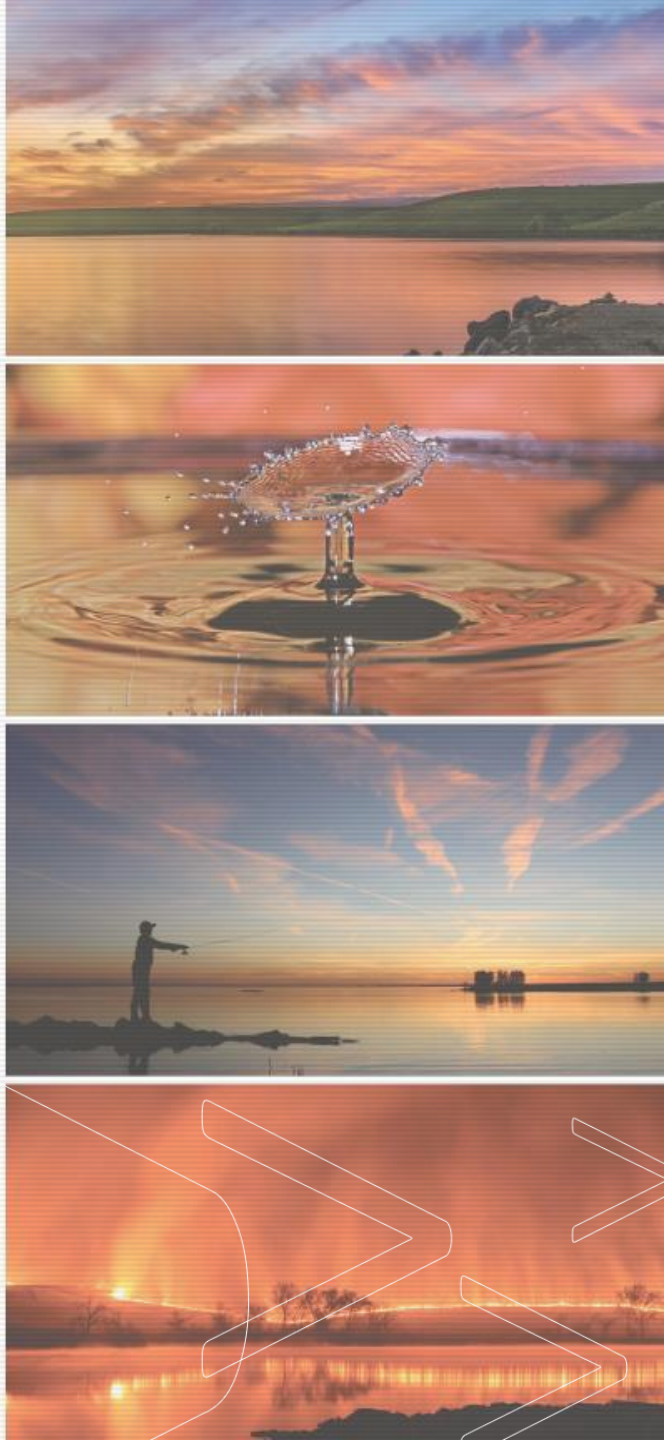
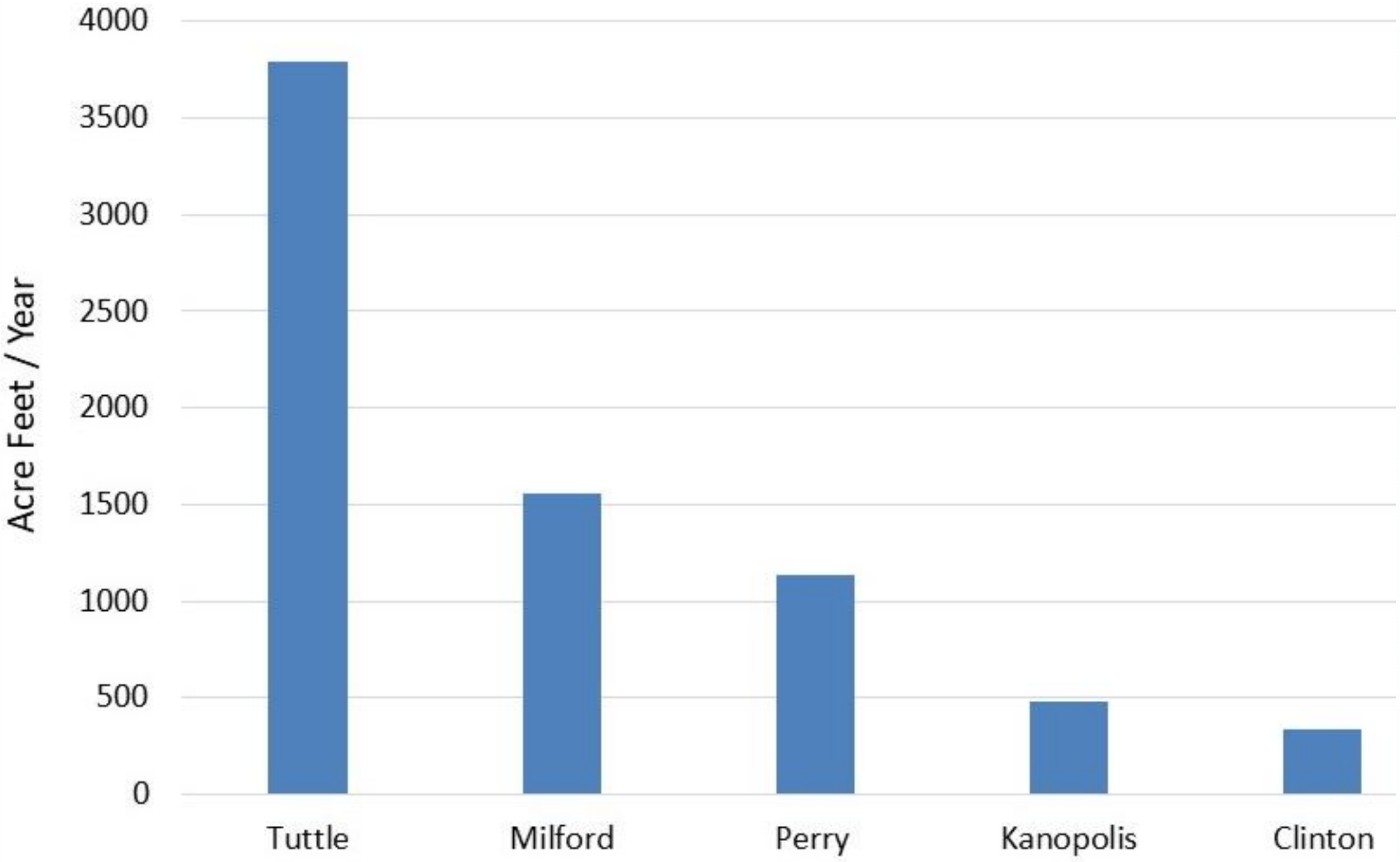
John Shelley, Ph.D., P.E.
US Army Corps of Engineers
Kansas City District

Water Injection Dredging for Tuttle Creek Lake

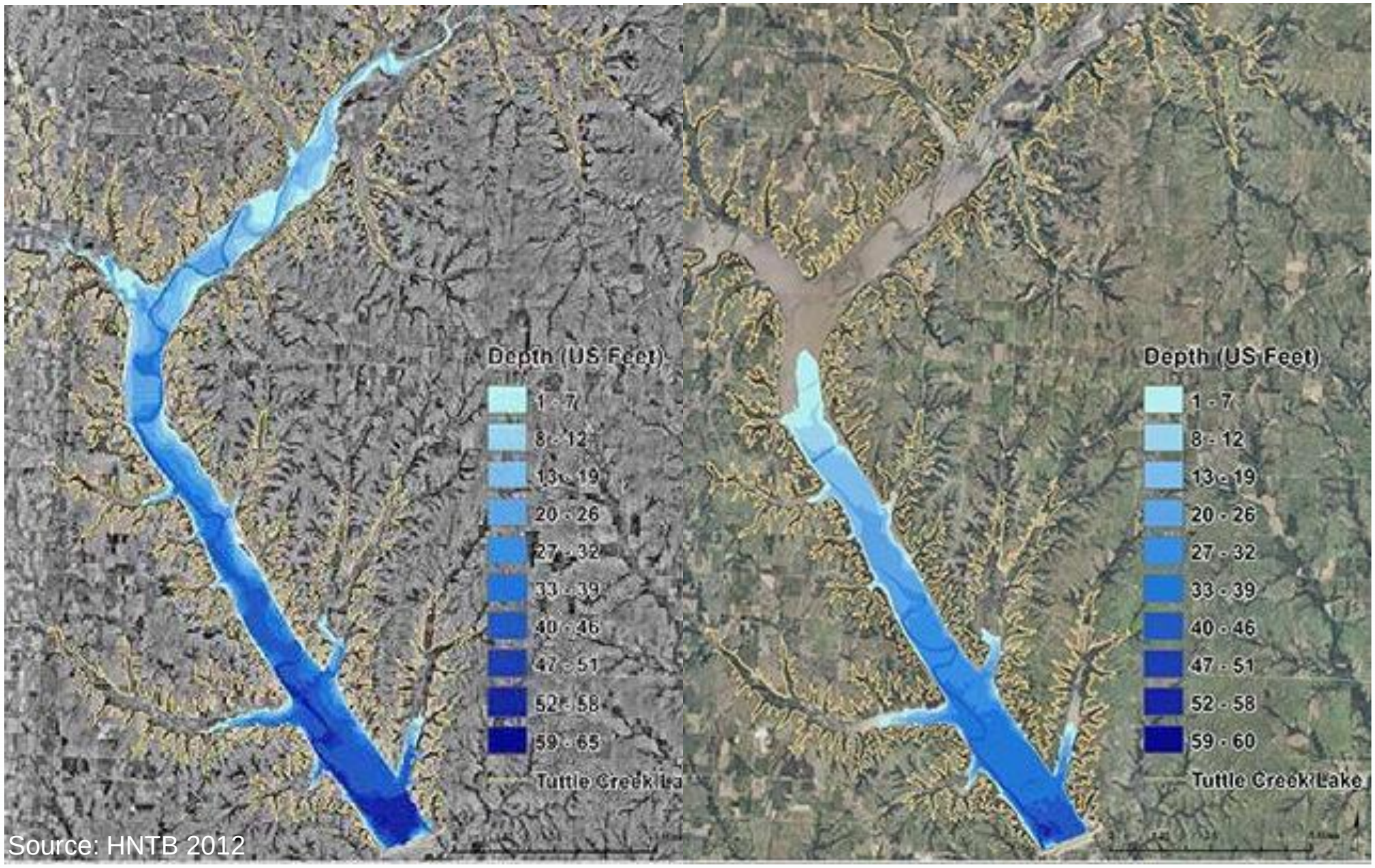


Governor's Conference on the Future of Water in Kansas

Sediment Accumulation in the Multipurpose Pool

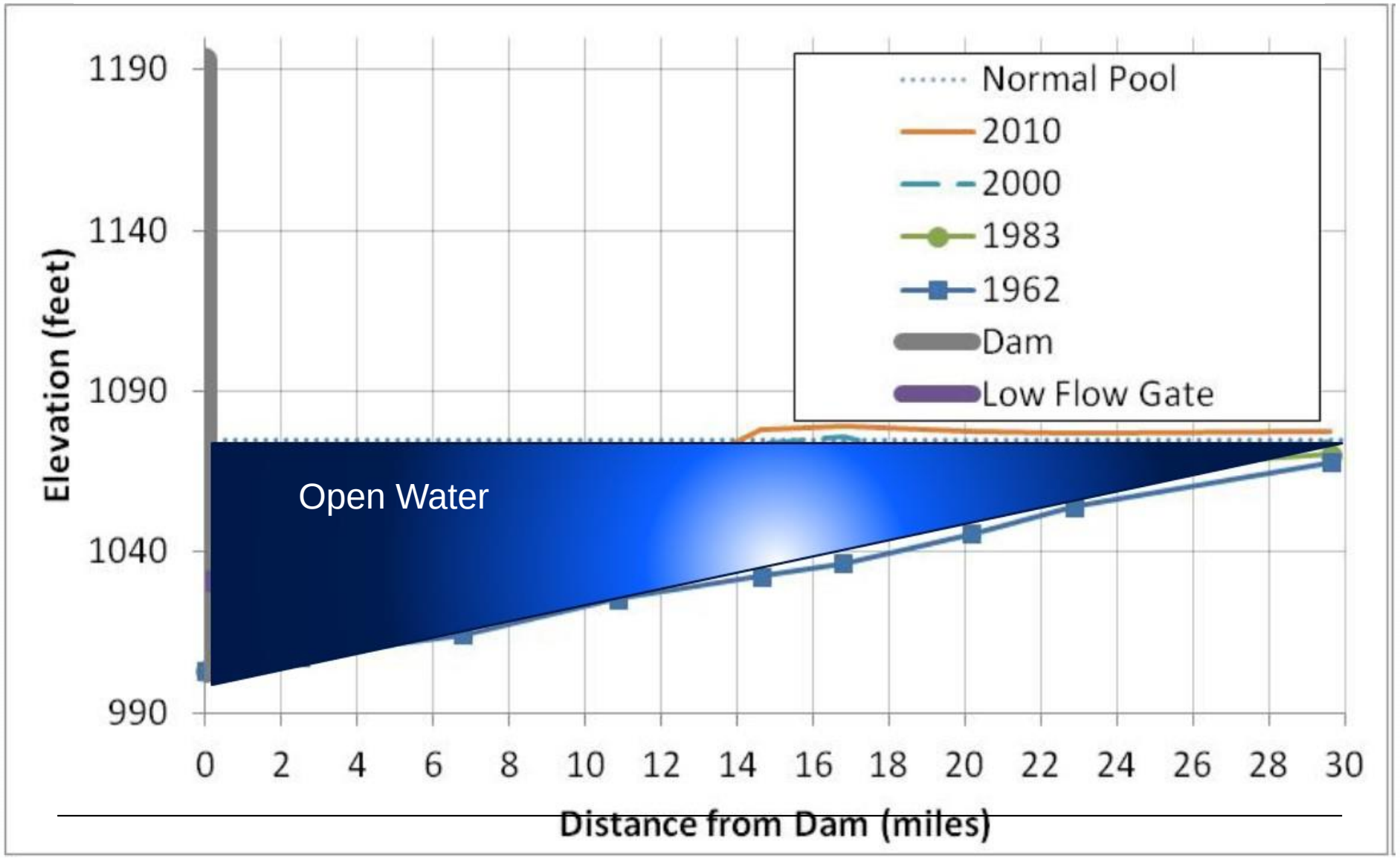


Tuttle Creek Lake: 1962 to 2010

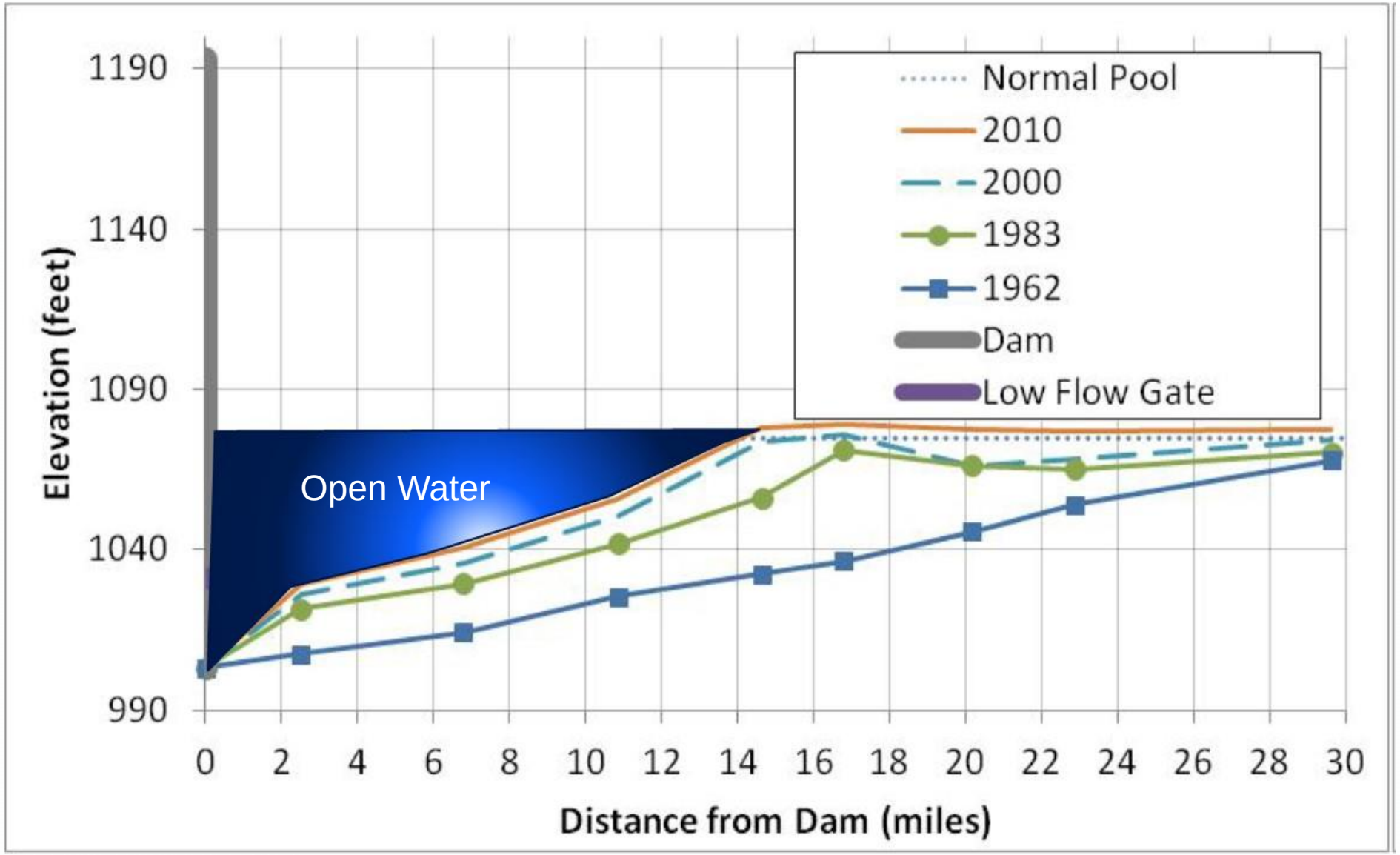


Source: HNTB 2012

Tuttle Creek Lake: 1962



Tuttle Creek Lake: 2010

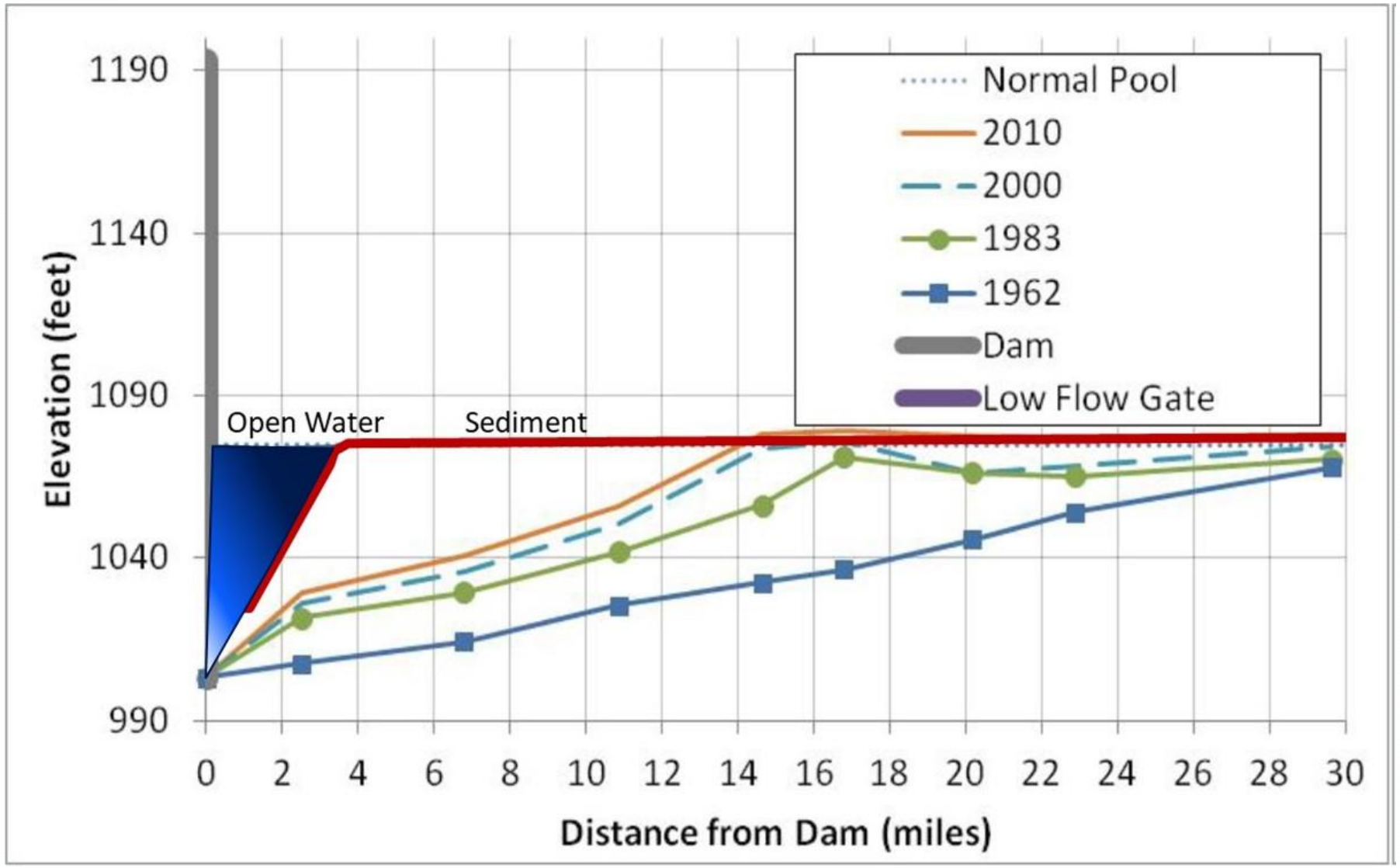


Tuttle Creek Lake

At the same annual rate of sedimentation:

- **Multi-purpose pool will be 88% full in 50 years**
- **Total storage (multi-purpose + flood control) will be 21% full**

What does 88% full look like?



*This is a rough sketch showing what 88% full looks like, not the result of detailed analysis. Results from the ongoing Kansas River Basin study will produce more representative projections.

The Good News

Reservoirs are operated sustainably around the world through a variety of methods.

But not every method is effective acceptable, or optimal for every situation.

Dredging Discharge from Millsite Dam near Ferron, Utah

Reservoir Sediment Management Strategies

- Water-injection Dredging
- Sediment yield reduction
- Sediment traps
- Sediment bypass
- Sediment pass-through (routing, sluicing)
- Drawdown flushing
- Hydrosuction
- Inlet extension
- Density current venting
- Dredging with land disposal
- Dredging with downstream recharge
- Pressure flushing
- Sediment focusing
- Reallocation
- New reservoirs/dam raises

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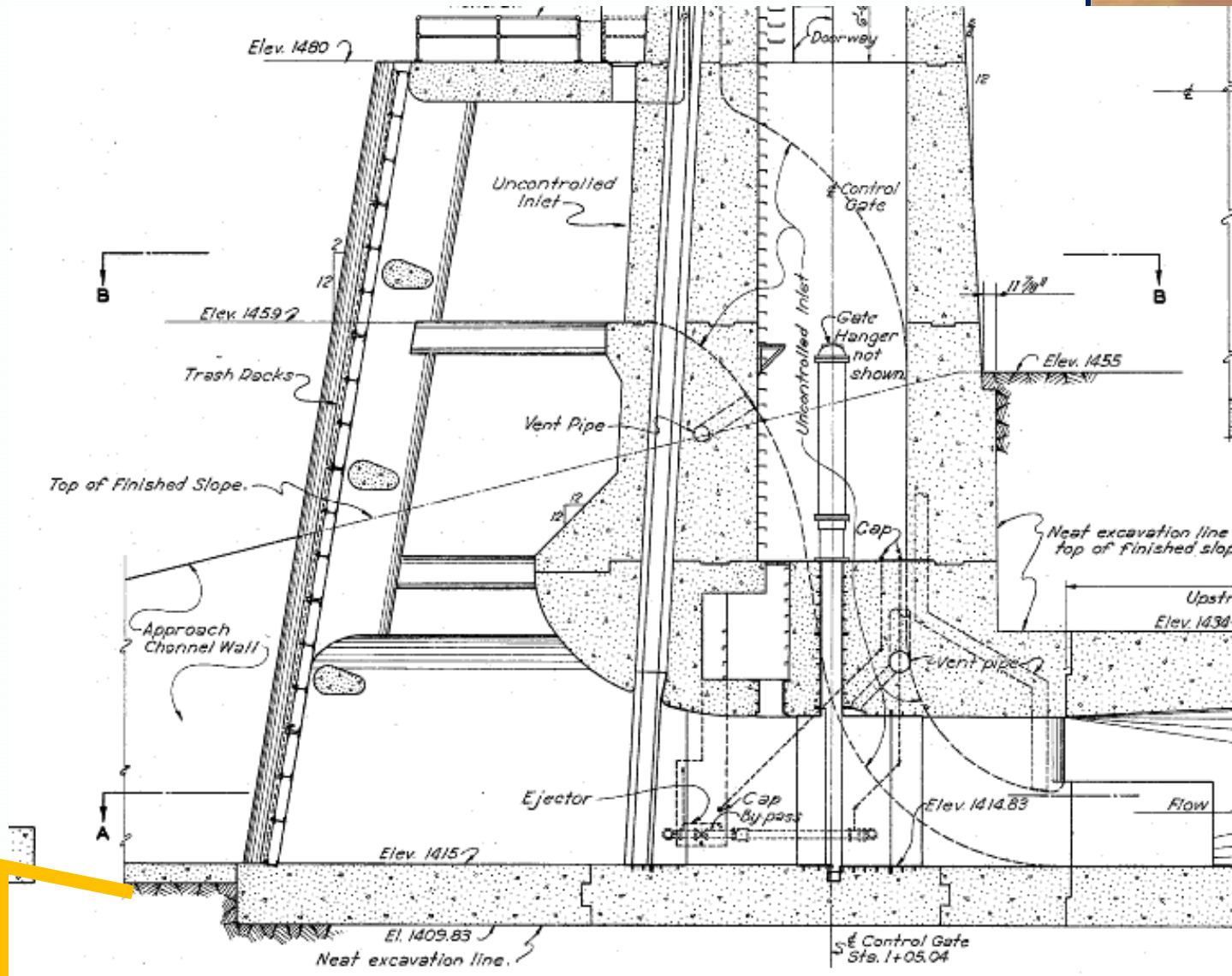
Water Injection Dredging (WID)

https://www.youtube.com/watch?v=JfVK5rLYXiM

More Good News: Tuttle Creek Lake Infrastructure

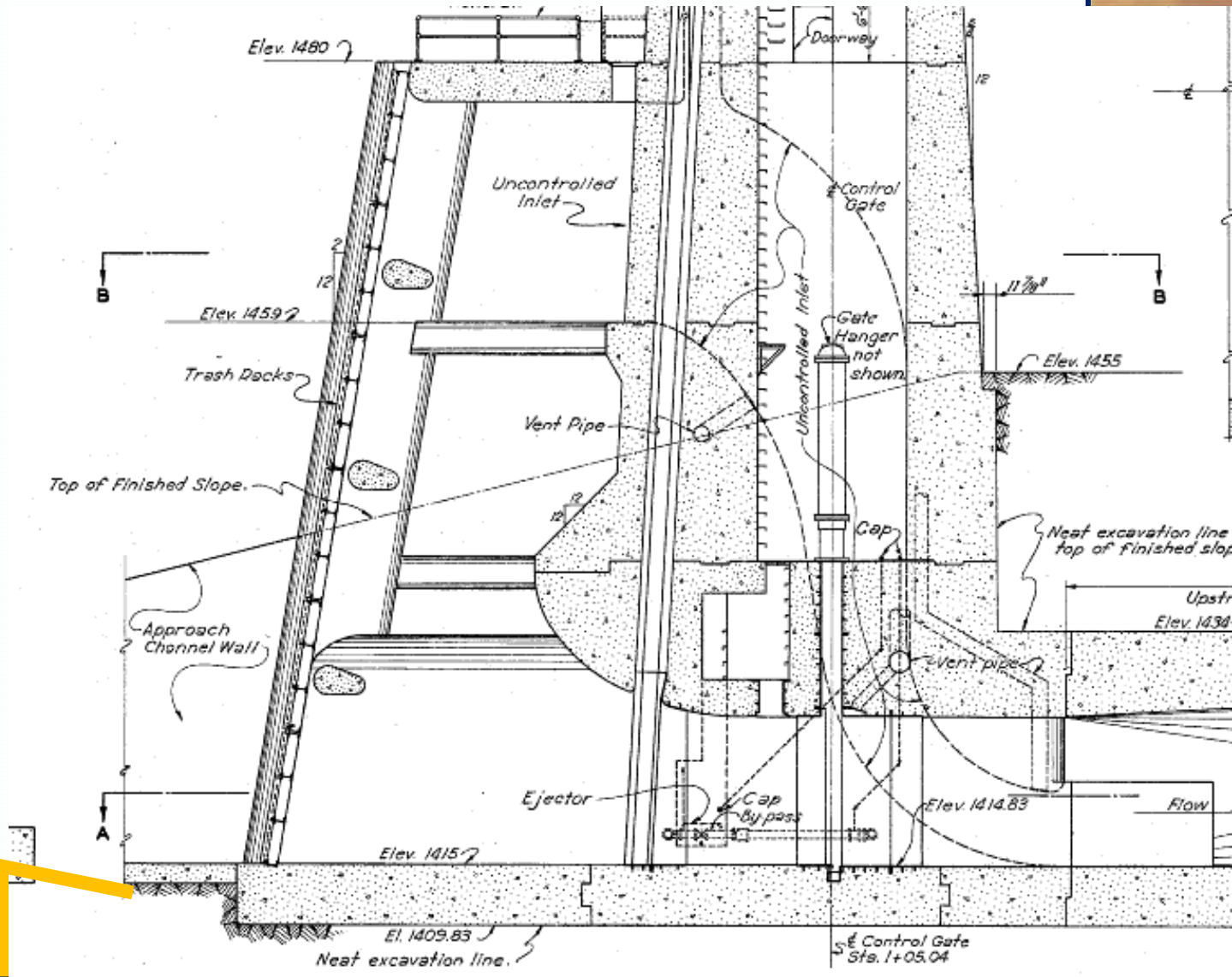


Lake Bottom

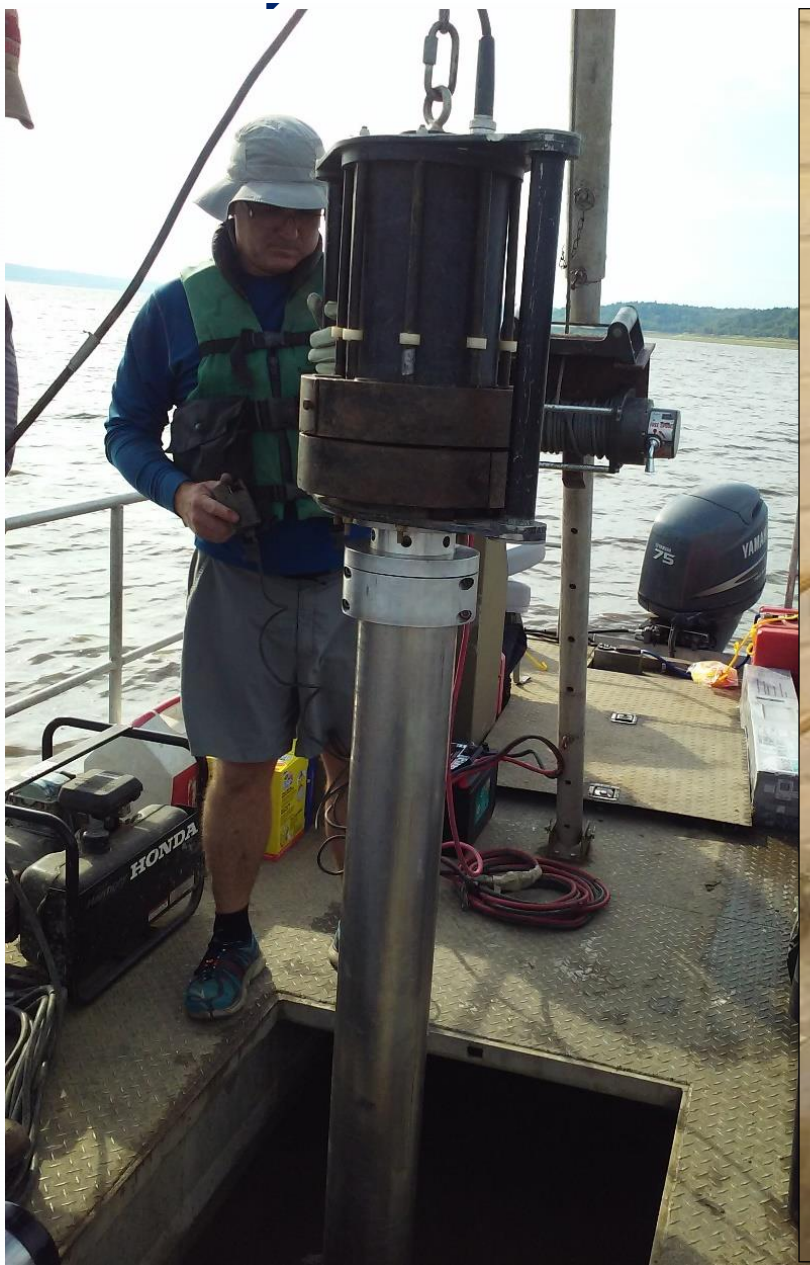
More Good News: Sediment is Clean

Sediment tests:
Not contaminated

Lake Bottom



More Good News: Sediment is Fine and Erodible

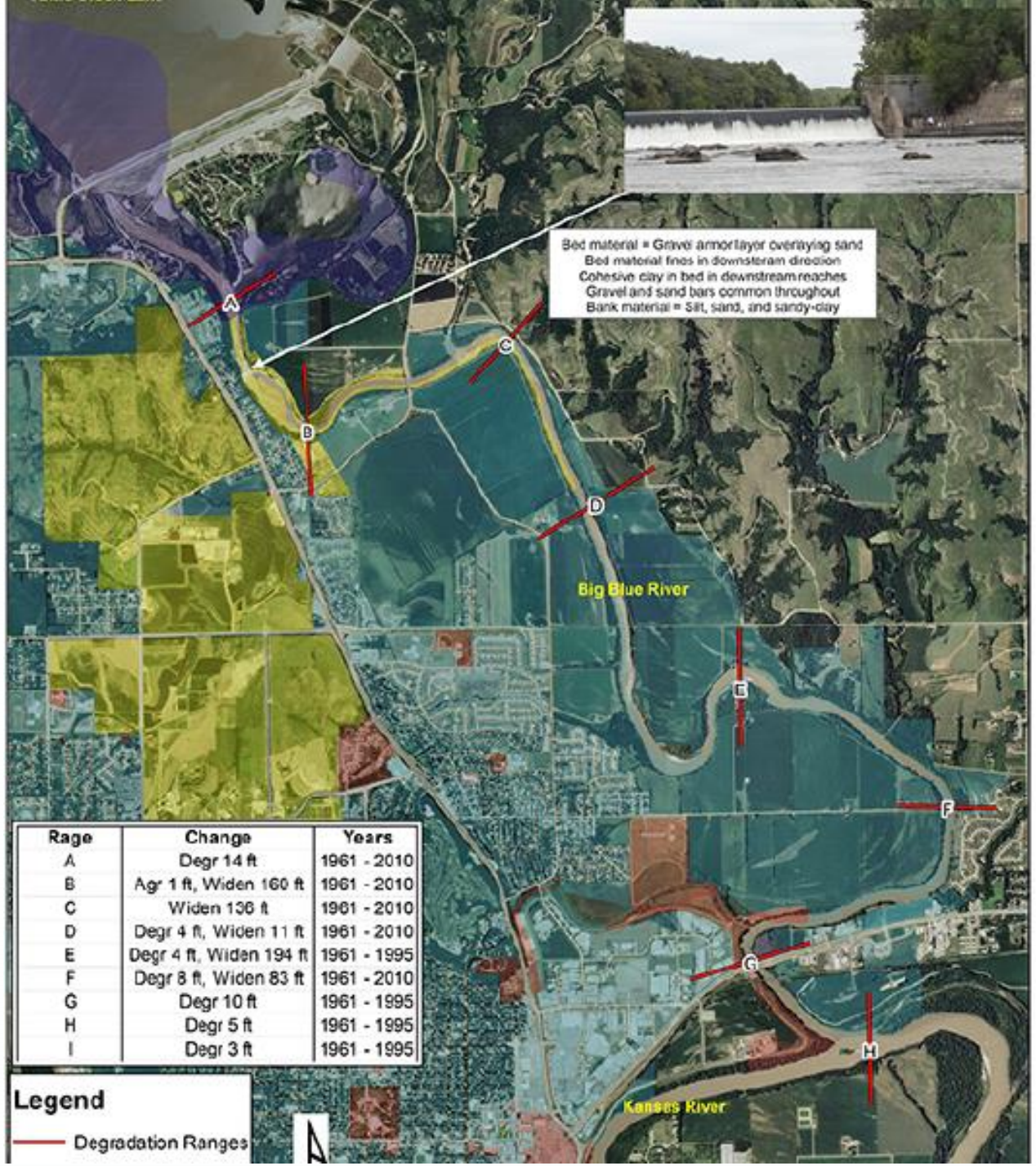


More Good News: Sediment is Fluidizable

https://youtu.be/VU3eExJjAsM

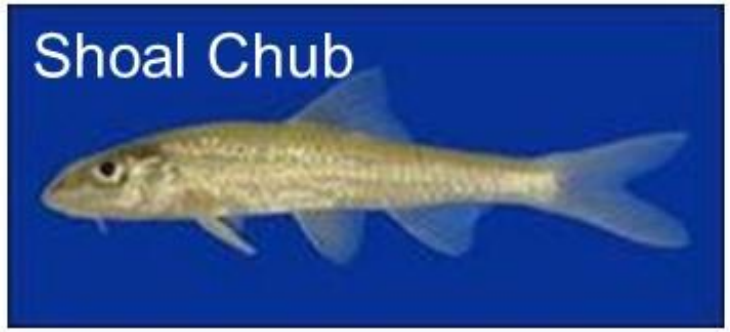
More Good News: Downstream Channel Conditions Favorable

Downstream Channel is Starved for Sediment



Rage	Change	Years
A	Degr 14 ft	1961 - 2010
B	Agr 1 ft, Widen 160 ft	1961 - 2010
C	Widen 136 ft	1961 - 2010
D	Degr 4 ft, Widen 11 ft	1961 - 2010
E	Degr 4 ft, Widen 194 ft	1961 - 1995
F	Degr 8 ft, Widen 83 ft	1961 - 2010
G	Degr 10 ft	1961 - 1995
H	Degr 5 ft	1961 - 1995
I	Degr 3 ft	1961 - 1995

Decline in Turbidity-Dependent Species in the Kansas River



Other impacted species showing significant decline or complete extirpation: Silver Chub, Flathead Chub, River Shiner, Carmine Shiner, Sturgeon Chub

Mississippi River Delta

OUR COASTAL CRISIS

Land Loss

Wasted Sediment

Louisiana's coastline—including the incredibly valuable and productive Mississippi River Delta—is vanishing at an alarming rate. **Every 100 minutes, a football field of land disappears into the Gulf of Mexico.** This coastal land loss is a crisis of national importance, as it affects people, wildlife and jobs not only across the region but also throughout the United States.

To fully grasp the scope and urgency of Louisiana's coastal crisis, it is important to understand how the Mi

http://mississippiriverdelta.org/our-coastal-crisis/wasted-sediment/

Dams Upriver

Valuable land-building sediment is trapped behind locks and dams on the Missouri, Mississippi and Ohio Rivers. Since 1850, the amount of sediment in the Lower Mississippi River has decreased by more than **70 percent**.

Table 1. USACE WID projects.

Project Name	Project Site	Cost ($)	Volume (yd^3)	Duration (hr)	Production Rate (yd^3/hr)
Upper Mississippi River 1992	WI and IL	NA	8,000	96	83
Calumet 1994	LA	41,438	15,644	24	652
New Orleans Harbor 1998	LA	731,975	650,482	1,368	476
New Orleans Harbor 2001	LA	794,260	334,530	849	394
Houston Ship Channel Emergency 2001	TX	335,810	113,200	96	1,179
Houston Ship Channel Bayport Flare 2001	TX	NA	116,671	48	2,431
Houston Ship Channel Carpenters to Green Bayou 2001	TX	NA	26,259	96	274
Houston Ship Channel Bayport Flare 2001	TX	NA	97,900	72	1,360
New Orleans Harbor 2002	LA	1,619,968	888,406	960	925
Michoud Canal 2002	LA	79,264	232,235	96	2,419
MRGO* 2003	LA	98,900	350,000	96	3,645
Houston Ship Channel Mid Bay 2004	TX	1,183,014	566,507	2,136	265
New Orleans Harbor 2005	TX	2,339,686	531,046	672	790
Calumet 2010	LA	260,436	22,406	24	934

Back of the Envelope: Effectiveness

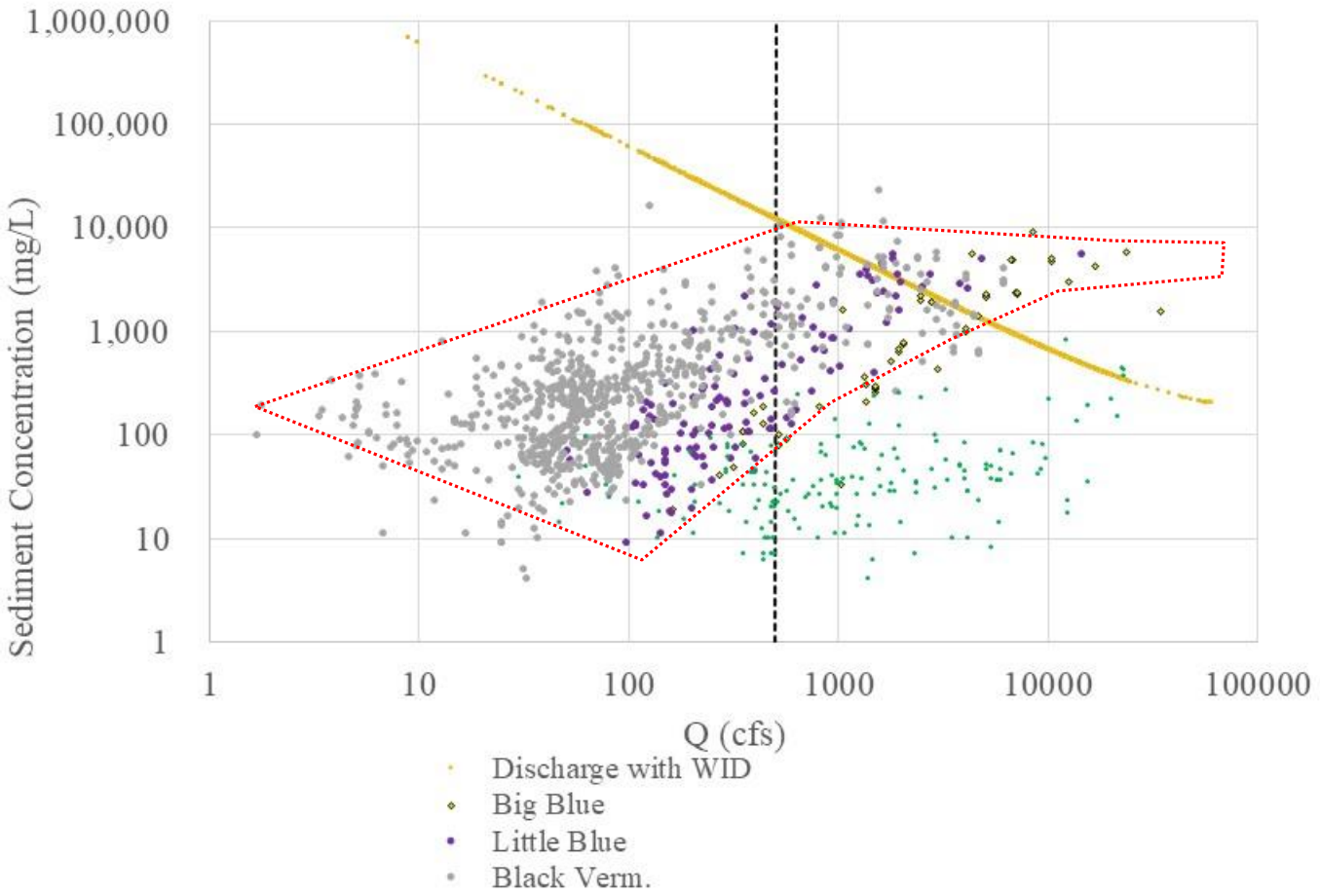
800 CY/hr

24 hours a day

But only on days when flows are at least 500 cfs

3,258 ac-ft/year

90% of annual trapped sediment passed downstream



Back of the Envelope: Cost

Range: $0.28 to $11.62 / CY

5.8 M CY/year

$1.6M to $67.5M / year

Costs from various harbors and navigation channels

$	CY	$/CY
41438	15644	2.65
731975	650482	1.13
794260	334530	2.37
335810	113200	2.97
1619968	888406	1.82
79264	232235	0.34
98900	350000	0.28
1183014	566507	2.09
2339686	531046	4.41
260463	22406	11.62

The Bottom Line

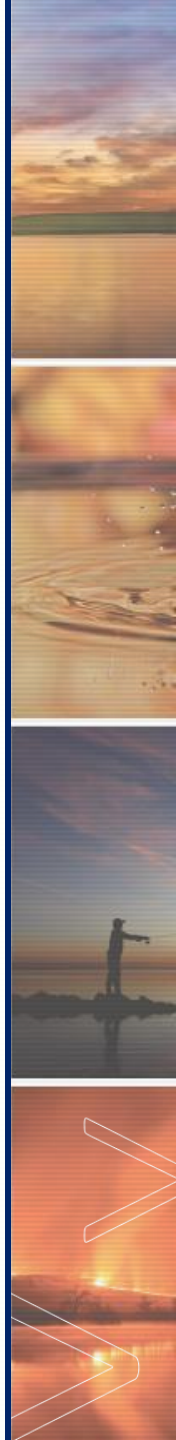
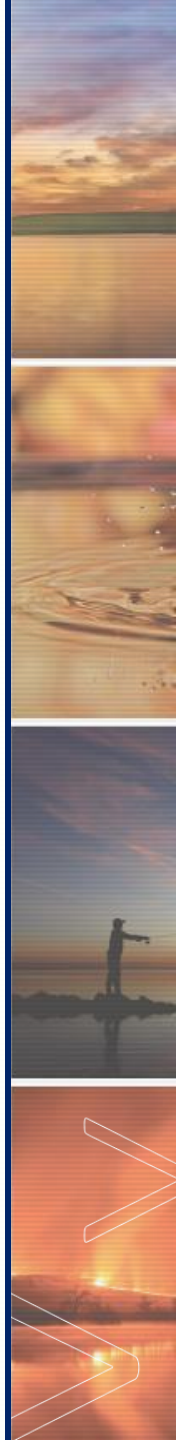
Physical conditions are promising for WID as a cost-effective solution at Tuttle.

But…

- WID has never been done in a reservoir.
- Sediment restoration new in the basin.

Short-term test:

- How effective?
- What cost?
- What impact (positive or negative) on the downstream channel?



Questions?