



Emergency Response to the Edenville Dam Failure

Dam Stabilization and Flood Risk Mitigation

MSPE Annual Conference

May 2021

Introduction: Who is Here Today and What are we Talking About?

Topics to Cover

- History of dams, review of dam characteristics, and regulatory action
- Storm event size and description, put it in context
- Day of failure/emergency response
- The stabilization action and plans
- Long-term plan



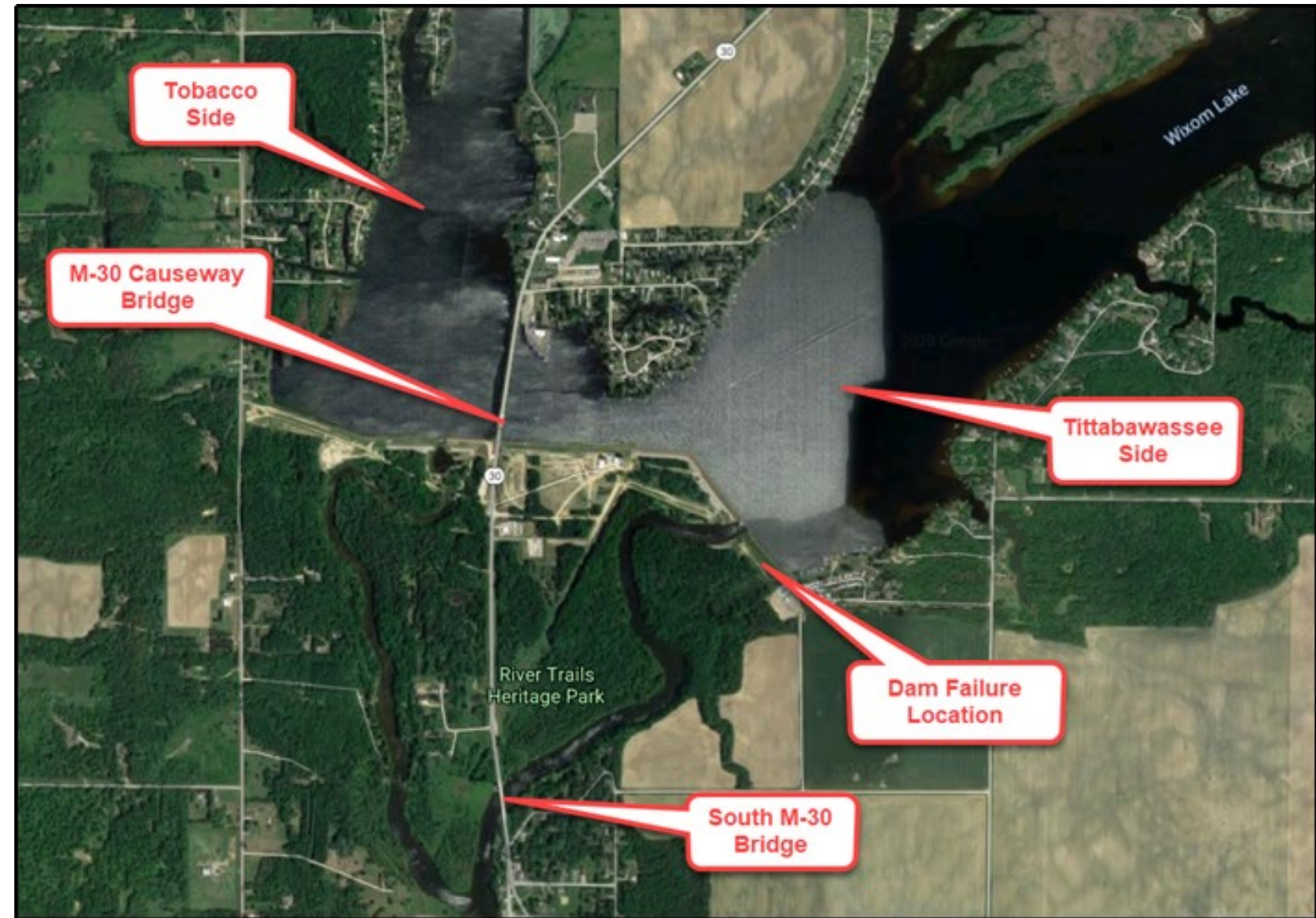
Dan DeVaux, PE
Dam Safety Engineer



Troy Naperala, PE
Water Resources Practice Lead

Quick History on Edenville Dam

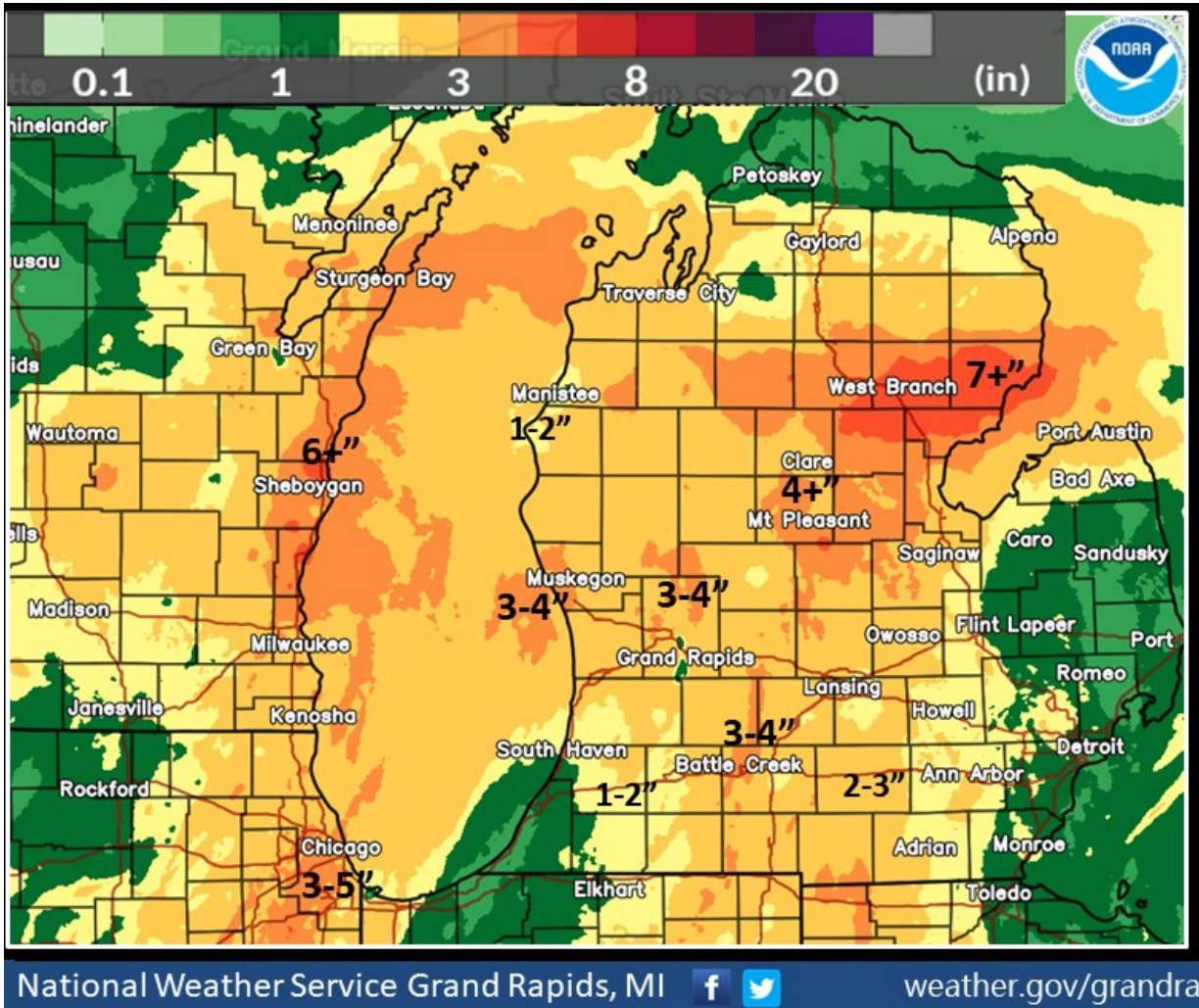
- Build 1925
- 6,600 feet earthen embankment
- 54 feet high
- Dual spillways
- Hydropower
- Spilled mostly through Tittabawassee River spillway
- Prior to 2021 was owned by Boyce Hydro, LLC.
- Gladwin & Midland Counties
Condemned property after failure
and FLTF is delegated authority.



The STORM!

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches) ¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
2-day	2.31 (1.94-2.77)	2.61 (2.19-3.13)	3.18 (2.66-3.82)	3.73 (3.10-4.51)	4.62 (3.76-5.93)	5.40 (4.26-7.00)	6.26 (4.76-8.34)	7.22 (5.24-9.90)	8.63 (6.00-12.2)	9.79 (6.57-13.9)

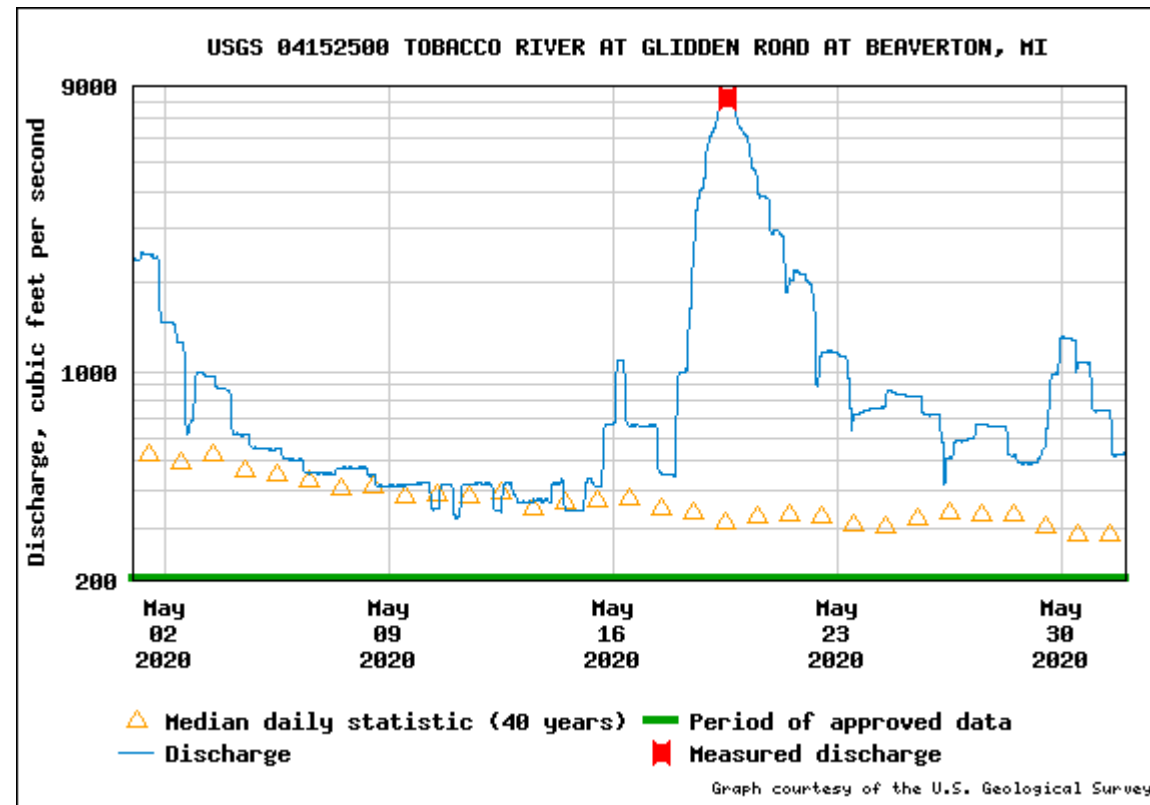
- Rainfall depth ranged from 6 to 8 inches across watershed
- Rainfall spanned May 18 and 19
- Approx. 48-hour period of rainfall



Total Rainfall: Sunday May 17 to Tuesday Morning May 19

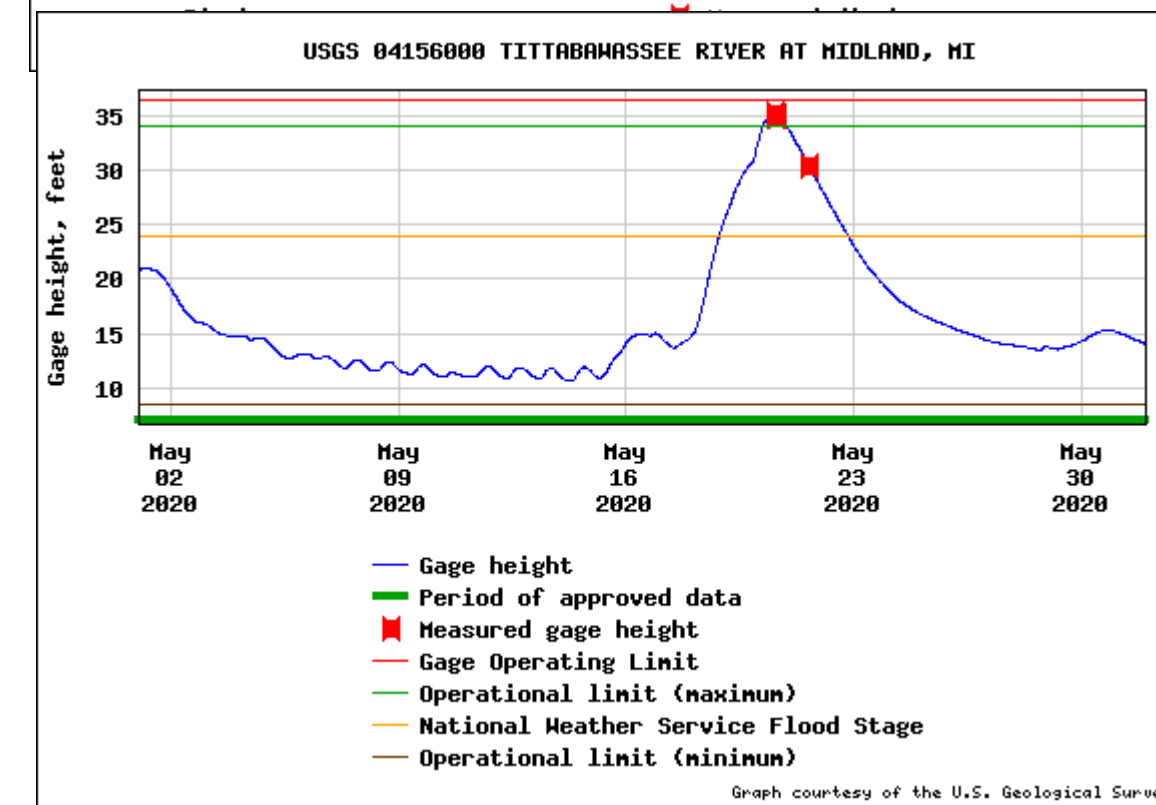
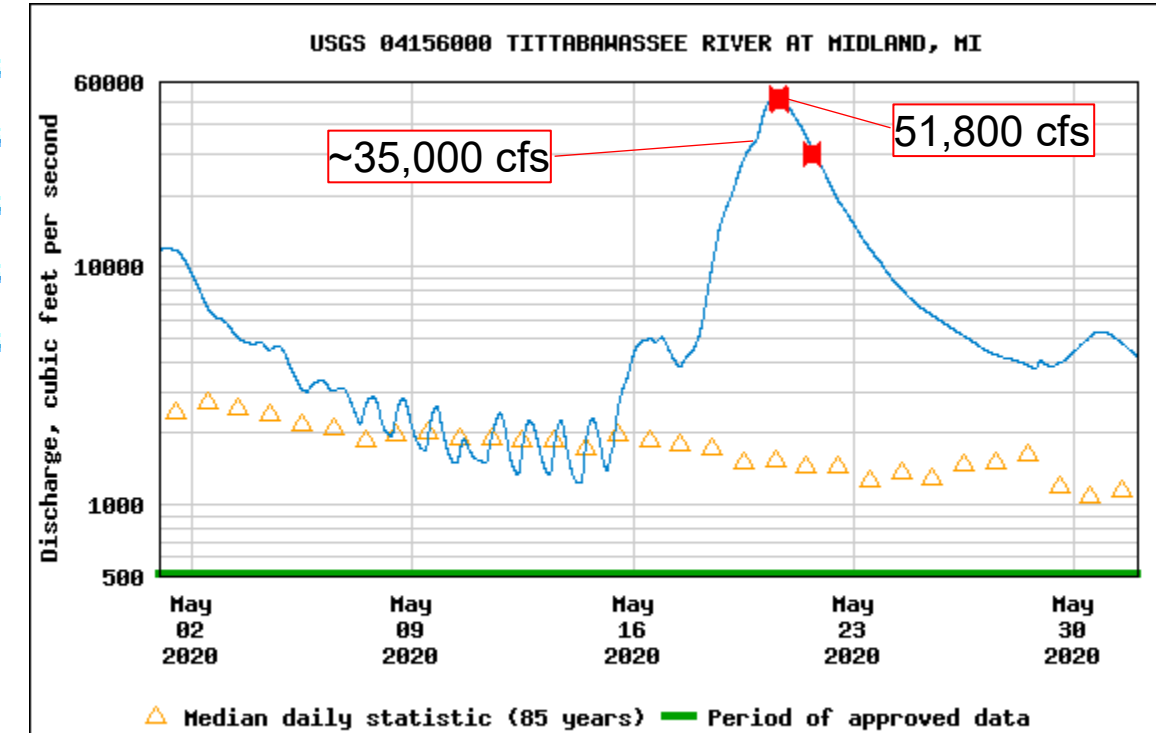
The STORM!

- Rainfall depth ranged from 6 to 8 inches across watershed
- Rainfall spanned May 18 and 19
- Approx. 48-hour period of rainfall



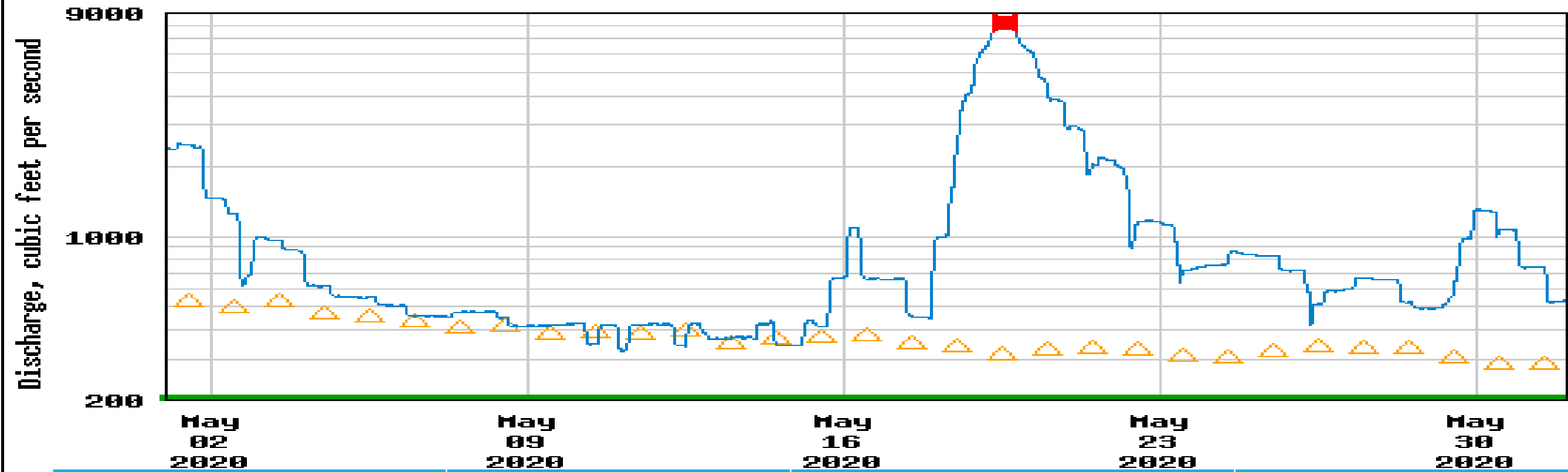
10%: 5900 cfs
2%: 8200 cfs
1%: 9200 cfs
0.5%: 10000 cfs
0.2%: 12000 cfs

10%: 28000 cfs
2%: 41000 cfs
1%: 47000 cfs
0.5%: 53000 cfs
0.2%: 62000 cfs



The STORM! – Watershed Hydrology Comparisons

USGS 04152500 TOBACCO RIVER AT GLIDDEN ROAD AT BEAVERTON, MI



	Tobacco Spillway	Tittabawassee Spillway	Combined
½ PMF			~38,000 cfs
500	13,000 cfs	14,000 cfs	27,000 cfs
100	10,000 cfs	9,900 cfs	19,900 cfs

Impact to Dam Embankment and Causeway

- 11,000 people evacuated
- 2,500 structures damaged



Impact to Dam Embankment and Causeway





Breach Flow Path



Tittabawassee Breach flow path

Breach Flow Path



Breach flow path appears higher than natural channel



Tobacco Spillway

Tobacco River Spillway

<https://www.youtube.com/watch?v=SMcf-EI1xcl>



Tobacco Spillway

Tobacco River Spillway



https://www.youtube.com/watch?v=_SMcf-EI1xcl

Emergency Response Activities (days and weeks)

- EGLE staff onsite leading up to and during failure.



Downstream Flooding

- 11,000 people evacuated
- 2,500 structures damaged



Emergency Response Activities (days and weeks)

- Damage assessments in weeks following event.
 - Dams, streams and road crossings within flood impact region



Emergency Response Activities (days and weeks)

- EGLE issued multiple orders for dam owner to address issues at Edenville Dam.
- Initial investigations identified concerns over hydraulic capacity and structural stability of the Tobacco spillway and embankment, as well as impacts to natural resources and transportation.



Edenville Dam Emergency Inspection Report

Updated July 24, 2020

configurations and soil properties previously discussed. Based on the results of the slope stability analysis, the slope right of the Tobacco Spillway can support additional hydraulic loading (water levels up to ELEV 665 NGVD), however, prior to installation of the proposed SSP wall, it is

Annual Peak Flows - USGS Gage 04152500 Tobacco River in Beaverton, MI

Water Year	Date	Gage Height (feet)	Stream-flow (cfs)
2015	Apr. 10, 2015	7.60	2,610 ⁵
2016	Apr. 01, 2016	9.29	3,950 ⁵
2017	Jun. 24, 2017	11.62	5,500 ⁵
2018	Feb. 21, 2018	12.73	6,420 ⁵
2019	Mar. 15, 2019	10.55	4,670 ⁵

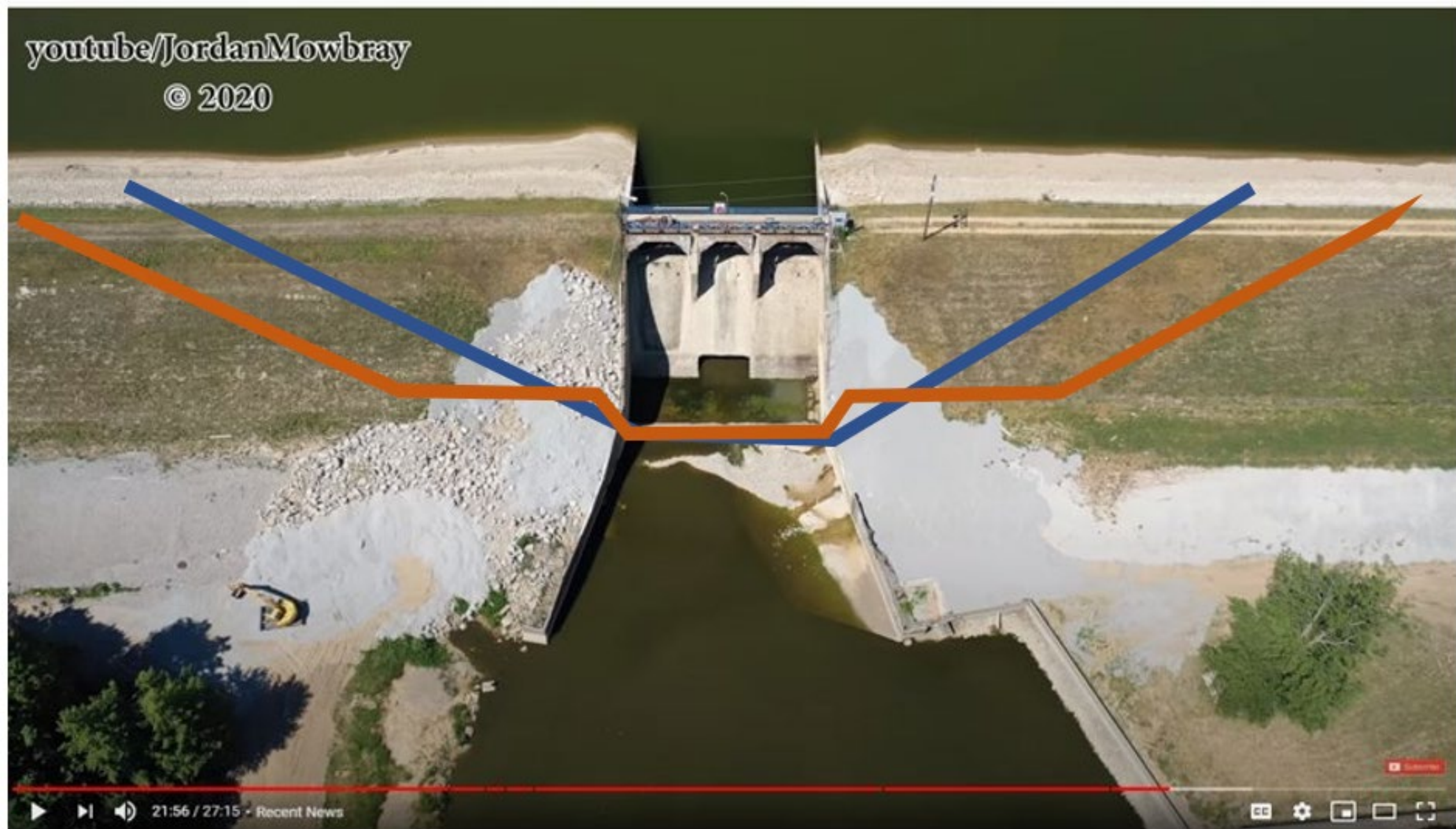
Scenario	Inflow (cfs)	Max. Reservoir WSE (ft)	Depth Dam Overtopping (ft)	Discharge Overtopping (cfs)	Tobacco Spillway EL (ft)	Tobacco Spillway (cfs)	M30 Causeway Weir El (ft)	M30 Causeway Channel Flow (cfs)	Total Flow (cfs)	Depth of Pool
Existing Conditions 50 yr	9,300	668.49	-13.6	0	667.8	307	657	8435	8,742	42.49
Existing Conditions 100 yr	10,000	668.84	-13.3	0	667.8	385	657	9040	9,425	42.84
Existing Conditions 200 yr	11,000	669.3	-12.8	0	667.8	490	657	9872	10,362	43.30
Existing Conditions to elev. 665	3,160	665	-17.1	0	667.8	0	657	3100	3,100	39.00
Existing Conditions to elevation 682	52,700	682.11	0.0	6	667.8	9770	657	39452	49,228	56.11

**AECOM Hydraulic
Analysis of
remaining Tobacco
Impoundment**

Emergency Response Activities (days and weeks)

- EGLE in partnership with MDOT contracts with AECOM to perform additional engineering analyses.
- Goals of the project:
 - Identify and quantify concerns
 - Explore alternatives to alleviate those concerns
- Due to inaction by the owner, EGLE issues Emergency Order to finalize design on the selected alternative and implement mitigation measures ahead of 2021 spring high flows.
- EGLE in partnership with DTMB, FLTF, and NRCS contract with Fisher Contracting Company to implement project.

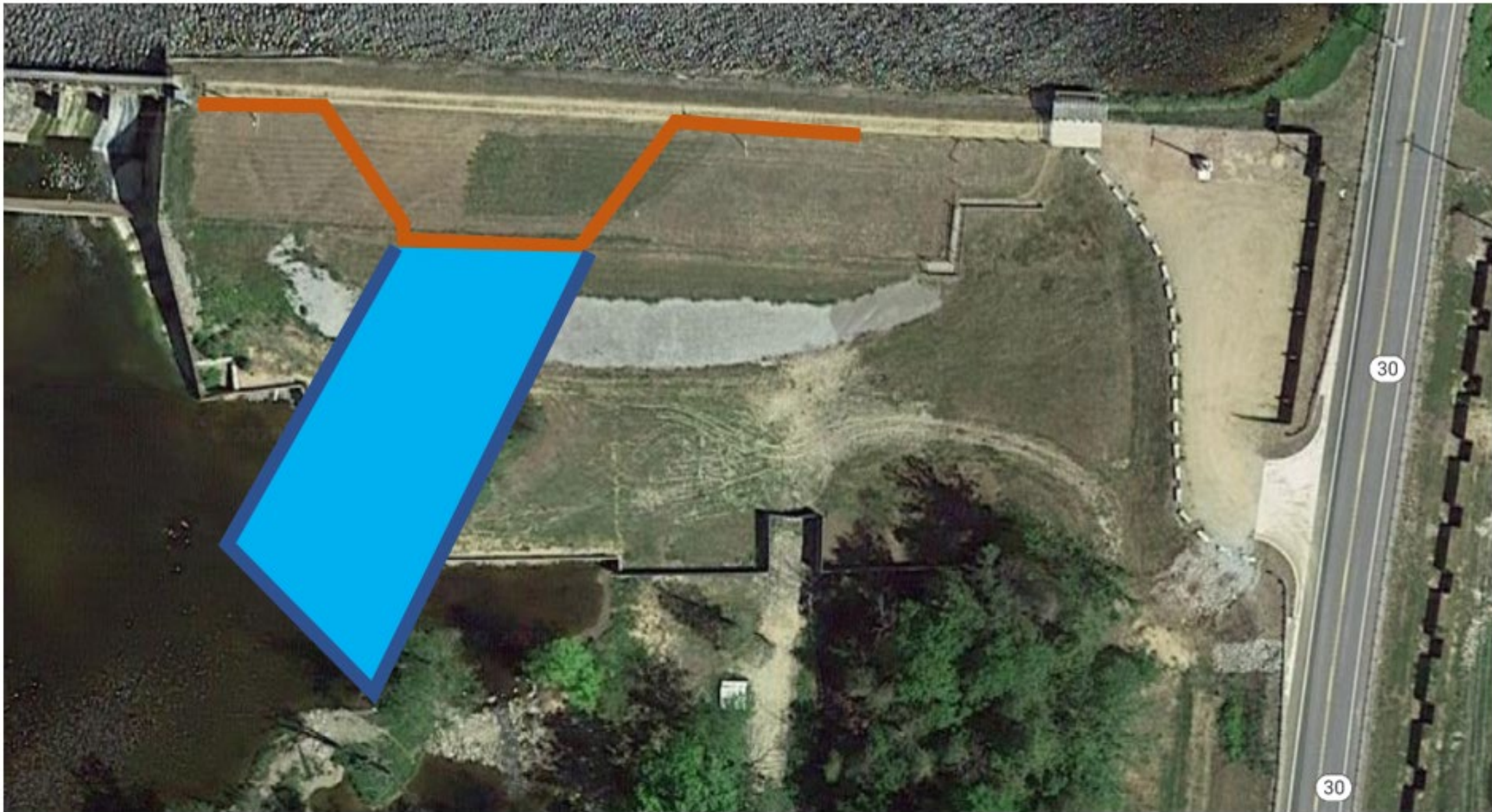
Tobacco River Alternative A – Full Dam Breach



Tobacco River Alternative B – Partial Dam Breach at Spillway



Tobacco River Alternative C – Breach at Earthen Embankment



Tobacco River Restoration



Alternative Selection Process

	Alternative A - Dam Breach		Alternative B - Modify Existing Spillway		Alternative C - Earthen Embankment Dam Breach		Alternative D - Dam Rehabilitation		Weight
Description	This option will construct a breach through the existing dam at the spillway capable of passing the ____ year event, maintain sediment load, and reestablish flow in the natural channel in the Tobbaco River.		This option will modify the invert elvation of the spillway to maintain a lower reservoir pool and have the storage capacity to attenuate the ____ yr event with adequate residual freeboard.		This option will construct a breach through the existing dam aembankment capable of passing the ____ year event, maintain sediment load, and reestablish flow in the natural channel in the Tobbaco River.		This option will rehabilitate the existing dam and spillway to meet current dam safety standards including low-level outlet, spillway sized to pass the ____ year event, stabilty requirements (static, rapid drawdown, seismic).		
Factor 1 –Dam Safety									
Subfactor 1.1: Improve the safe operation of the dam.	Full breach of the dam minimizes storage potential behind the dam.	0	Lowers the reservoir elevation, increases the spillway capactiy, improvements to the existing dam to meet current dam safety standards including: low-level outlet, slope protection.	0	Full breach of the dam minimizes storage potential behind the dam.	0	rehabilitates the dam to meet current dam safety criteria	0	1

Selected Alternative

- New mass concrete stepped spillway weir with a crest El. 647 Used 650 CY concrete Conveys the 200 yr events with a peak reservoir elevation of 658.74 9300 cfs and approximately 1700 cfs through the M30 Causeway



Summary

- Heavy rains lead to high flows
- Wave action, high water level, and saturated soils resulted in failure
- Dams design not up to current design standards
- Flooding downstream impacts 1,000 people and resulted in >\$250M damages
- FLTF taking on rebuilding of dams. Expected cost to rebuild all 4 dams is \$300M - \$400M and 5 years



QUESTIONS?