Using new satellites to supplement a river monitoring program: An example from the Dolores River

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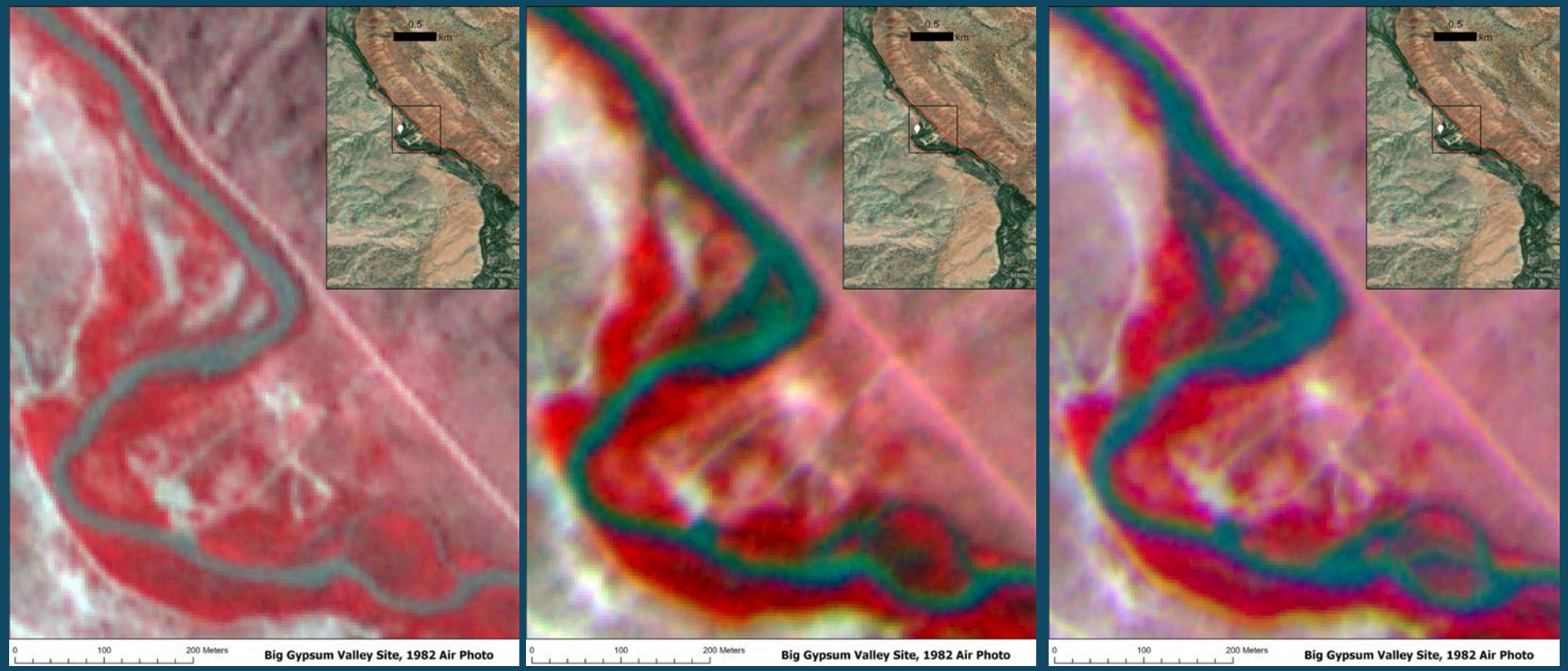

Wednesday, March 4, 2026 – Rivers Edge West Riparian Restoration Conference – Grand Junction, CO

DRAMS Project

Funding

Partners

Academic Team

- Melissa Clutter, FLC Geosci
- Carolyn Cummins, FLC Water Ctr
- Cynthia Dott, FLC Biology
- Jon Harvey, FLC Geosciences
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M&R Team Members

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Other Team Members

- Melissa Neubaum, REW/DRRP
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- Shannon Hatch, USBR
- Kevin Hyatt, BLM
- Tarryn Dixon, Conservation Legacy

Consultants

- Seth Mason & Bill Hoblitzell, Lotic Hydrologic

Talk Outline

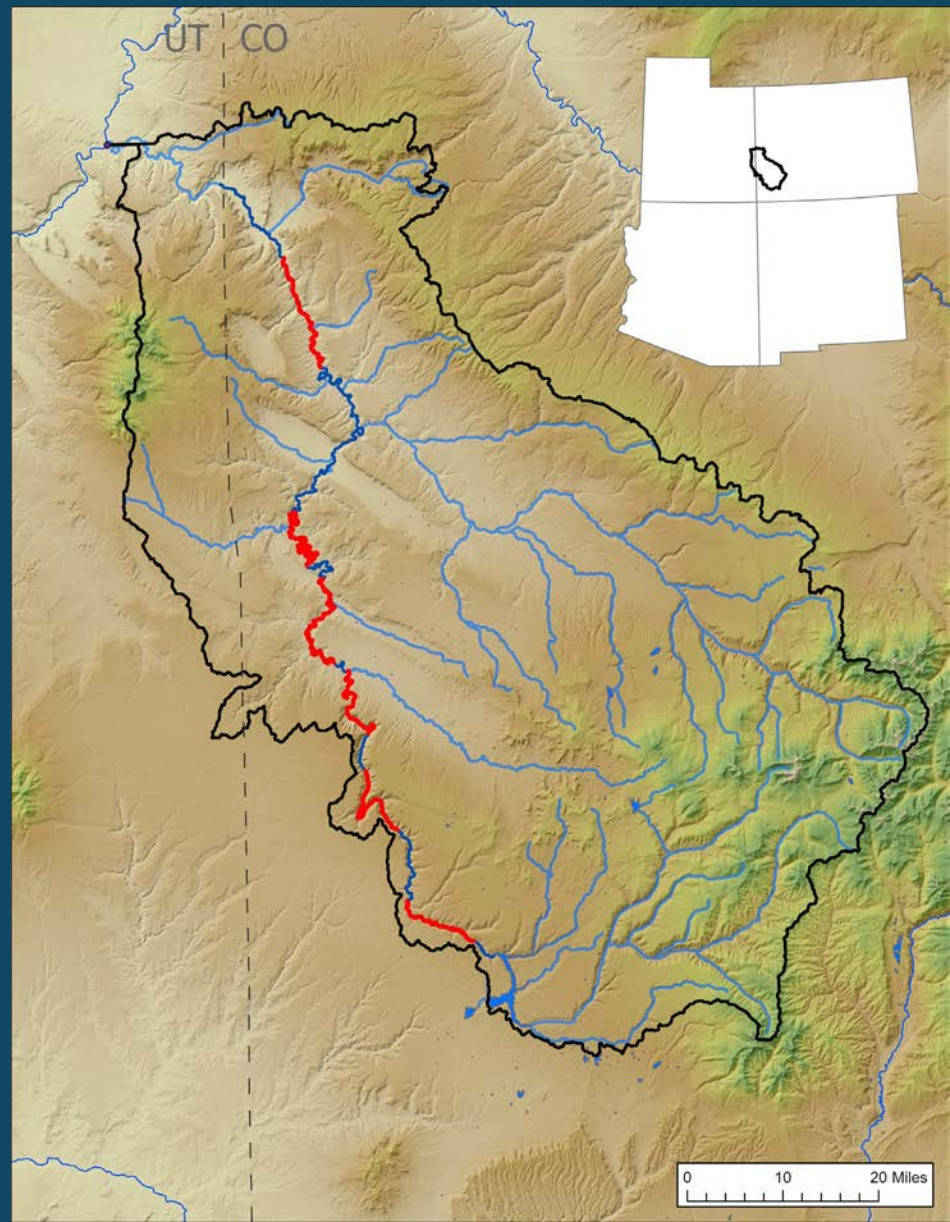
- **Monitoring the lower Dolores with DRAMS**
  - Known trends and transitions
  - Geomorphic monitoring campaign 2021-2025

- **How are satellites useful in our work?**
  - Side channel connectivity analysis using 2019 release
  - Floodplain connectivity analysis using 2023 flood release
  - Identifying key thresholds during the drying-up phase (e.g. 2021 drought)

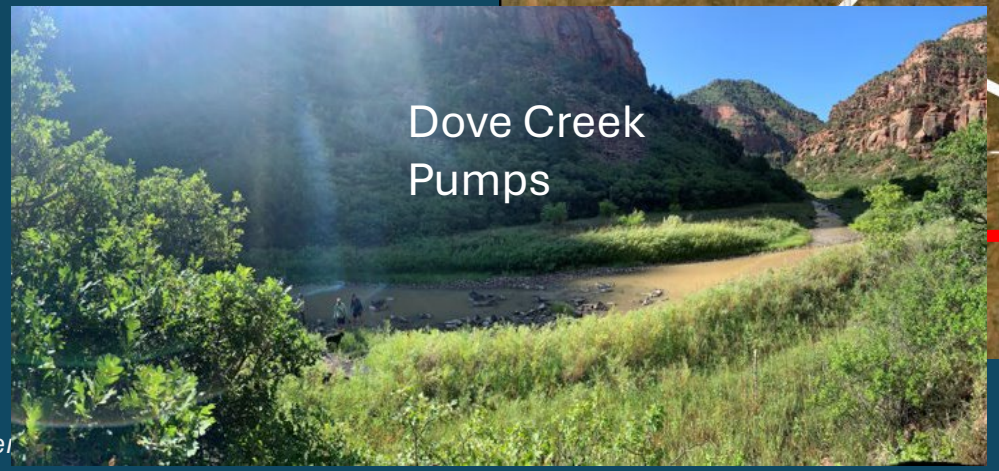
Monitoring the lower Dolores with DRAMS

- 5-year program to establish regular geomorphic and vegetation monitoring protocol (2021-2025)

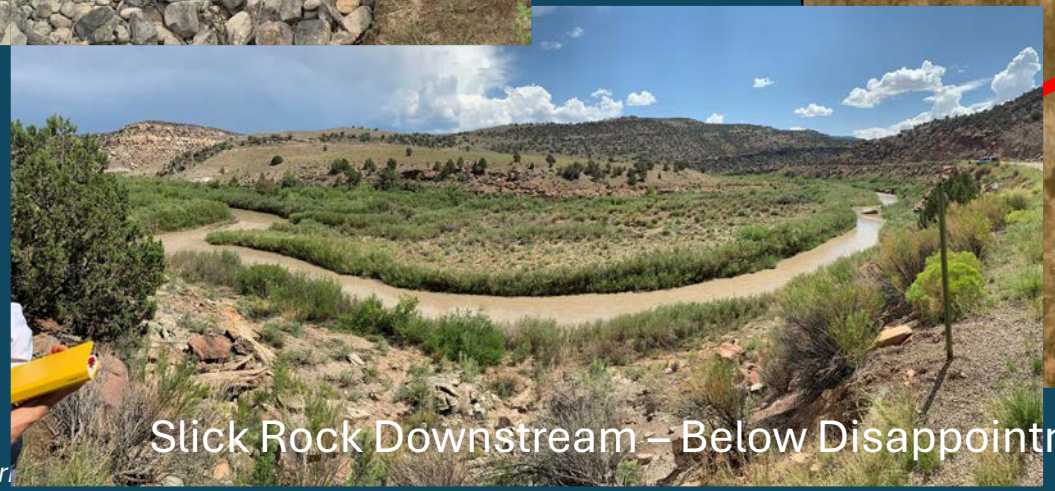
- *Tracking trajectories of channel and floodplain geomorphology and vegetation in post-McPhee flow regime*
  - *Focus on native fish habitat*
  - *Study SITES and SEGMENTS*



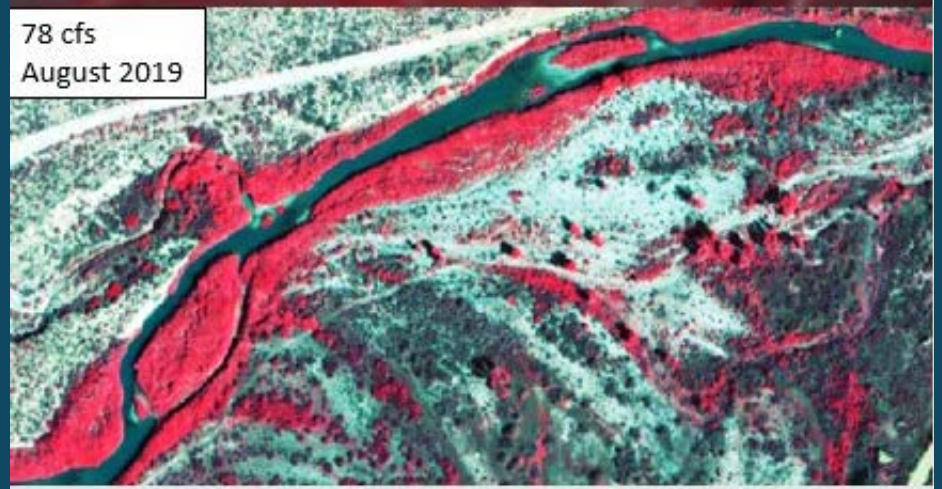
Monitoring Design – Study Sites



Monitoring Design – Study Sites

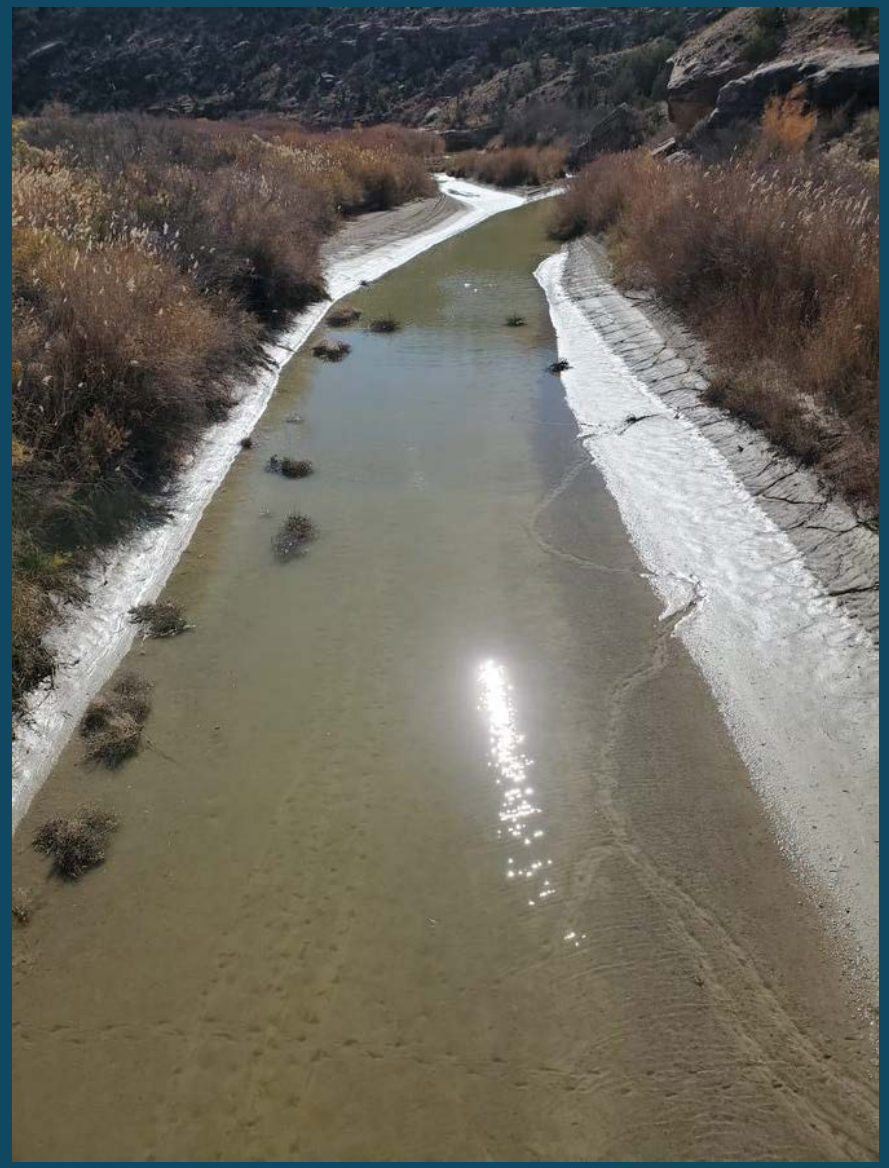

Slick Rock Downstream – Below Disappointment Creek

Channel Simplification




Privet/Tamarisk
Side Channel
Higher 'bar' with
colonized upland scrub
Willow Fringe

Sediment from disappointment creek smothering cobble bars



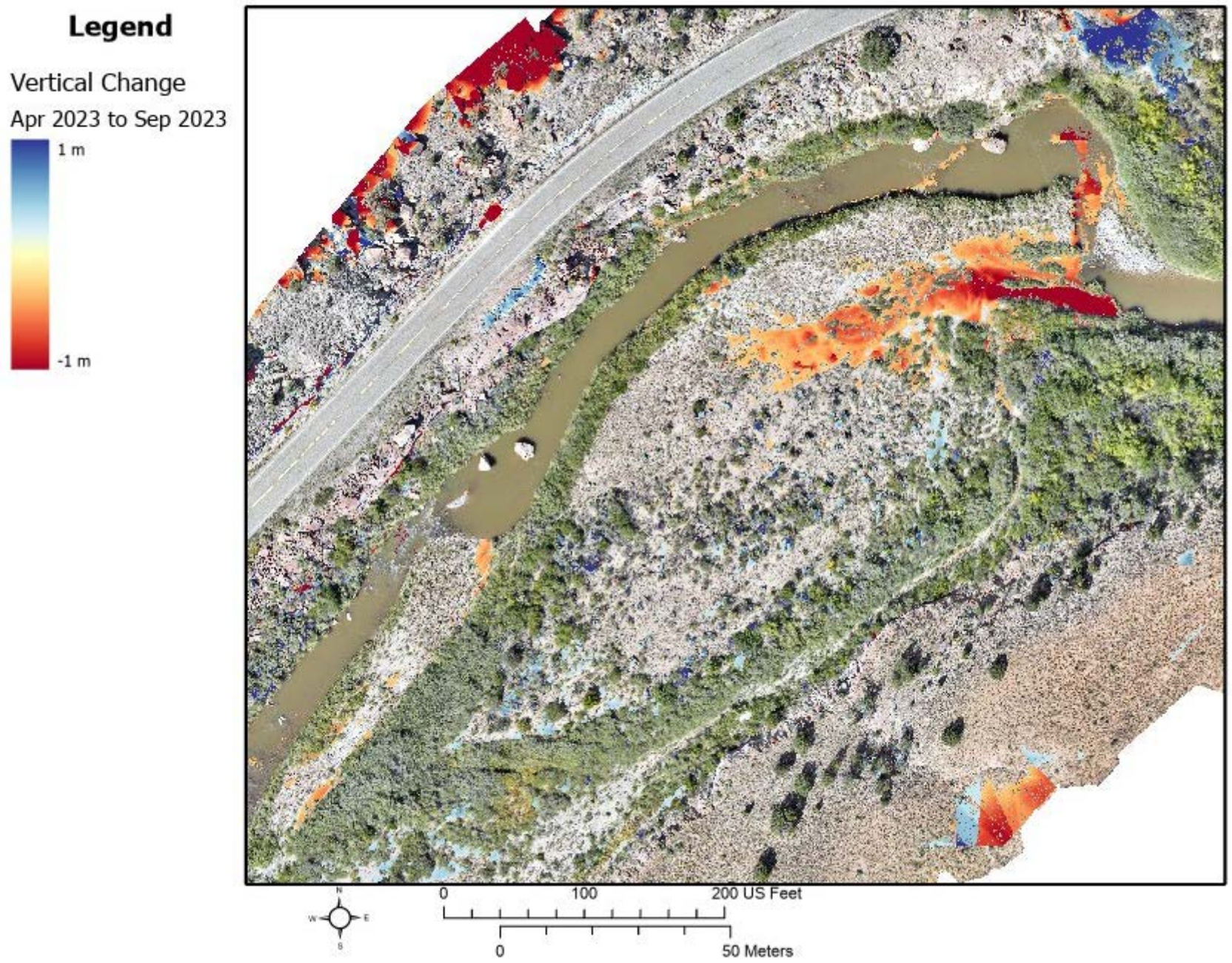
Slick Rock Sites
November 7-8, 2021
Post-monsoonal floods

Monitoring the lower Dolores with DRAMS

Side channel at Salt Creek Site, Nov 2021

Image credit: J. Sholtes

- Cross section surveys
- Substrate grain size analysis
- Repeat UAV surveys



Drone's eye view

- Deep incision along 3000+ cfs thalweg incl. transport of large cobbles
- Incision in side channel entrance area
- Deposition of sand bars on higher/ downstream areas of bar

Focus on channel characteristics **critical to native fish habitat** :

- presence of **clean spawning gravels**,
- connected and engaged **side channels and sloughs**,
- channel **complexity with shallow, refugia zones,** and
- **deep pools** that serve as refugia during low flow years.

Monitoring the lower Dolores with DRAMS

- **How do different dam releases 'show up' in the canyon below?**
  - Need better understanding of stage-discharge relations at the **SEGMENT** scale

Remote Sensing on the Dolores River

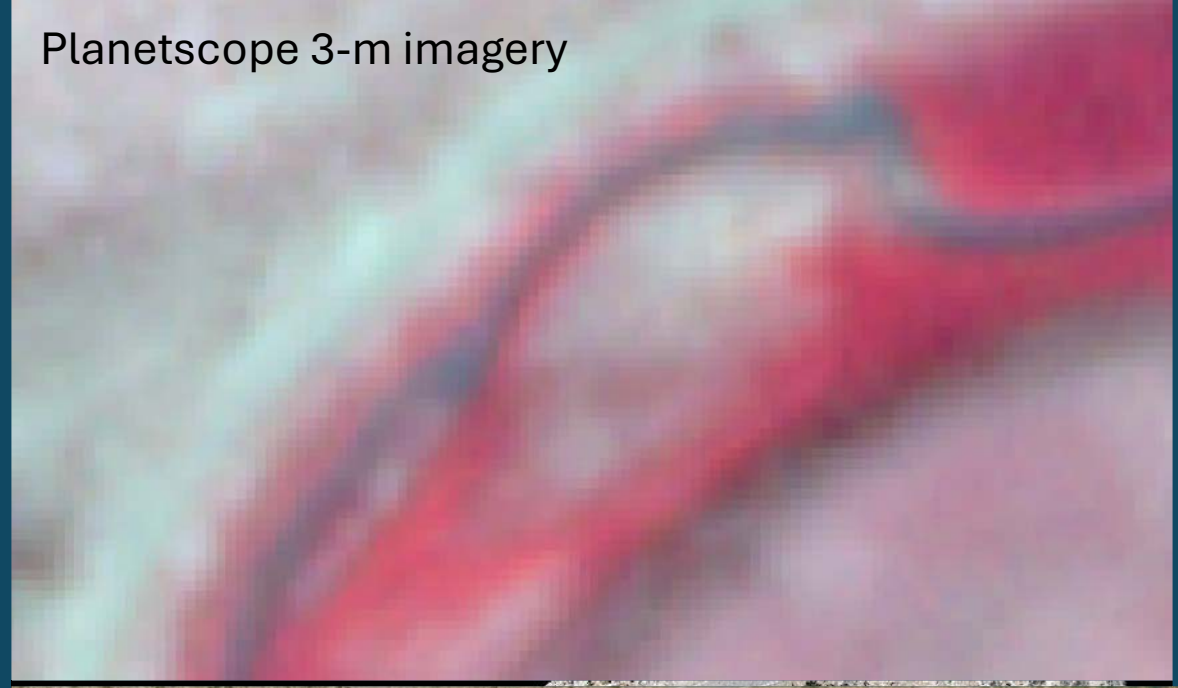
- Newer Satellites offer enough resolution to permit monitoring of rivers through the rising and falling limbs of a flood

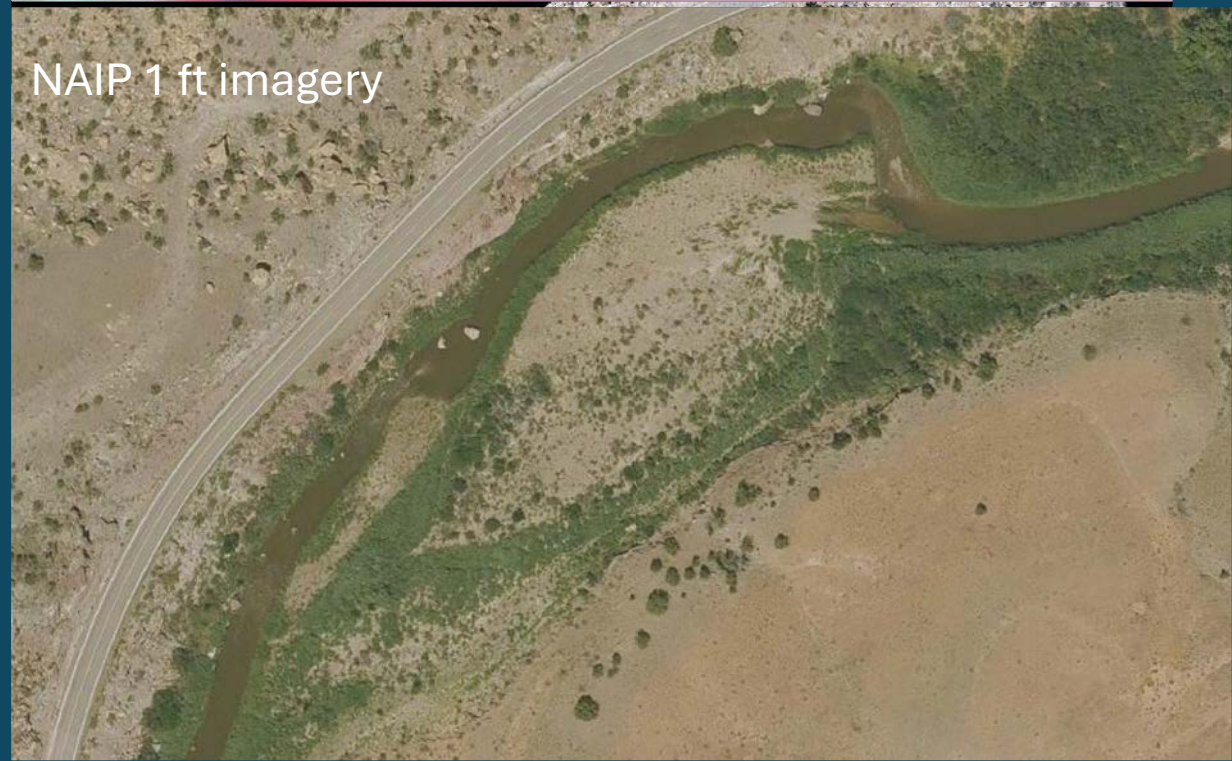
- Can we use it to quantify channel complexity metrics at different flow levels?

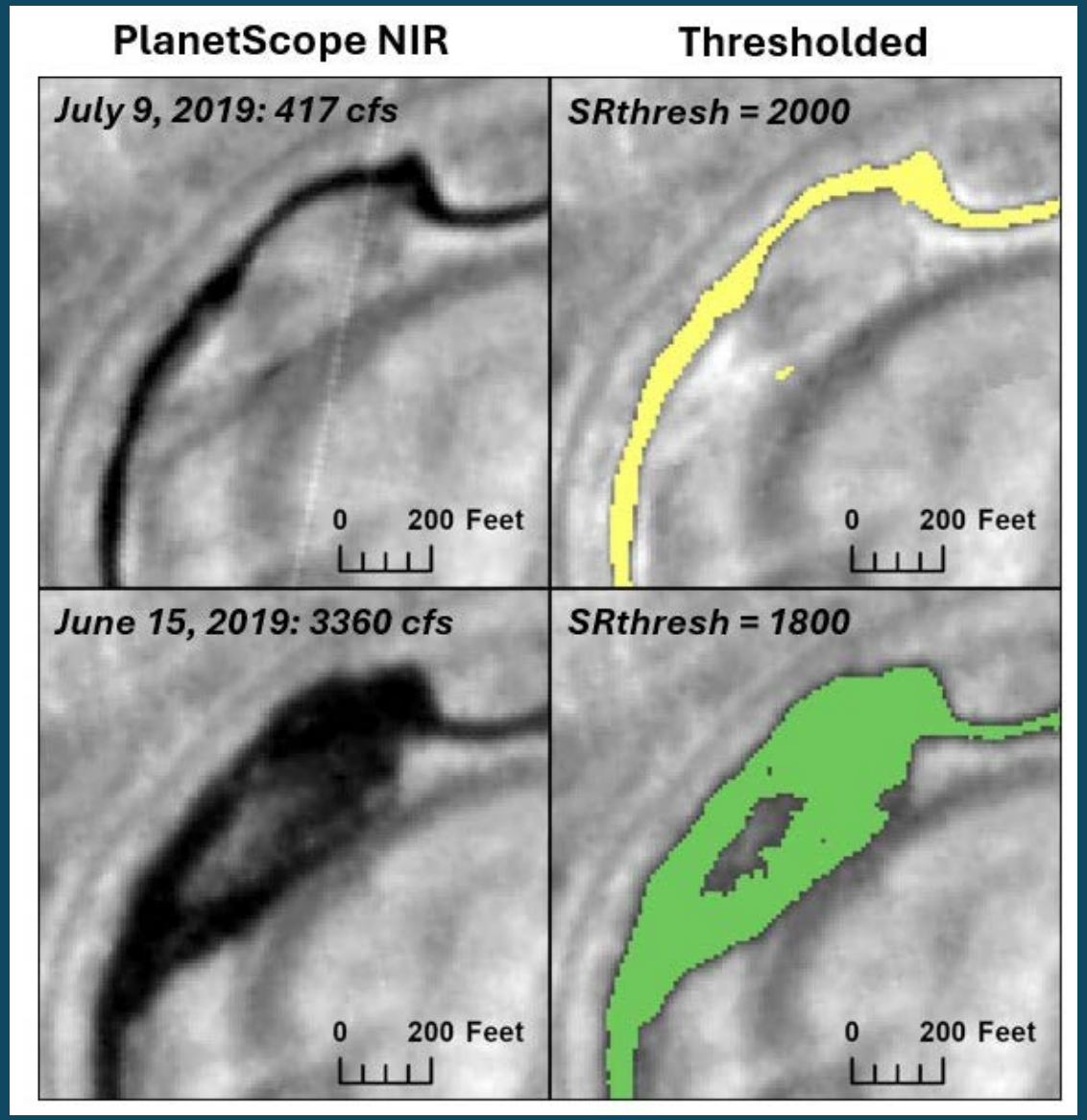
Planetscope Imagery

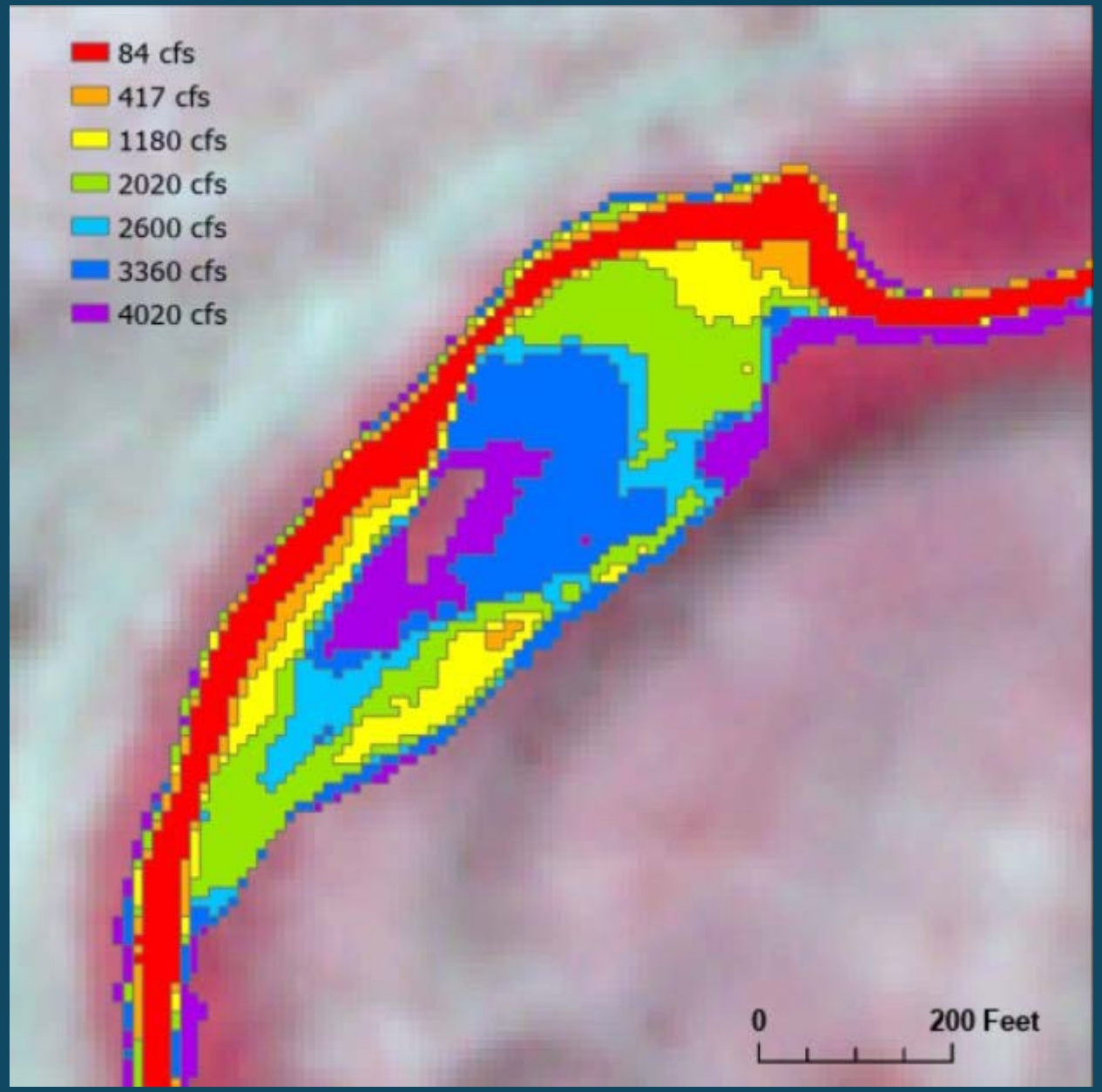
- Constellation of satellites (88 doves)
- 3 m spatial resolution
- 4 bands (R, G, B, NIR)
- Usually 1-2 flyovers per day

- limited interpretability, but still interpretable!



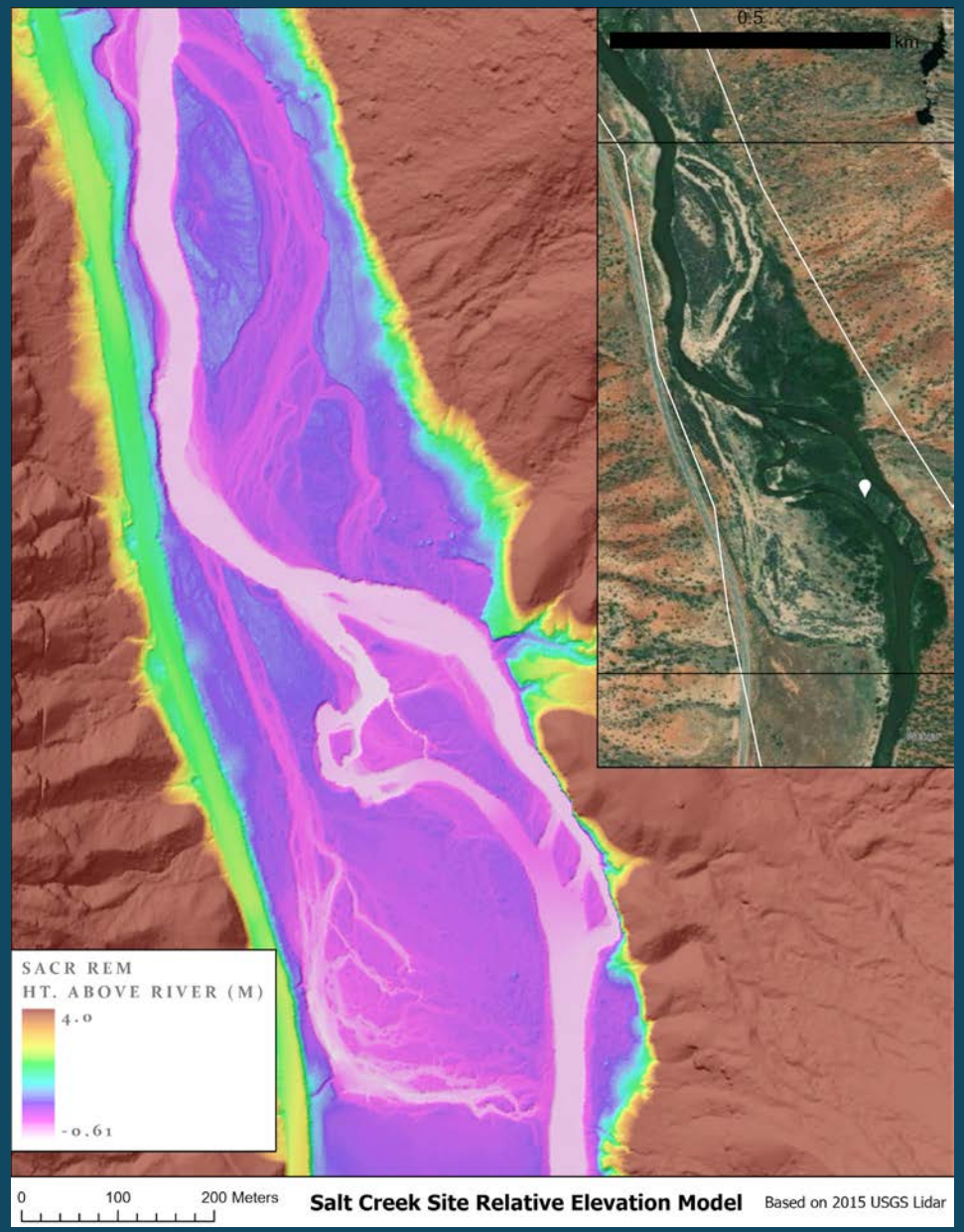


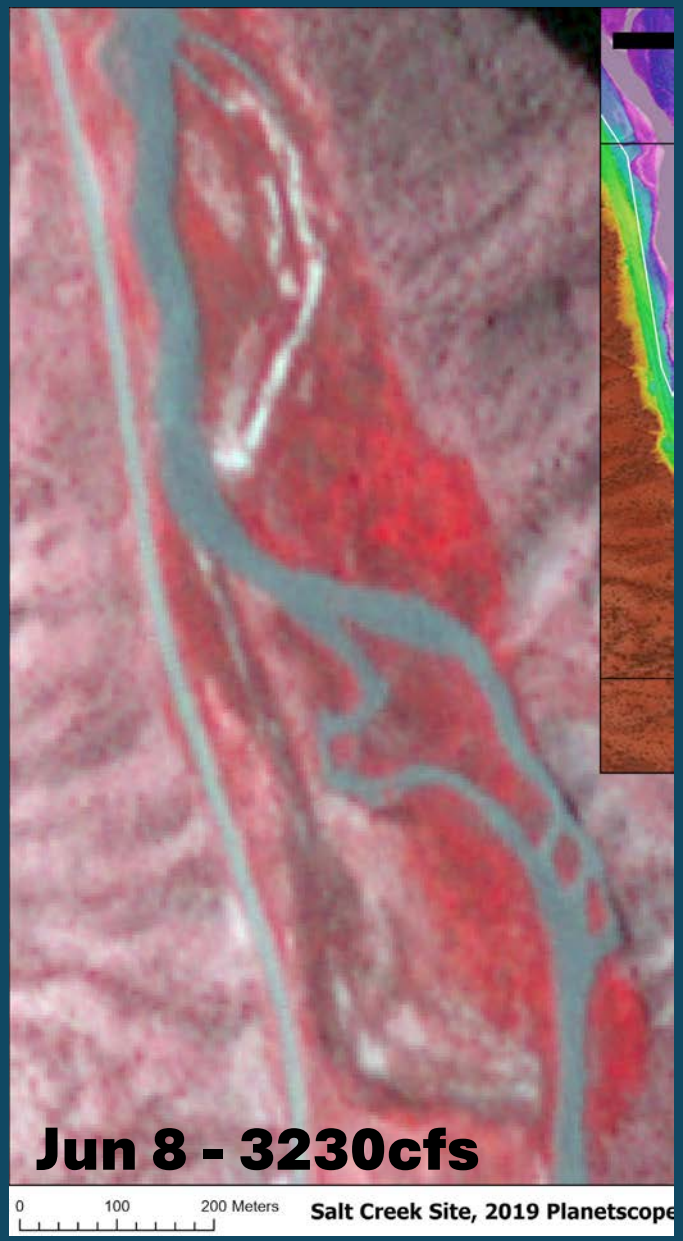

PlanetScope NIR
Thresholded
July 9, 2019: 417 cfs
SRthresh = 2000
June 15, 2019: 3360 cfs
SRthresh = 1800
0 200 Feet
0 200 Feet
0 200 Feet
0 200 Feet

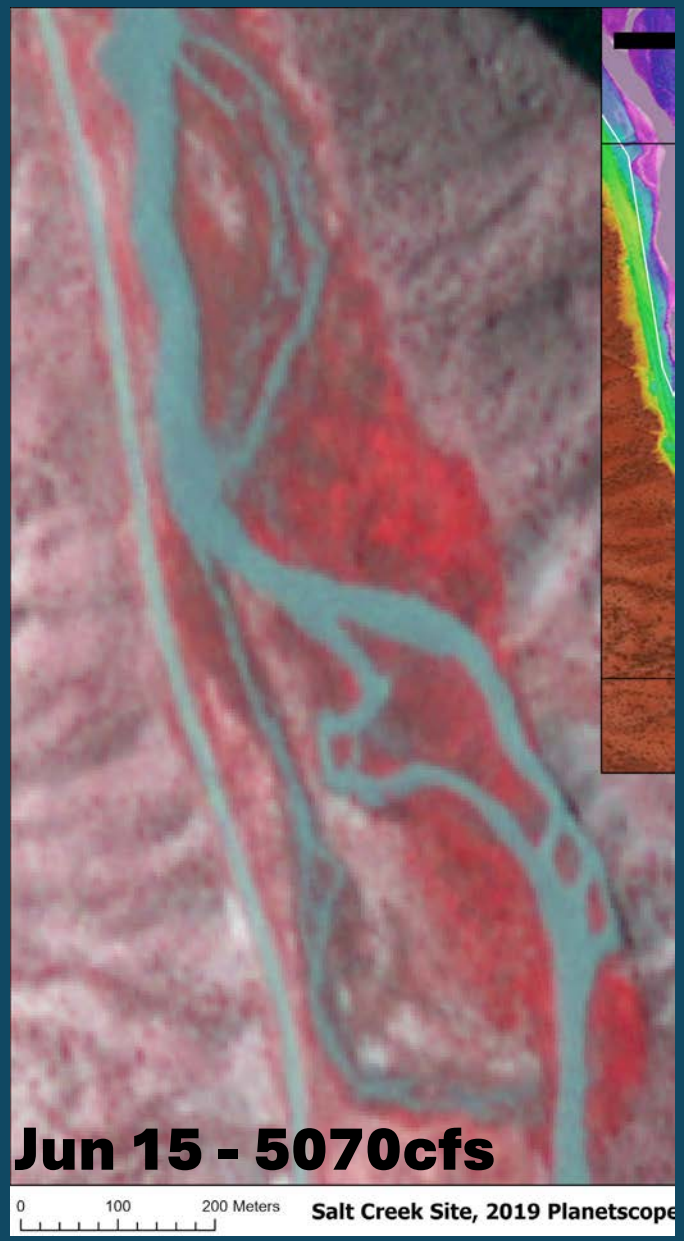

84 cfs
417 cfs
1180 cfs
2020 cfs
2600 cfs
3360 cfs
4020 cfs
0
200 Feet

APPLICATIONS

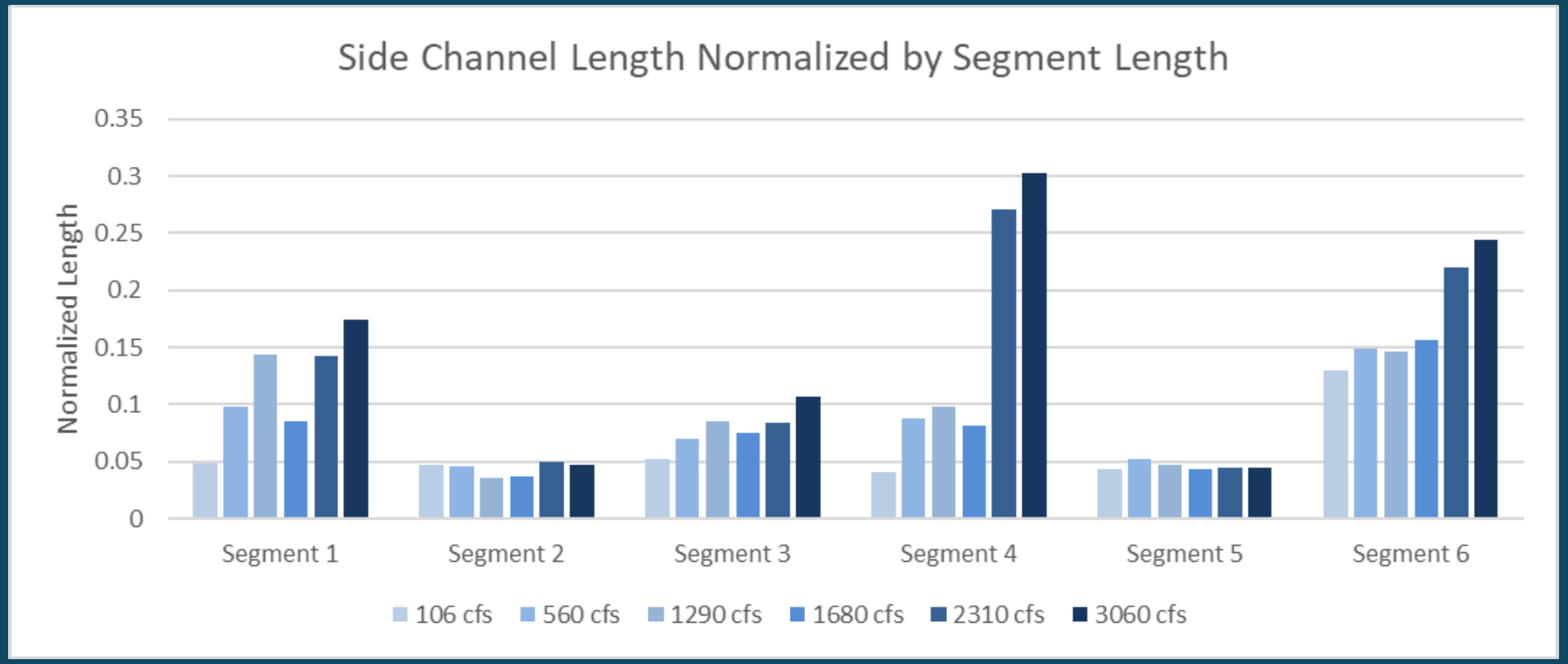
At what discharges do we get connected side channels?

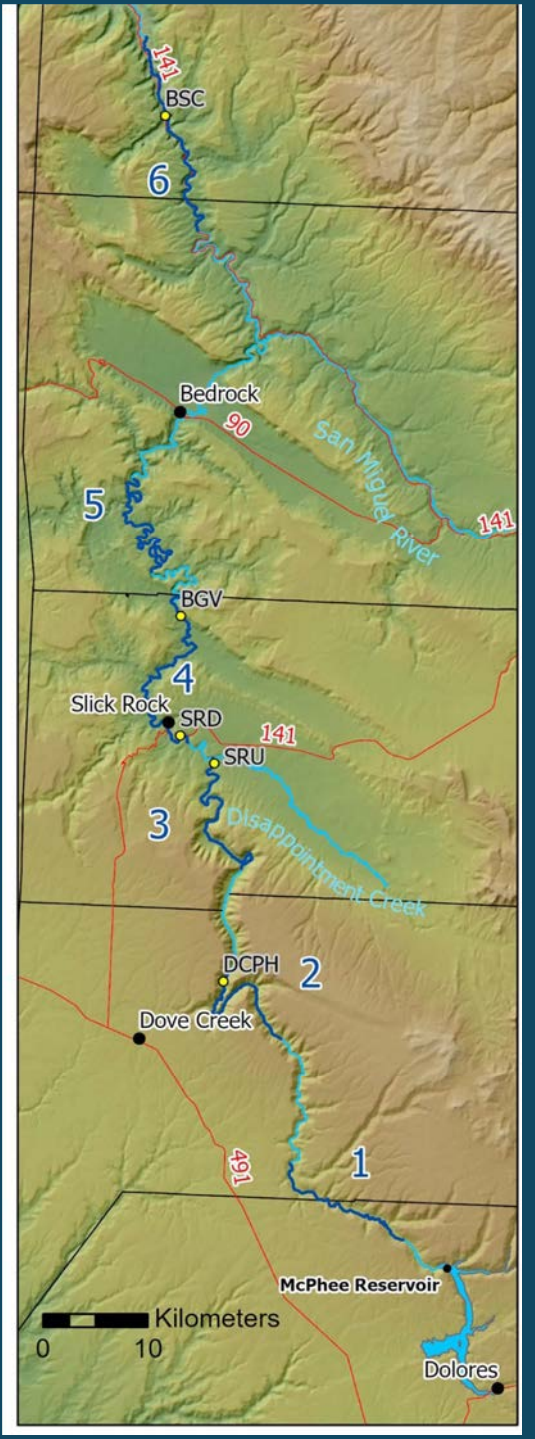






How does side channel connectivity change with discharge?

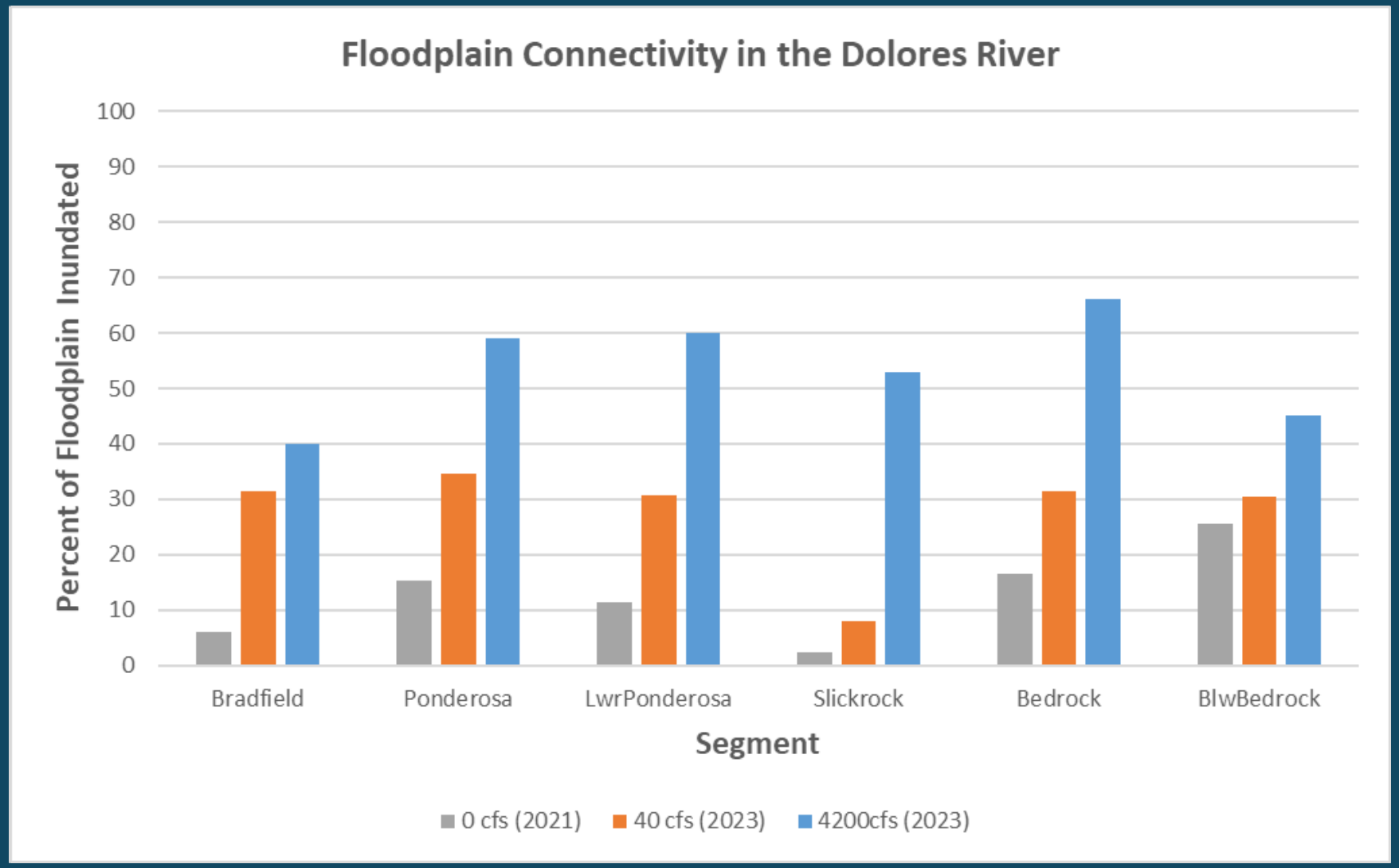




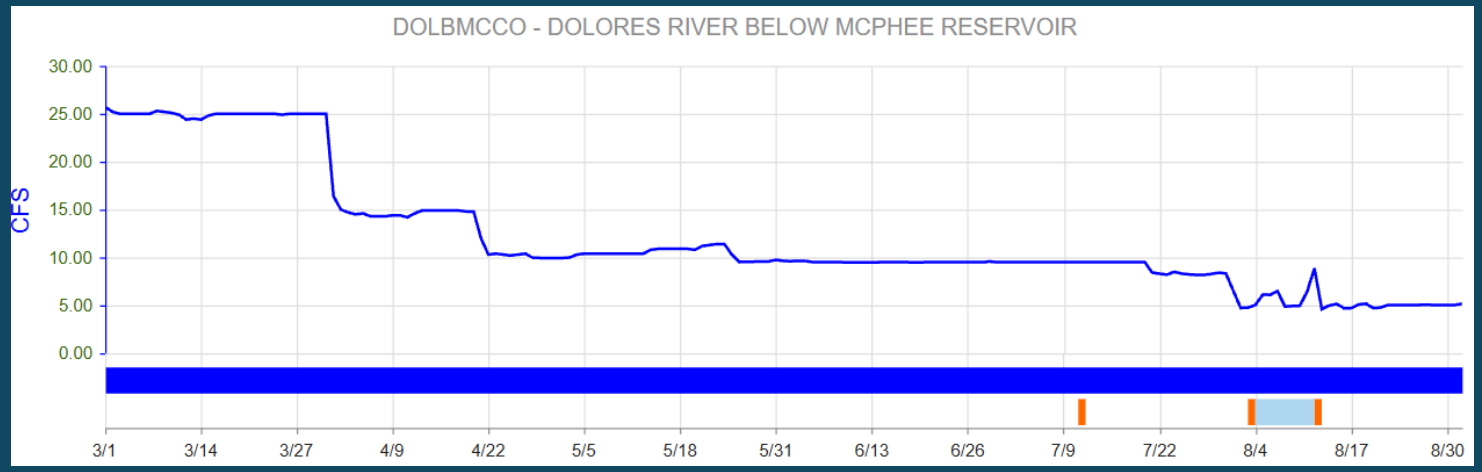
How does floodplain connectivity change with discharge?

- Use lidar to map floodplains
- Use planetscope imagery to identify inundated pixels
- Calculate % inundation at different Qs

How does floodplain connectivity change with discharge?

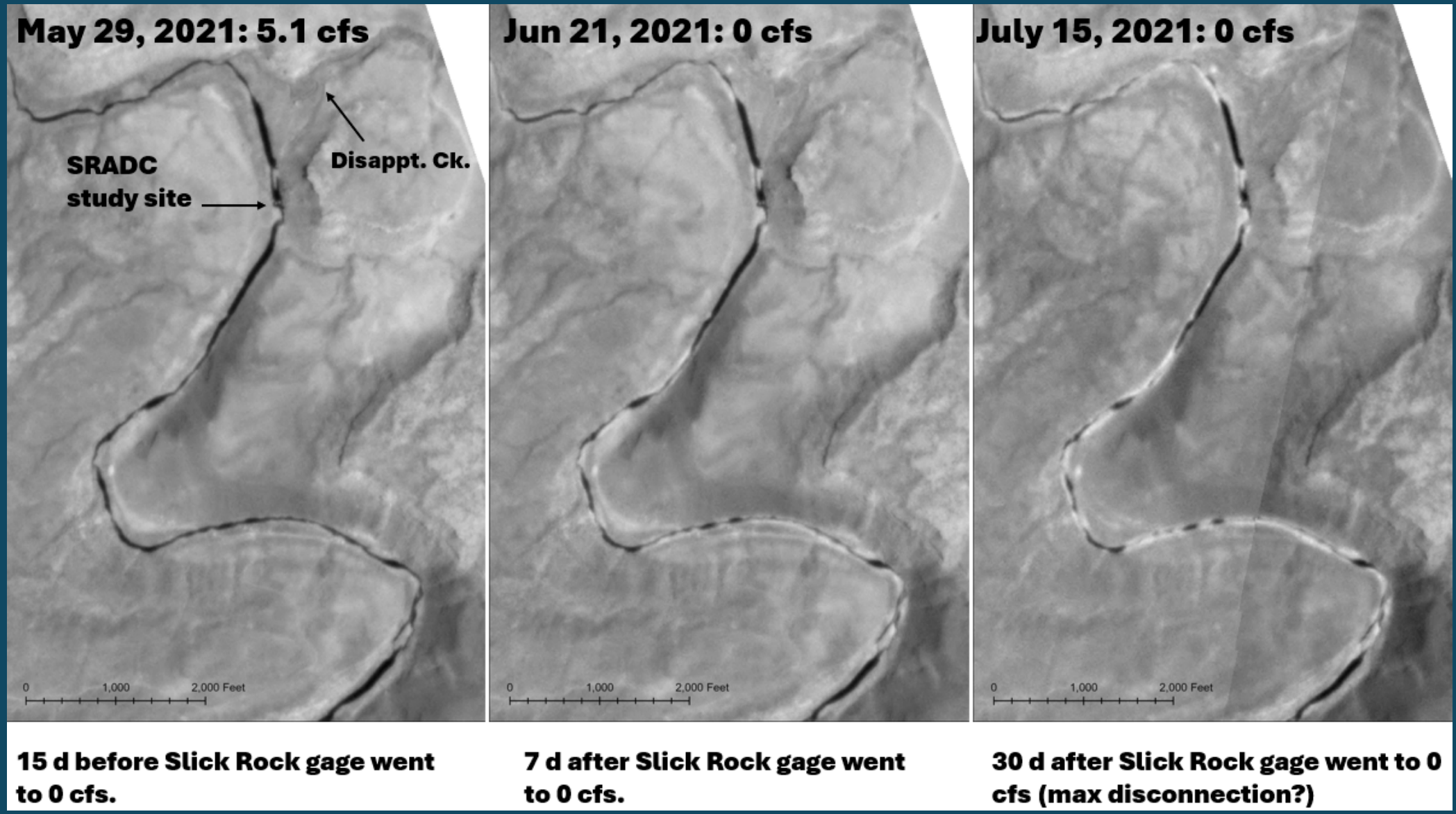


Where do pools remain during extreme drought?



- Summer 2021 – releases from Mcphee fell from 5-10 cfs
- Recorded as 0 cfs downstream for >1 month

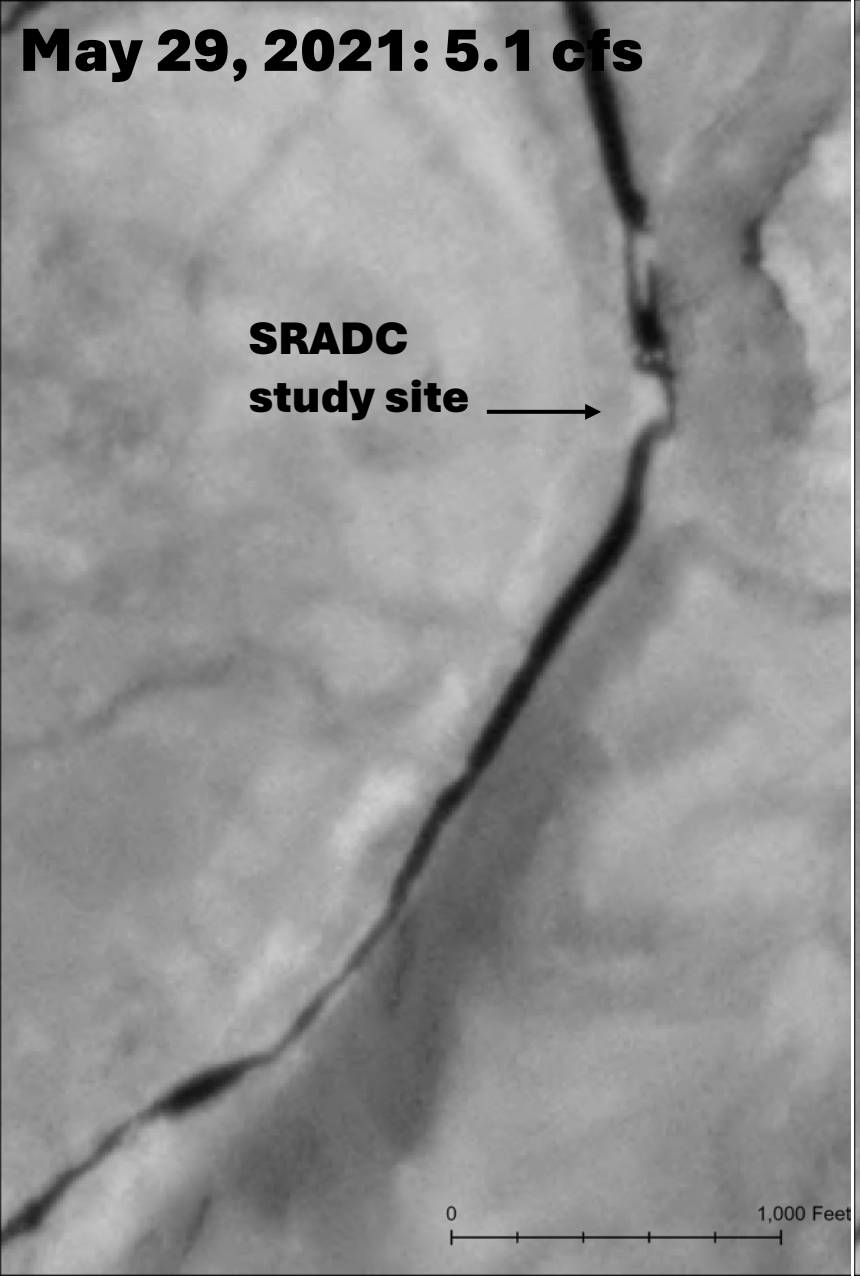
Where do pools remain during extreme drought?



15 d before Slick Rock gage went to 0 cfs.

7 d after Slick Rock gage went to 0 cfs.

30 d after Slick Rock gage went to 0 cfs (max disconnection?)



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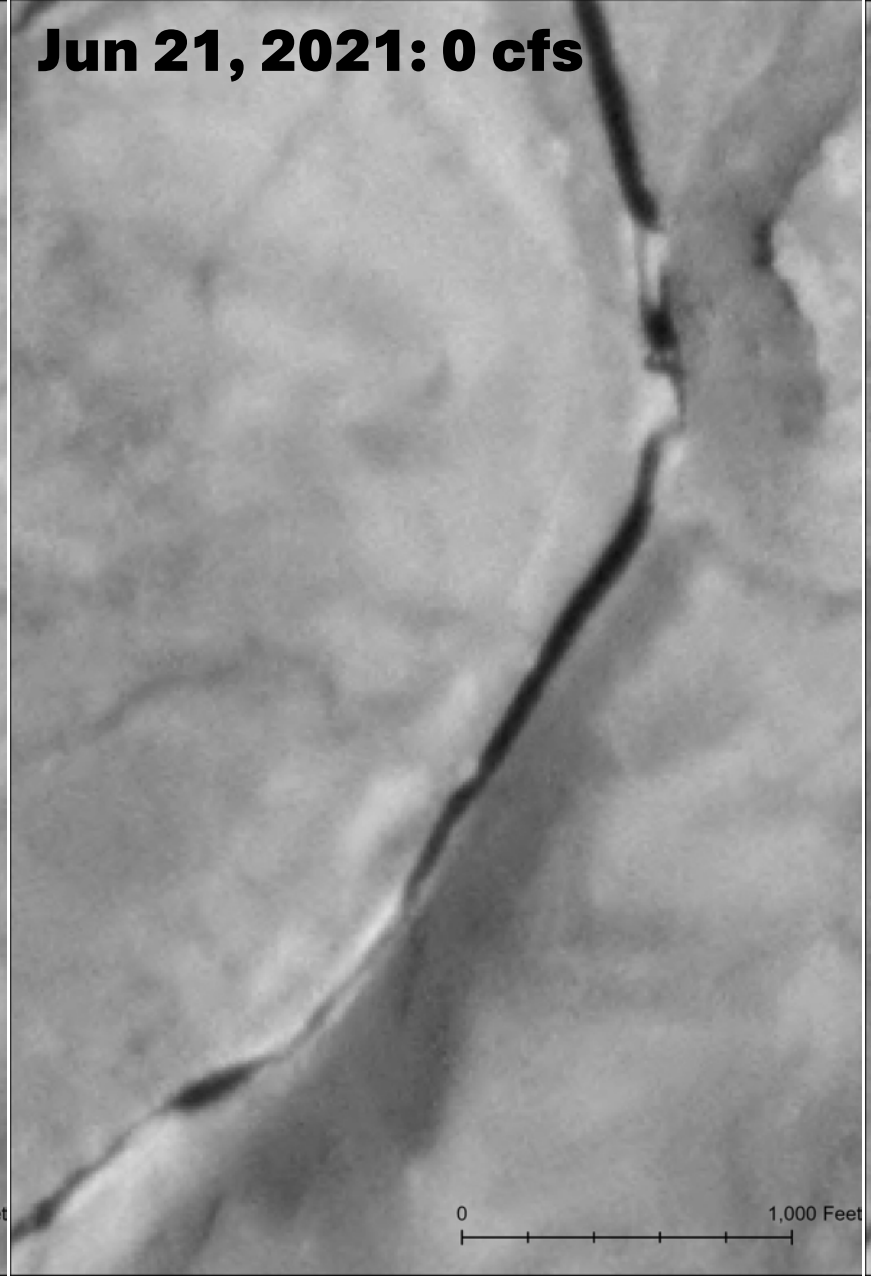

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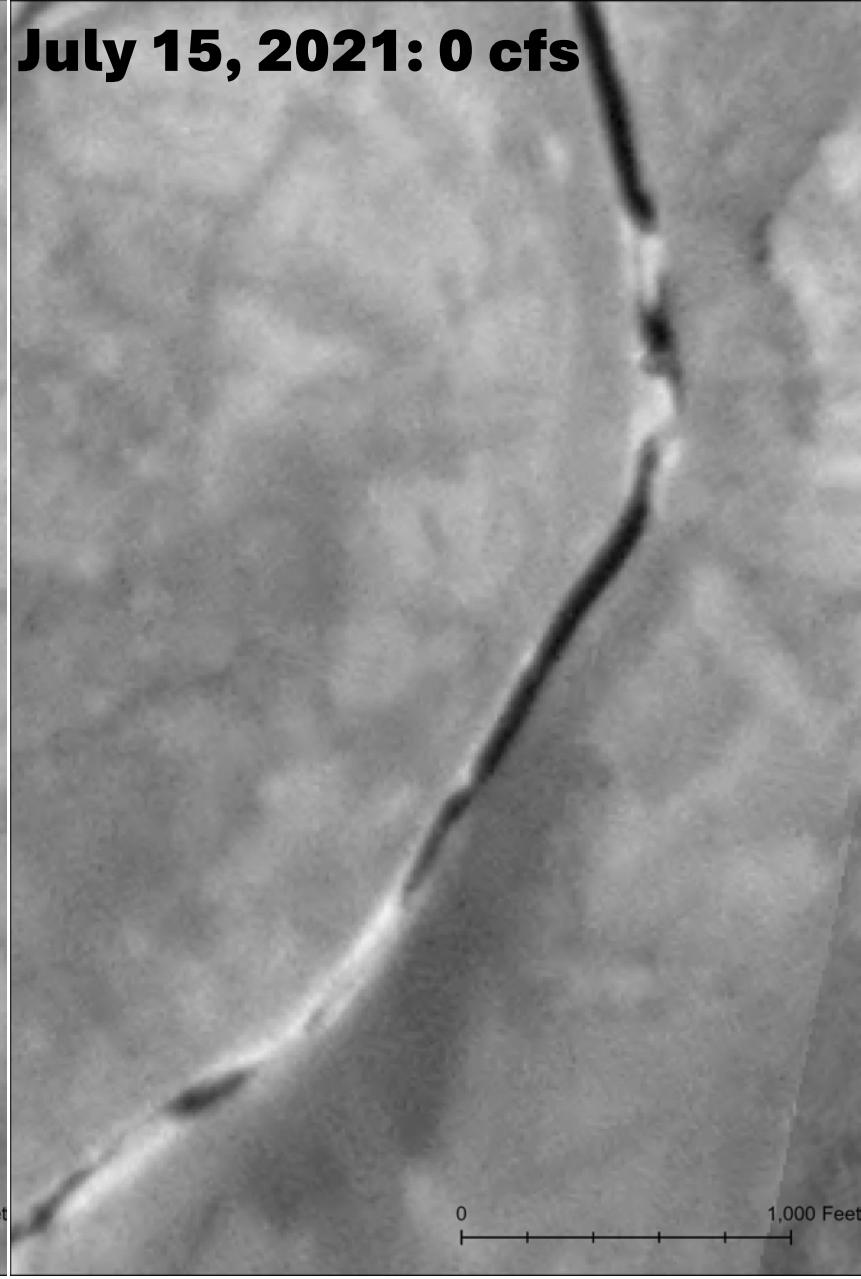

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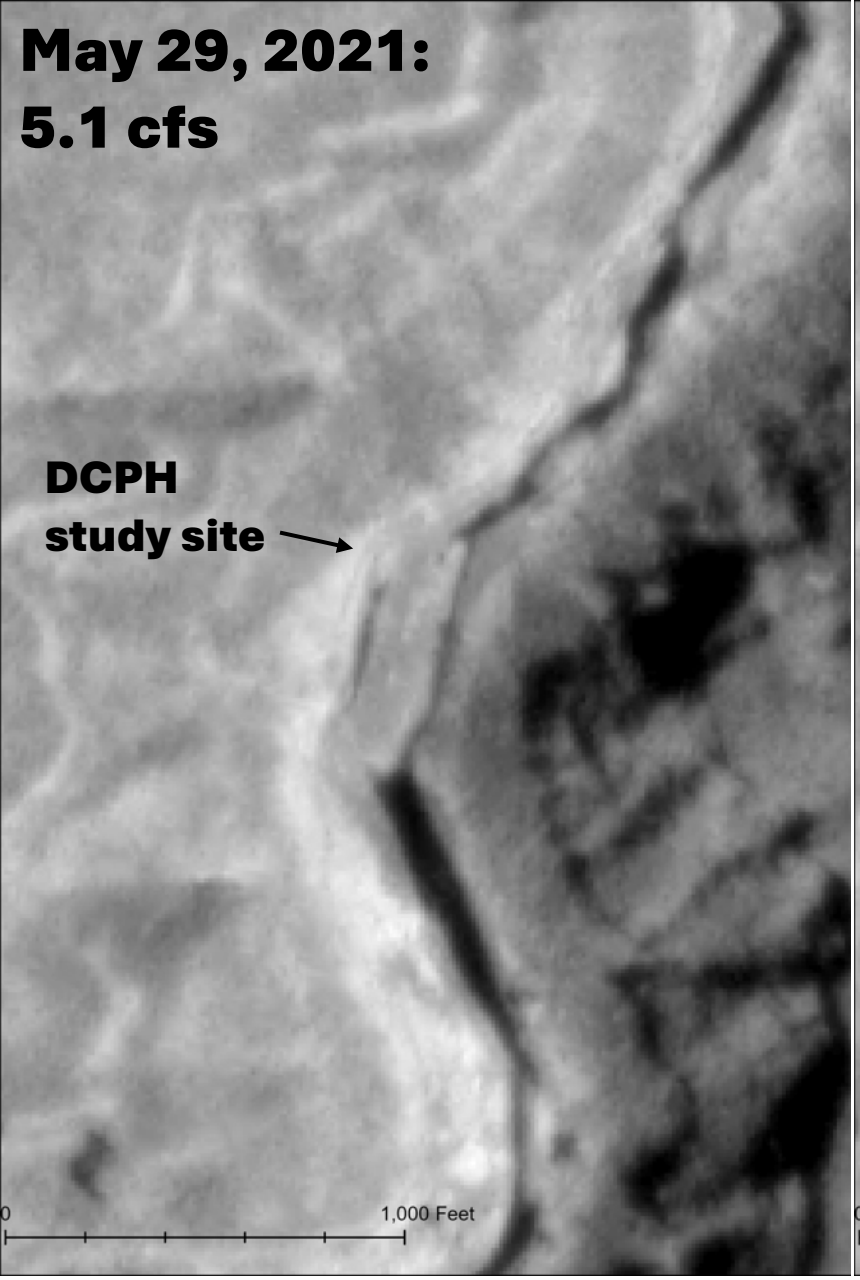

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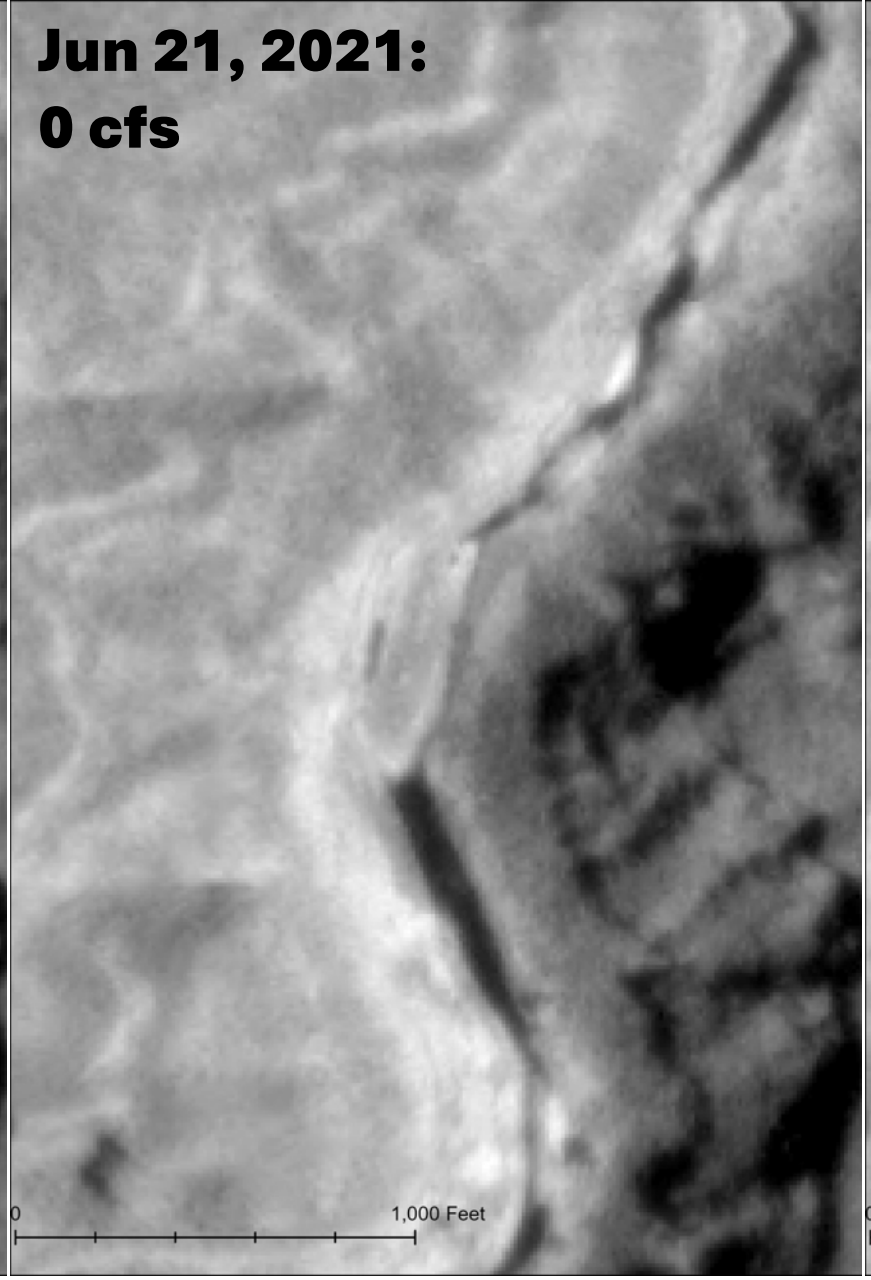
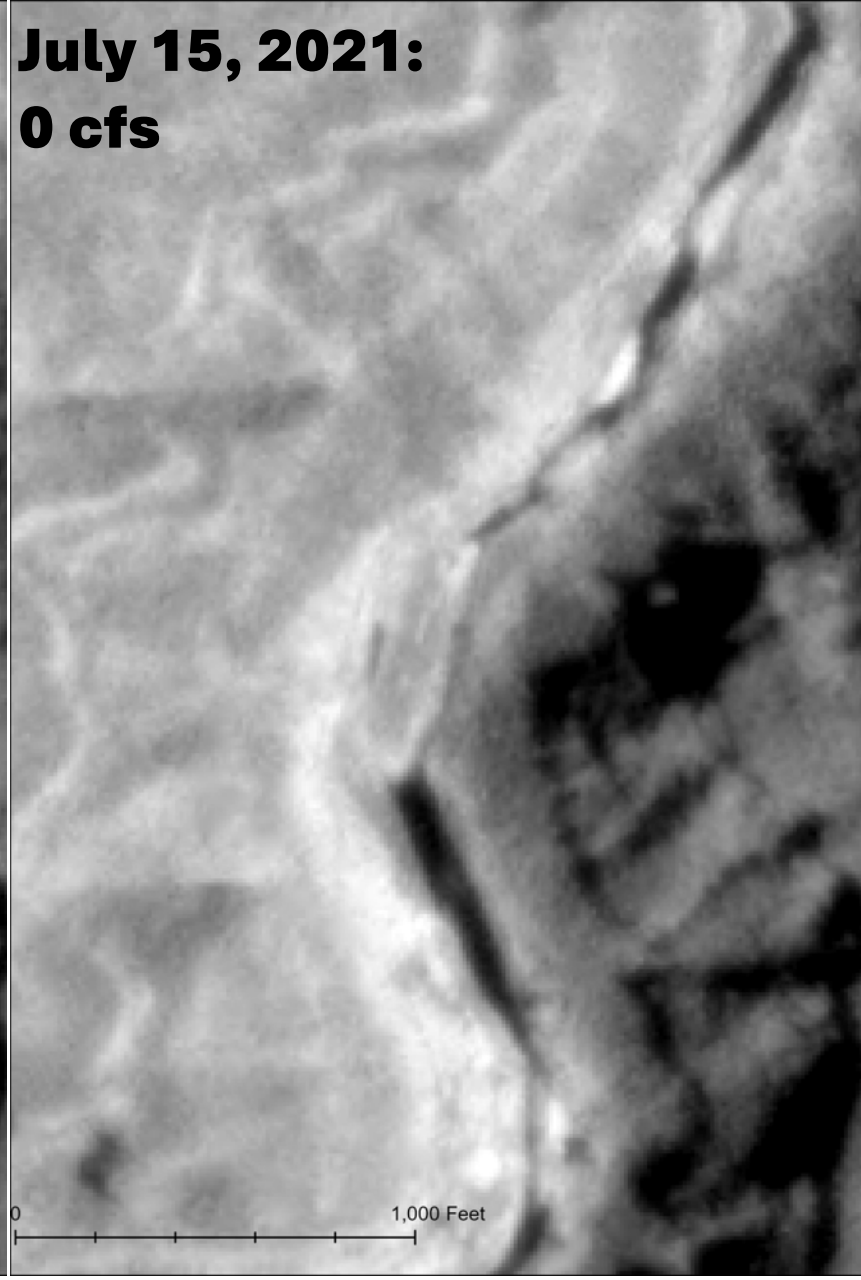
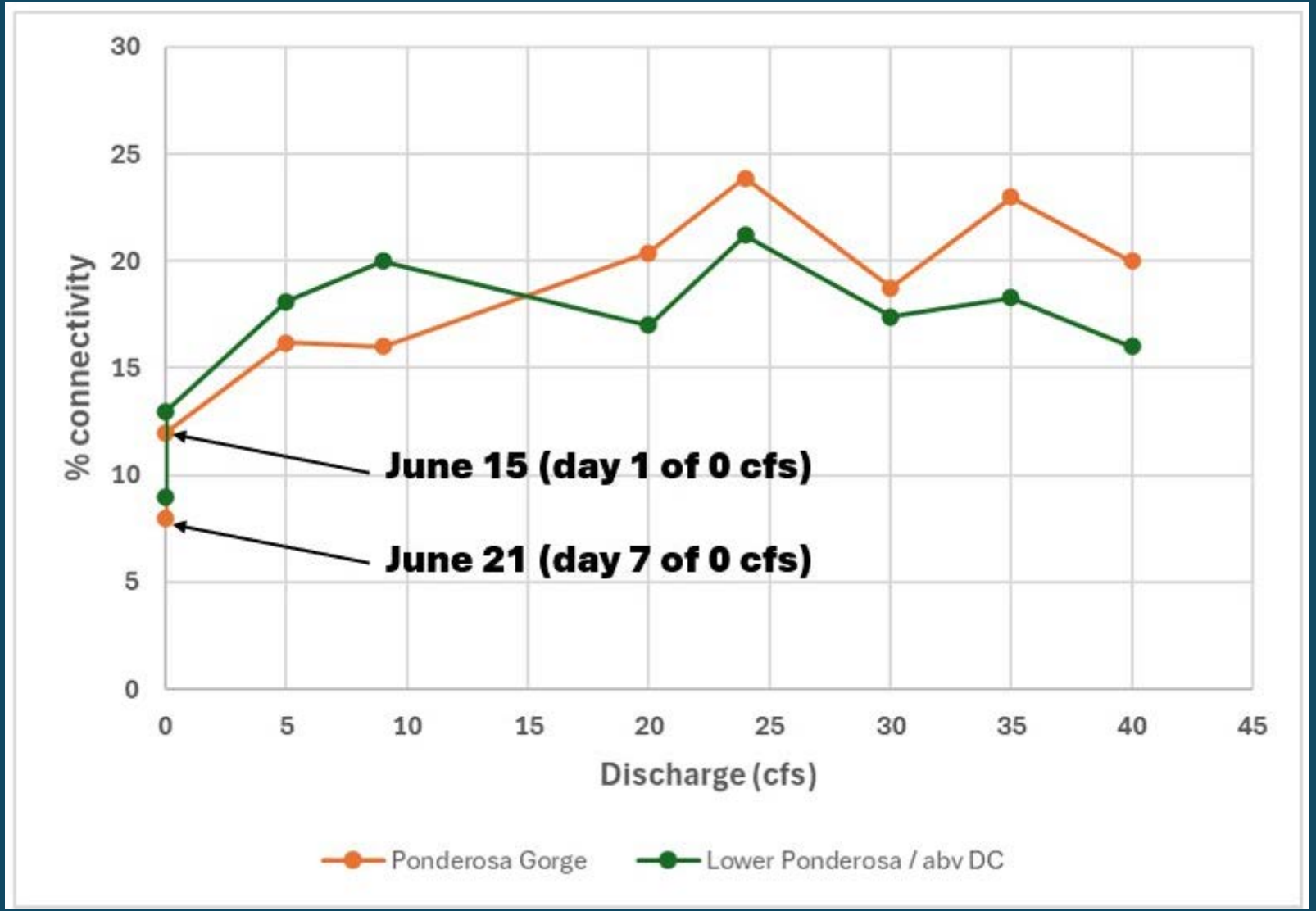


7 d after Slick Rock gage went to 0 cfs.



30 d after Slick Rock gage went to 0 cfs (least connected day?)

At what point is the river actually ‘drying up’?



How are satellites useful in our work?

- Measuring visible complexity metrics at reach-scale across a range of Q
- Enables a more sensitive approach to flow management
- long-term: quantify channel-changing trends

Challenges and Opportunity

- Every scene requires careful inspection to identify best NIR threshold for water / non-water
- Difficult to ID water:
  - Dense riparian veg with shallow inundation
  - Turbid flows
  - Narrow side channels (<2-3m)

- The future is exciting!
  - Doves (3 m) -> Owls (1 m) -> Pelicans (30-50 cm)

Questions?

- Thanks to Several FLC Student Assistants!
  - Jack Tingwall (side channel analysis)
  - Charlie Brockway (side channel analysis)
  - Marshall Kinnamon (floodplain connectivity analysis)
  - Sophia Werren (bar area / veg area trends)