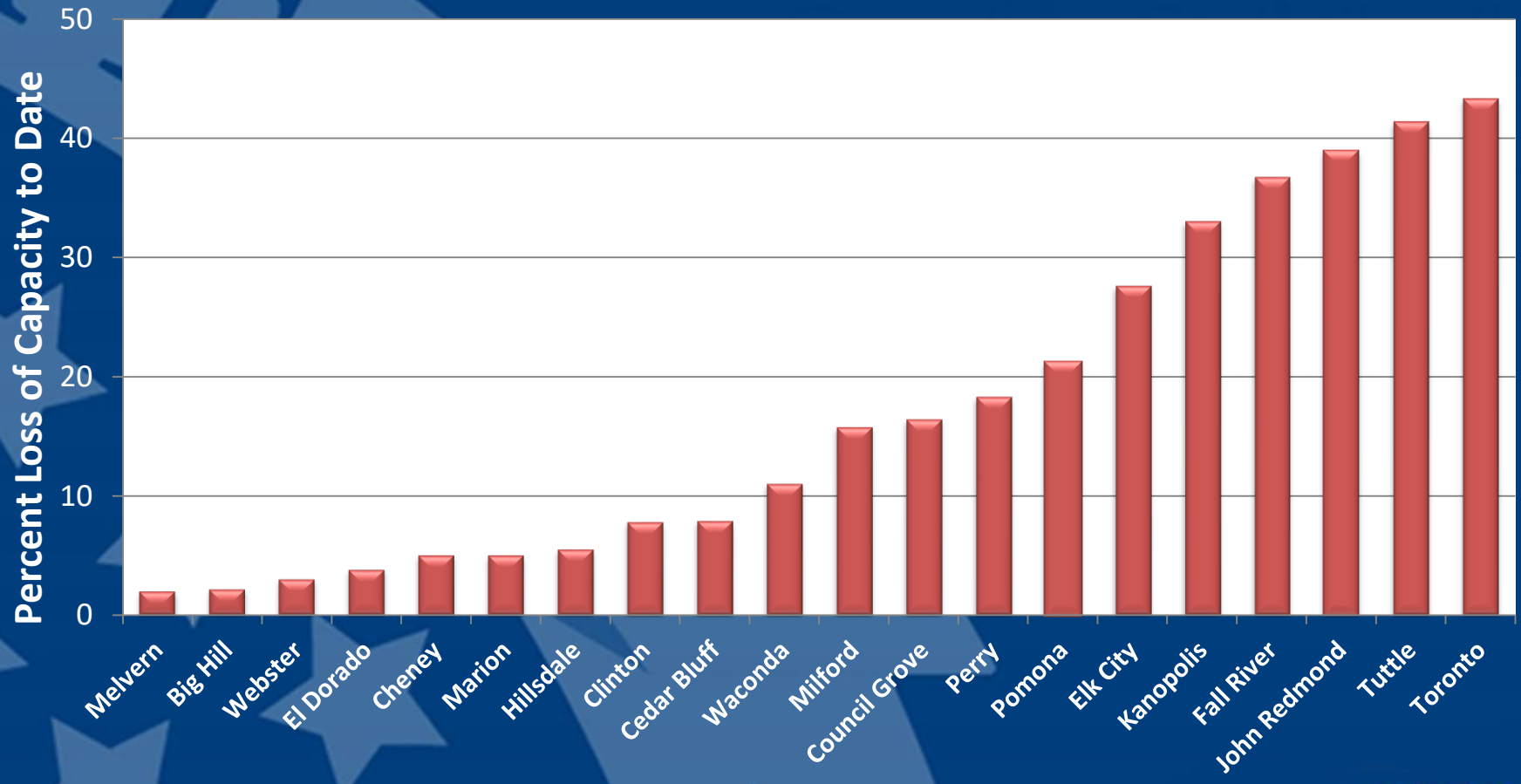
Water Injection Dredging (WID) Demonstration at Tuttle Creek Lake

Josh Olson – Kansas Water Office

October 5, 2019

Kansas Reservoir Loss of Capacity



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Reservoir Sediment Sustainability

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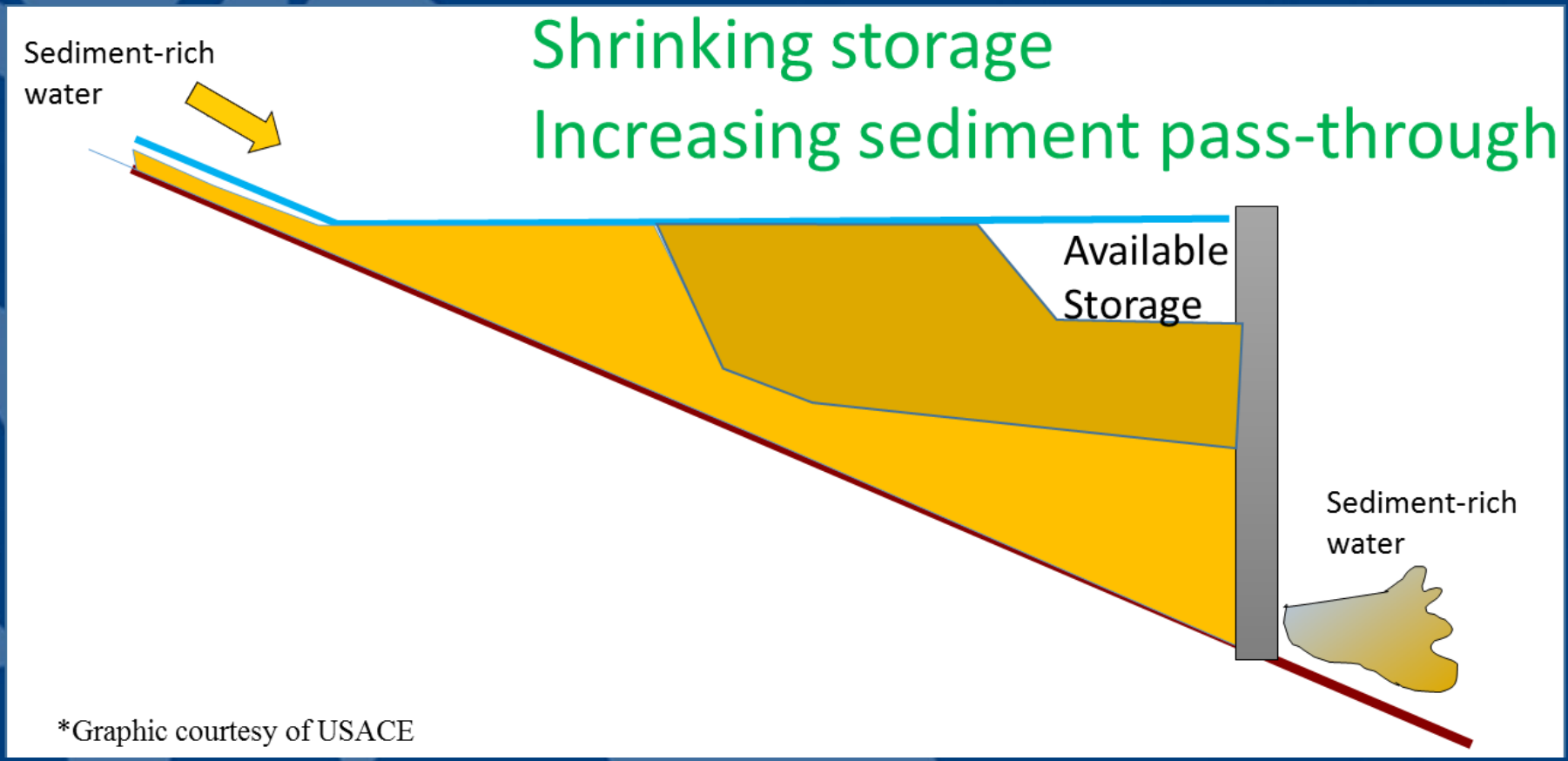
Without Reservoir Sustainability



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Without Reservoir Sustainability

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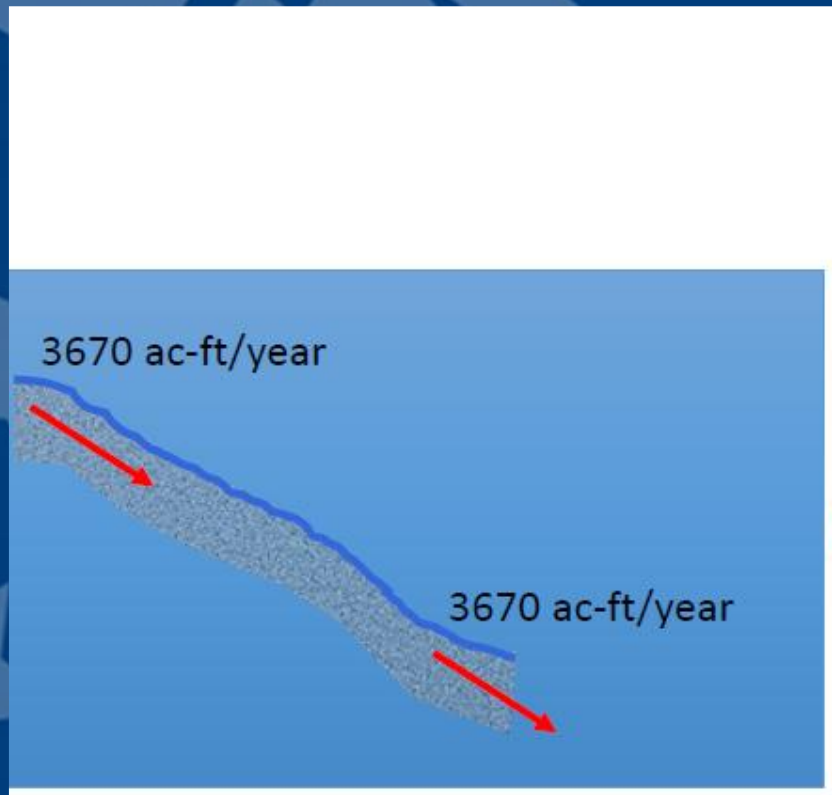
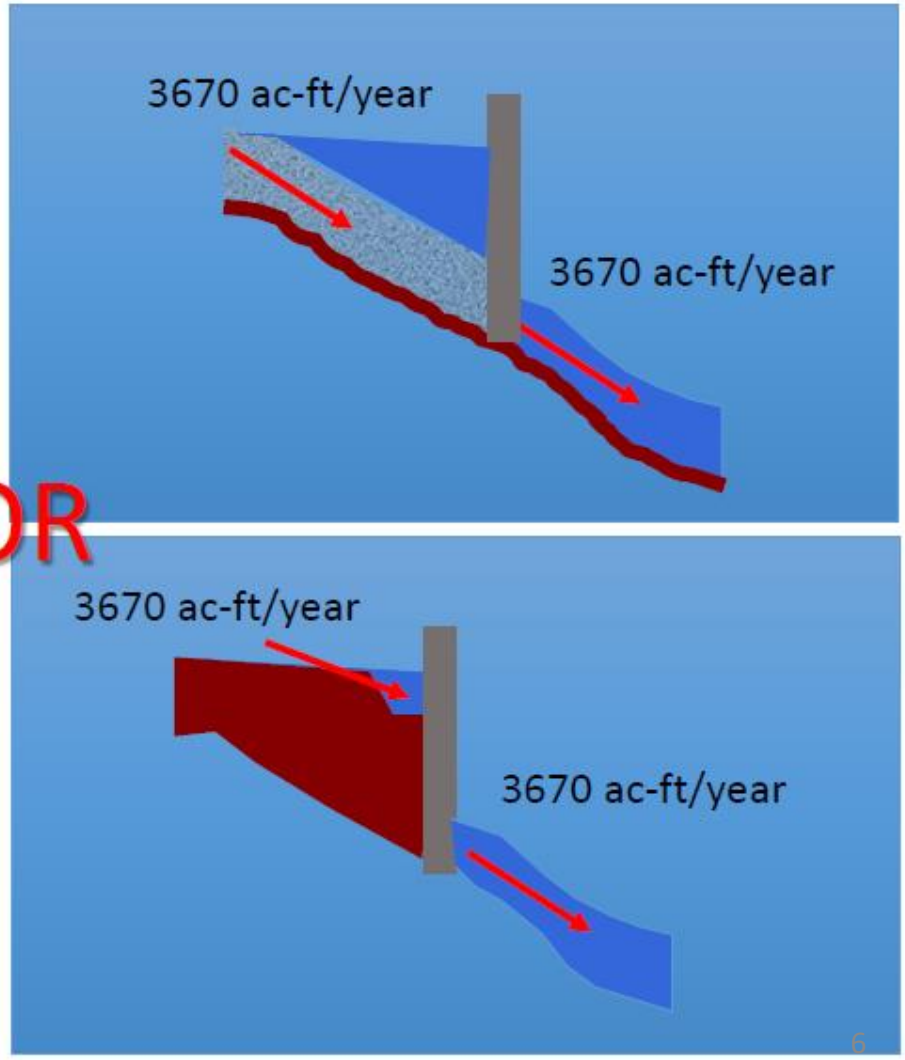
Reservoir Sustainability = Sediment Continuity NOW rather than LATER



OR



*Graphic courtesy of USACE

Addressing the Problem

Watershed Efforts

- Interagency SB Team continues to implement Streambank Stabilization (SBS) above reservoirs to reduce highly eroding “hotspots”
- Other best management practices

Traditional Dredging

- John Redmond Reservoir

Other Alternatives

- Requires extensive study, planning & coordination

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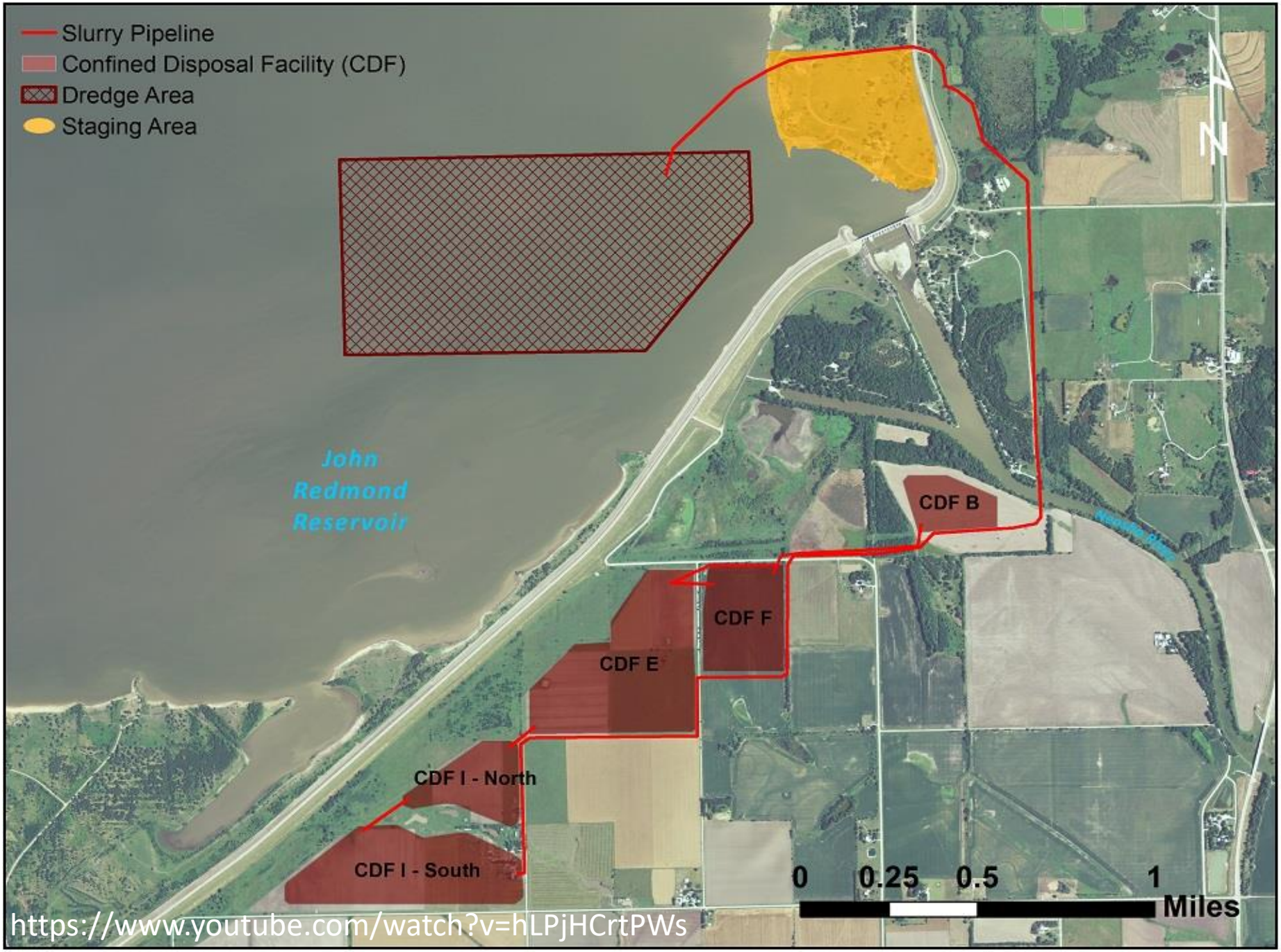
John Redmond Reservoir Dredging
May - October 2016


Slurry Pipeline
Confined Disposal Facility (CDF)
Dredge Area
Staging Area
John Redmond Reservoir
CDF B
CDF F
CDF E
CDF I - North
CDF I - South
0 0.25 0.5 1
Miles
https://www.youtube.com/watch?v=hLPjHCrtPWs

Project Summary & Costs

- 3,000,000 CY of sediment removed (~1,900 AF)
  - Average: ~19,000 CY/day
  - Max: ~32,000 CY/day
- $20 million ~ $6.67/CY (~$3.00 transport/disposal)
  - Total cost includes permitting, engineering & design, construction, dredging, lease payments and land reclamation
  - Includes some funds for streambank stabilization above reservoir

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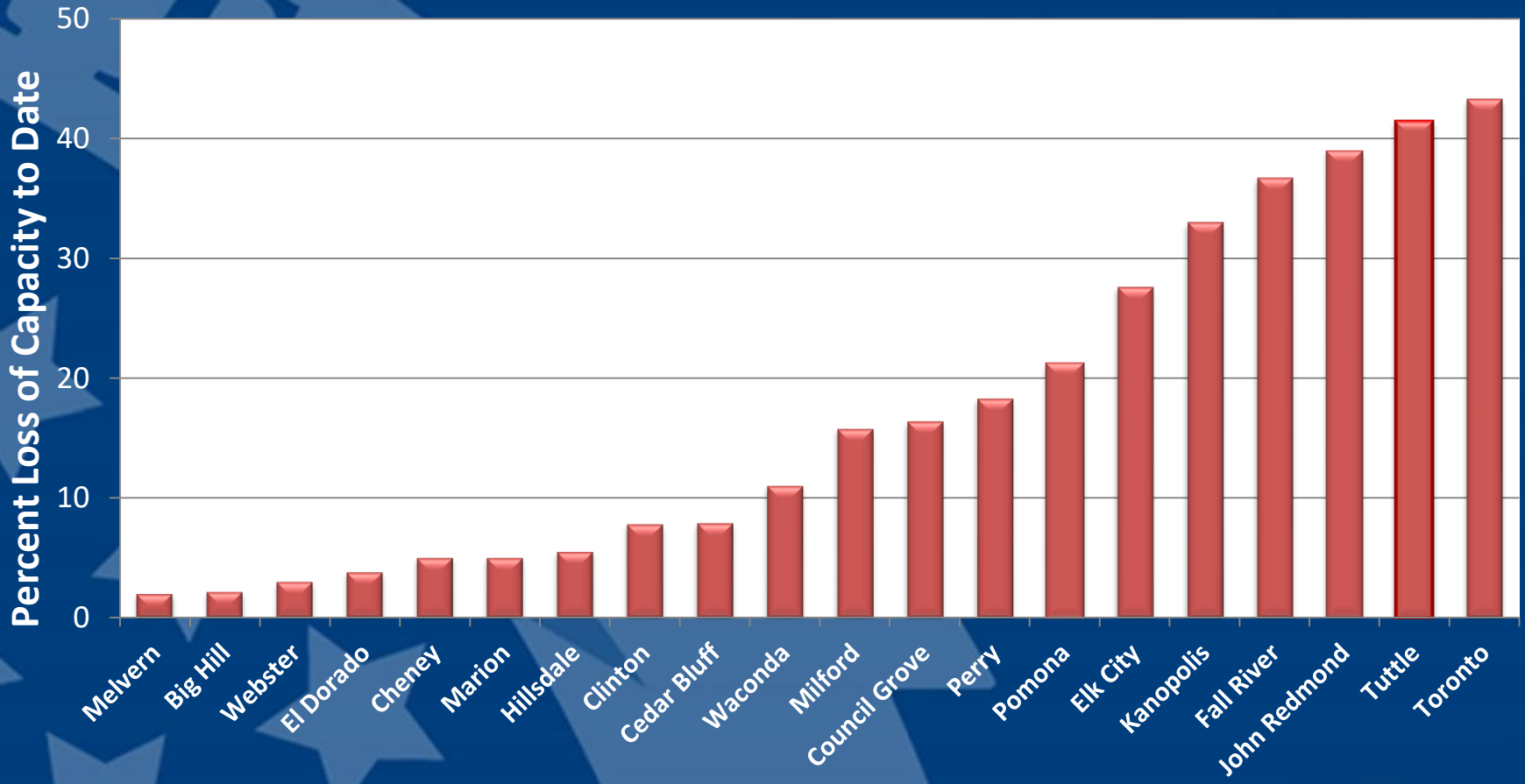
Tuttle Creek Reservoir

Kansas Reservoir Loss of Capacity



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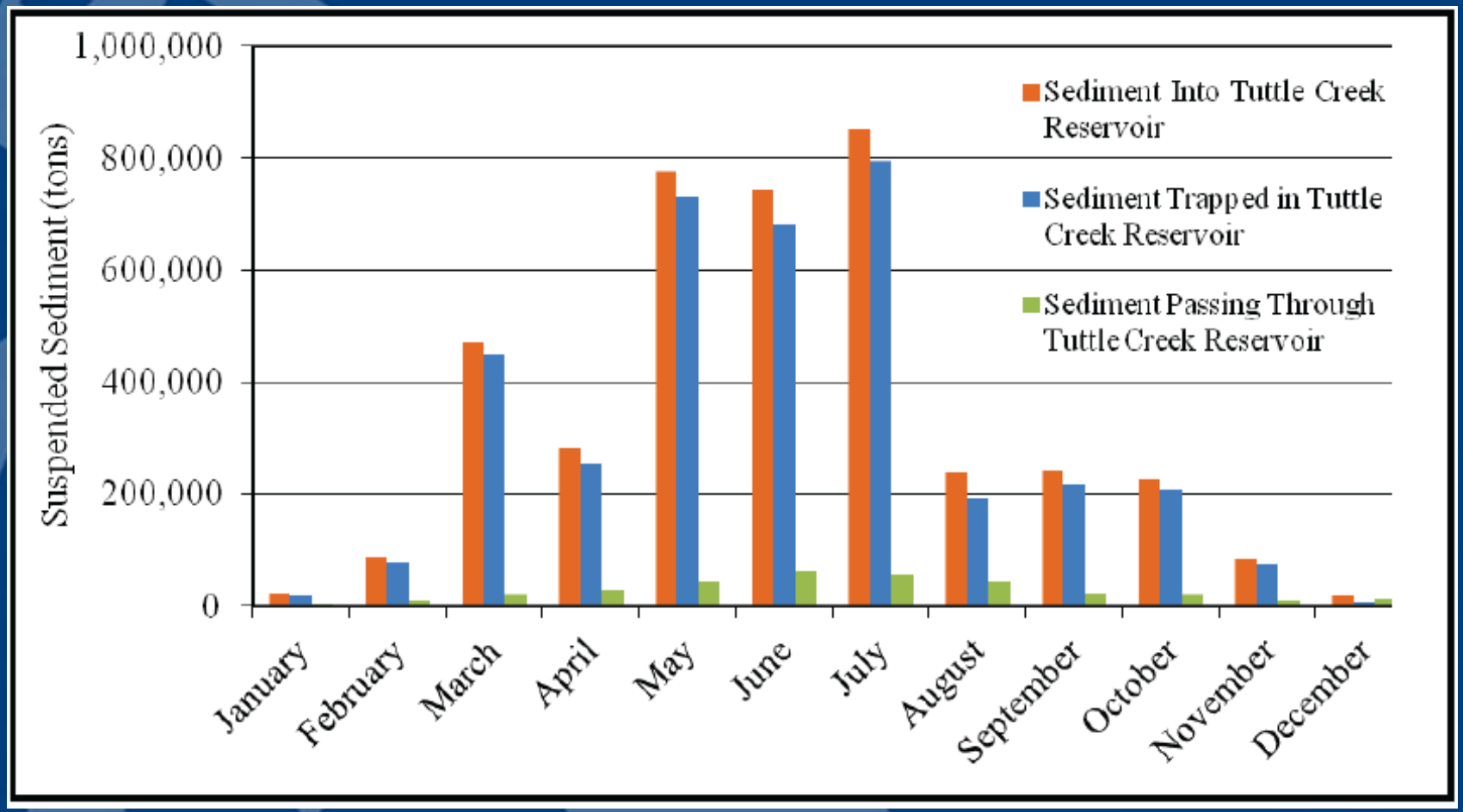
Reservoir Sediment Sustainability



*Graphic courtesy of USACE

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Annual Storage Volume Lost

Sedimentation rate in Tuttle multi-purpose pool (1962 to 2009):

3,600 ac-ft/yr

5.6 million yd^3 / year

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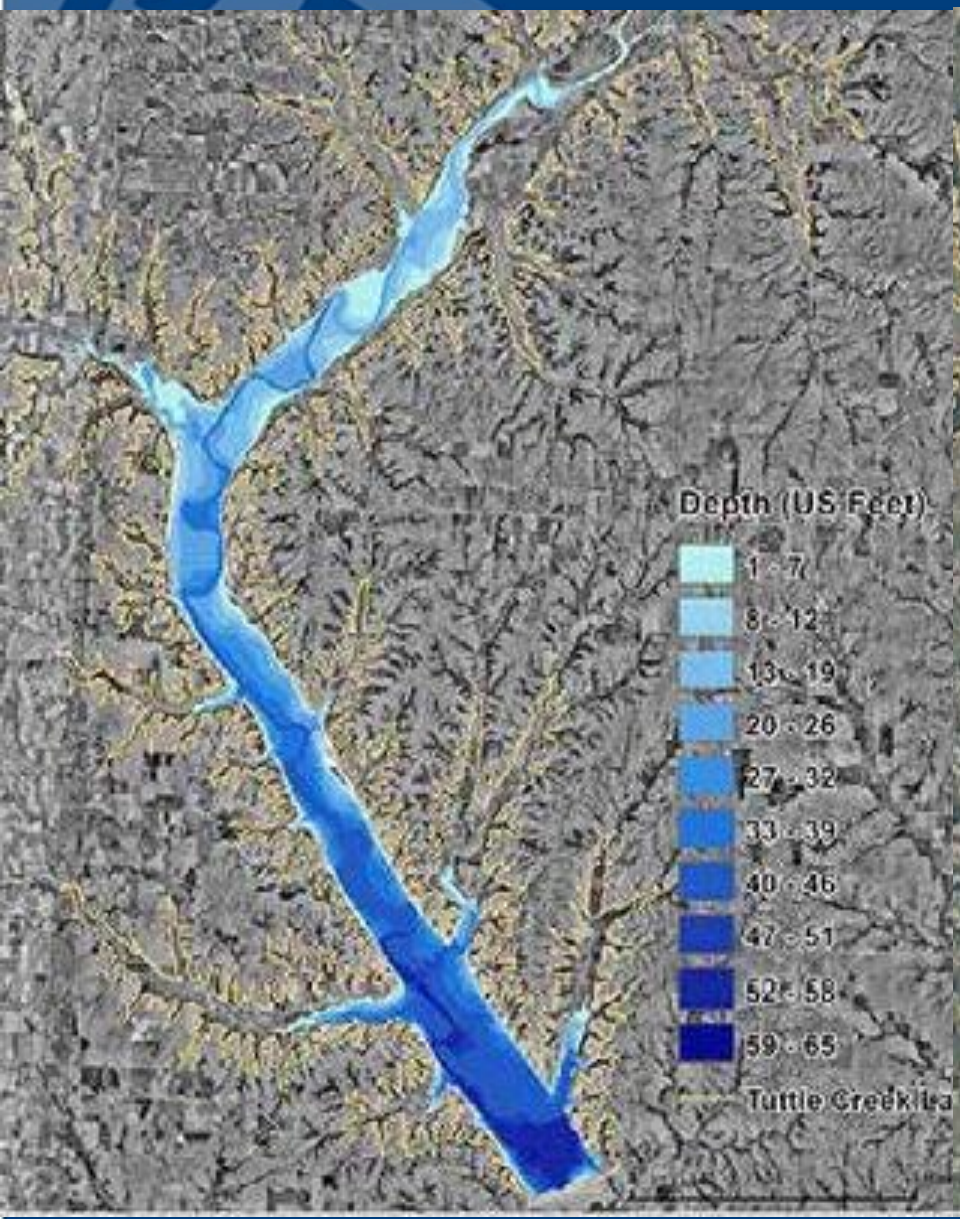
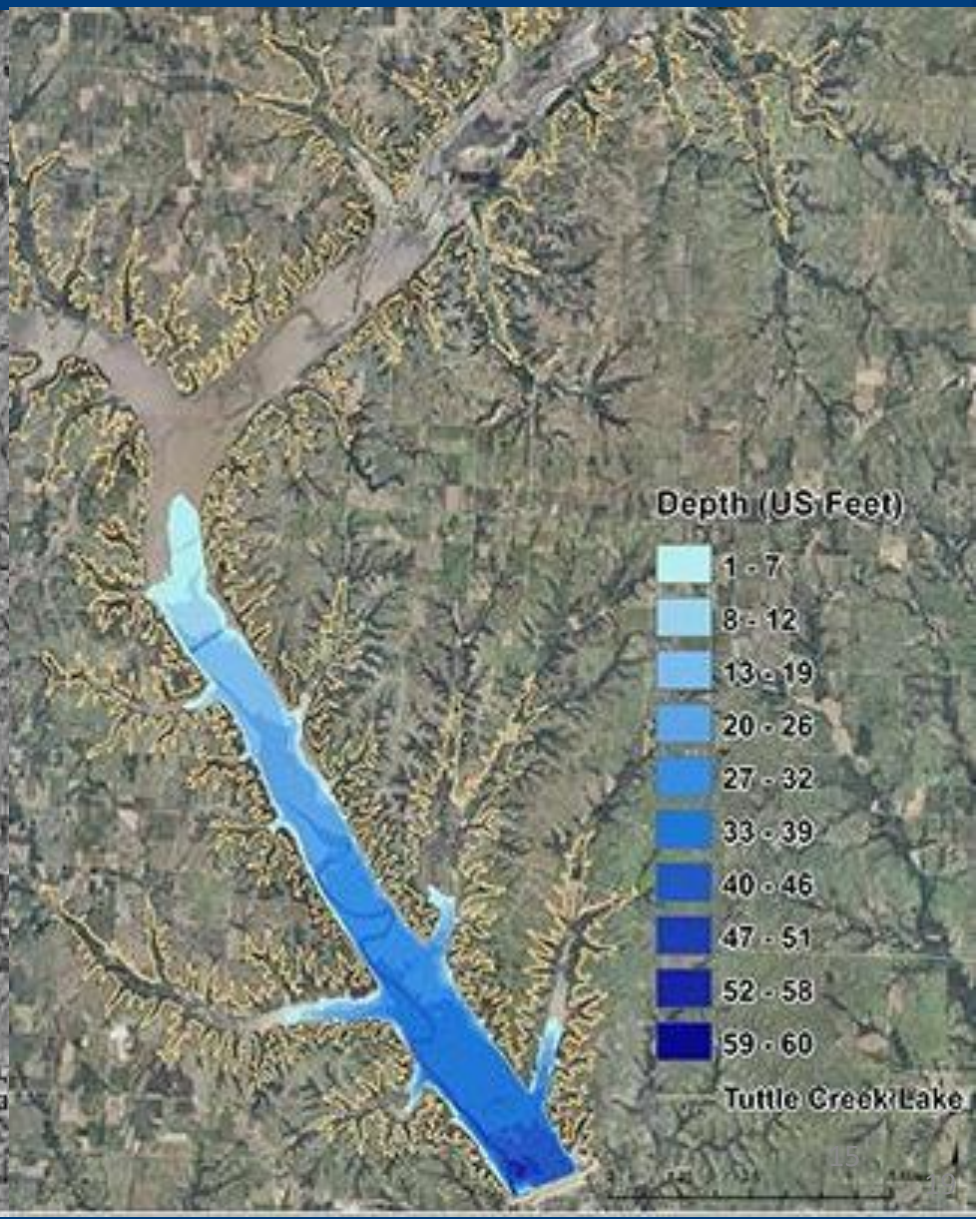
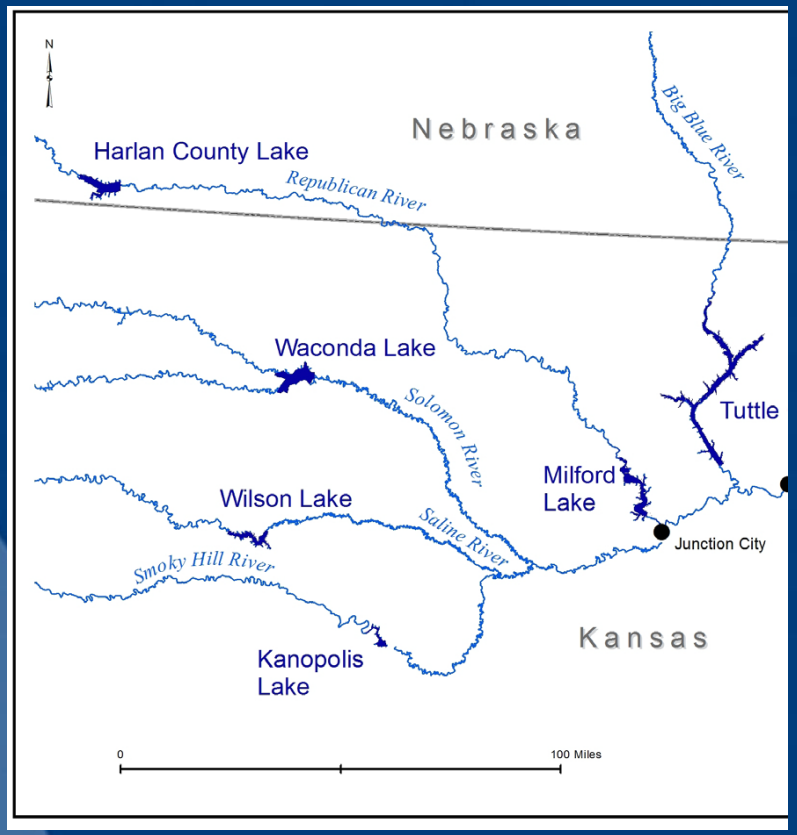
Tuttle Creek Lake: 1957 to 2010

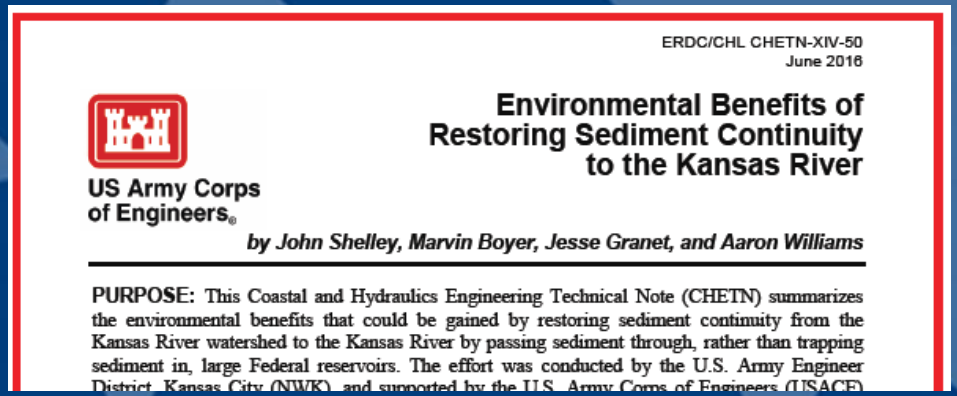




Reduced Sediment Load in Kansas River

- Pre-dam Sediment Load:
  - 44 million tons per year
- Post-dam Sediment Load:
  - 13 million tons per year
- A 70% reduction in sediment transport





ERDC/CHL CHETN-XIV-50
June 2016

US Army Corps of Engineers

Environmental Benefits of Restoring Sediment Continuity to the Kansas River

by John Shelley, Marvin Boyer, Jesse Granet, and Aaron Williams

PURPOSE: This Coastal and Hydraulics Engineering Technical Note (CHETN) summarizes the environmental benefits that could be gained by restoring sediment continuity from the Kansas River watershed to the Kansas River by passing sediment through, rather than trapping sediment in, large Federal reservoirs. The effort was conducted by the U.S. Army Engineer District, Kansas City (NWK), and supported by the U.S. Army Corps of Engineers (USACE)

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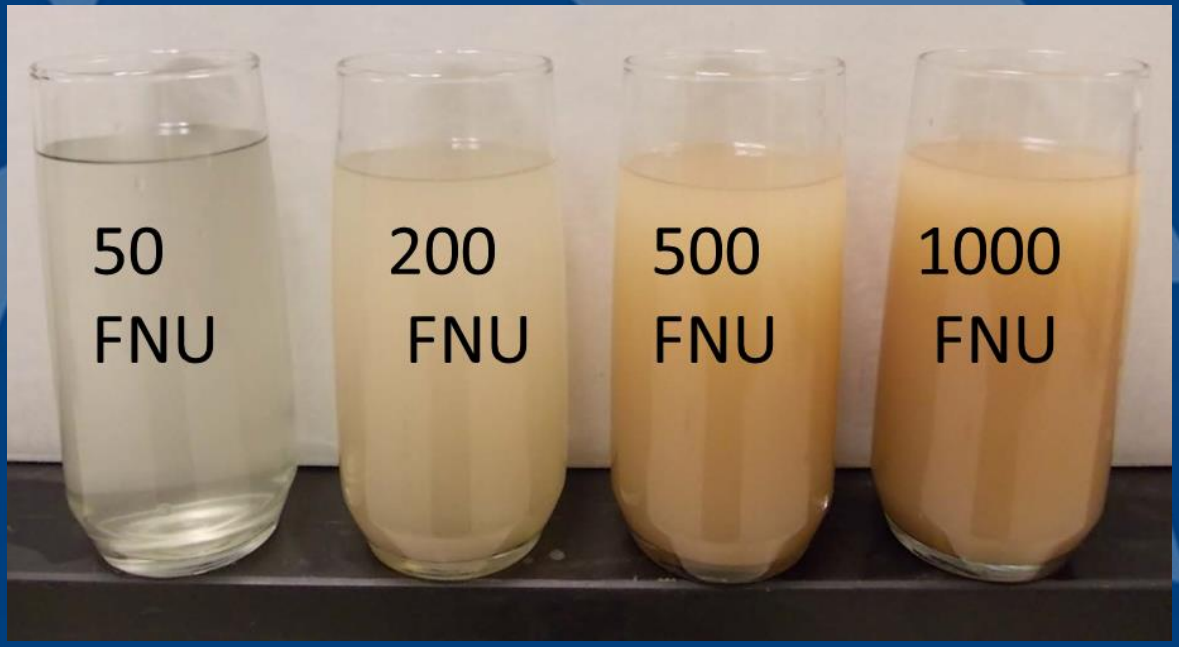
Lack of Turbidity Downstream

- Studies indicate certain native fish species in Kansas River have decreased in numbers (comparison to pre-dam conditions)
  - Pallid and shovelnose sturgeon, Macrhybopsis, flathead chub, plains minnow, western silvery minnow, river carpsucker
- Some are now federally protected
- Lack of turbidity interrupts life cycle, easier for predators



Humpback Chub numbers have decreased substantially and they are now federally protected. One primary reason is that the Colorado River used to be usually over 1000 FNU, but after construction of Glen Canyon Dam now is usually below 50 FNU. The small chub become easy prey for trout species in clear water.

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Traditional Dredging with Disposal into a CDF

- 3,600 ac-ft/year into Tuttle's multi-purpose pool
- At \$6.7/yd^3 = \$39M/year

- Cost increases as available disposal sites are filled
- Does not address the sediment deficit downstream

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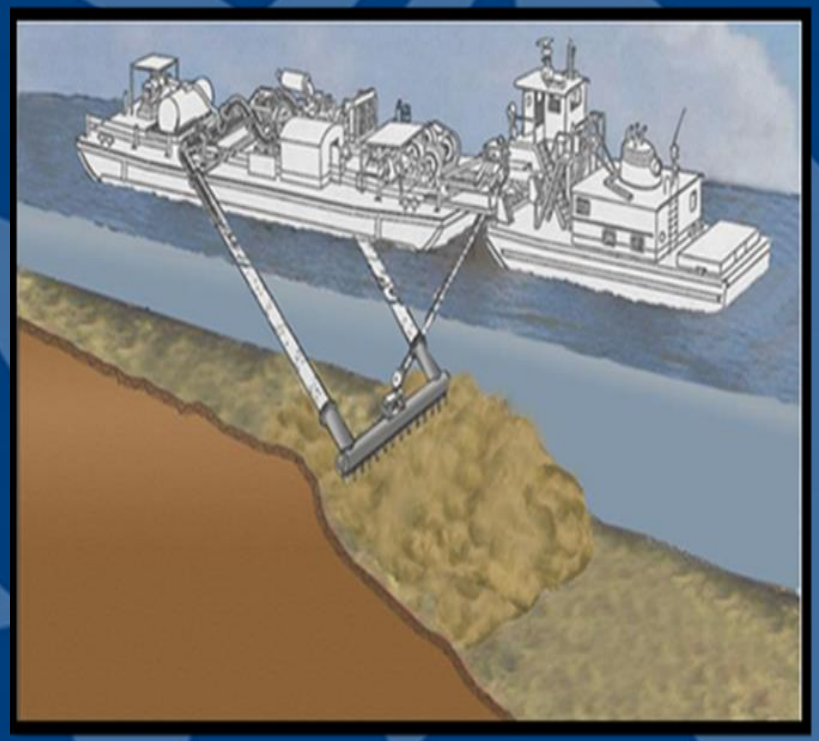
Water Injection Dredging



- Inject water into the sediment deposits to induce a density current.
- Open the gates and release the sediment through the existing conduit.

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

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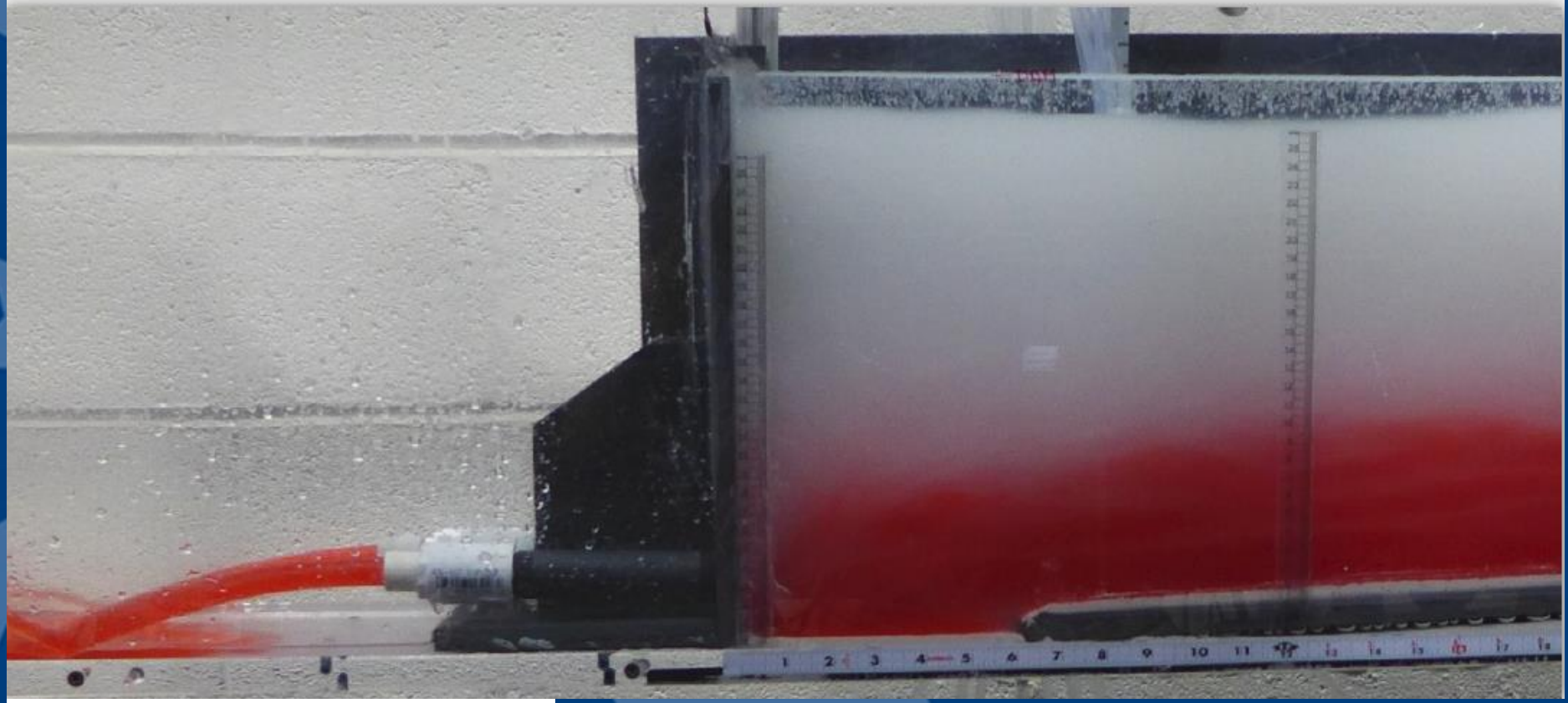
Density Current Venting



*Courtesy of U.S. Corps of Engineers

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*Courtesy of USACE Engineer Research and Development Center

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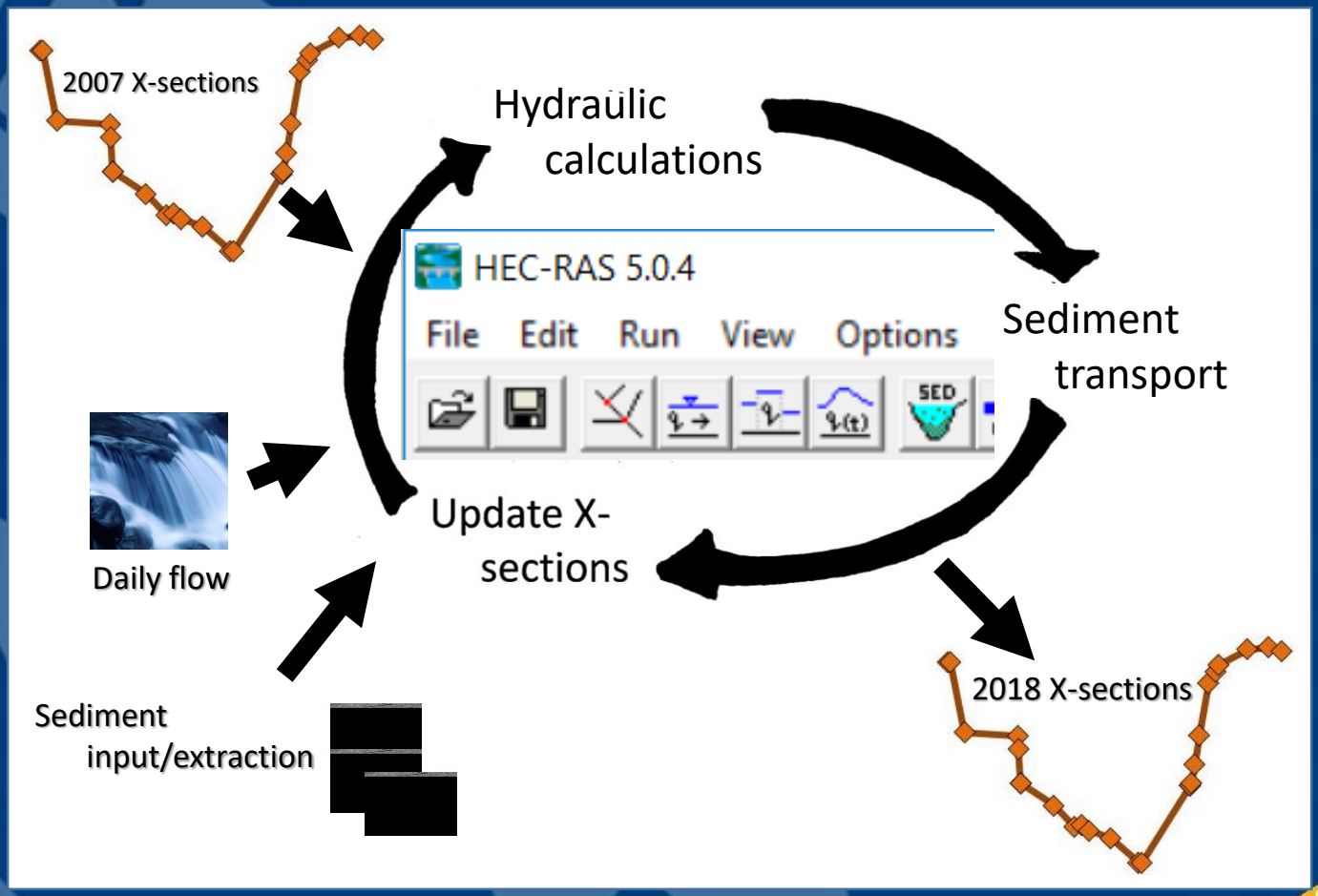
Kansas River Sediment Transport Model



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Monitoring Plan Development

- Downstream monitoring at USGS gages
- Water quality sediment samples
- Elutriate testing
- In-lake turbidity monitoring and pre- and post-demonstration bathymetric surveys
- Big Blue River cross sections
- Dam safety monitoring

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Downstream Monitoring

- Establish baseline suspended-sediment, turbidity, specific conductance (SC), water temperature, DO, TOC, and nutrients
- Monitor turbidity, SC, and temperature at four USGS gage locations downstream
  - Big Blue River near Manhattan, Kansas (06887000)
  - Kansas River at Wamego, Kansas (06887500)
  - Kansas River at Topeka, Kansas (06889000)
  - Kansas River at Desoto, Kansas (06892350)
- Added DO, TOC, and nutrient monitoring at the Big Blue River below Tuttle Creek Lake

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Downstream Monitoring

Water Quality Sediment Samples

- Samples collected August 2018
- Developed in coordination with KDHE

- SVOCs
- PCBs
- Organophosphorus compounds
- Nutrients
  (phosphorus, nitrate, nitrite, TKN, ammonia)
- pH
- Metals (22-TAL)
- Mercury
- Total organic carbon
- Organo-pesticides (including chlordane)
- Chlorinated herbicides

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Elutriate Testing – October 2019

(Vicinie, Palermo, and Matko, 2011)

- Five sediment cores and water samples to be collected by Kansas Biological Survey
- ERDC performing elutriate testing and analysis for OP pesticides, metals, nutrients, atrazine, and acetochlor

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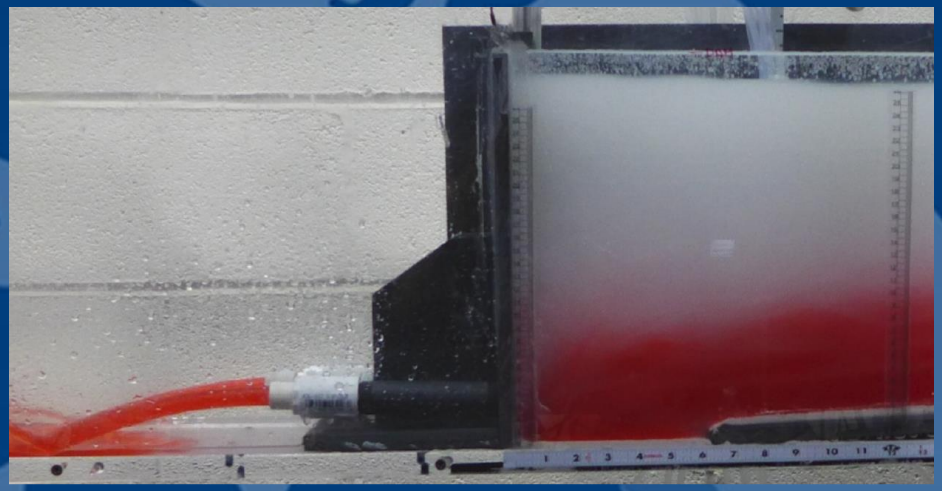
In-Lake Monitoring - Turbidity



*Courtesy of U.S. Corps of Engineers

- Establish baseline turbidity prior to demonstration
- Depth discrete turbidity measurements and water sampling during the demonstration
- Possibly Acoustic Doppler Current Profiler (ADCP) to monitor the sediment plume

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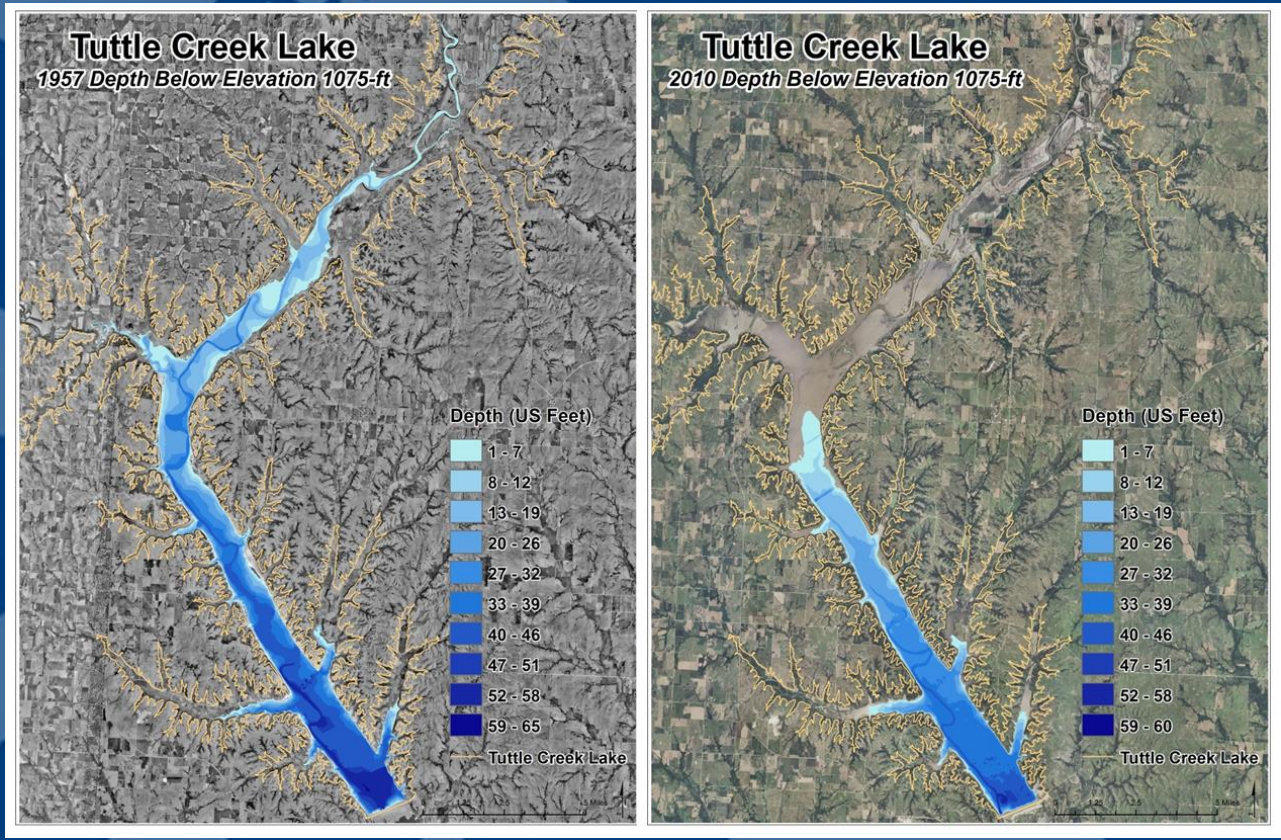
In-Lake Monitoring - Bathymetry



- Pre- and post-demonstration bathymetric surveys
- Evaluate changes in reservoir storage

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Big Blue River Cross Sections

- Completed cross sections prior to major recent releases

- Plan to complete cross sections again after releases/reservoir elevation return to normal

- Intend to do similar monitoring pre- and post-demonstration to assess downstream sedimentation from WID

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In-Lake Monitoring – Dam Safety

https://www.kansas.com/latest-news/1mbt2o/picture906300/ALTERNATES/FREE_960/072514tuttle

- Monitoring to ensure sediment is not building up at the gates and preventing their ability to function
- Monitoring strategy currently under discussion

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Path to WID Demonstration at Tuttle Creek Lake

- Scale, duration, and timeline still being determined based on ongoing study findings and funding availability

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