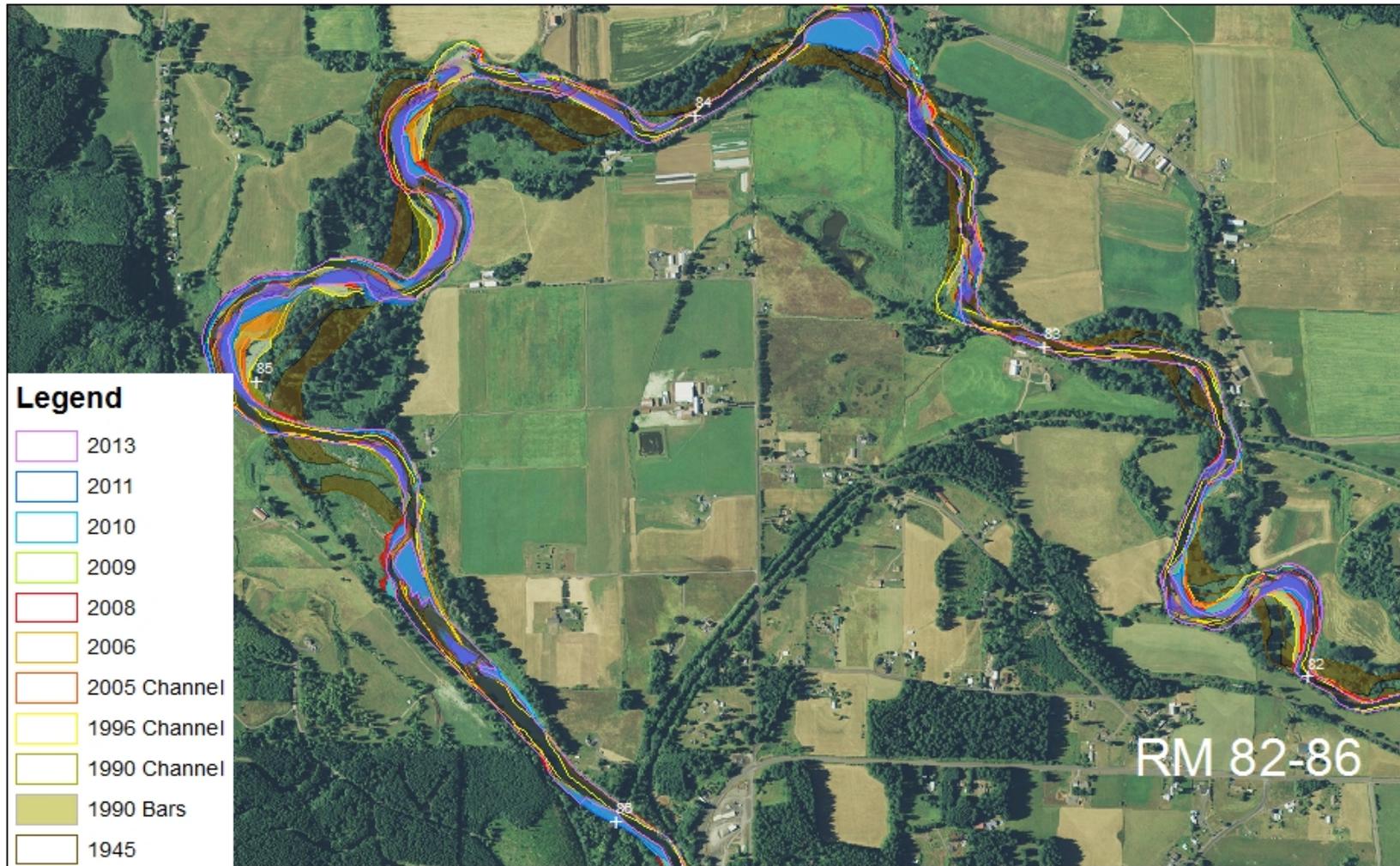
Channel Migration Rates
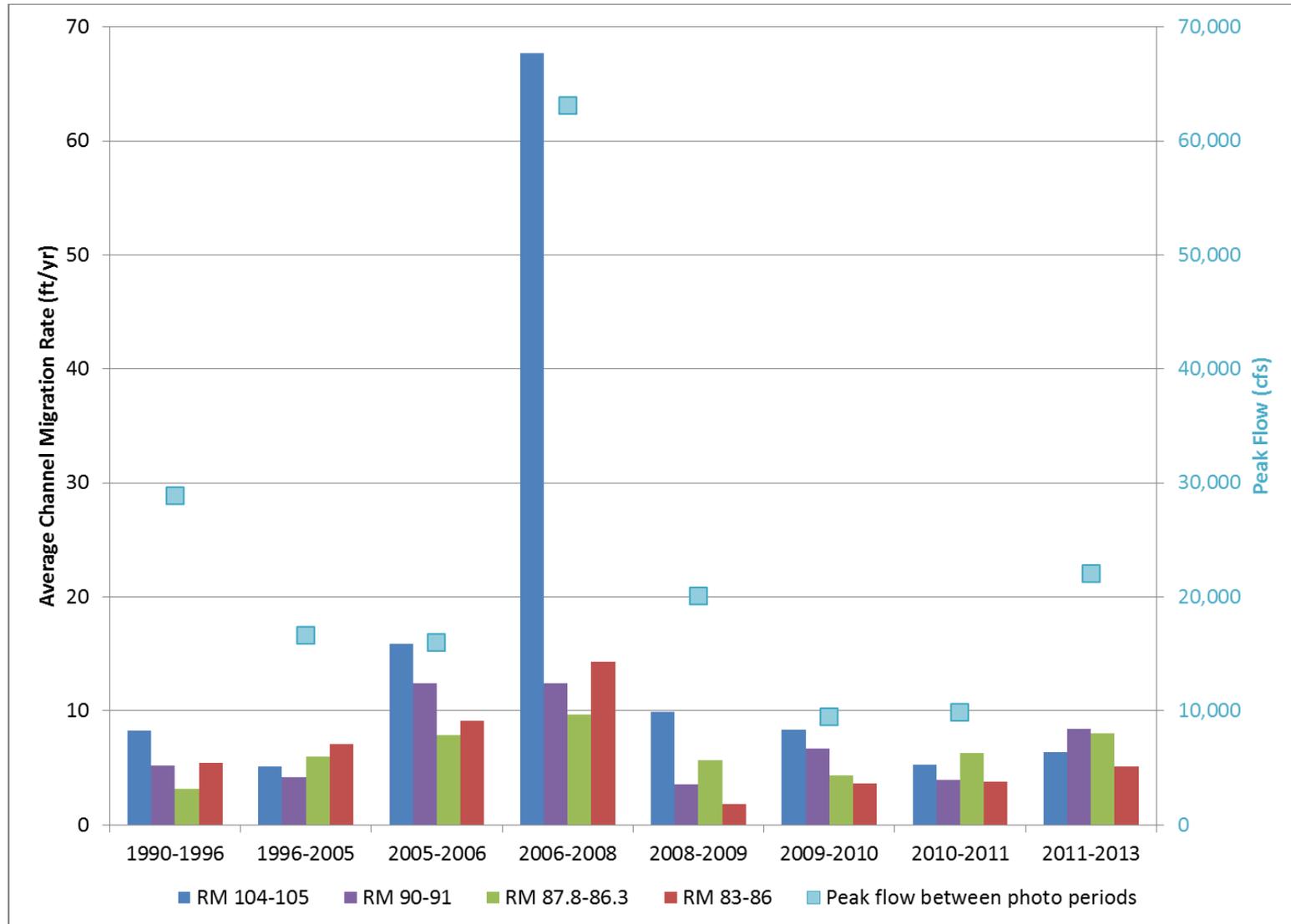
Channel Migration

- Small amounts of channel migration occur during small (2-year recurrence) peak flows ~10,000 cfs at Doty

- Major channel change takes place in response to large woody debris loading (e.g., 2007)

- Reduction in peak flows under with-Project scenarios would likely result in narrower active channel and somewhat less channel migration

Large Woody Debris

- Existing low levels of large woody debris
- Large woody debris would be trapped in either reservoir
- Management plan – likely transport wood around structure, place in downstream channel
- Interruption/reduction of large woody debris transport
- Less input of large woody debris if less bank erosion between dam and RM 70

Bedload Transport through Reservoir

- Bedload transport would occur if:
  - No pool
  - Discharge high enough to transport bedload
- Multi-purpose – pool at all times, no bedload transport through reservoir, approx. 90% of fine grained sediment retained
- Flood Retention Only – pool only during peak flows; portion of bedload would be transported through structure (50-75%)

Bedload Transport Through Flood Retention Only Reservoir

Estimated Bedload Transport Capacity through Flood Retention Only Reservoir
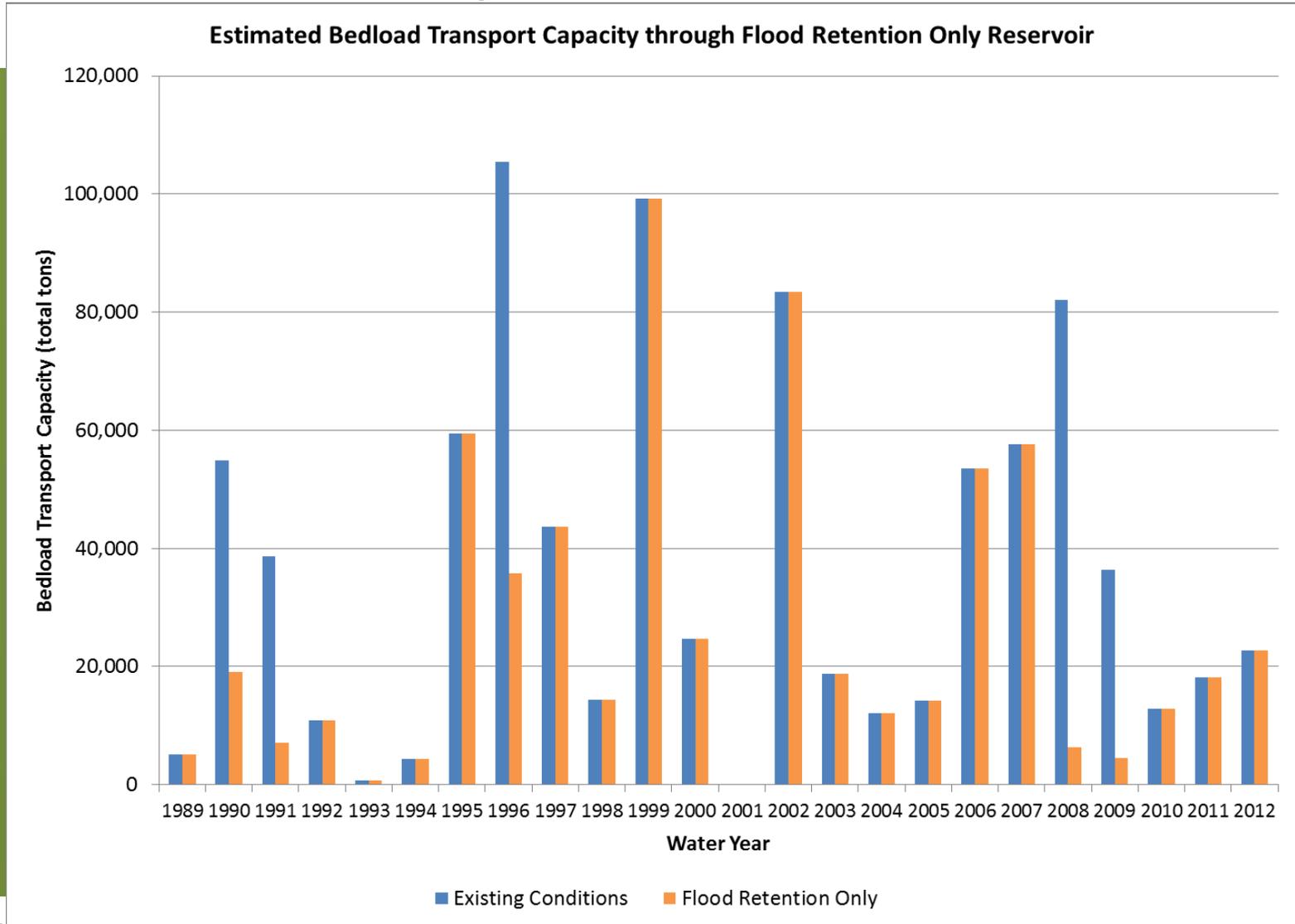
Reservoir Sediment and Debris Loading

- Long term operations/maintenance concern
- Multi-Purpose
  - All bedload, 86-93% of suspended load (42 acre-ft/yr)
- Flood Retention Only
  - 25-50% of bedload (4.3-8.7 acre-ft/yr)
- Larger amounts of woody debris expected during floods with 10-25 year recurrence interval
- 2007 flood event (extreme flood)
  - 2,000-3,000 acre-ft of coarse sediment
  - 230 acre-ft of woody debris

Geomorphic Reaches and Sub-Reaches
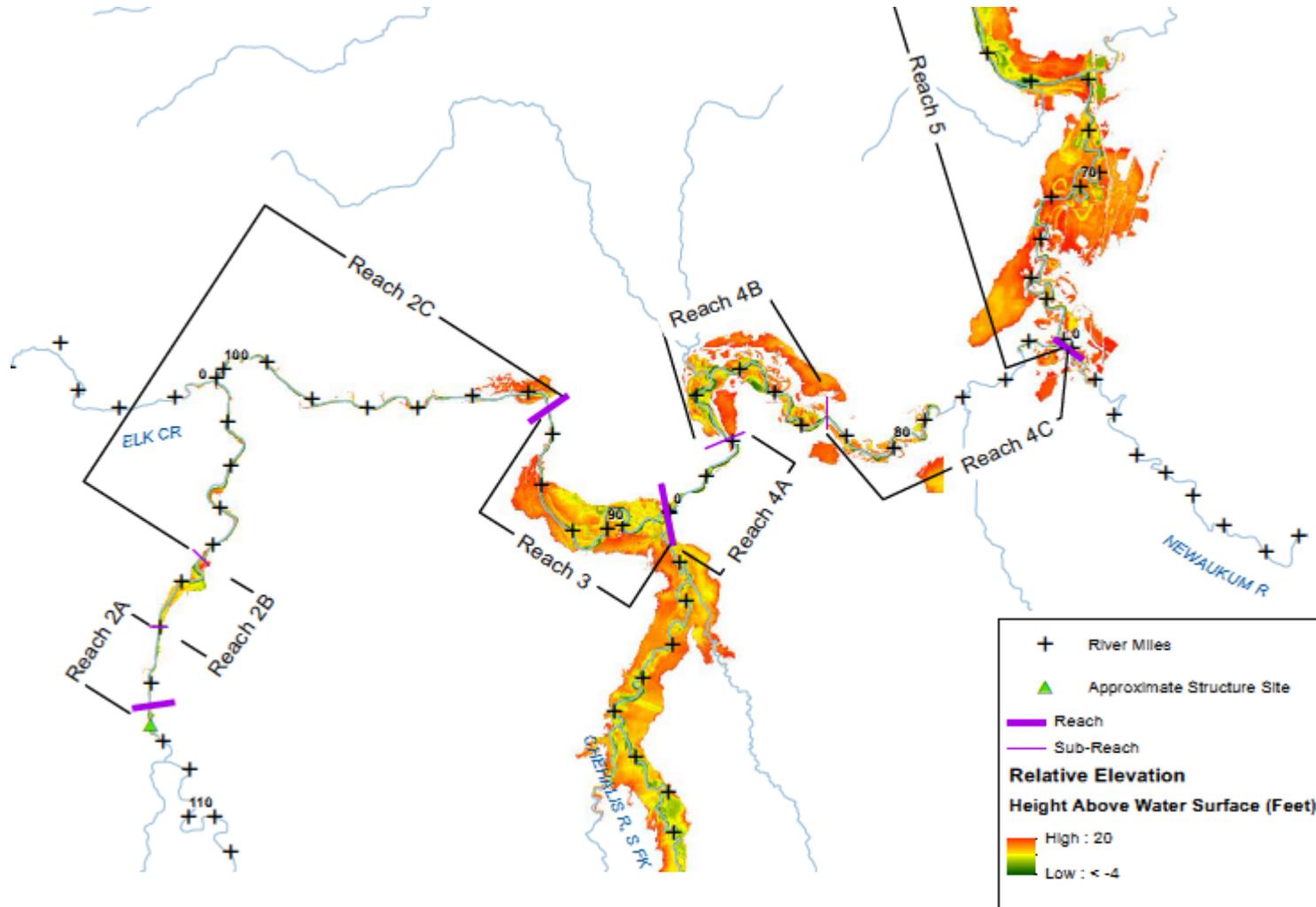
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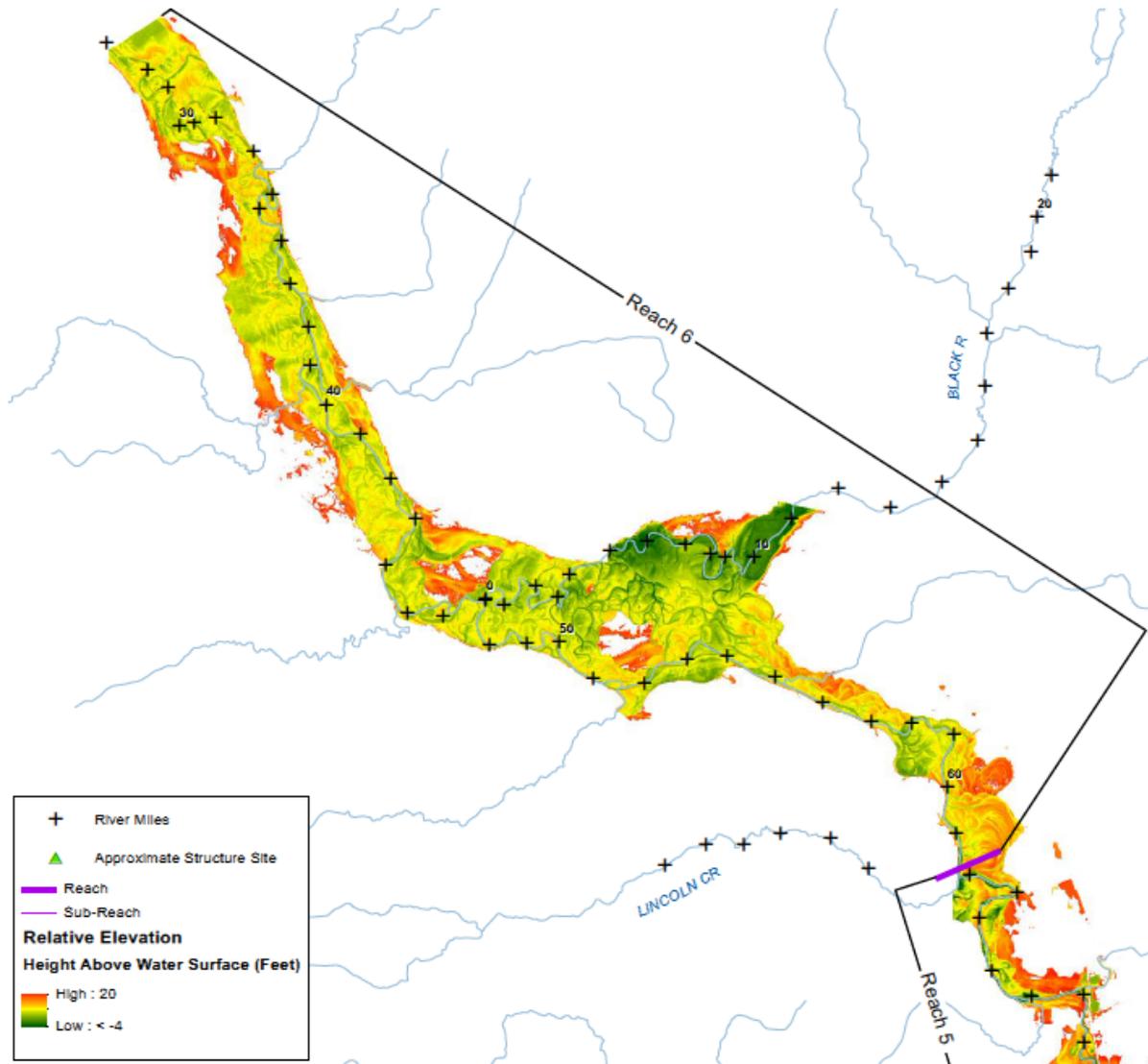
Effects on Aquatic Habitat

Reach 1 – Reservoir

Variable	Flood Retention Only	Multi-Purpose
Substrate/Spawning Gravel	Finer substrate/ transient delta	Inundated
Channel Width/Depth	Likely wider/ shallower wetted channel	Inundated
Large Woody Debris	Wood trapped – transported around dam	Wood trapped – transported around dam
Channel Migration	n/a - confined	n/a - confined

Effects on Aquatic Habitat

Confined Reaches – 2A, 2C, 4A, 4C

Variable	Flood Retention Only	Multi-Purpose
Substrate/Spawning Gravel	Minor changes	Erosion/ coarsening
Channel Width/Depth	Minor changes	Possible narrower channel
Large Woody Debris	Likely less LWD	Likely less LWD
Channel Migration	n/a - confined	n/a - confined

Effects on Aquatic Habitat

Unconfined Reaches – 2B, 3, 4B

Variable	Flood Retention Only	Multi-Purpose
Substrate/Spawning Gravel	2B - Continued aggradation/fining 3 - Minor changes 4B – Possible coarsening	Erosion/ coarsening
Channel Width/Depth	Minor changes	Possible narrower channel
Large Woody Debris	Likely less LWD	Likely less LWD
Channel Migration	Likely less channel migration	Likely less channel migration

Effects on Aquatic Habitat

Reaches 5, 6 – Downstream of RM 75

- Limited changes – bedrock control re-sets bedload transport

- Tributary input of water/wood sediment mute effects of flood control facilities

Questions