A New Flow Regime, Ethics, and Beavers:

A 30-year story of Eastern Sierra Stream Restoration and An Uncertain Future

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Geosyntec consultants
engineers | scientists | innovators

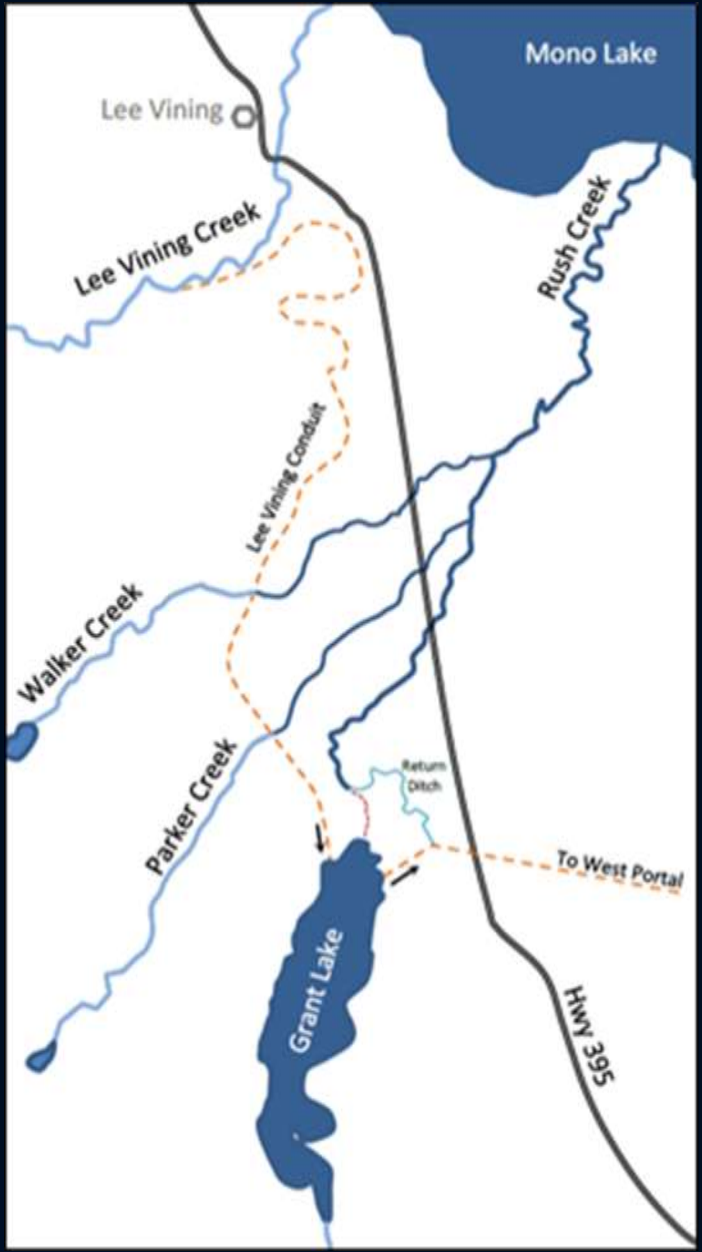
Presentation Outline

1. Geographic context
2. Project background
3. The new stream flow
4. Long-term bed degradation Analysis
5. Beavers - a new(er) partner
6. Beavers - an unlikely hero?

Geographic Context

Eastern Sierras Timeline

- Late 1800's to 1940: Agricultural Diversions Increase in the Mono Basin
- 1940: LADWP's Water Right Applications 8042 and 8043 Approved
- 1979: Public Trust Lawsuit Filed
- 1986: Continuous Flows Reintroduced to Streams
- 1994: Landmark Decision 1631
- 1998: Order Nos. 98-05 and 98-07 Issued; Monitoring Program Begins
- 2010: Synthesis Report Finalized
- 2011: Facilitated Process Initiated
- 2013: Settlement Agreement Signed
- 2021: Environmental Document approved by LADWP Board



Looking Back to 1987

Lower Rush Creek – Reach 4

Lower Rush Creek – Reach 5

Current Status

Through the implementation of Scientist Recommended Stream Flows D1631/ 98-05 (SRFs)

- The Stream Recovery Program is a Success Story
- Status of Restoration Compliance is Complete
- Termination Criteria per Order 98-07 are Achieved
- State-Appointed Stream Scientists Recommend
  - New Stream Flow Regime (SEFs) to "accelerate restoration"
  - Termination Criteria no longer needed

LADWP's Restoration Progress

- Total woody riparian acreage for Rush and Lee Vining Creeks exceeds established targets
- Stream lengths are all within established targets except for two reaches on Lee Vining where they are impractical, and revisions would be justified
- Fisheries conditions are stable, productive, and self-sustaining based on review of annual measured data and original established criteria along with comparison to other applicable Eastern Sierra streams

Tributary	Vegetation	Channel Length	Fisheries Condition
Rush Creek	~1,200 acres	43,705 ft	Stable, productive and self-sustaining
Lee Vining Creek	~600 acres	21,705 ft	
Parker Creek	~300 acres	NA	
Walker Creek	~250 acres	NA	

Figure 24. Brown trout with PIT tag #17021569 recaptured in the Bottomlands section in 2014.

A New Stream Flow:
SRF ("old") vs SEF ("new")

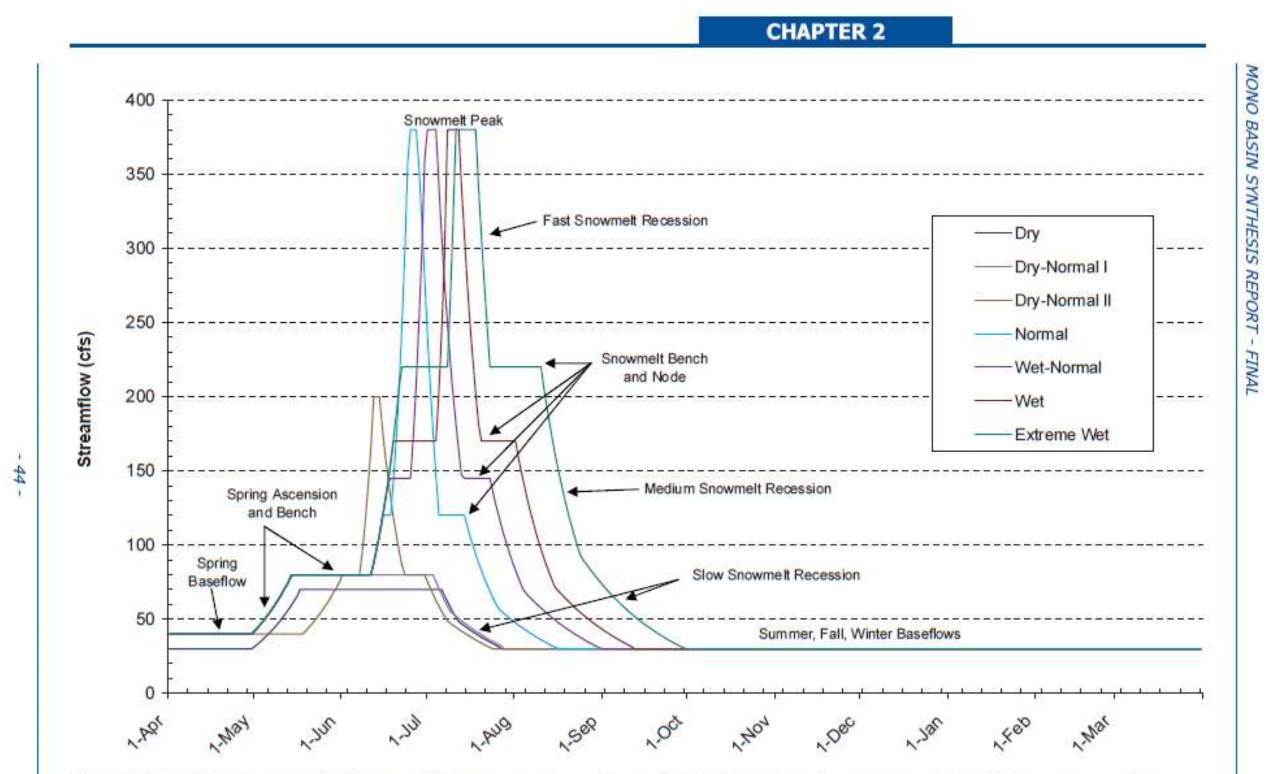


Figure 2-7. Rush Creek proposed SEF Annual Hydrographs released via the MGORD (not including recommended spills) for seven runoff year types.

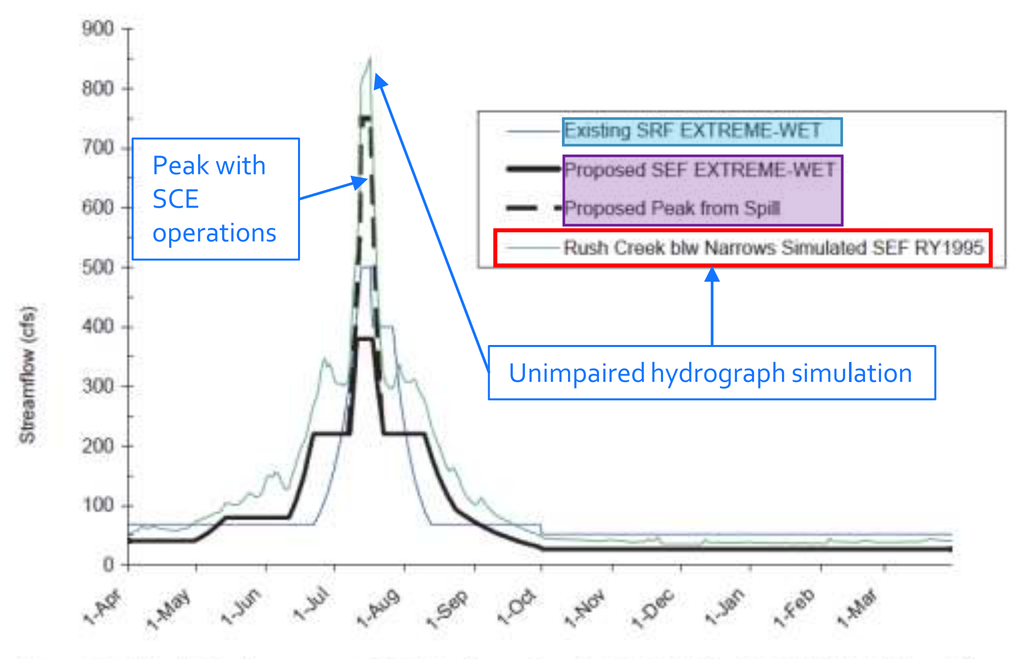


Figure 2-14. Rush Creek recommended SEF releases from the MGORD for EXTREME-WET runoff years.

- We supported the addition of hydrograph components with minor to moderate changes in flow magnitude and duration based on data

- 1940 condition had impaired flow conditions already from irrigation diversions and SCE operations in upper watershed
- The legal framework only pointed back to restoring the 1940 condition…
- SEF peak flow <u>environmental</u> effects

Long-term Bed Degradation Analysis

- Operational Considerations
  - (eSTREAM)
- Water Temperature
- Hydrology/Exports
  - Volume
  - Frequency
  - Duration
- Hydraulics
  - Inundation
  - Shear Stress
  - Velocity
  - Depth
- Floodplain Connectivity
- Sediment Transport
  - Bank Erosivity
  - Bedload Transport and Bed Scour
- Geomorphic Analyses – RY 2017/2018
  - Channel and Infrastructure Investigations
  - Geomorphic Change Detection (GCD)

Geomorphic Change Detection (RY2017/2018)

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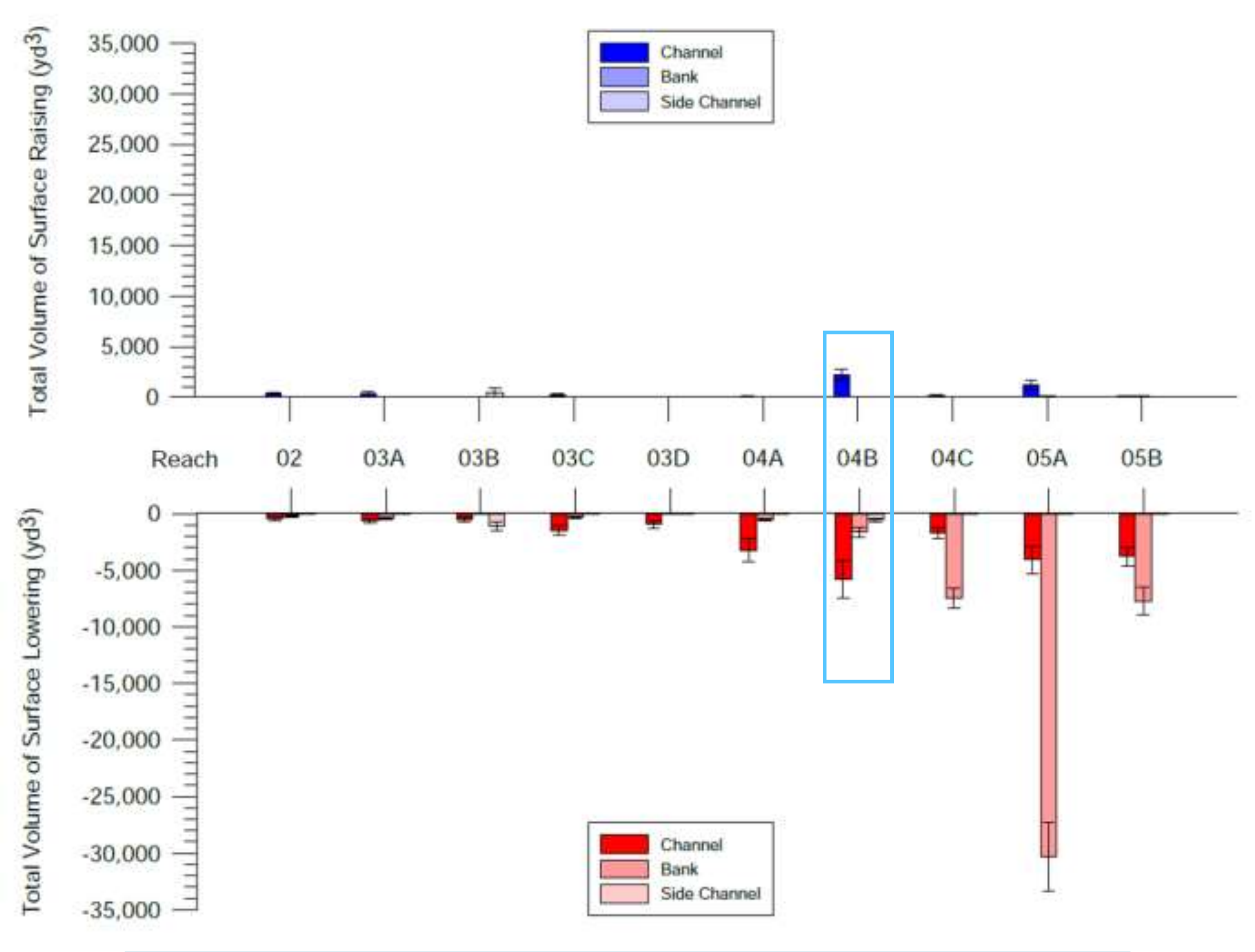

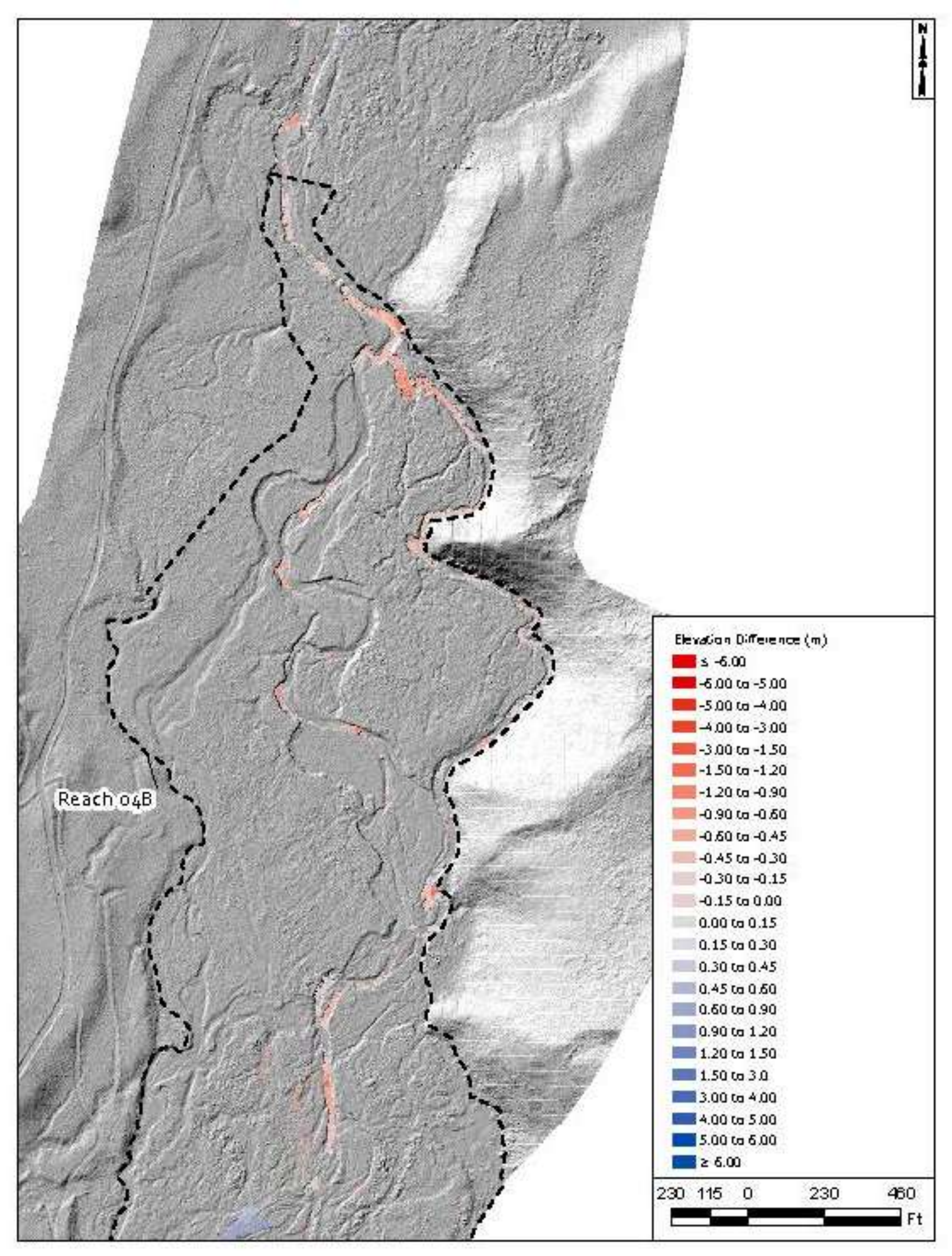

RY 2017/2018 → significant changes in bed and banks

Geomorphic Change Detection (RY2017/2018)

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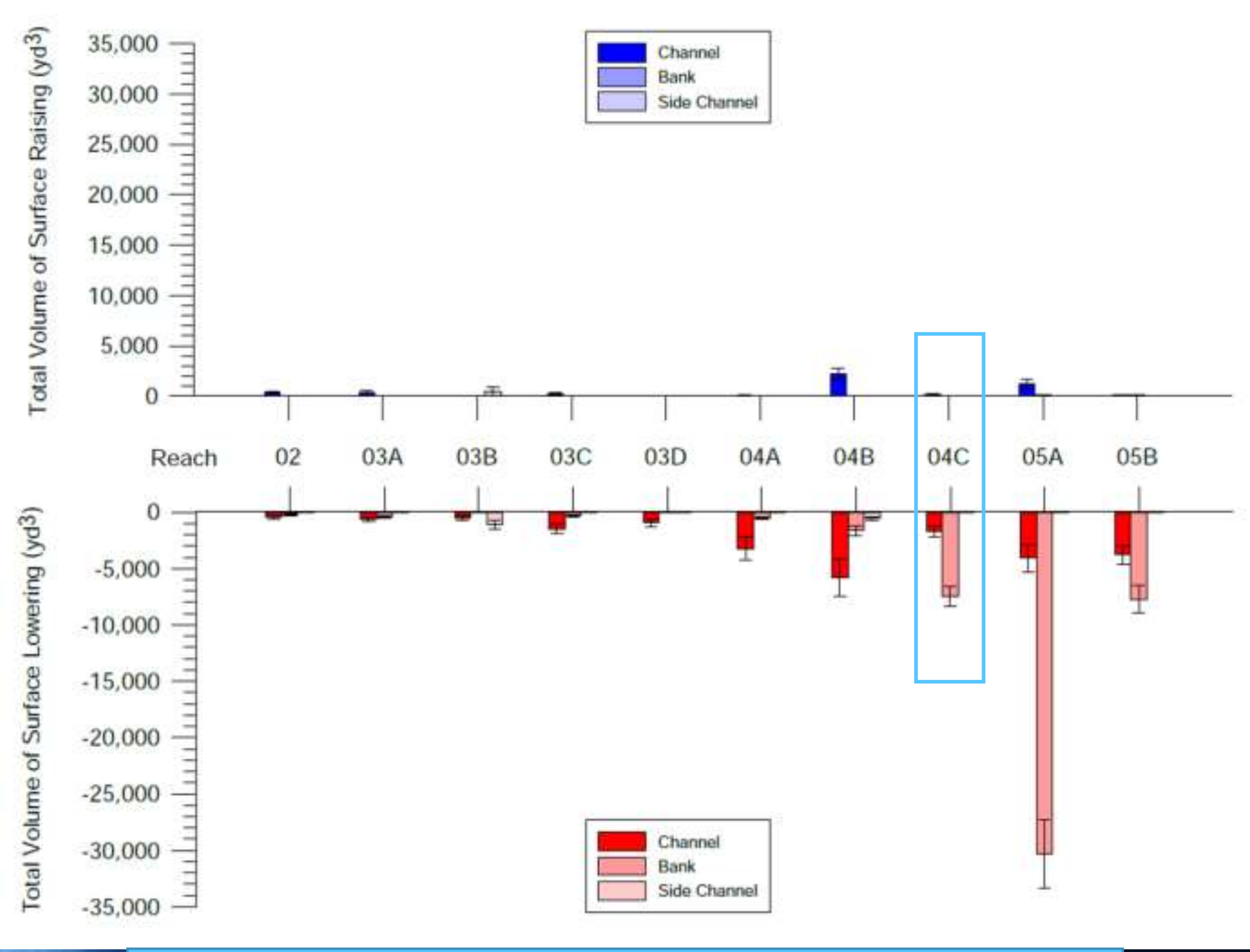

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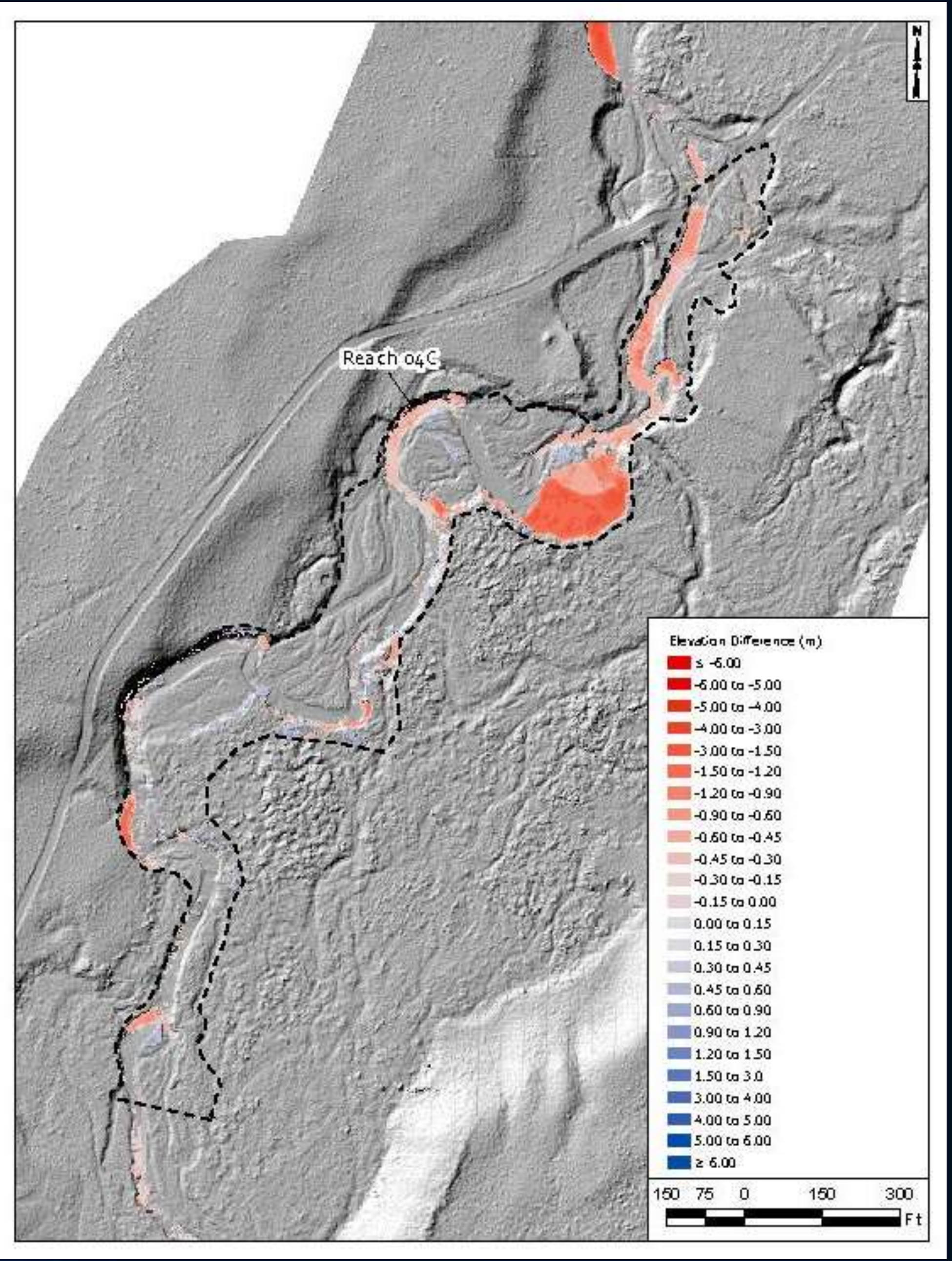

Geomorphic Change Detection (RY2017/2018)

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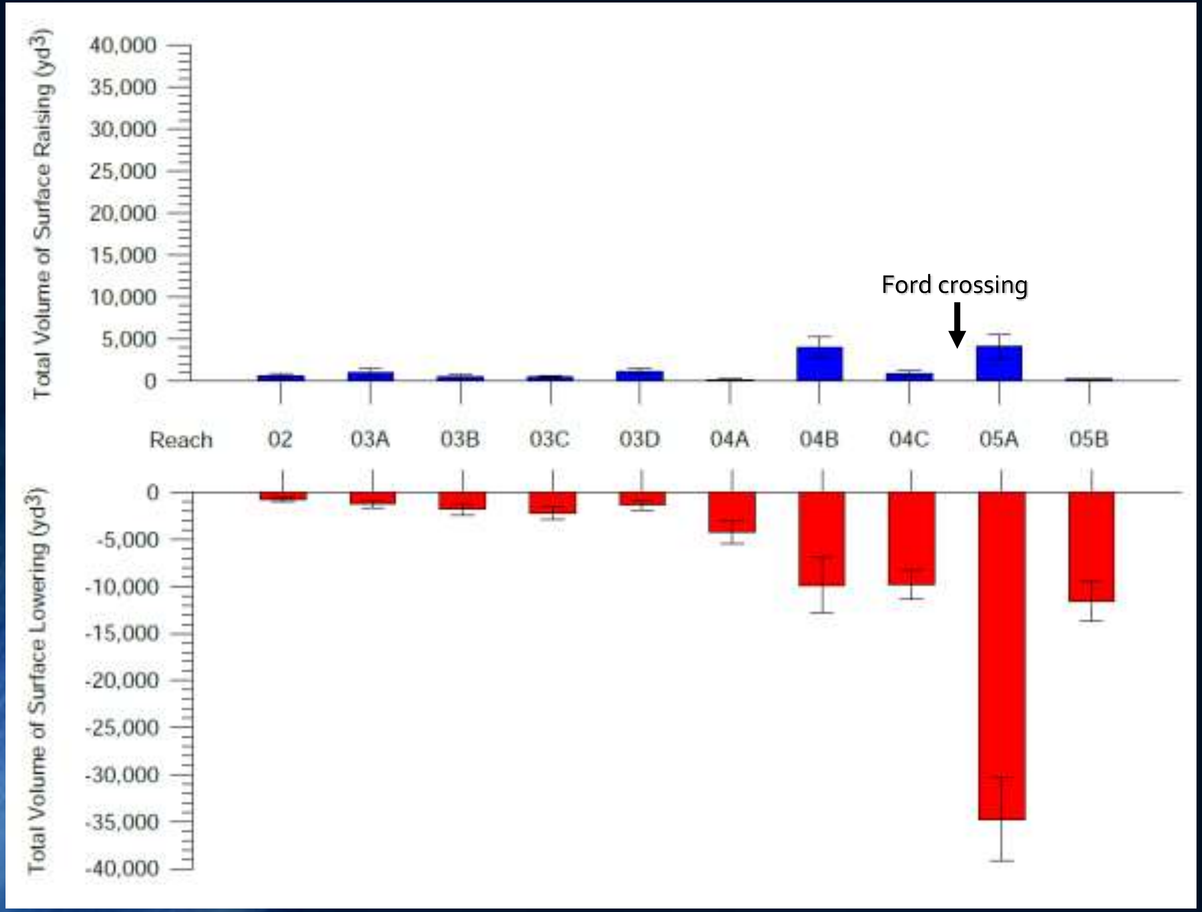
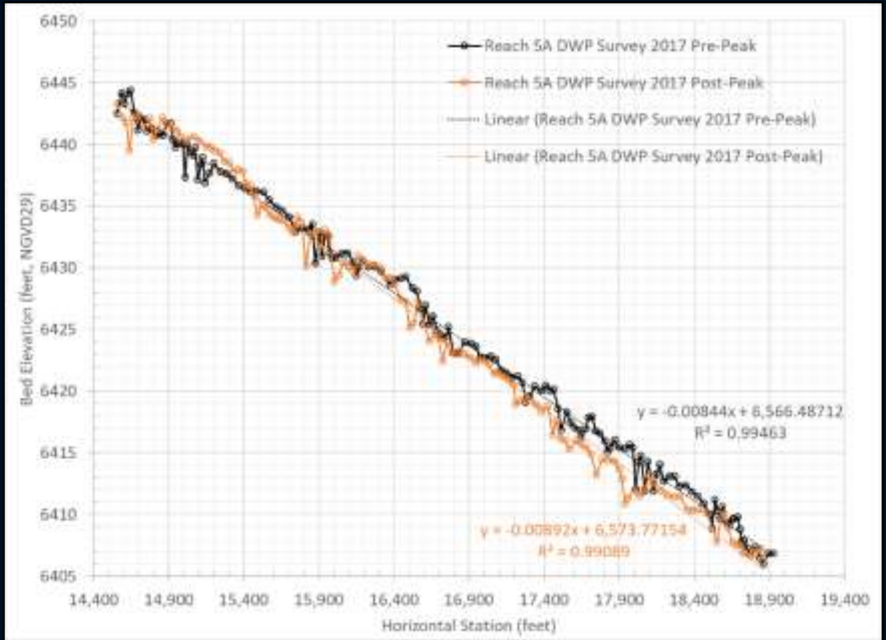
Rush Creek

Cumulative Volume of Erosion (red) and Deposition (blue)

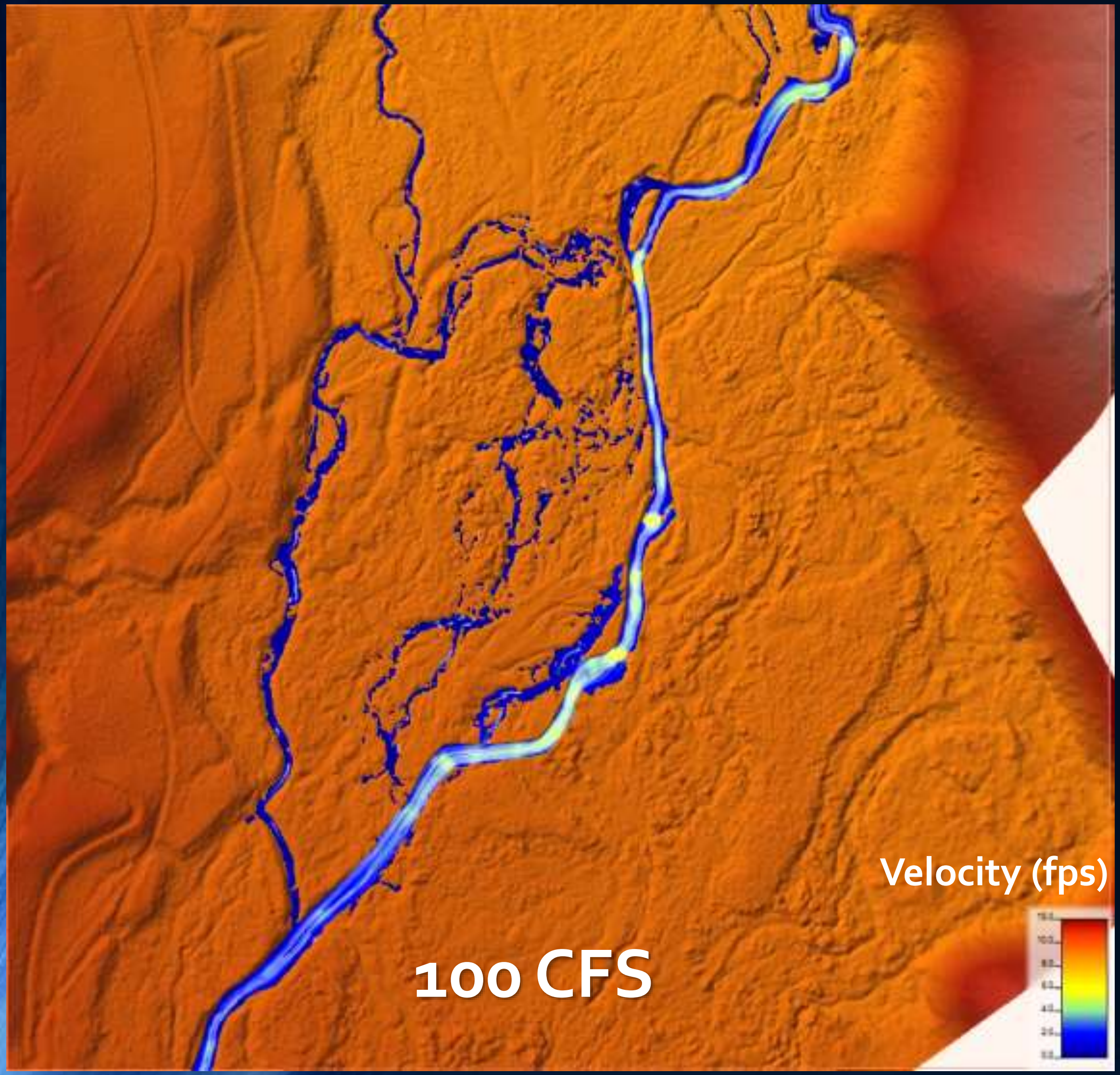


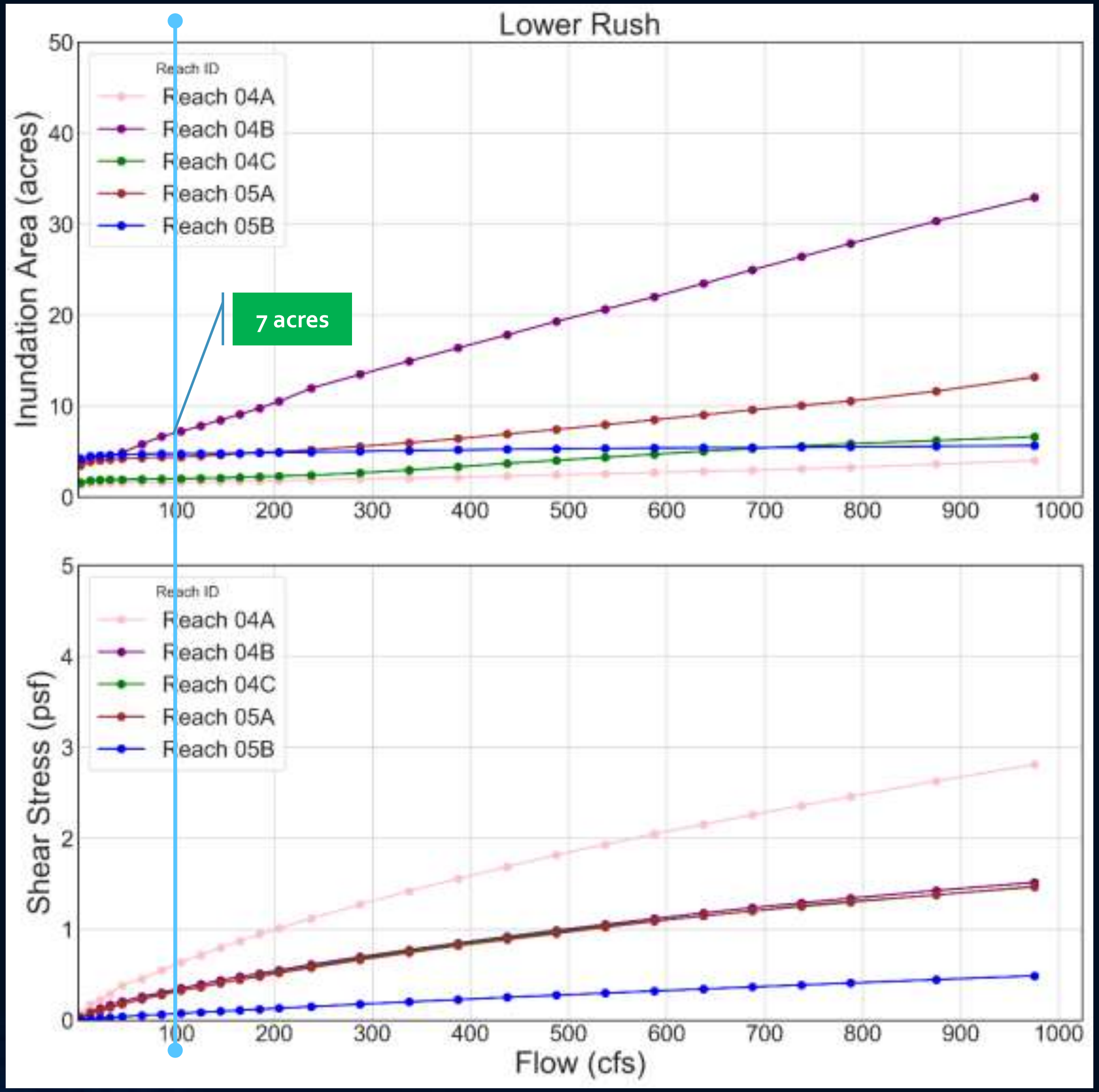


Rush Creek lost a total of 64,090 cubic yards of bed and bank material in 2017

Analyses

Hydraulics – Lower Rush Creek Example





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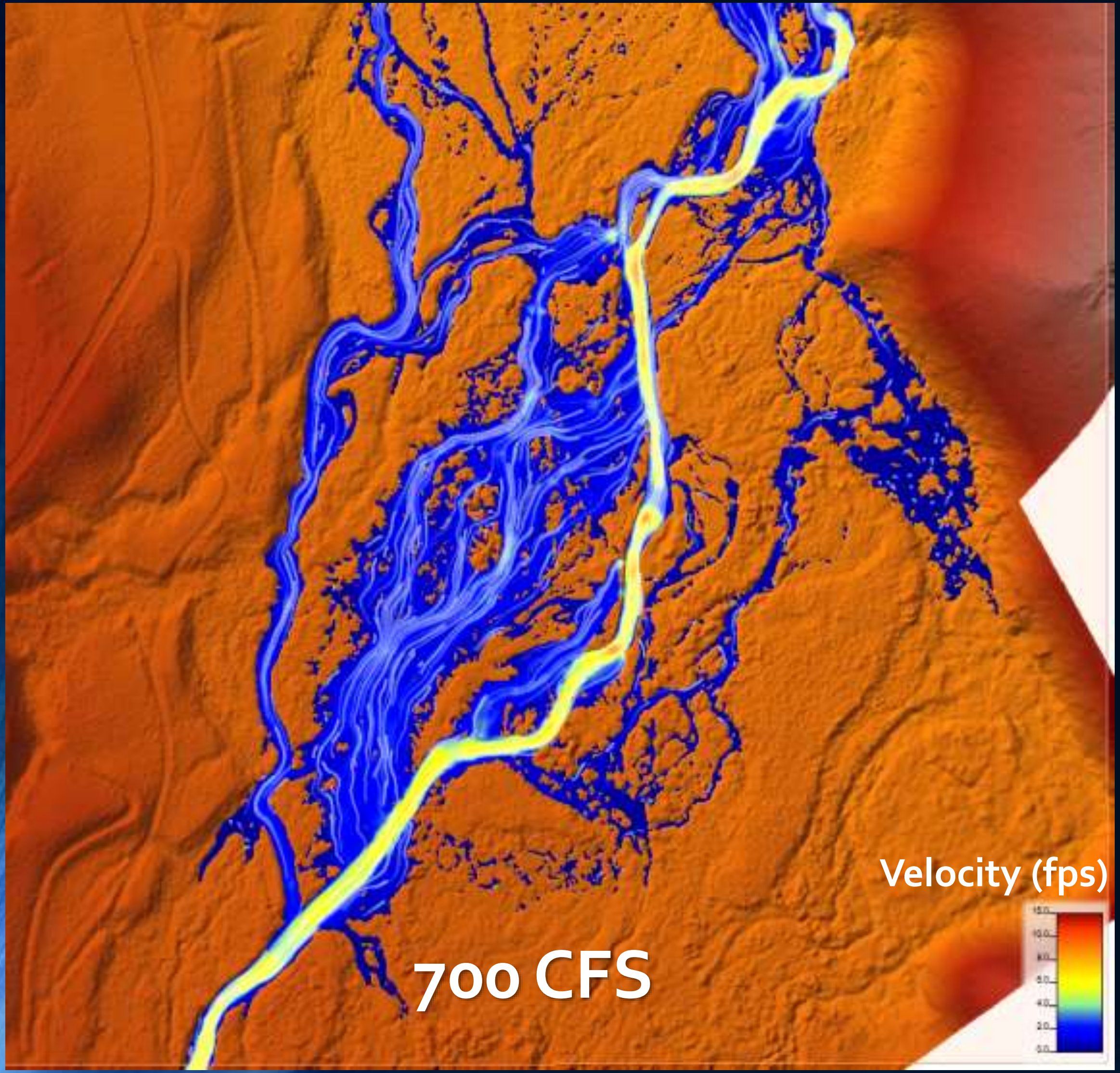
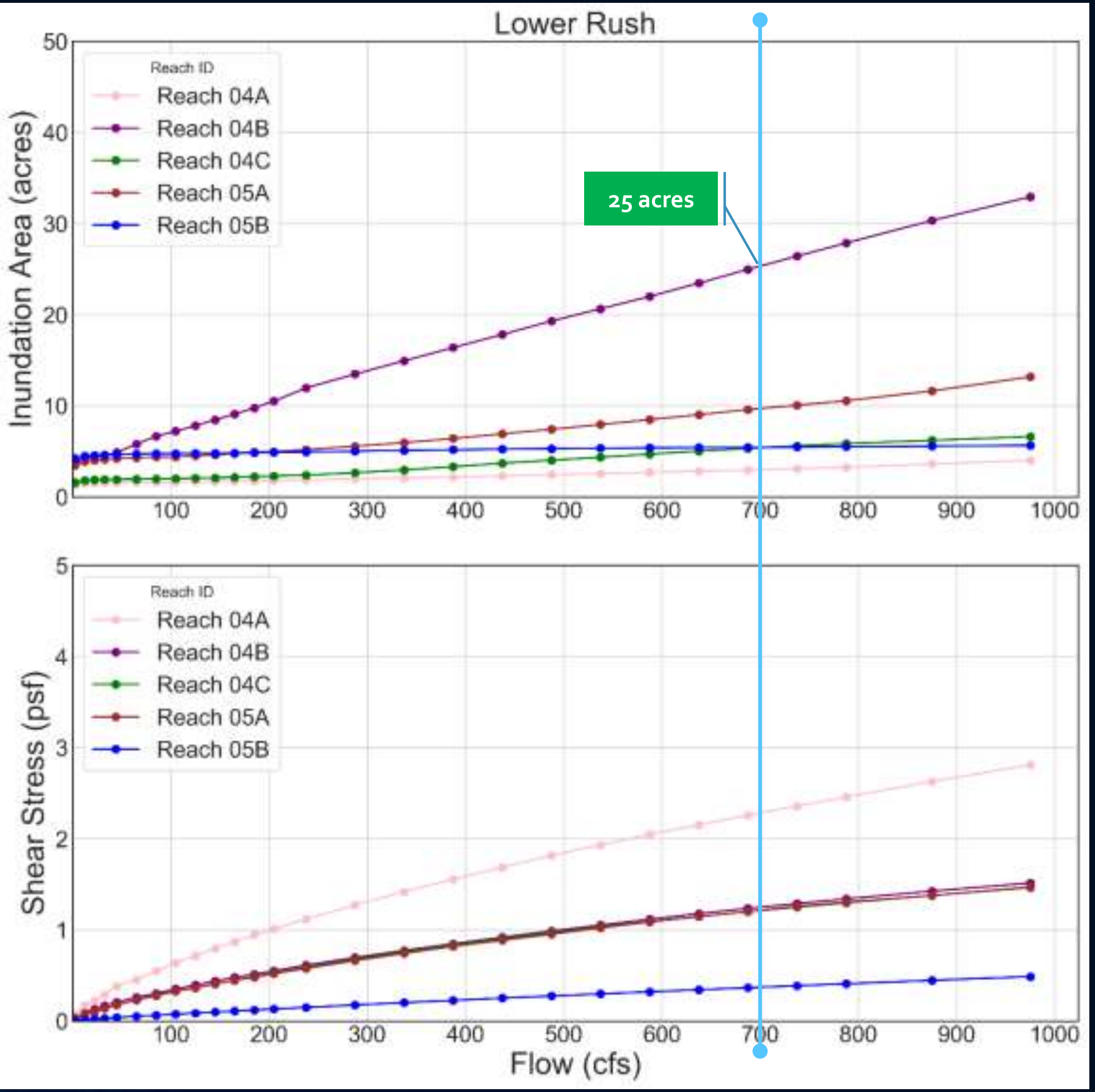
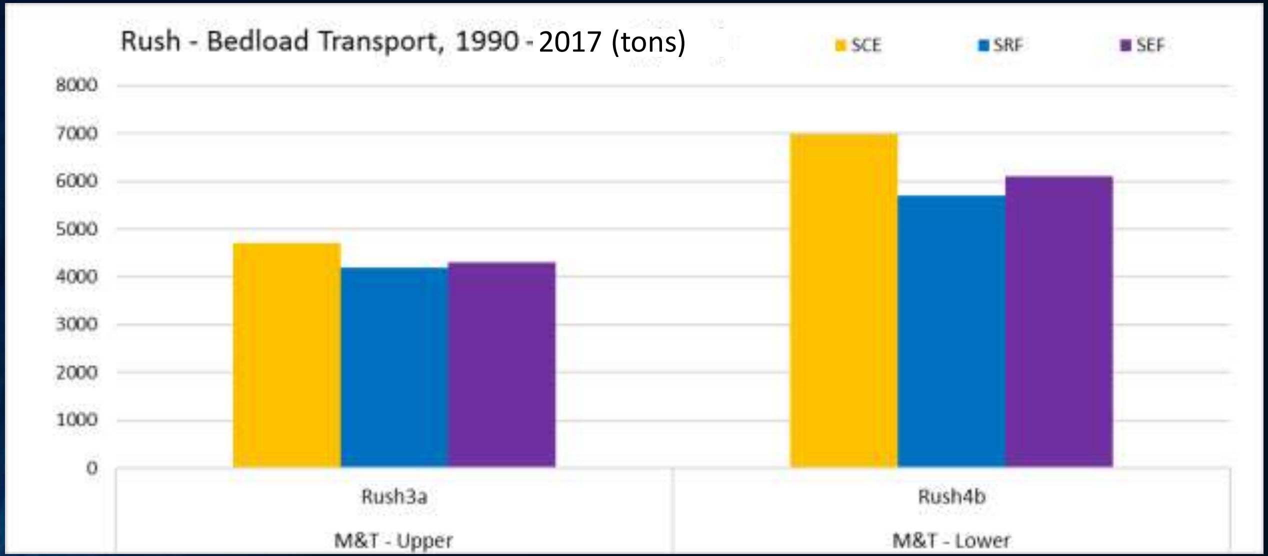
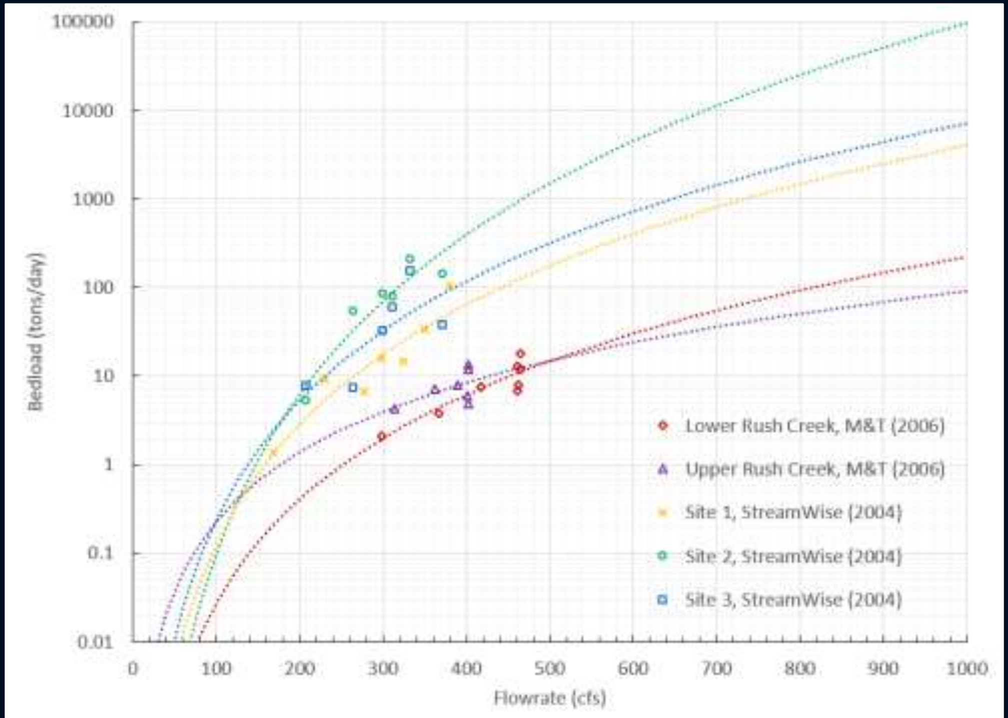




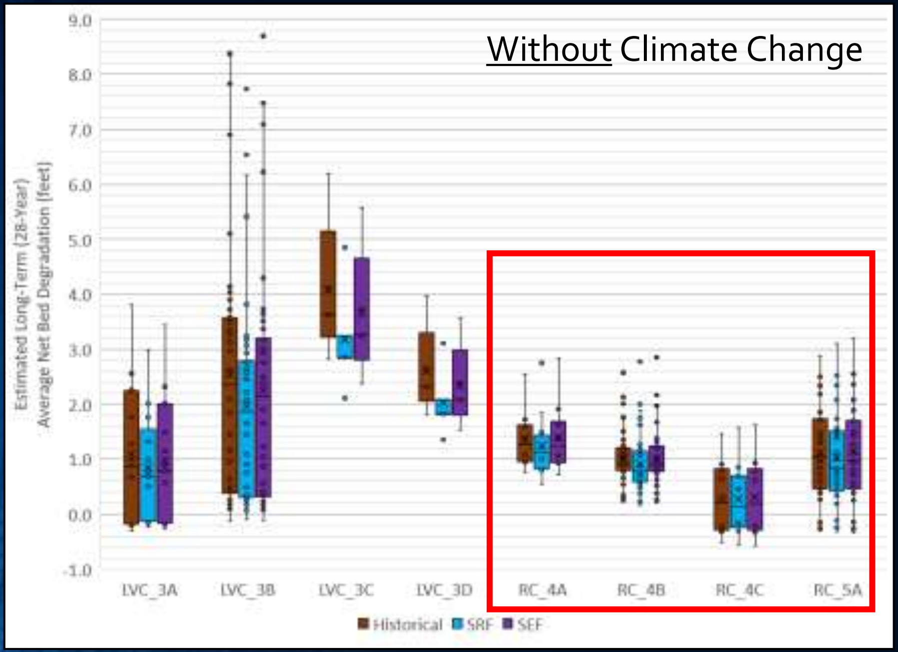
Sediment Transport – Bedload Transport and Bed Scour





Rush Creek: Bedload transport for SEF is slightly higher than SRF. Upper Rush is more resistant to incision; however, Lower Rush is more susceptible to increased vertical instability with the SEF since it possesses a less course substrate and has a limited sediment supply.

28-year Bed Degradation Potential Prediction



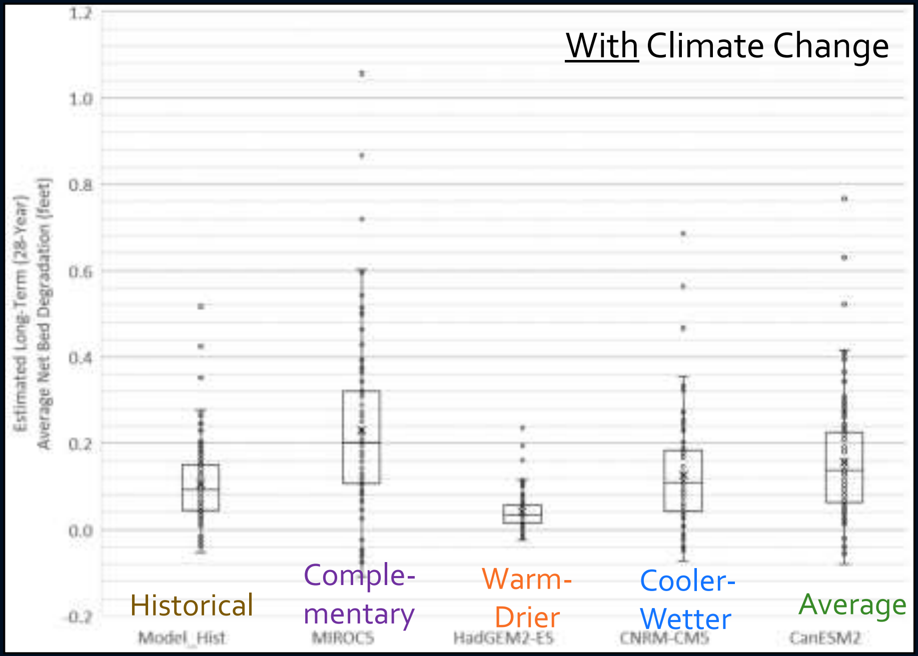


Table 1. Rush Creek Long-Term (28-Year) Average Net Bed Degradation Results (feet) without Climate Change

Reach	Combined		4A		4B		4C		5A	
Flow Scenario	SRF	SEF	SRF	SEF	SRF	SEF	SRF	SEF	SRF	SEF
Sample Size	105	105	10	10	50	50	10	10	35	35
Maximum Outlier	3.11	3.20	2.75	N/A	2.77	2.85	N/A	N/A	N/A	N/A
Upper Limit	2.09	2.37	1.86	2.83	1.89	1.95	1.57	1.62	3.11	3.20
3rd Quartile	1.29	1.38	1.43	1.70	1.15	1.25	0.70	0.83	1.51	1.70
Mean	0.93	1.03	1.25	1.39	0.92	1.02	0.28	0.31	1.03	1.15
Median	0.81	0.92	1.11	1.24	0.78	0.90	0.15	0.20	0.84	0.99
1st Quartile	0.58	0.70	0.82	0.93	0.59	0.77	-0.25	0.29	0.43	0.47
Lower Limit	-0.32	-0.33	0.54	0.72	0.16	0.21	-0.55	-0.57	-0.33	-0.33
Minimum Outlier	-0.55	-0.57	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

- Riparian groundwater response to changes in flow stage height have shown that stage changes even as small as 0.1 to 0.25 ft can lower the local groundwater between 2.15 ft (in fall) and 0.56 ft (in summer), respectively (Synthesis Report, 2010).

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Bed Degradation Conclusions

1. For both creek systems, the SEF results in approximately 14-percent more bedload transport over the long-term, on average, than the SRF.

2. Estimates of the 28-year net average bed degradation (w/o climate change) for Rush Creek have a reach average of 0.9- to 1.0-feet for the SEF versus 0.8- to 0.9-feet for the SRF, while small can magnify reduction in groundwater availability bordering riparian areas.

3. Long-term bed degradation results by reach while small do not reflect local (sub-reach) and habitat-scale changes (typically greater). However, they do provide a basis for assessing long-term channel degradation behavior. Therefore, monitoring at the local level remains necessary.

4. The four climate models applied to the data illustrate the variability in the results and magnitude of potential change in long-term bed degradation. Three of the four climate models analyzed result in increased long-term bed degradation under the SEF.

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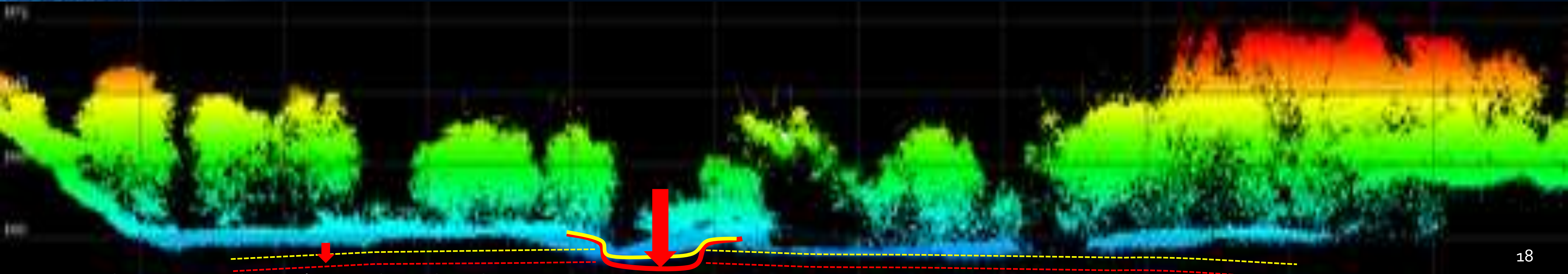
Expectations Going Forward

- Current geomorphic and vegetative "dynamic equilibrium" will adjust over the next several decades
- During the adjustment period, temporary changes may include:
  - Stream degradation ->
  - Reduction in floodplain access ->
  - Reduced groundwater access ->
  - Increased stress on riparian ecosystem ->
  - Potential effects to fisheries from negative feed-back loops, BUT….



Change in groundwater elevation due to degradation

Beavers – a new(er) partner

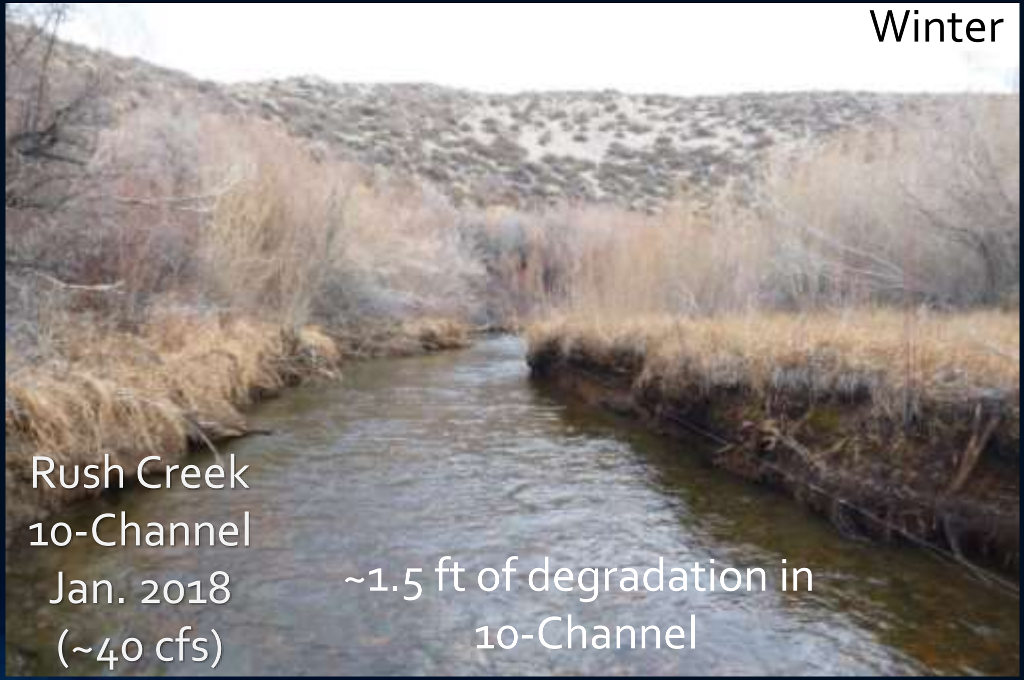
- Presence increased between 2013 and 2016 runoff years (drought)
- Dense willows provide reinforcement to dams during peak flows
- Influence channel morphology and shallow groundwater dynamics

Rush Creek

Geomorphic Work:

- Significant main channel aggradation, avulsion, and floodplain inundation
- Potential increase in active floodplain width caused by aggradation (and beavers?)

Impacts to Streams from Higher Peak Flows



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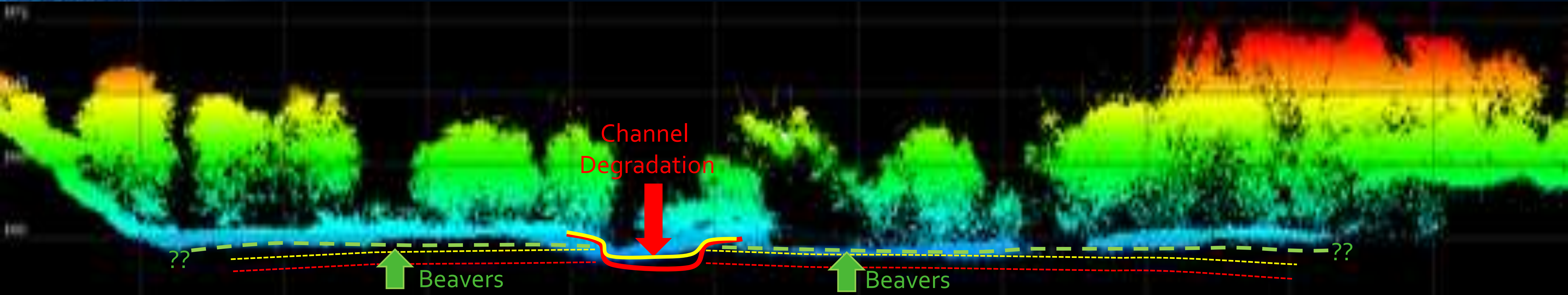
Beavers - An unlikely hero?

- Presence of beavers are providing a new dynamic to protect and enhance restoration progress
  - Increase floodplain groundwater levels
  - Reduce instream summer water temperatures
  - Reduce potential for degradation initiated by a change in peak flow regime (SEFs)
  - Enhance fishery age classes



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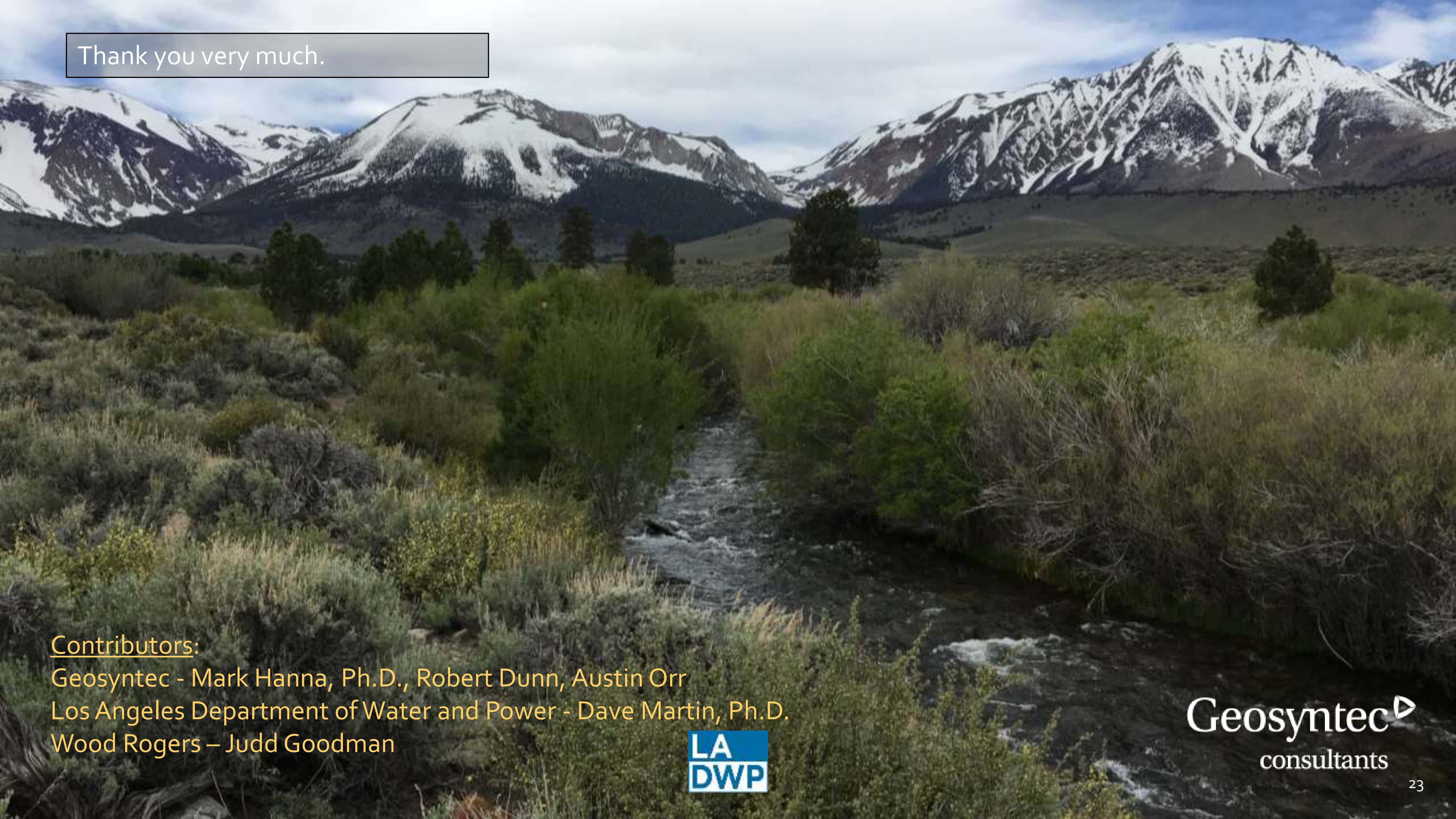

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