AN UPCOMING PILOT PROJECT FOR RESERVOIR SEDIMENT REMOVAL VIA WATER INJECTION DREDGING

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WEDA

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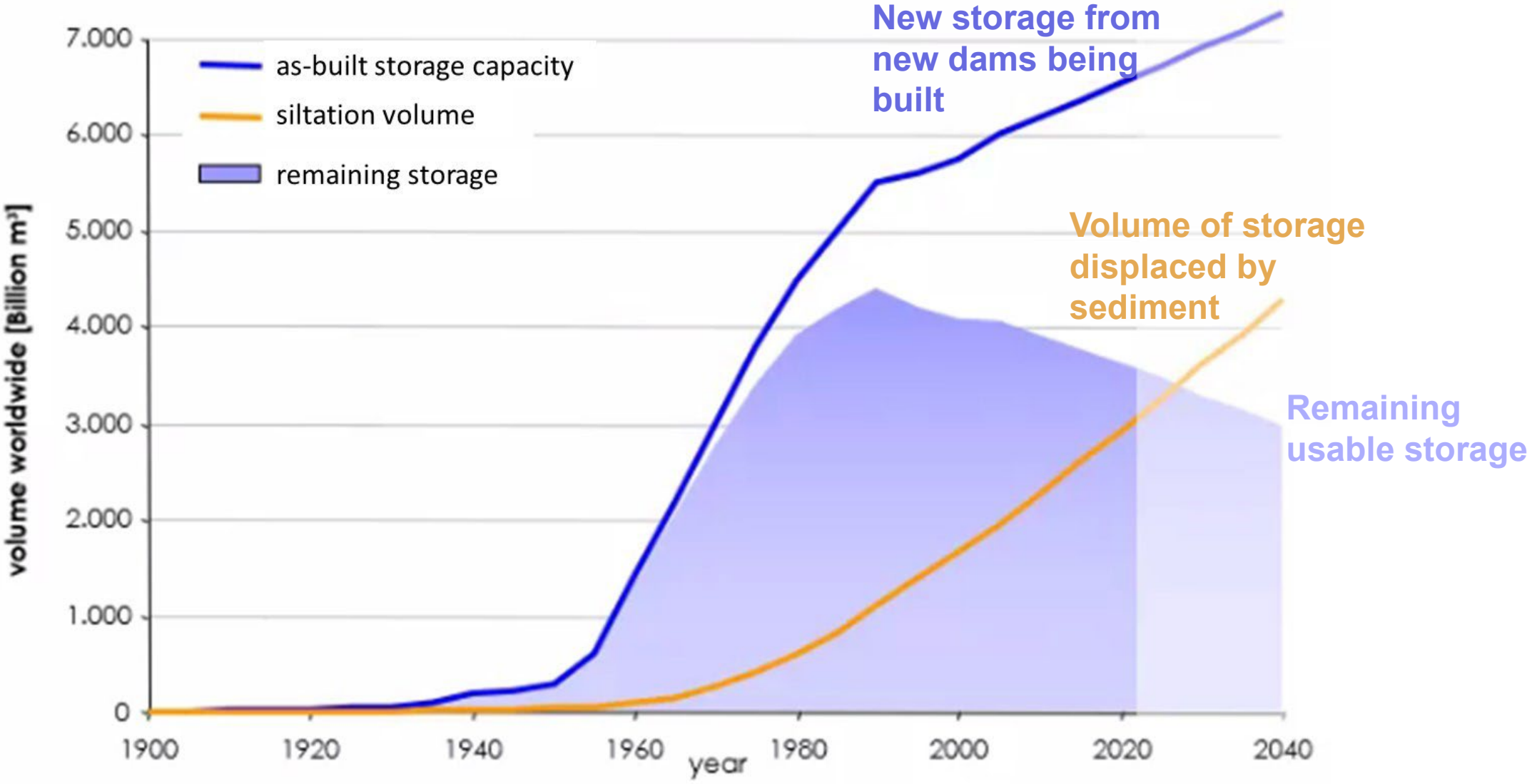
Furthermore, aspects of the project will likely change as we move forward with agency and public coordination.

WORLD-WIDE AVAILABLE STORAGE IS SHRINKING



sources: DB Sediments; Jolanda Jenzer, Giovanni De Cesare: *Möglichkeiten und Anwendung einer Datenbank bezüglich der Stauraumverlandung von alpinen Speichern*, Wasser Energie Luft, 2006, Heft 3

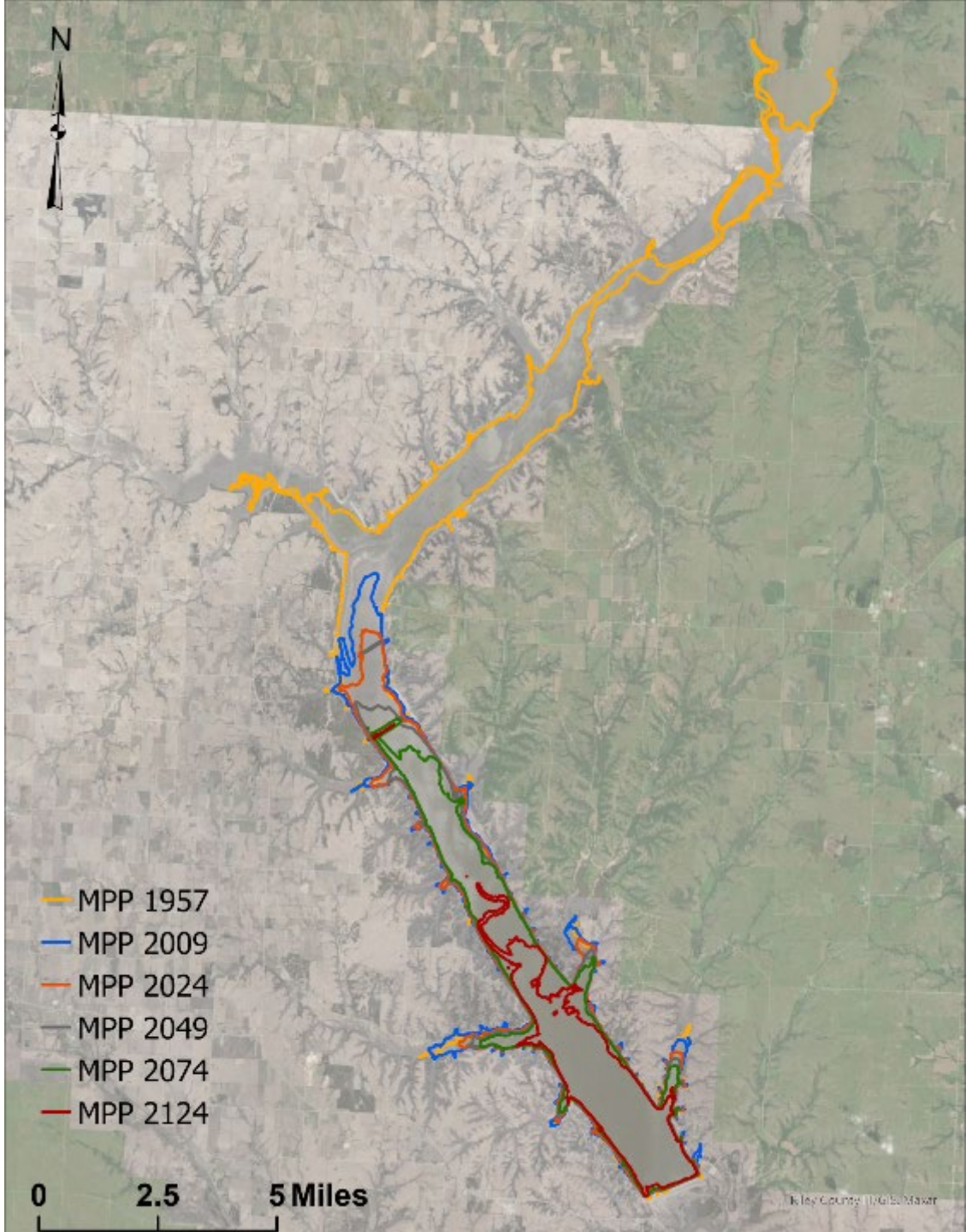
OUTLINE

- Tuttle Creek Lake
- Traditional Dredging vs. Water Injection Dredging
- Density Currents
- Project Considerations
- Conclusion

TUTTLE CREEK LAKE

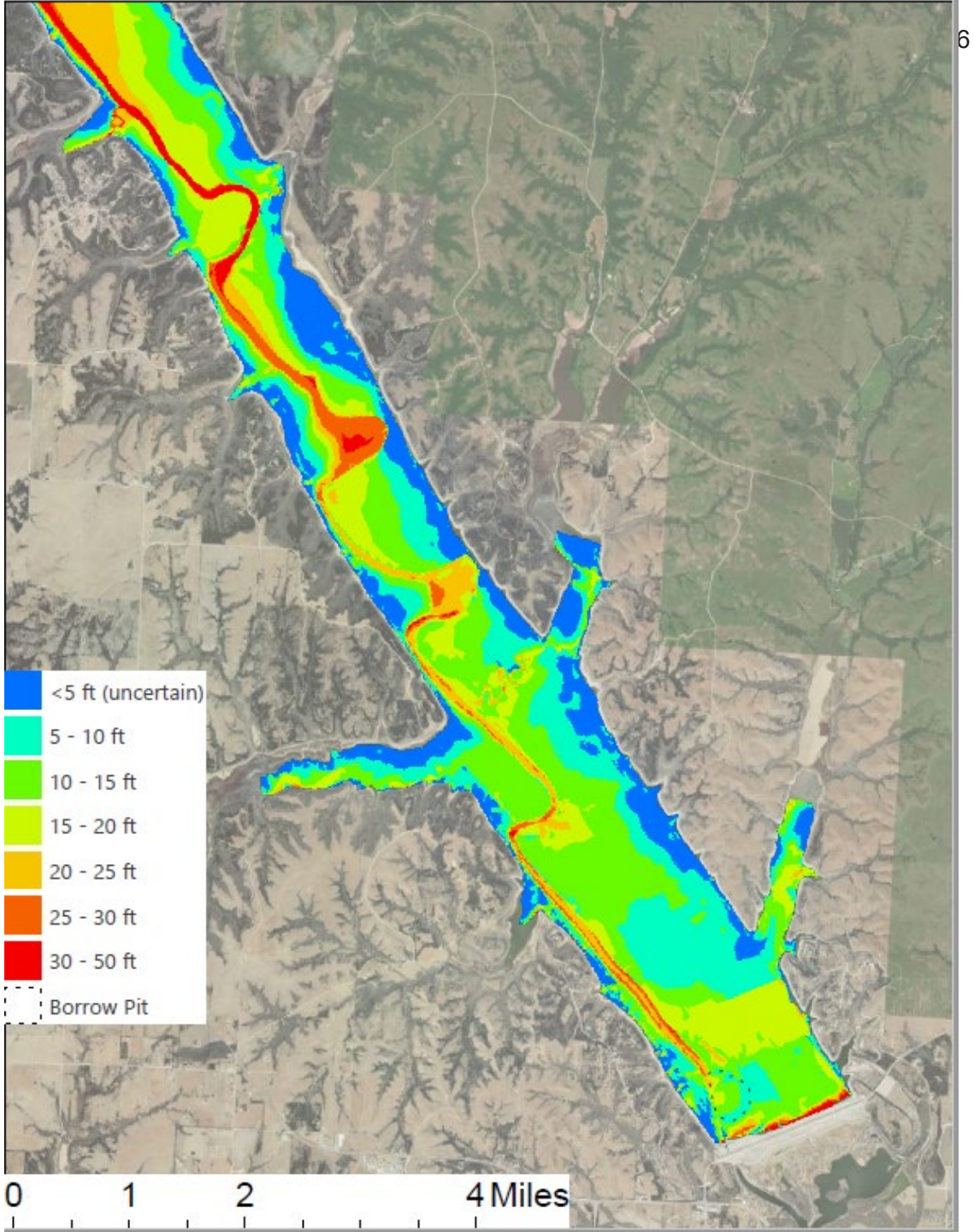
TUTTLE CREEK LAKE MULTIPURPOSE POOL SEDIMENTATION

- 49% full of sediment (multipurpose pool)
- 3780 ac-ft/year (6.1 MCY/year)
- On par with original projections
- Future without action: near total loss of multipurpose pool



TUTTLE CREEK LAKE MULTIPURPOSE POOL SEDIMENTATION

- Deposition thickness
  - 25 to 50 ft in the submerged channel
  - 5 to 20 ft in the submerged floodplain
- Clay and silt with high erodibility

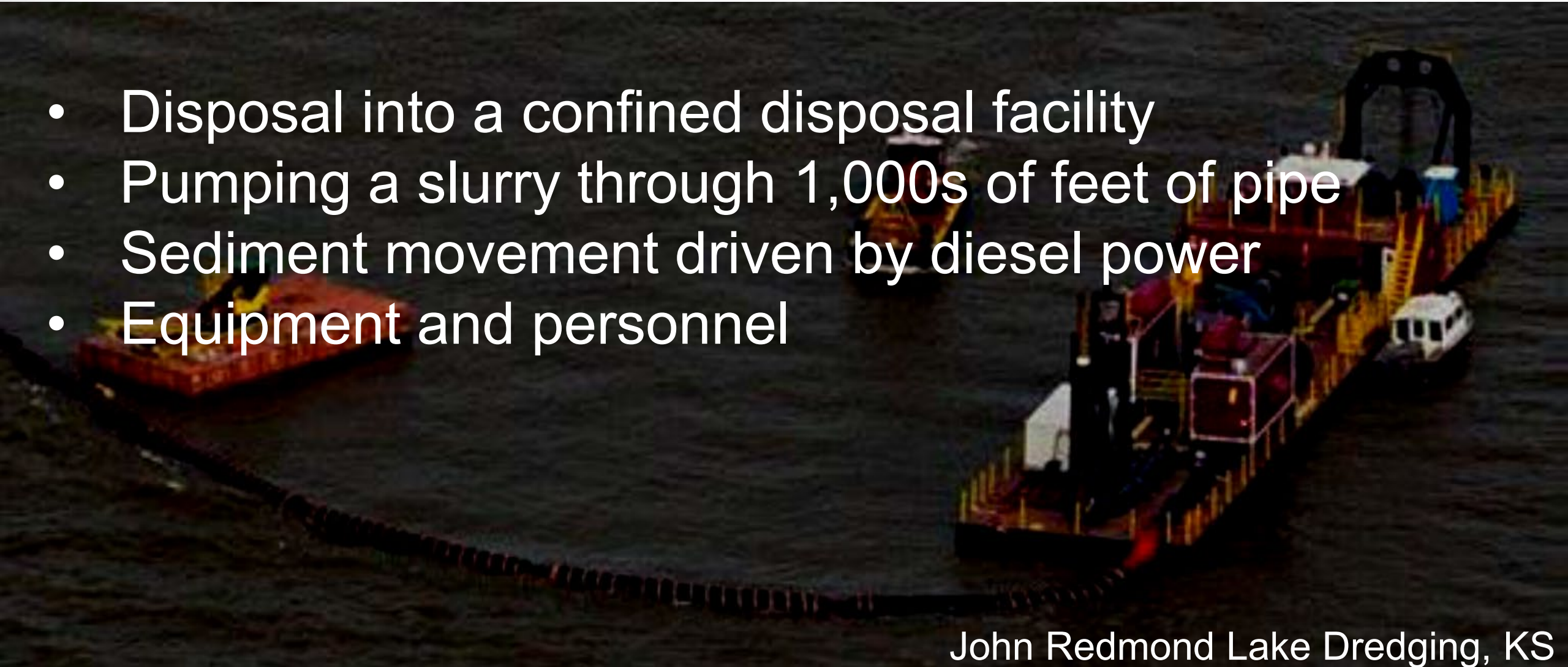


TRADITIONAL DREDGING

John Redmond Lake Dredging, KS

TRADITIONAL DREDGING: MAJOR COSTS

- Disposal into a confined disposal facility
- Pumping a slurry through 1,000s of feet of pipe
- Sediment movement driven by diesel power
- Equipment and personnel



John Redmond Lake Dredging, KS

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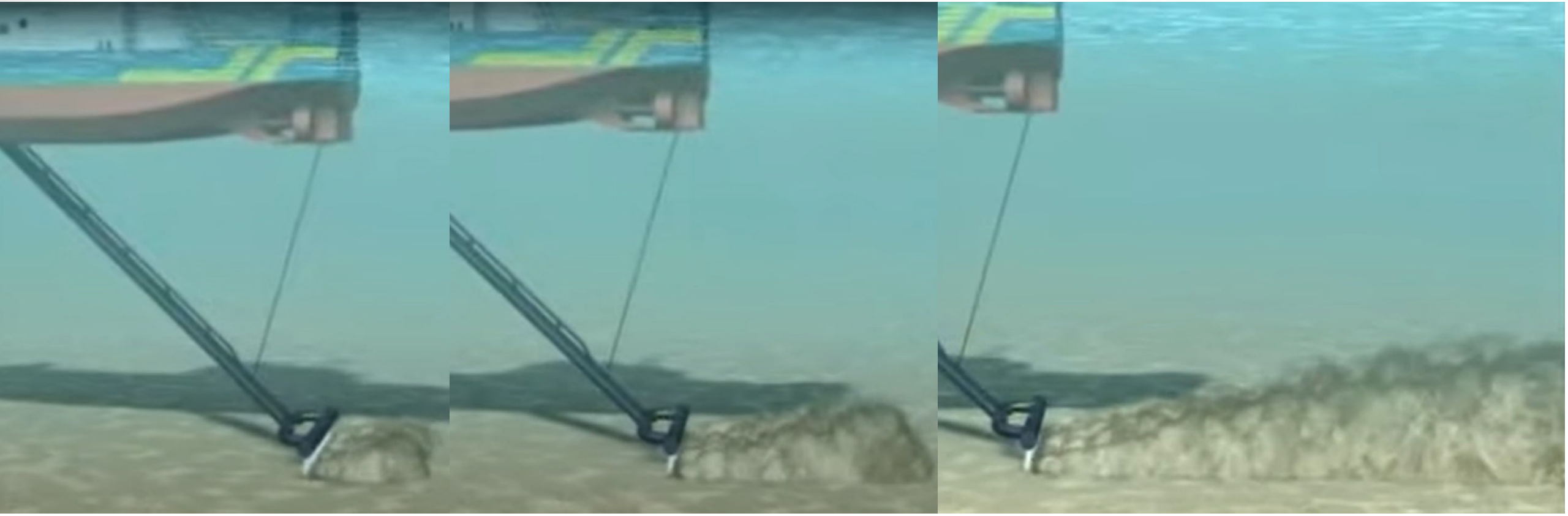
WATER INJECTION DREDGING



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

0:12 to 1:05

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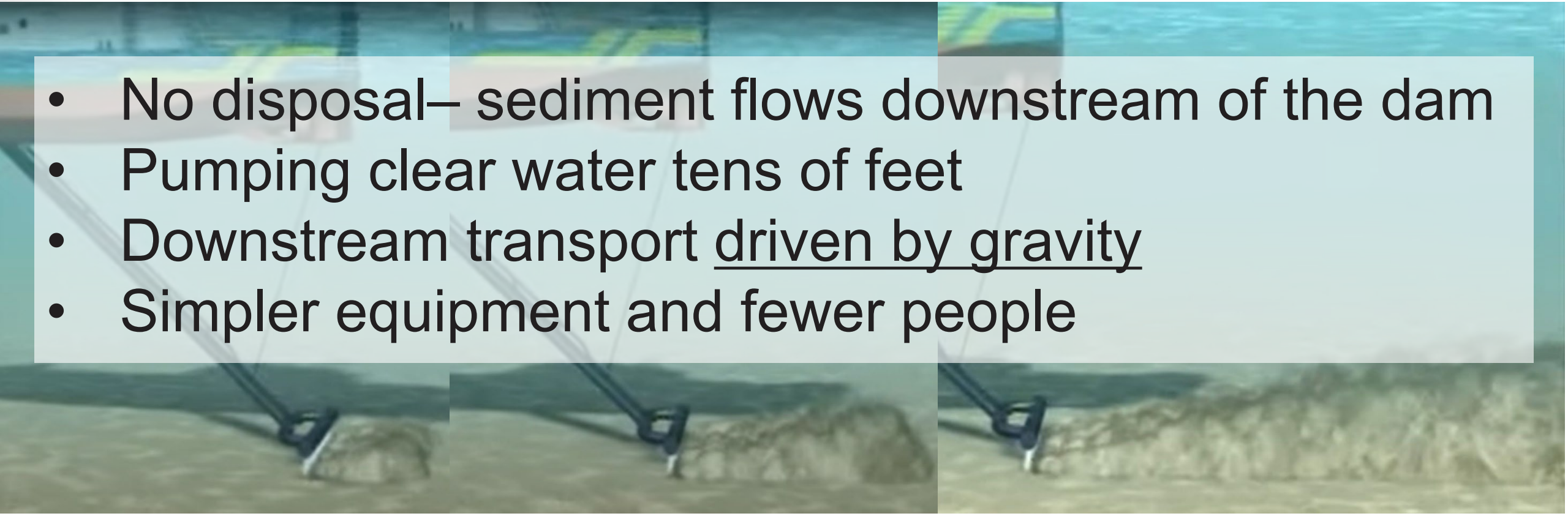
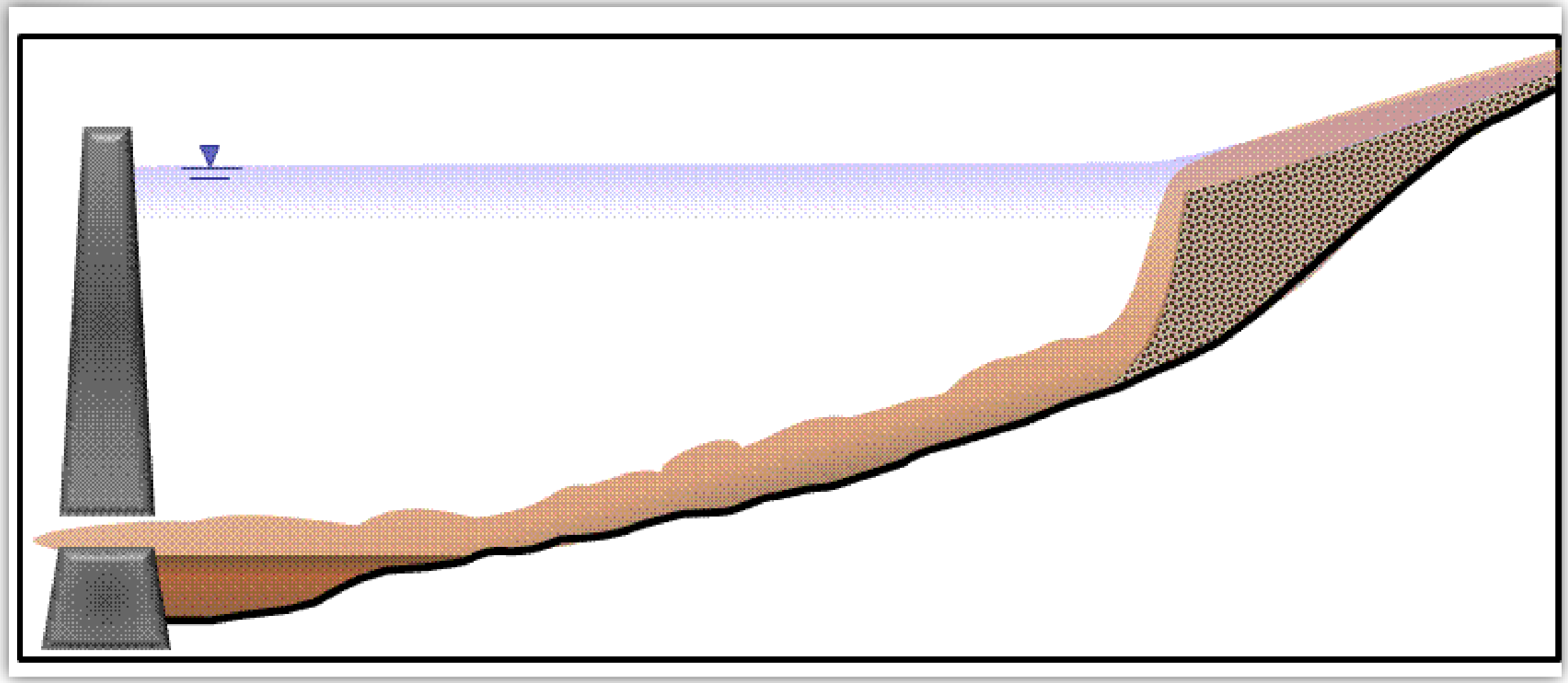
WATER INJECTION DREDGING



- No disposal– sediment flows downstream of the dam
- Pumping clear water tens of feet
- Downstream transport driven by gravity
- Simpler equipment and fewer people

https://www.youtube.com/watch?v=JfVK5rLYXiM
0:12 to 1:05

DENSITY CURRENTS



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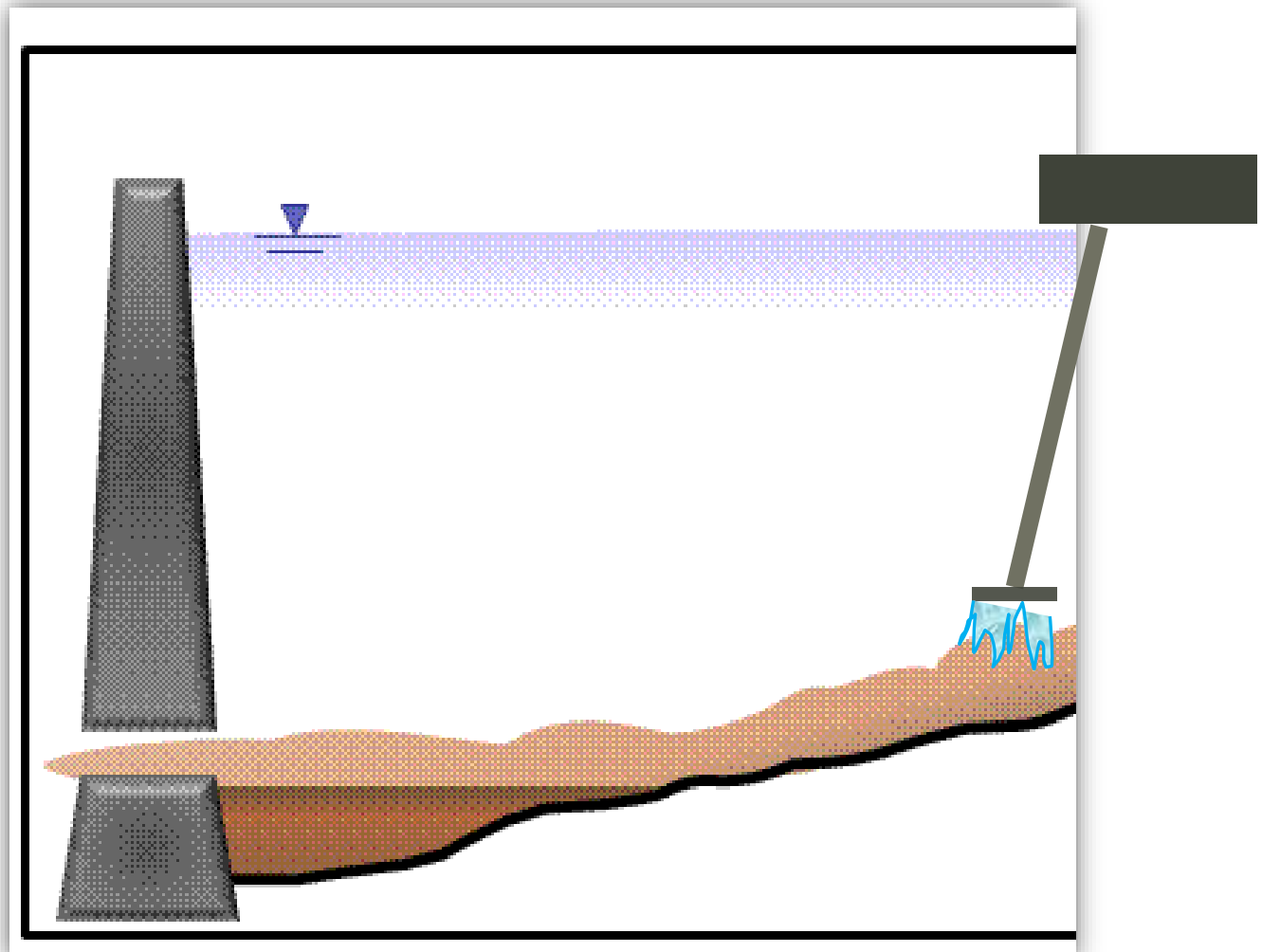
EASY WAY TO THINK ABOUT IT

- Heavy things sink
- Heavy things will flow downslope



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MORE COMPLETE WAY TO THINK ABOUT IT

- Fluid flows down *gradient* (energy gradient)

$$E = z + \frac{P}{\gamma} + \frac{v^2}{2g}$$

P = γ_{water} * D

P = γ_{slurry} * D

$$E = z + D\frac{\gamma_{slurry}}{\gamma_{water}} + \frac{v^2}{2g}$$

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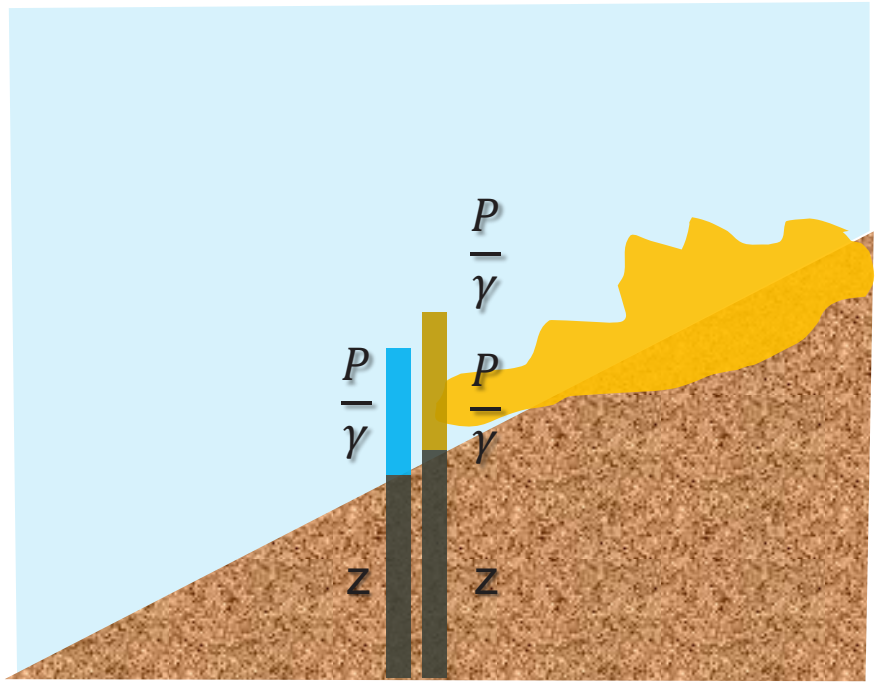
MORE COMPLETE WAY TO THINK ABOUT IT

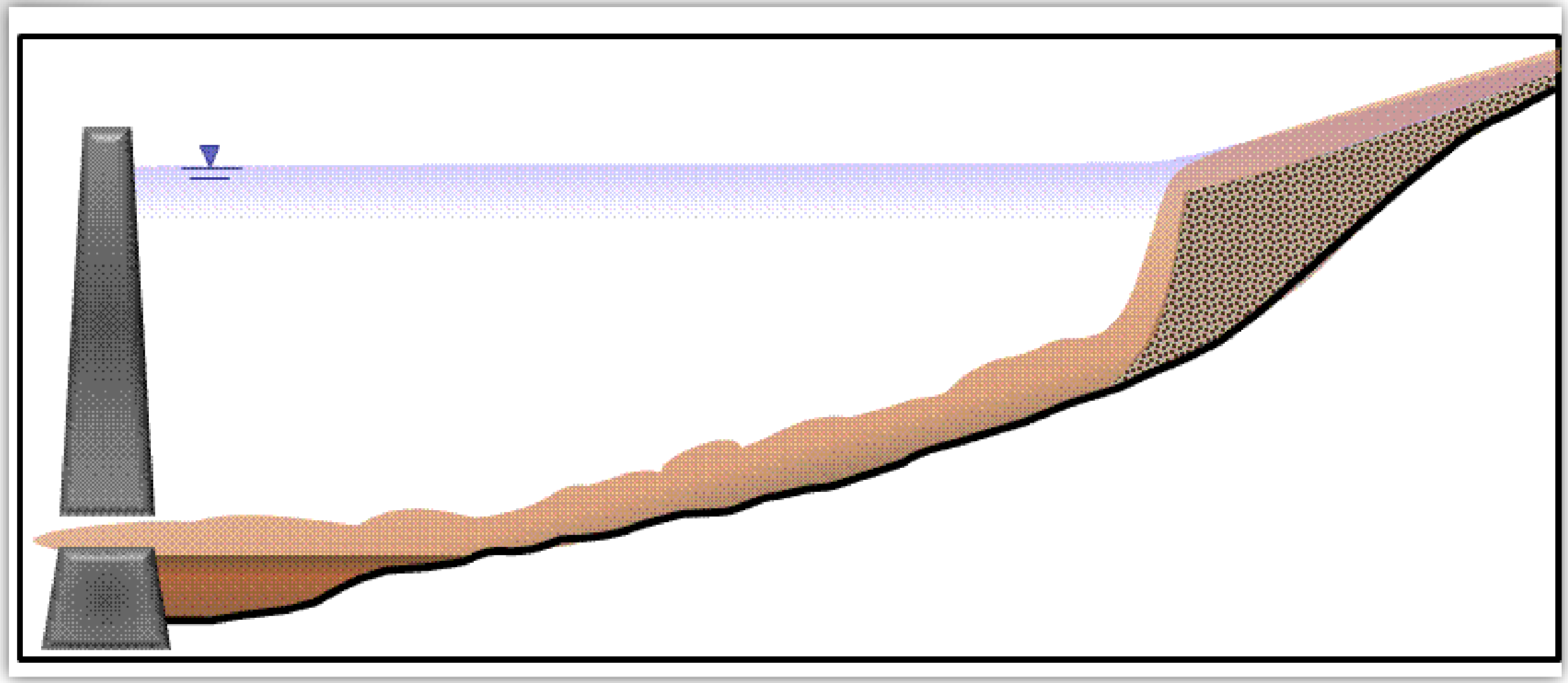
- Fluid flows down *gradient* (energy gradient)

$$E = z + \frac{P}{\gamma} + \frac{v^2}{2g}$$



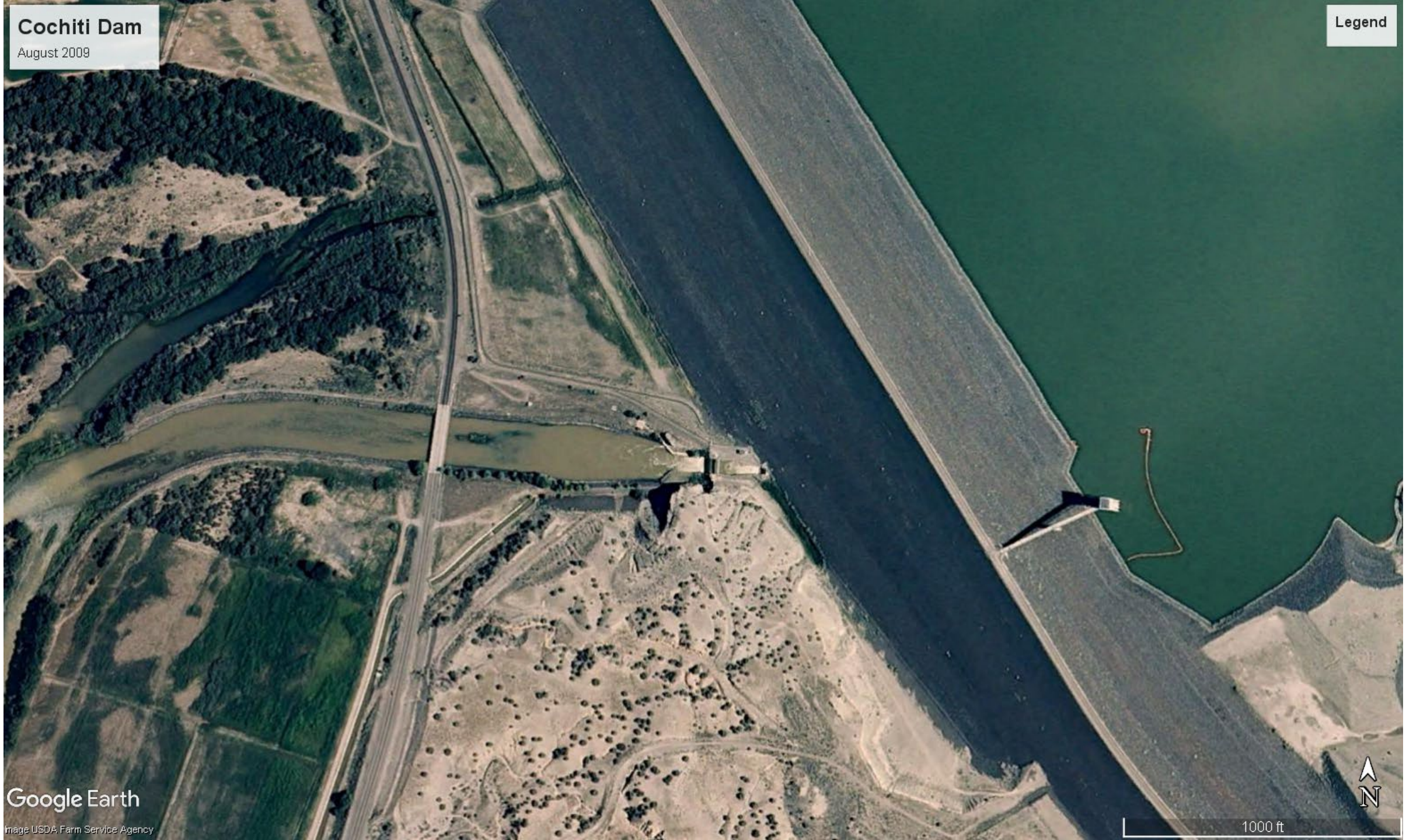
γ for muddy water > γ for clear water
Therefore, muddy water will have a higher head
Therefore muddy water will travel even with no slope

DENSITY CURRENTS




Cochiti Lake
August 2009
Legend
Cochiti Lake
Google Earth
Image USDA Farm Service Agency
N
2 mi


Cochiti Lake
August 2009
Google earth
Image USDA Farm Service Agency
N
1 mi


Cochiti Dam
August 2009
Legend
Google Earth
Image USDA Farm Service Agency
N
1000 ft

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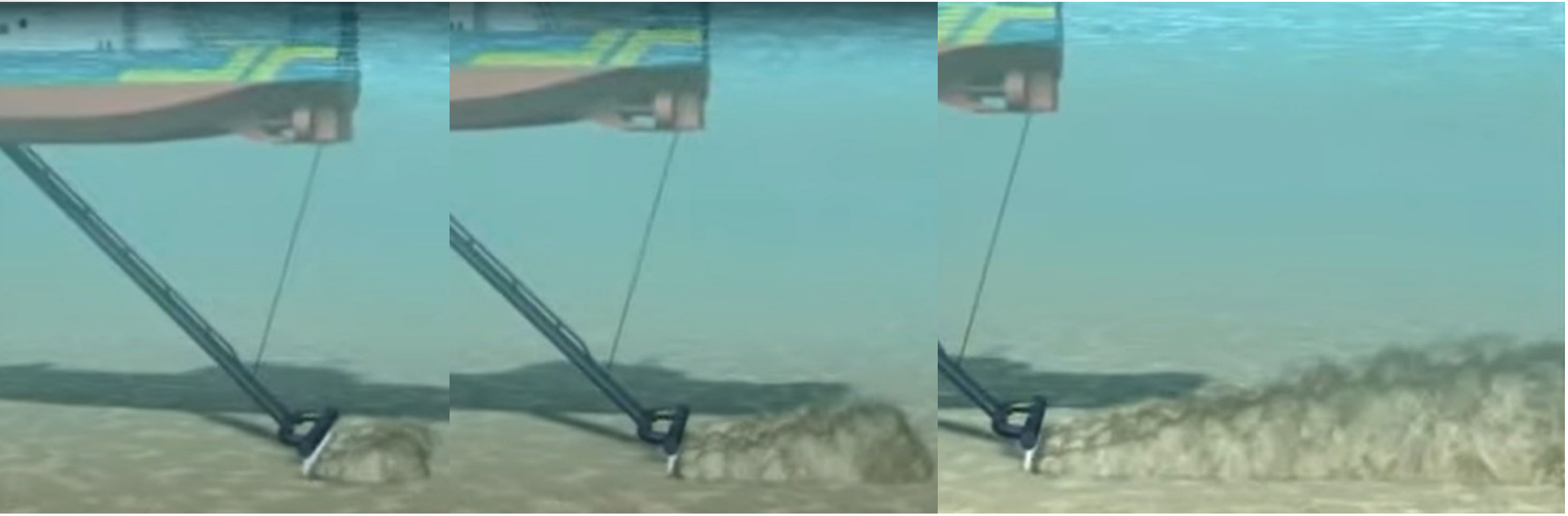
WATER INJECTION DREDGING



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

0:12 to 1:05

TUTTLE CREEK LAKE DEMONSTRATION

- First in the *world*
- Only lake in USACE with intentional sediment passing
- Timeline –Moving Dirt Spring*/Summer/Fall 2024**

*Subject to some contracting unknowns
**Subject to water availability

“HOW MUCH SEDIMENT WILL YOU REMOVE?”
--EVERYBODY

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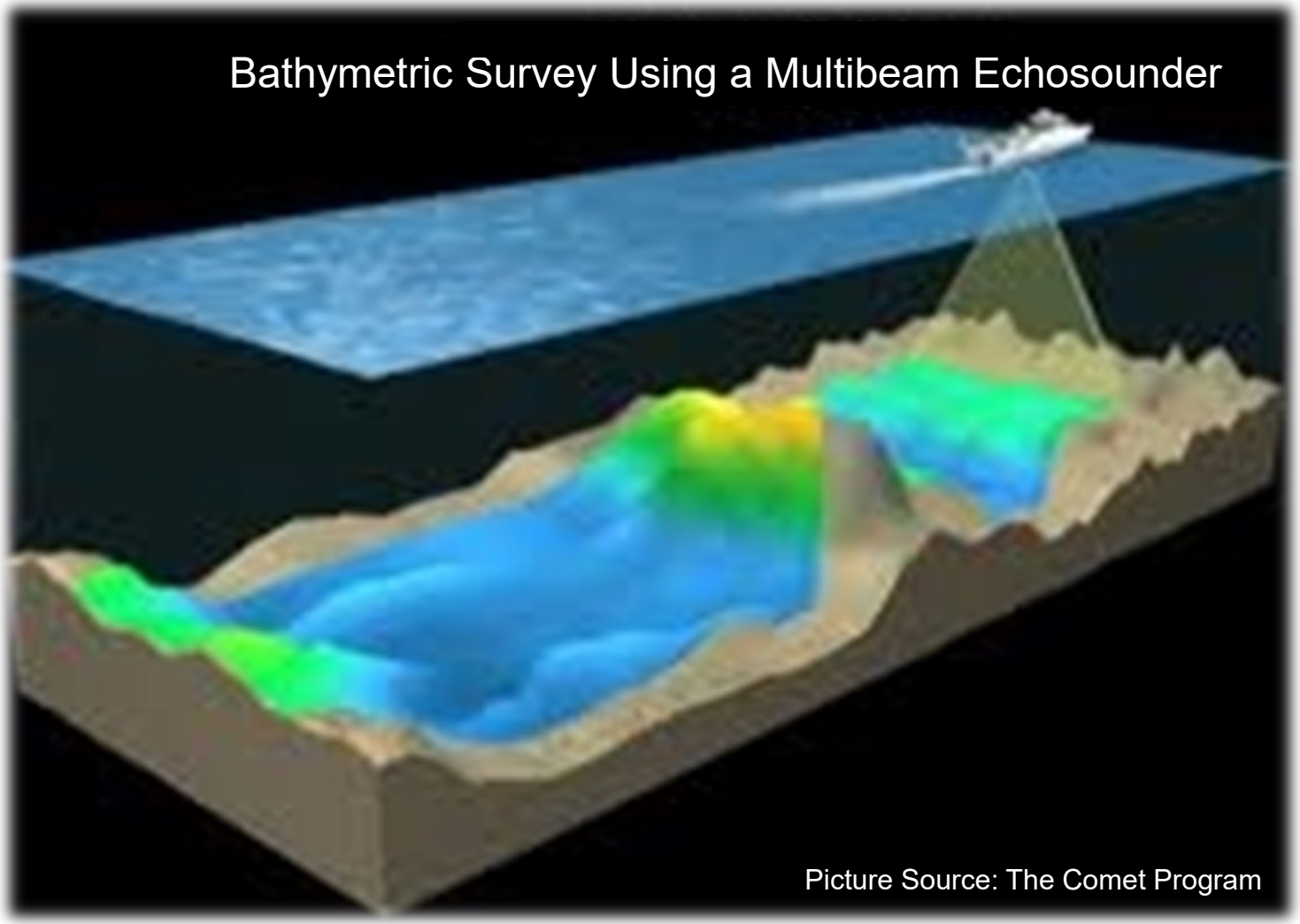
IN-LAKE MEASUREMENTS

We don’t know.

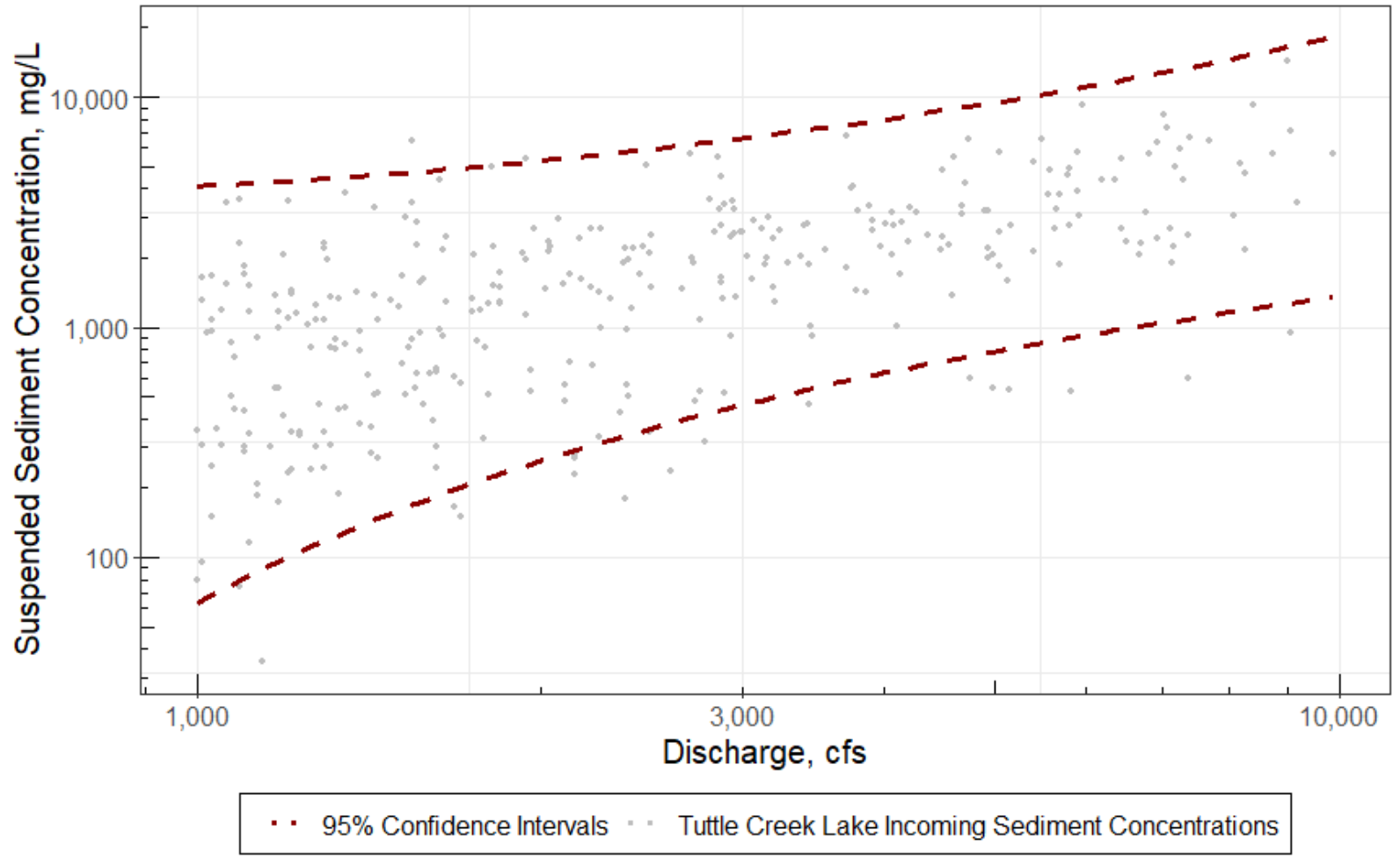
Extensive multibeam surveys planned.

Continuous turbidity/SSC downstream.



“HOW MUCH SEDIMENT WILL YOU RELEASE…AND IS THAT OKAY?”
--EVERYBODY

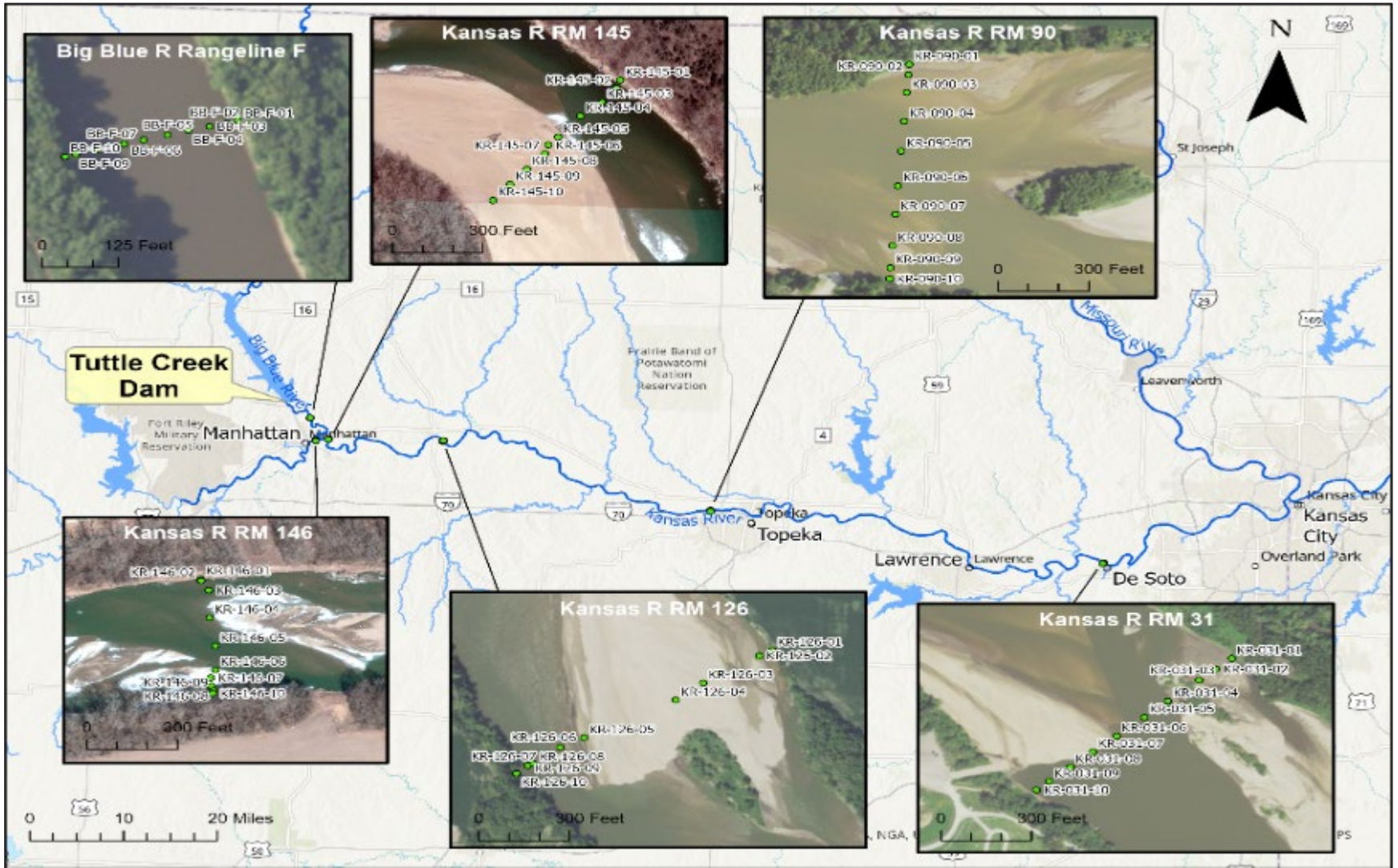
CONCENTRATION LIMITS AND ADAPTIVE MANAGEMENT



- Operate at robust flows (not low flows)
- Do not exceed the natural range of sediment concentrations in incoming flows
- Adaptive management: Release more water if needed to lower concentrations

DOWNSTREAM CHANNEL MONITORING PROGRAM

- 5 continuous gage stations (turbidity/water quality)
- Additional pre/post water/sediment quality measurements
- Cross-sections
- Bed/sandbar sediment
- Invertebrates



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CONCLUSION

- Water injection dredging induces a density current– gravity drives transport
- Potential for significant cost savings
- 1st in the world lake water injection dredging project– Tuttle Creek Lake
- Stay tuned!