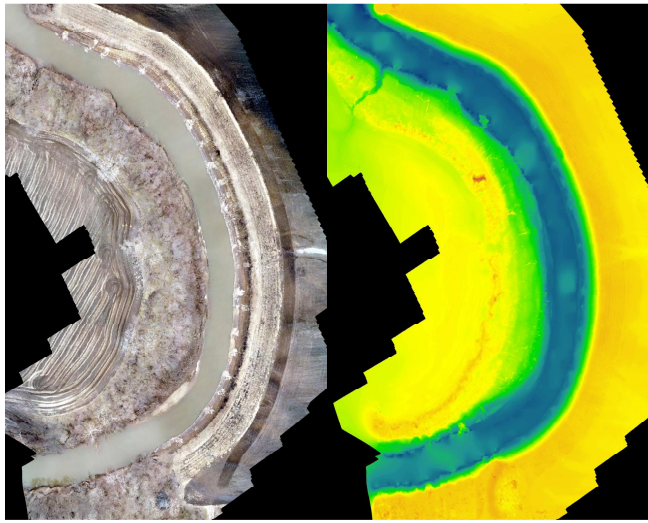
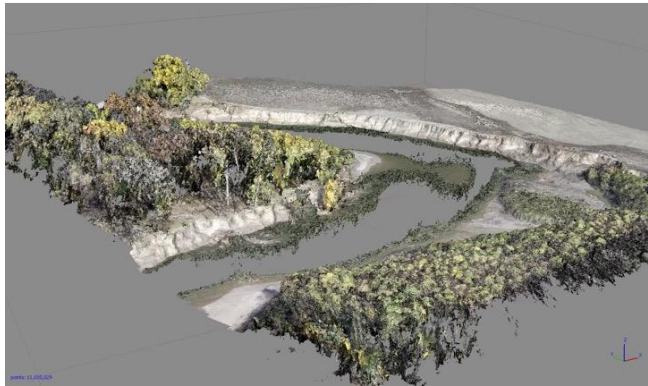
The use of Unmanned Aircraft Systems to assess streambank erosion and related engineering solutions

Tony Layzell
Kansas Geological Survey

Governor's Conference on the Future of Water in Kansas





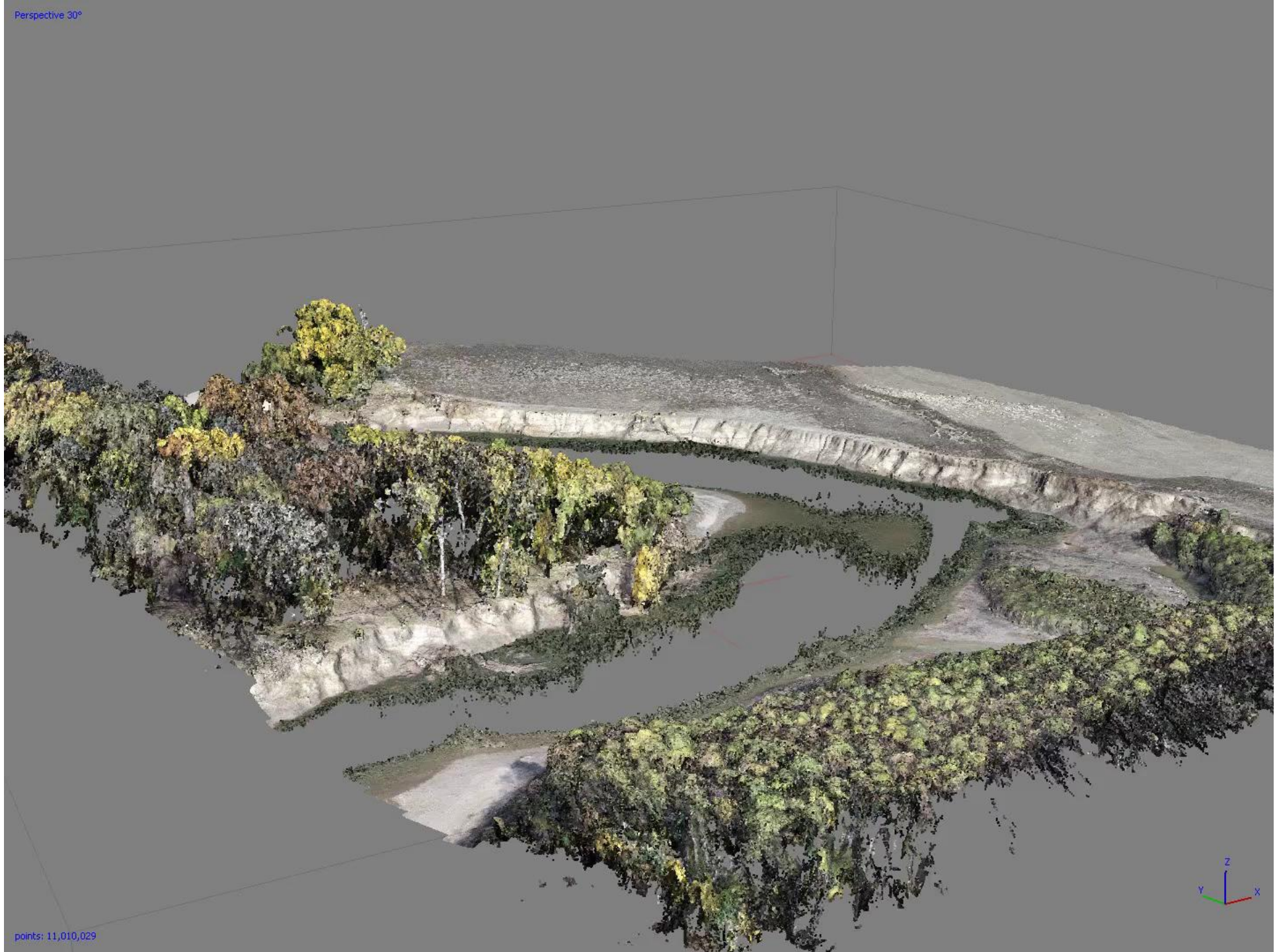
Reconnaissance

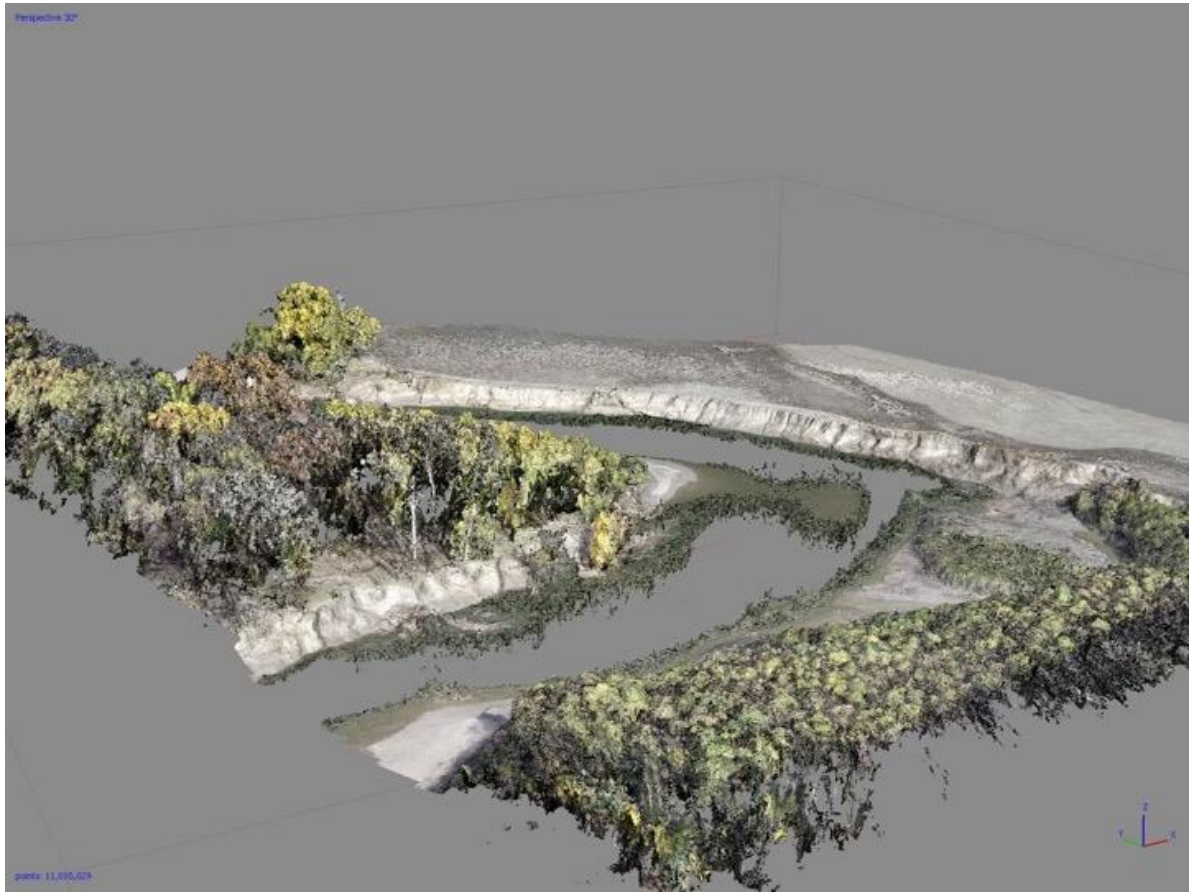
Cottonwood River

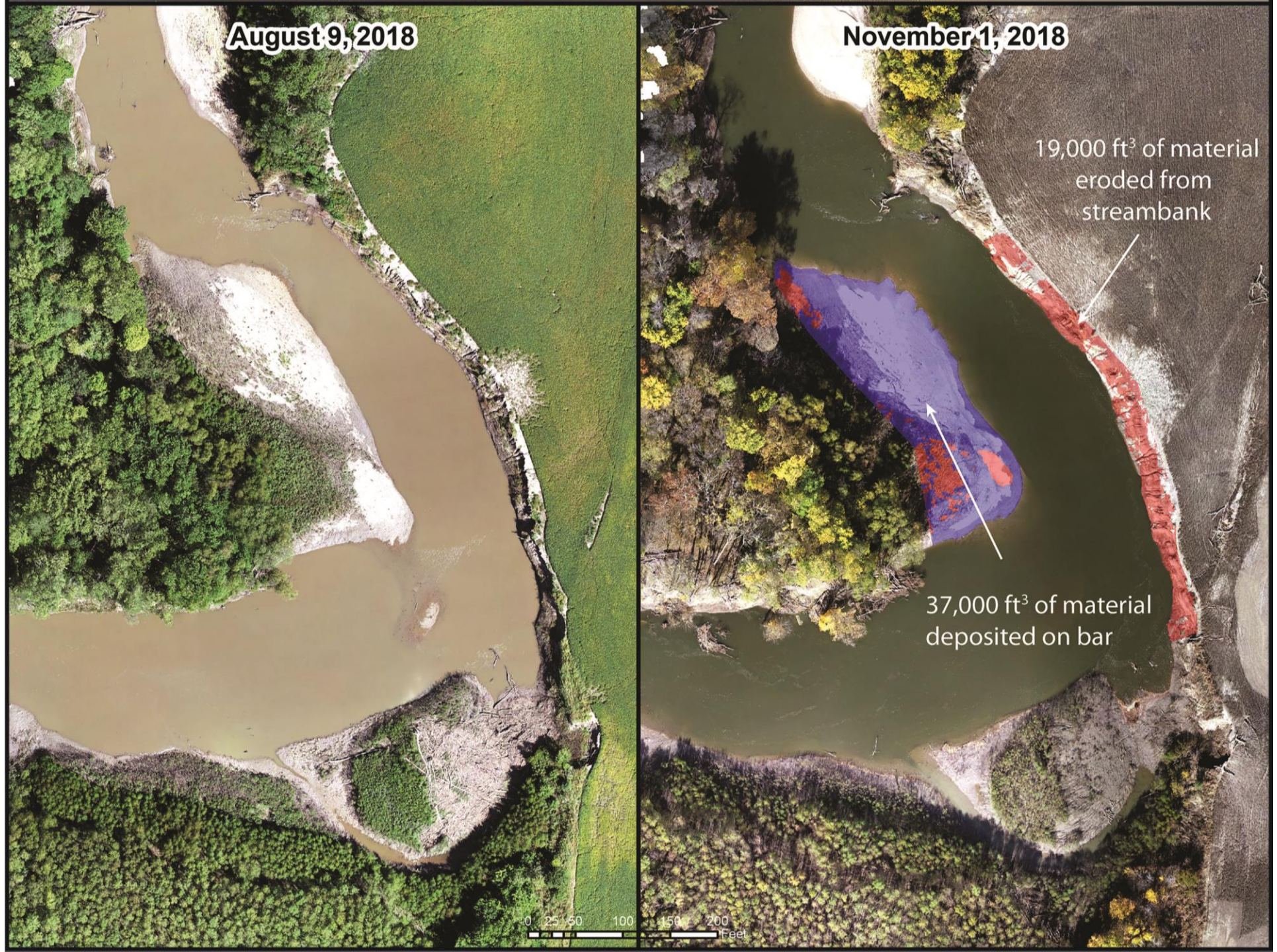
400
CHALLENGER

Monitoring flood events

Cottonwood/Neosho flooding – Oct 10th 2018


Perspective 30°
points: 11,010,029
Z
Y
X


Perspective 30°
points: 11,095,029

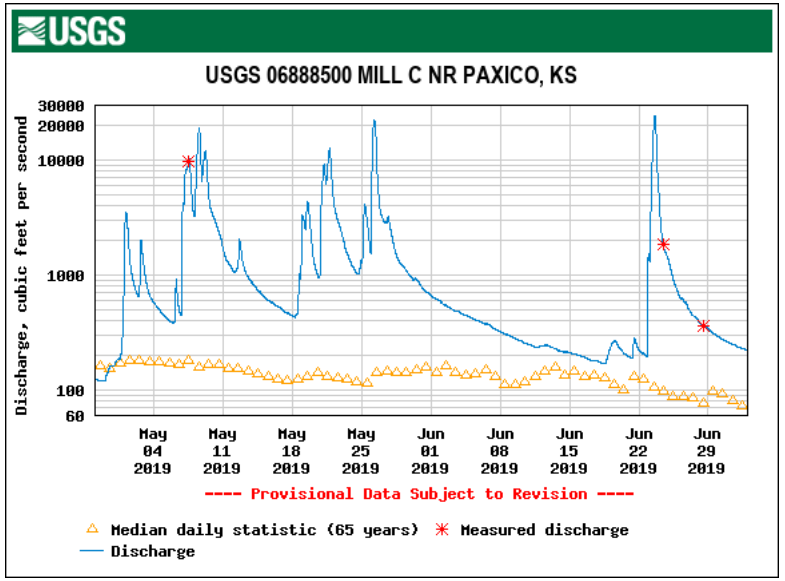

August 9, 2018
November 1, 2018
19,000 ft³ of material eroded from streambank
37,000 ft³ of material deposited on bar
0 25 50 100 150 200
Feet

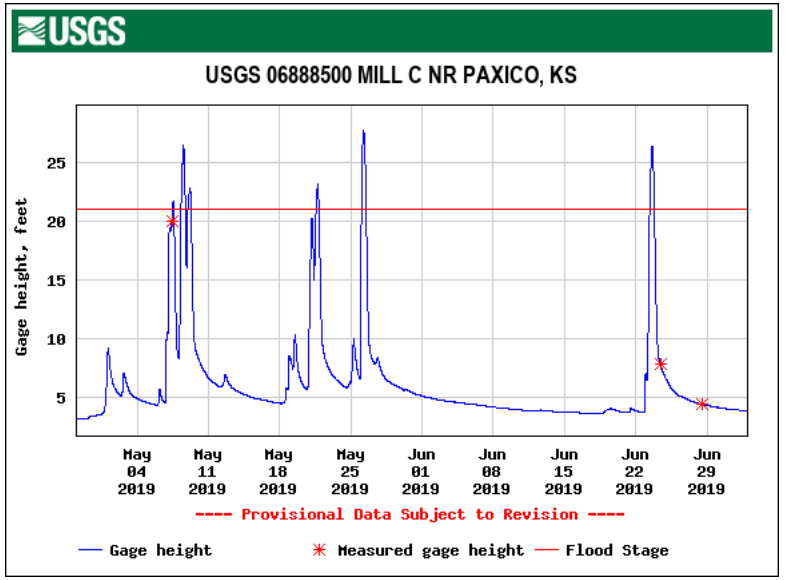
April 24, 2019

July 2, 2019

129,319 ft^3 eroded

26,551 ft^3 stored on bank toe





Assessing the effectiveness of streambank stabilization projects

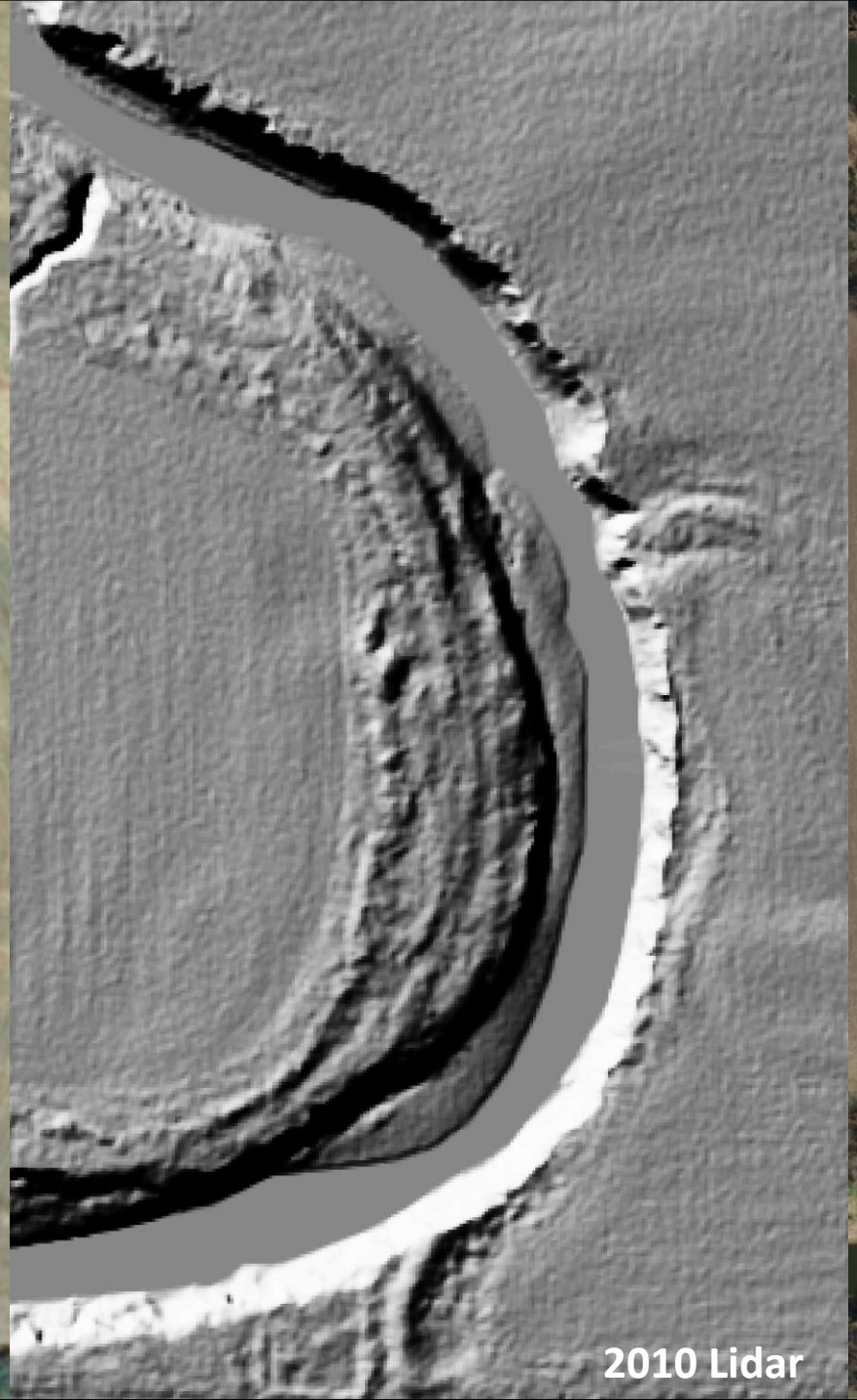
Photos courtesy of Brock Emmert

As built – April 2015

Post flood – October 2015
Photos courtesy of Brock Emmert

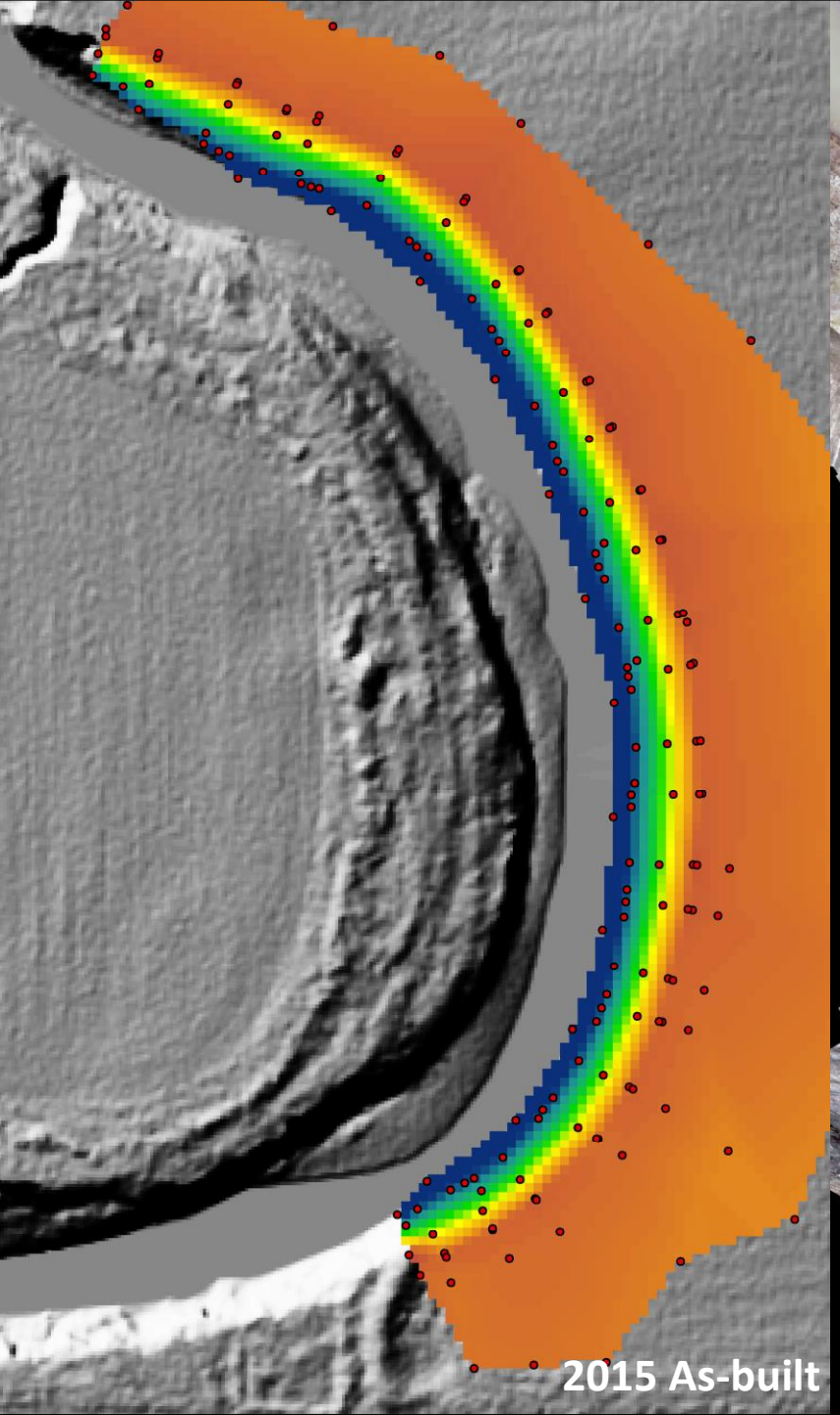
October 2019

2008 NAIP

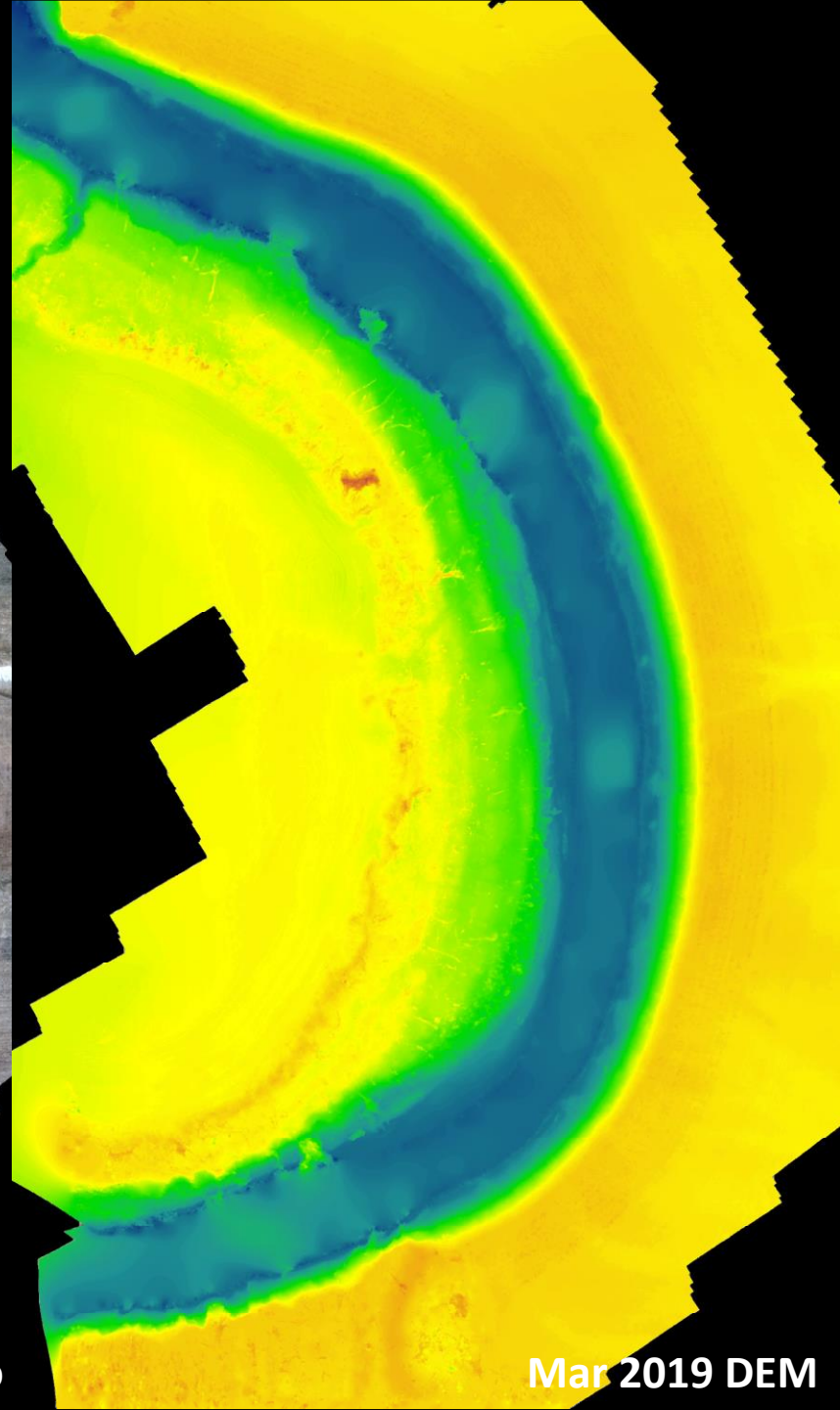

2010 Lidar

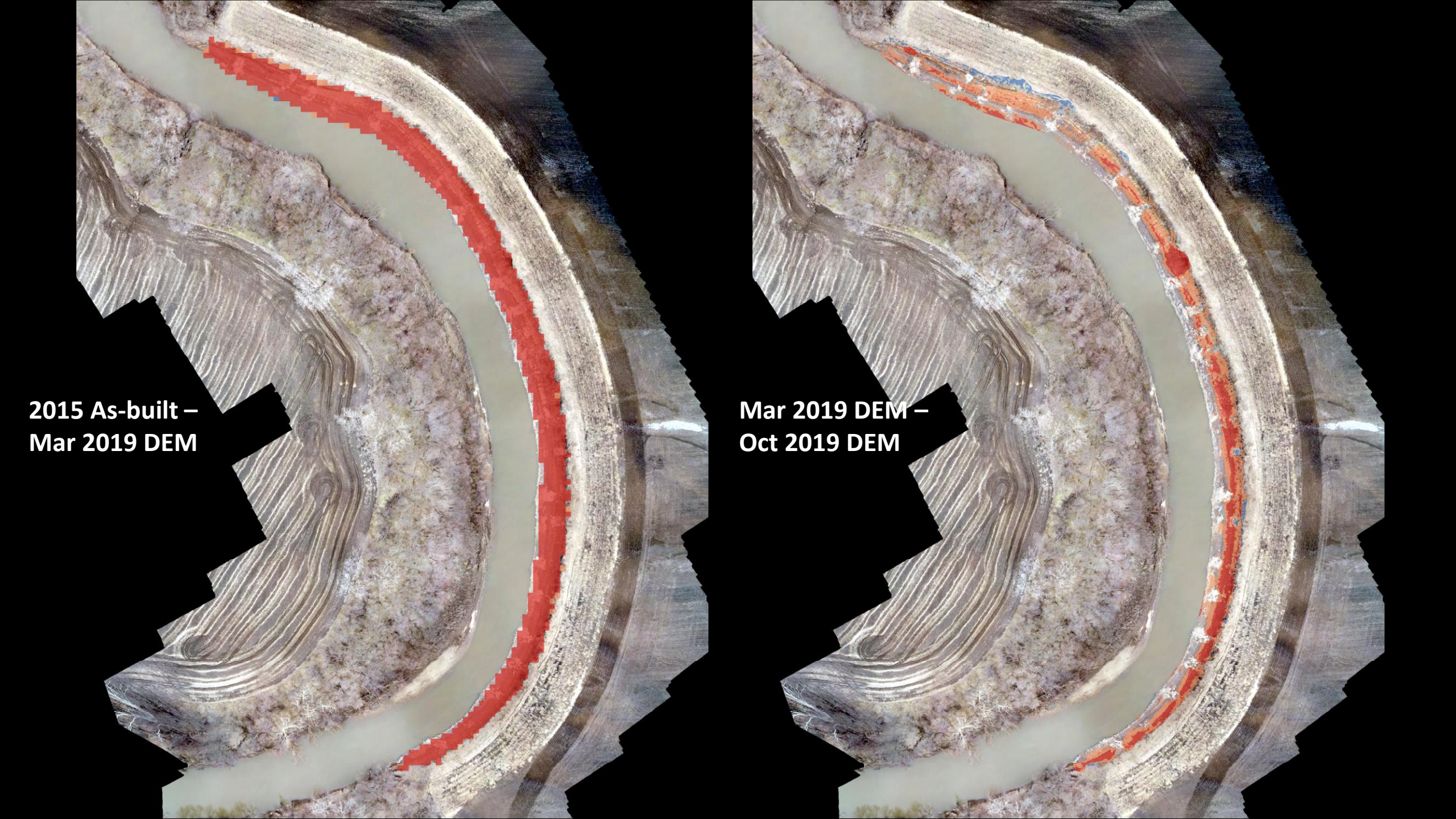
2014 NG911

Site C62			Volume eroded			
Time period	No. days	No. years	Total (ft^3)	per year (ft^3/yr)	per year (tons/yr)	per year/bank length (tons/yr/ft)
7/23/08-12/15/10	874	2.4	**149155**	62290	2772	1.7
12/15/10-4/1/14	1201	3.3	**102832**	31252	1391	0.8

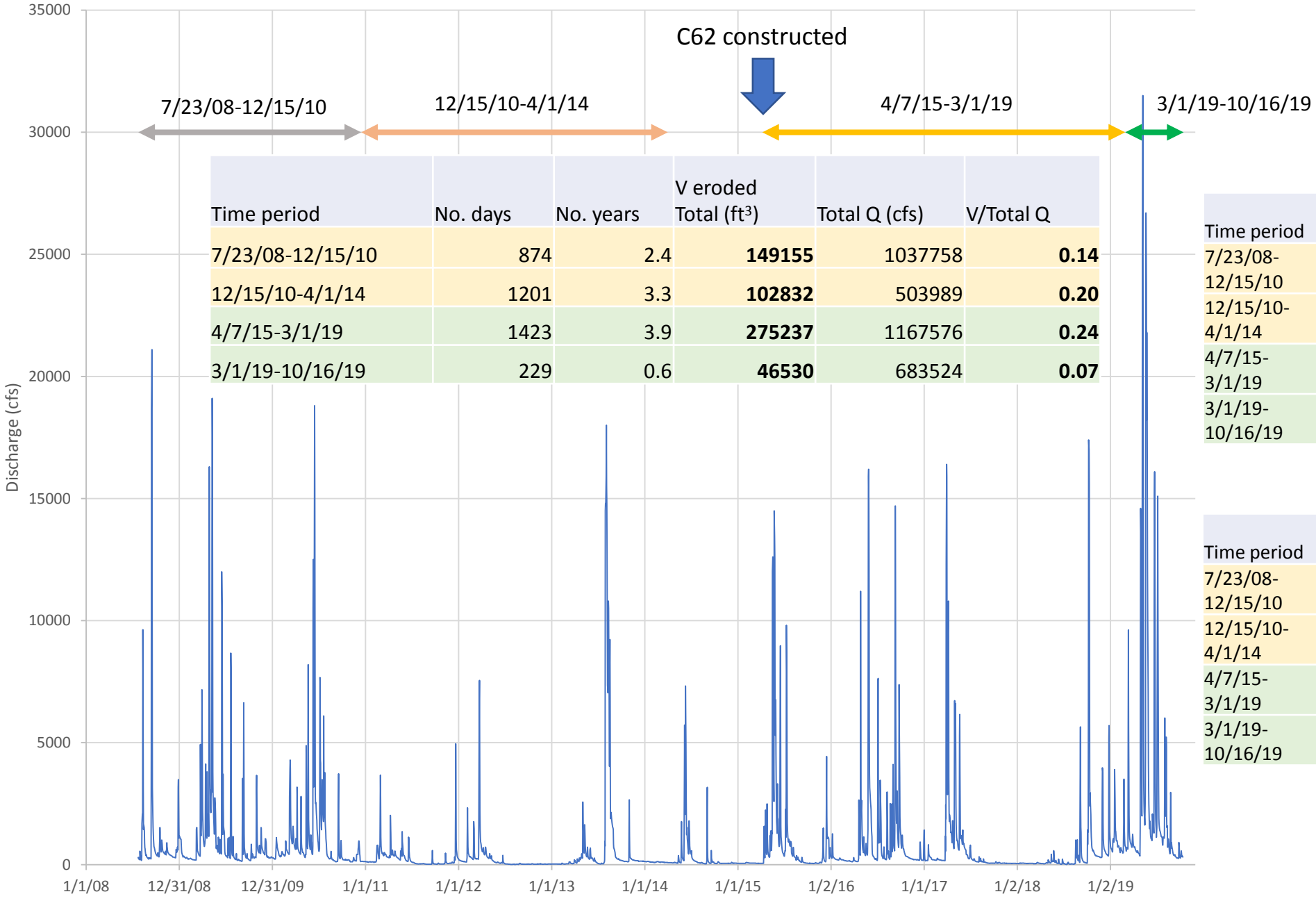

2015 As-built

Mar 2019 Ortho


Mar 2019 DEM


2015 As-built –
Mar 2019 DEM
Mar 2019 DEM –
Oct 2019 DEM

Site C62			Volume eroded			
Time period	No. days	No. years	Total (ft^3)	per year (ft^3/yr)	per year (tons/yr)	per year/bank length (tons/yr/ft)
7/23/08-12/15/10	874	2.4	**149155**	62290	2772	1.7
12/15/10-4/1/14	1201	3.3	**102832**	31252	1391	0.8
4/7/15-3/1/19	1423	3.9	**275237**	70598	3142	1.9
3/1/19-10/16/19	229	0.6	**46530**	74164	3300	2.0



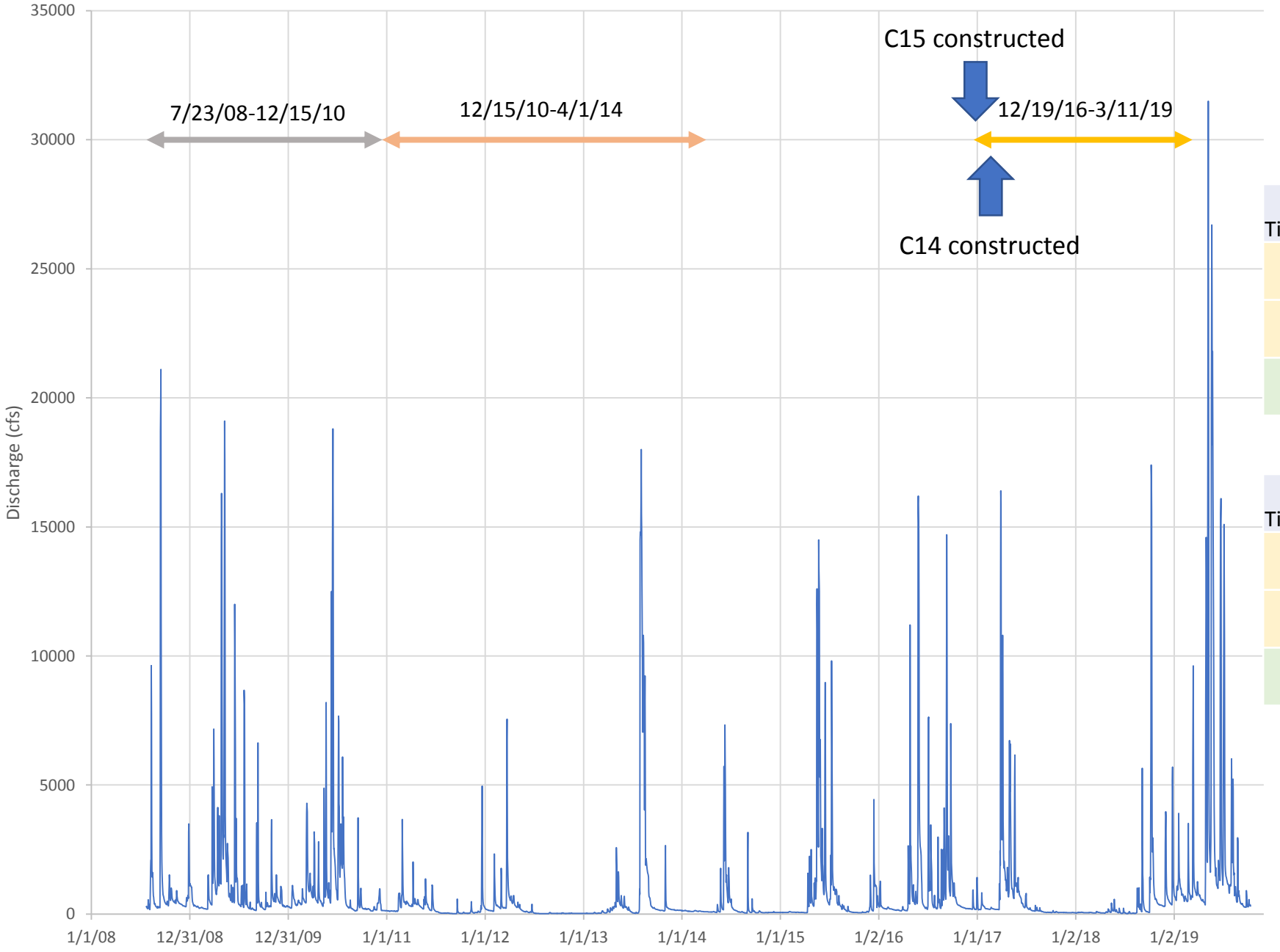
Time period	No. days	No. years	V eroded Total (ft³)	Total Q (cfs)	V/Total Q
7/23/08-12/15/10	874	2.4	**149155**	1037758	**0.14**
12/15/10-4/1/14	1201	3.3	**102832**	503989	**0.20**
4/7/15-3/1/19	1423	3.9	**275237**	1167576	**0.24**
3/1/19-10/16/19	229	0.6	**46530**	683524	**0.07**

	No. of events			
Time period	Q>2000 cfs	Q>5000 cfs	Q>10000 cfs	Q>14000 cfs
7/23/08-12/15/10	**108**	**33**	**18**	**10**
12/15/10-4/1/14	37	21	11	6
4/7/15-3/1/19	**117**	**51**	**20**	**9**
3/1/19-10/16/19	59	34	22	11

	No. of events/day			
Time period	Q>2000 cfs	Q>5000 cfs	Q>10000 cfs	Q>14000 cfs
7/23/08-12/15/10	**0.12**	**0.04**	**0.02**	**0.01**
12/15/10-4/1/14	0.03	0.02	0.01	0.00
4/7/15-3/1/19	**0.08**	**0.04**	**0.01**	**0.01**
3/1/19-10/16/19	0.26	0.15	0.10	0.05

Site C15			Volume eroded			
Time period	No. days	No. years	Total (ft^3)	per year (ft^3/yr)	per year (tons/yr)	per year/bank length (tons/yr/ft)
7/23/08-12/15/10	874	2.39	**284735**	118911	5292	3.2
12/15/10-4/1/14	1201	3.29	**141492**	43001	1914	1.1
12/19/16-3/11/19	811	2.22	**14184**	6384	284	0.2

Site C14			Volume eroded			
Time period	No. days	No. years	Total (ft^3)	per year (ft^3/yr)	per year (tons/yr)	per year/bank length (tons/yr/ft)
7/23/08-12/15/10	874	2.39	**140750**	58780	2616	1.6
12/15/10-4/1/14	1201	3.29	**51014**	15504	690	0.4
2/6/17-3/11/19	763	2.10	**59681**	28550	1270	0.8



C15

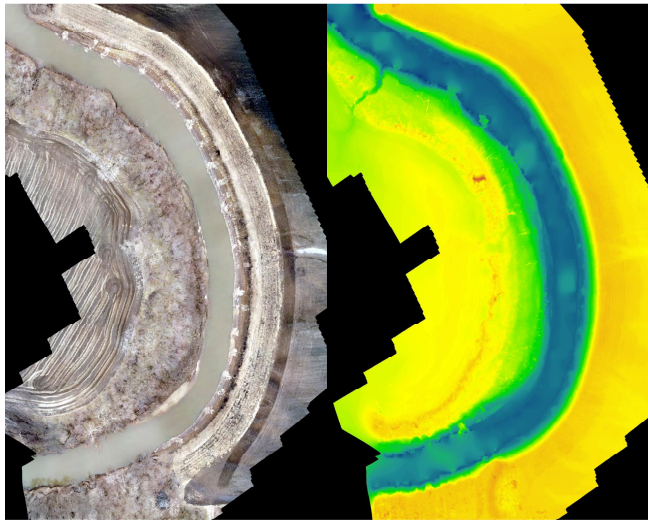
Time period	V eroded Total (ft^3)	Total Q (cfs)	V/Total Q
7/23/08-12/15/10	**284735**	1037758	**0.27**
12/15/10-4/1/14	**141492**	503989	**0.28**
12/19/16-3/11/19	**14184**	1174248	**0.01**

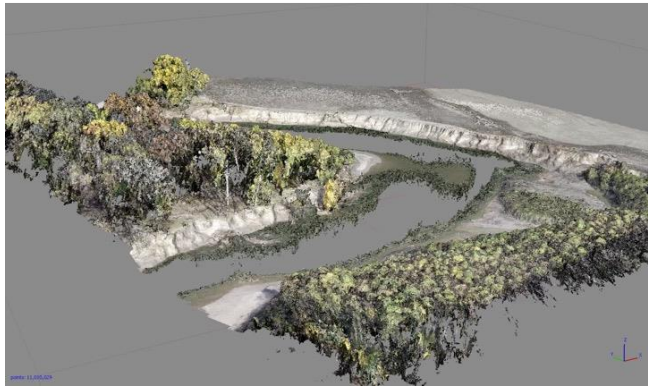
C14

Time period	V eroded Total (ft^3)	Total Q (cfs)	V/Total Q
7/23/08-12/15/10	**140750**	1037758	**0.14**
12/15/10-4/1/14	**51014**	503989	**0.10**
2/6/17-3/11/19	**59681**	865102	**0.07**

Take home points

- Stabilized streambanks continue to erode
- Are post-stabilization erosion volumes acceptable given the cost of construction?
- Site to site variability
- Disclaimer - Preliminary data. Future work:
  - 17 sites still to analyze
  - Better estimates of Q at each SBS site
  - Consider reach scale & areas of deposition





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