

# A solution for invasive carp in Minnesota

*Peter Sorensen*  
*University of Minnesota*

*July 21 2022*



# Outline

- Aquatic Invasive Species (AIS)
- Bigheaded carp
- A feasible option to stop Bigheaded Carp
- Summary
- Questions and answers



*Silver Carp: the “invasive carp” of greatest interest*

# A decade ago, 5 AIS threatened the ecological integrity of our inland waters

- Common carp



- Curly leaf pondweed



- Eurasian Milfoil



- Zebra mussel



- Bigheaded carp



# Frankly, we have not done very well.

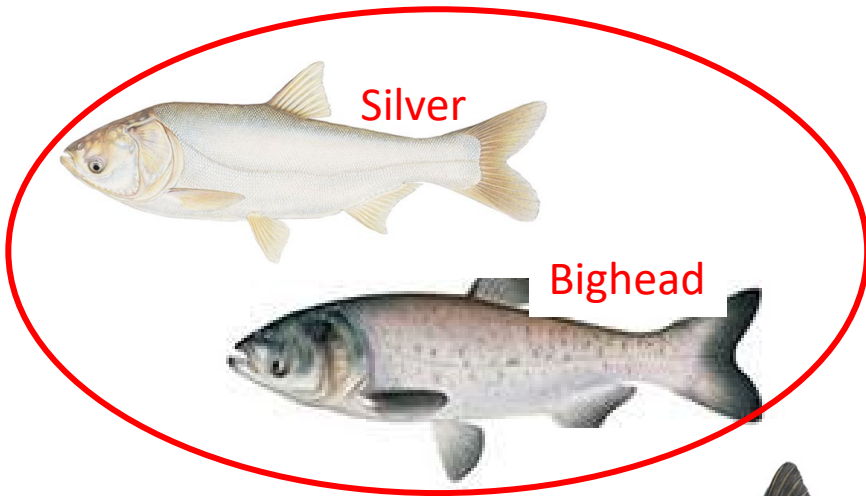
2022: Nearly 900 lakes (8%) are now infested and that number continues to grow for all species except one



**We still have one great opportunity to redeem ourselves with bigheaded carp!**

# Bigheaded (Invasive) Carp

- 4 species of carp from Asia: Bighead, Silver (or Bigheaded), Black, and Grass
- 1960s: Introduced in Arkansas
- Spreading north and establishing (breeding and producing young)



2 species of Bigheaded carp



© Joseph R. Tomelleri

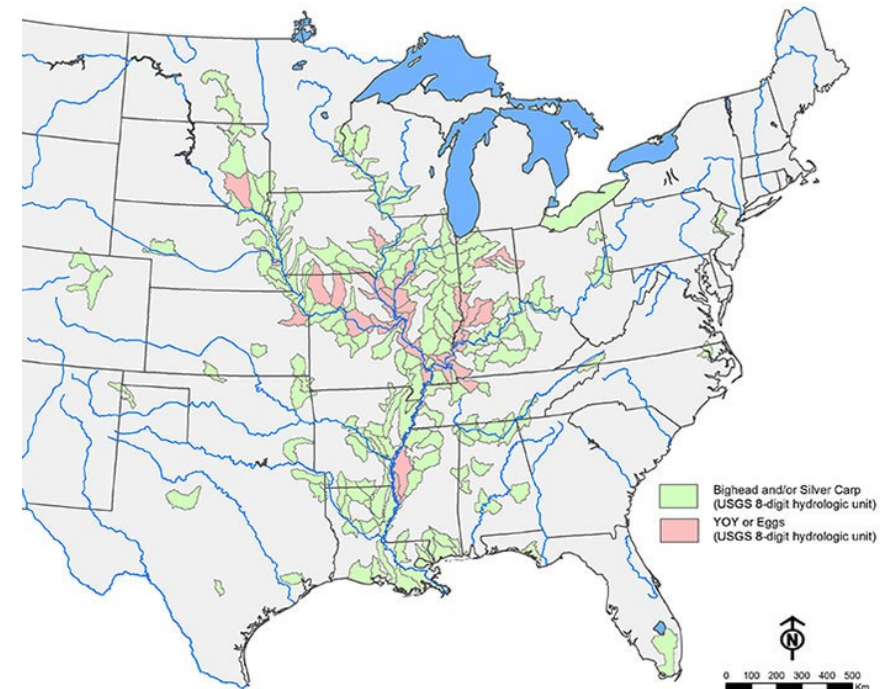
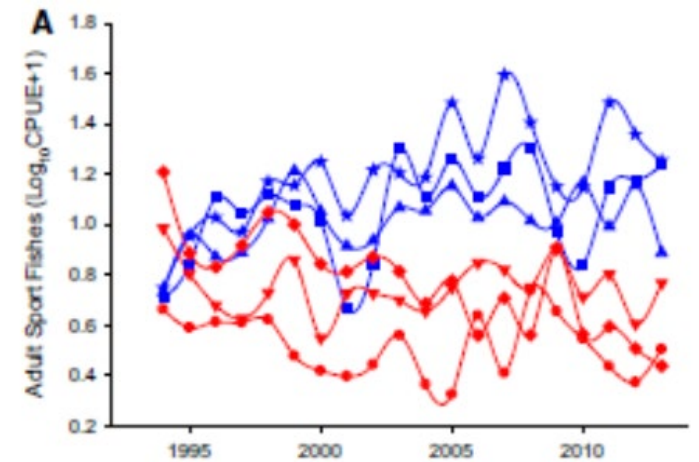


Photo from: [www.asiancarp.us](http://www.asiancarp.us)  
Data Sources: U.S. Geological Survey and Illinois Dept. of Natural Resources

## Bigheaded carps have caused 6 ecological problems:

1. Driven a 50% reduction in gamefishes in rivers (Chick et al. 2020 *J Biol Inv*).
2. Driven 10-25% reduction in the size of native planktivorous fish (ex. bigmouth buffalo; Irons et al. 2007. *J. Fish Biol*).
3. Driven a 90% reduction in macroplankton species richness (biodiversity) and abundance (Sass et al. 2014; *J Great Lakes Res*; DeBoerer, 2018. *Freshw Biol*).
4. Reduced the size (57-87%) of larval fish and zooplankton (Fletcher et al. 2019).
5. Reduced the size of freshwater mussels (Tristano et al. 2019. *Aqu Conserv*)
6. Caused eutrophication of the benthic environment (feces and bacteria) (Kolb et al. 2019)

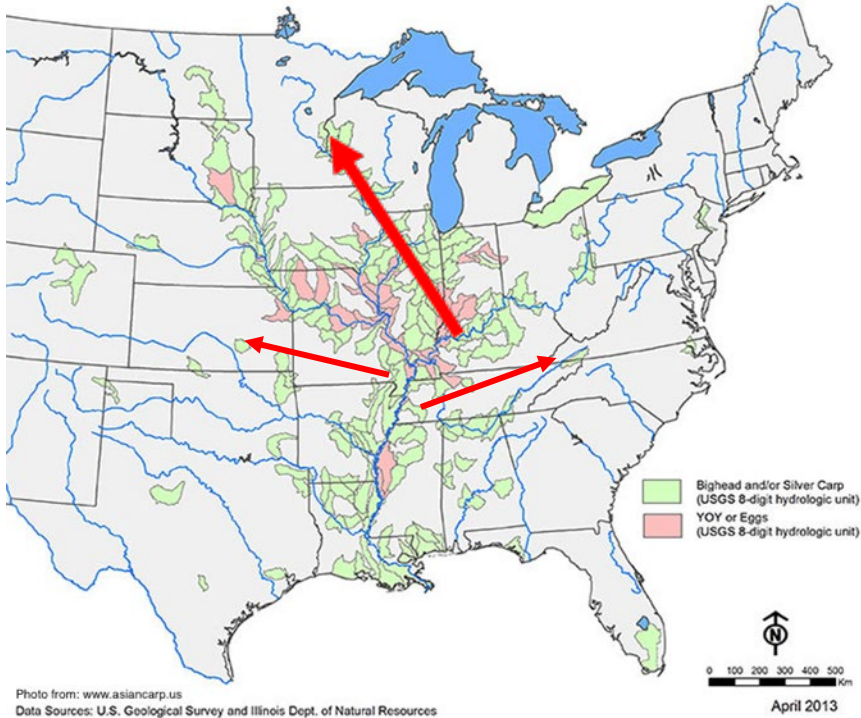


(Chick et al. 2020)

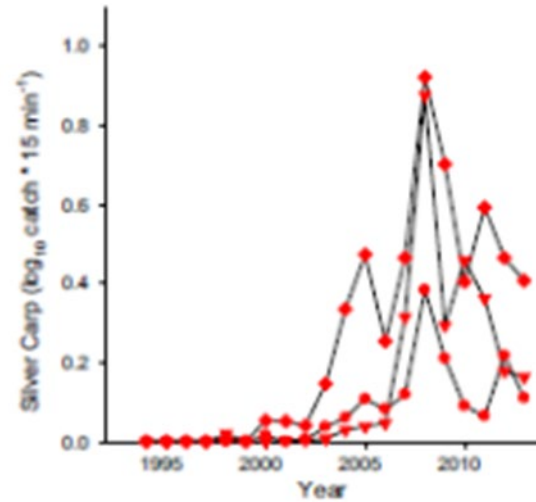
**Silver carp also jump 9 feet in the air, posing danger to boaters!**



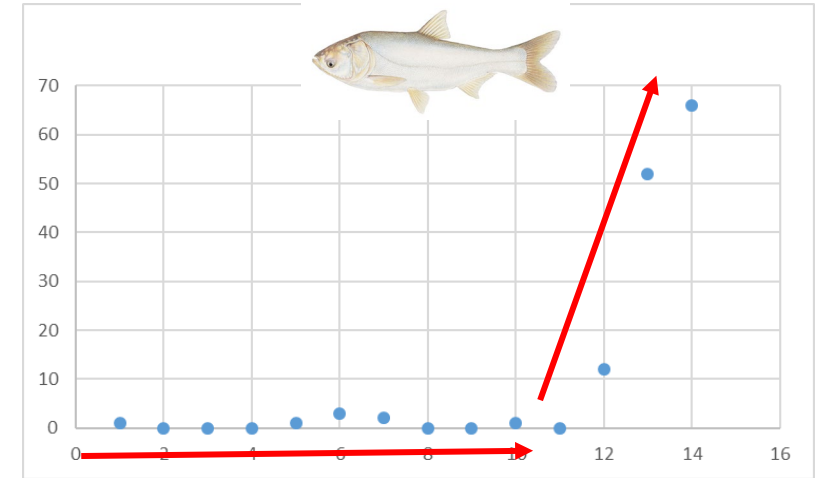
# Presently invading Minnesota waters and now routinely being seen and caught



Silver carp now problematic in 12 states - a quarter of the USA!



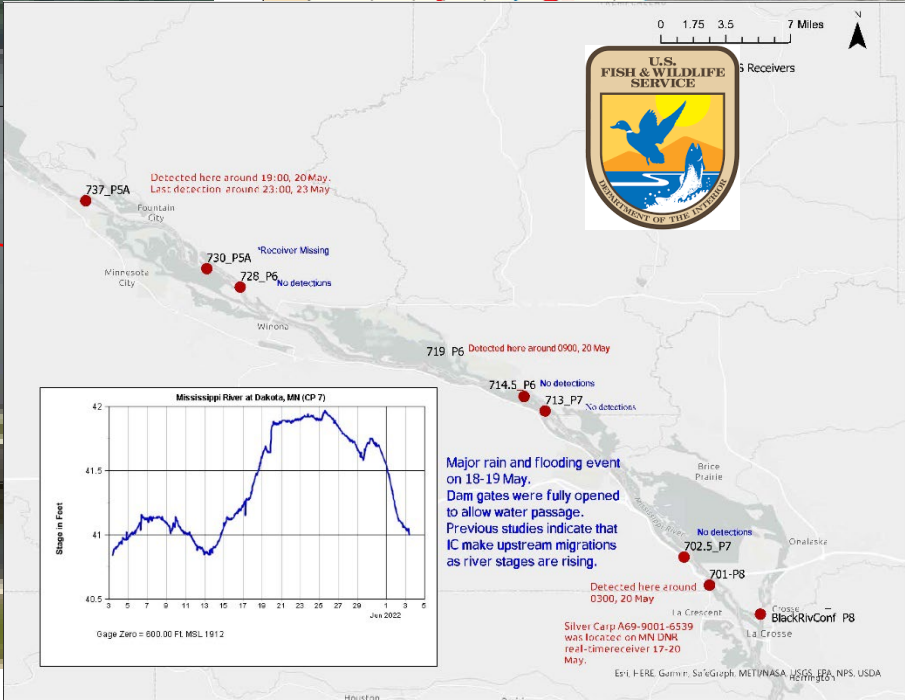
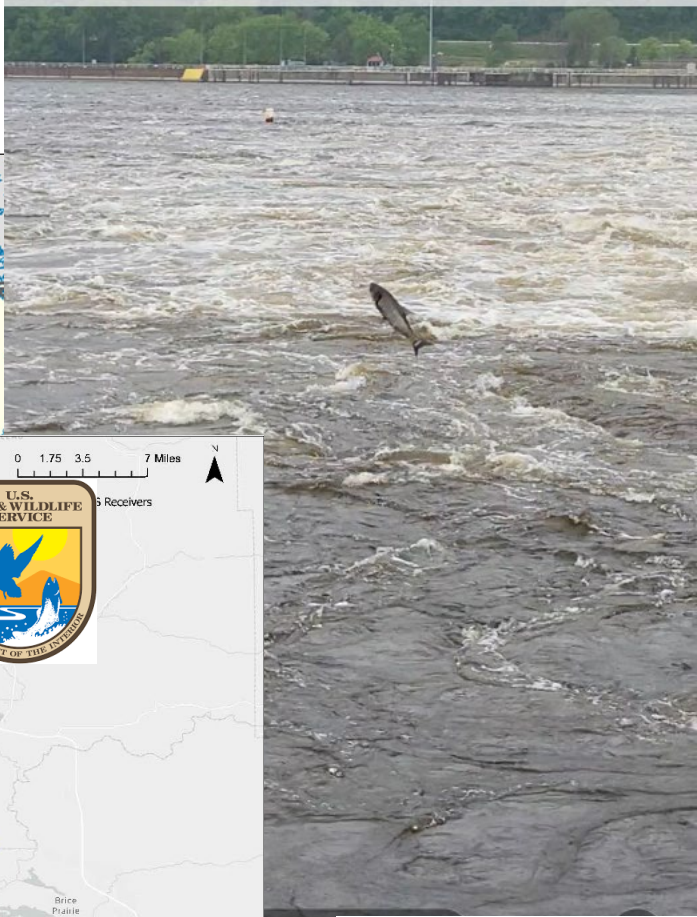
Rapid increase seen in Illinois after years of no change: sudden, explosive growth (Sass)



**ONLY QUESTION: WHEN WILL THEY REPRODUCE?**



# Special Concern: Silver Carp are now being routinely seen at Lock and Dam #5



- Public sightings
- Confirmed by USFWS and U of MN:  
1 of 2 tagged silver carp in Pool 8 tracked here
- CONFIRMED by WI DNR:

(Brian Brecka, Bob Jumbec, WIDNR “jumping at a rate of once a min below the spillway” June 6 2022 and a few days later”  
Dozens??



## This is very serious!

- 1) Lock and Dam 5 (LD5) is **the last place to stop these carp** south of the Twin Cities
- 2) **As few as 20 female carp** can be expected with 75% certainty to reproduce and create a viable population within as little as 10 years! (Cuddington et al. 2014)
- 3) **Once carp reproduce, prevention is not possible**, only management.



## Today, I describe an option that could save the state from these carp—if we act very quickly

- **Reasonable** (multiple component and options, adaptive)
- **Developed by the UMN with LCCMR funding** (\$5 million) after a decade of research
- **Validated** by the scientific community (8 peer-reviewed publications)
- **Doable** (validated by Barr Engineering Company (feasibility and cost analysis))
- Cost: about \$11 million—if not implemented, state will pay \$2 million/year for carp control and **our fisheries and ecosystems are damaged forever**
- Must be **implemented now** (2022) to have a good chance of working
- The **MN DNR is currently not on board**

# First, what are Locks and Dams and why stop carp there?

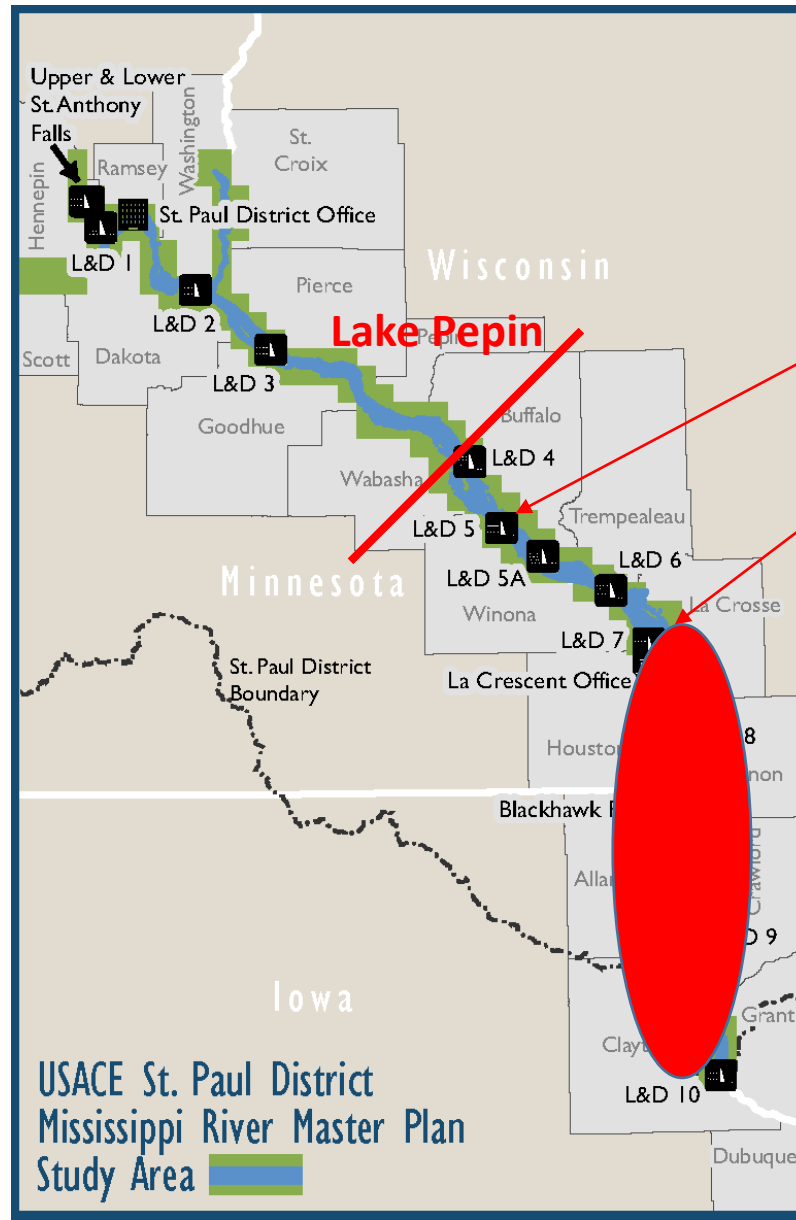
- 29 Locks and Dams (LDs) span the Mississippi River and regulate water depth
- **All fish swimming upstream must pass through them. Some LDs now stop 50-85% of fish.**
- **All LDs have 2-3 components that affect passage and provide excellent pre-existing options for control:**
  1. A **navigation lock** (10% of structure, allows fish to pass when opened)
  2. A **dam with spillway gates** that open/close to maintain depth in lock (usually 90% of structure; the less they open, the less often fish can pass)
  3. *Sometimes a fixed-crest overflow spillway*



**Only 3 ways to pass**

# Six LDs between the invasion front and Lake Pepin

LD4, LD5, LD5A, LD6, LD7, LD8



Silver carp now seen 2022

51 adult invasive carp caught in 2019

Adult invasive carp relatively abundant

**All 6 LDs evaluated for their potential to stop carp: Multiple criteria point to LD5 as the only option for carp control, and also an excellent one!**



LD	lock can house deterrent	upstream pool (miles)	lacks fixed crest spillway	% of time gates passable
4	X	13.9	X	7.8%
5	X	14.9	X	2.5%
5A	X	9.6		18.5%
6	X	14.4		12.7%
7	X	11.6		8.0%
8	X	23.3		8.8%

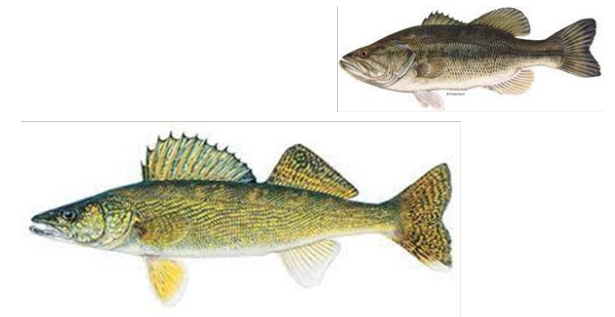
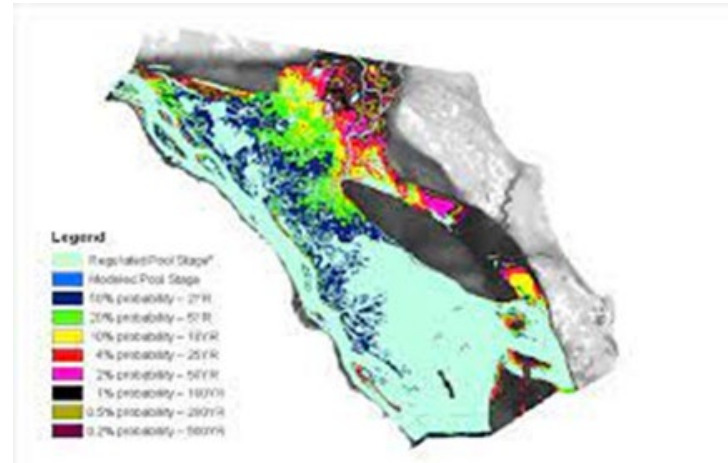
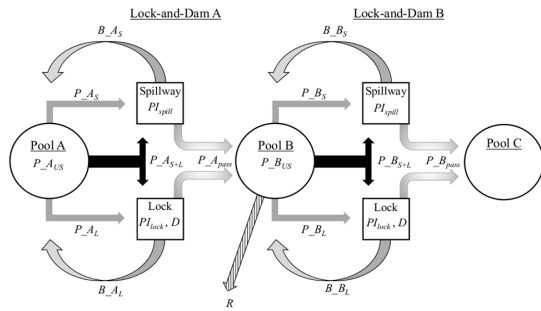
# LD 5 near Winona is the only place carp can be stopped if four approaches are employed

## What must happen at LD5 (4 approaches):

1. A carp deterrent must be added to LD5's lock
2. Its spillway gates must be adjusted
3. Carp must be removed above and below LD5
4. A fishway for native fish must be installed



Numeric simulation shows that if a carp deterrent were added to LD5 and the 3 other strategies were pursued, LD5 will stop 99+% of invasive carp from reaching Lake Pepin (Pool 4). This number is high enough that carp will likely die of old age before reproducing.



### Ex. 3 of 108 options considered:

1. 66% efficient Deterrent at LD5, no gate modification, no removal: **~98.8 ± 0.05 % blocked**
2. 66% efficient Deterrent at LD5, gates modified, 0% removal: **~98.9 ± 0.03% blocked**
3. 66% efficient BAFF at LD5, gates modified, 10% removal: **~99.6 ± 0.03% blocked**



# Question recently posed to Barr Engineering Company: Could a carp deterrent be deployed at LD5, and in time?

*“An Engineering Assessment of the Feasibility and Estimated Cost of Installing a State-of-the-art BAFF Carp Deterrent at Mississippi Lock and Dam 5”*

## Tasks:

1. Confirm location
2. Can an effective deterrent system be identified and installed at LD5?
3. What is the best type of deterrent?
4. Could the state get permits for this deterrent?
5. How much would it cost?
6. Can it be installed in time?



## **Barr Engineering Co. study confirms Lock & Dam 5 is the best location to stop carp**

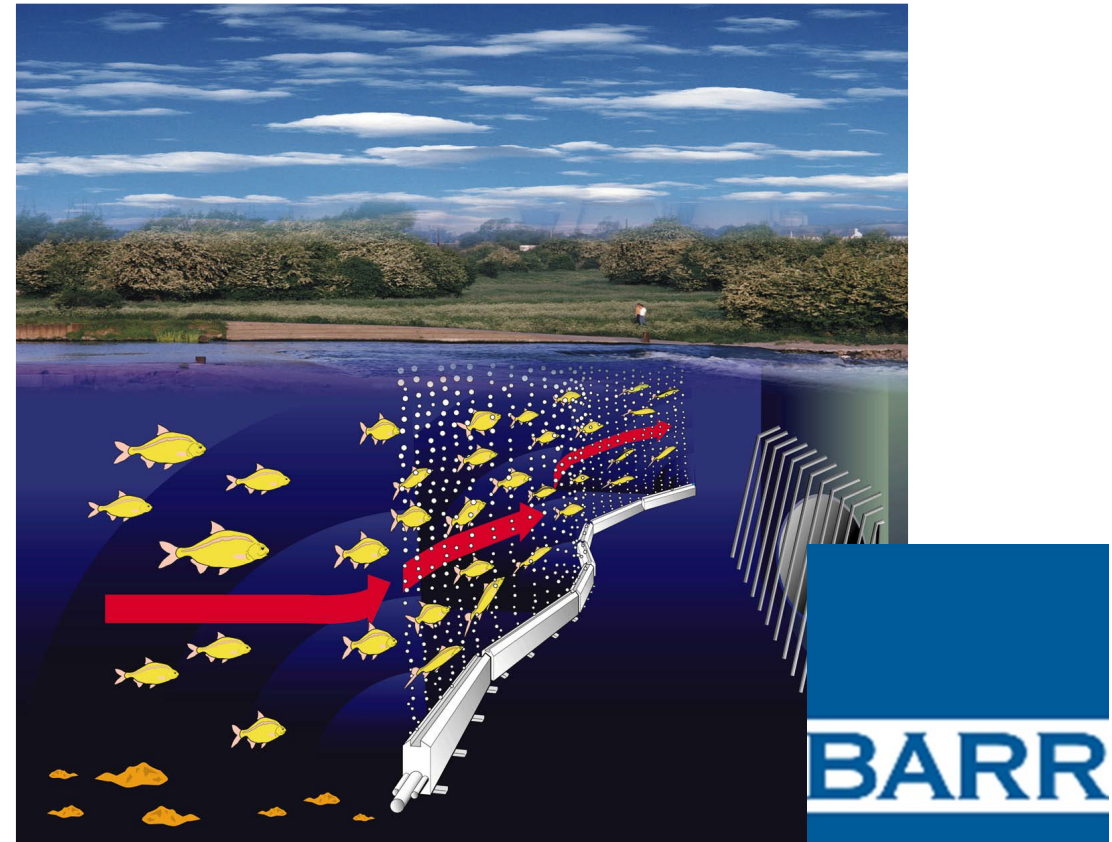
1. No overtopping fixed crest spillways/submersible dams
2. Spillway gates only open 2% of the time
3. Lock can accommodate a deterrent
4. Pool 5 can be selectively fished with L&D 4 as redundant upstream deterrent

# Barr Engineering Co. found that a Bioacoustic Fish Fence (BAFF)- an acoustic deterrent- is the best commercially available carp deterrent for LD5

- Effective
- Affordable
- Safe

## A BAFF:

- Combines acoustic signal with a bubble curtain to create a wall of sound
- Signal can be focused on key species
- Commercially available
- Tested in lab and now in the field for carp

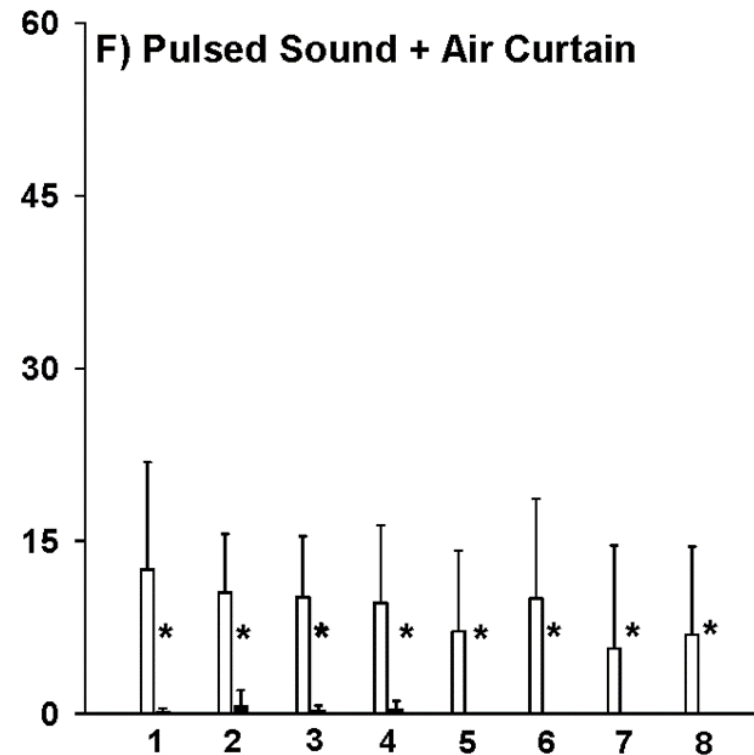


# BAFF blocks 97% of invasive carp in published lab test



Air coupled with sound (Bioacoustic Fish Fence or BAFF)

**97% BLOCK**



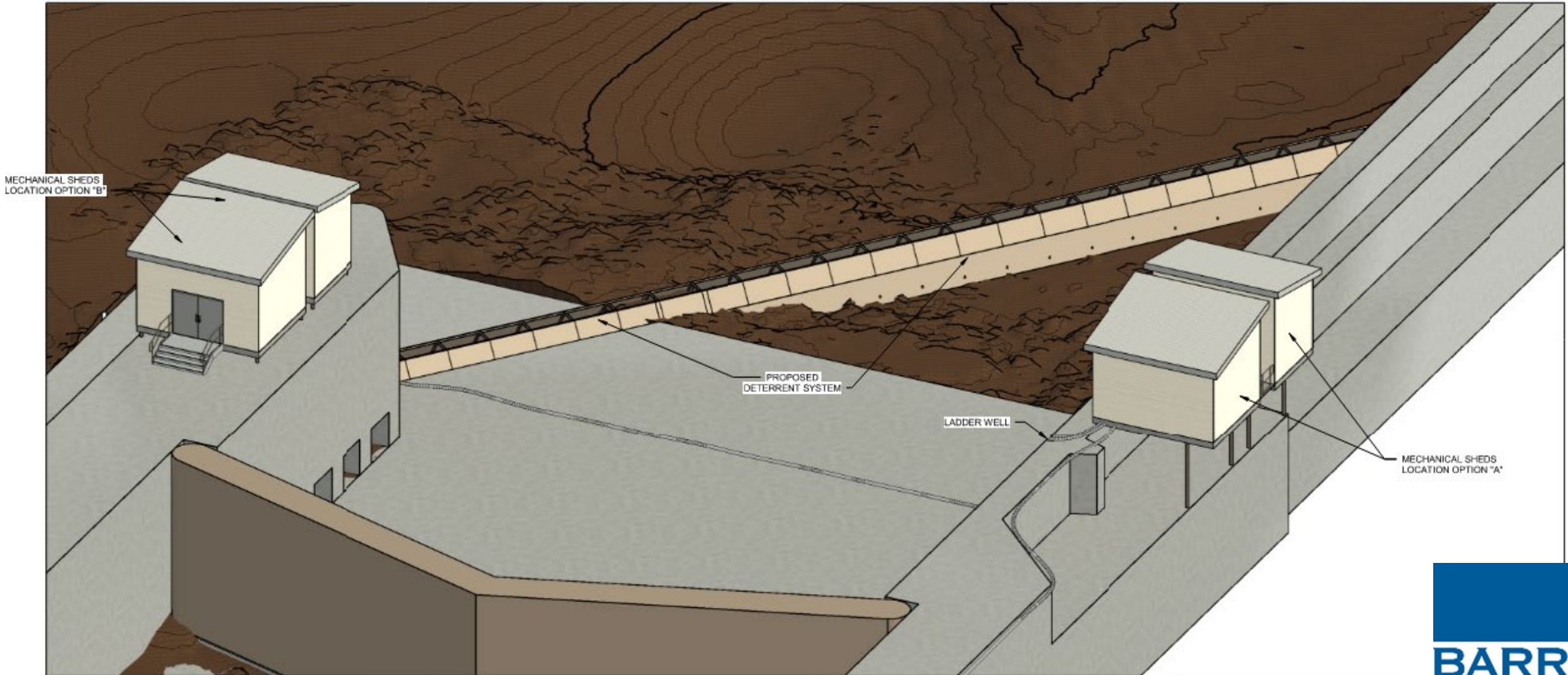
Published: Dennis et al. 2019 . Biol. Invasions

# BAFF being tested by USFWS at Barkley Lock, KY with favorable results



**71% effective to date (enough)**

# Barr confirms a BAFF deterrent can be added at LD5: with 10% design deterrent system layout



# Barr found that permits for a BAFF can be obtained relatively quickly

Agency	Authorization	Estimated Agency Review Timeframe
USACE	Clean Water Act (CWA) Section 404 and Rivers and Harbors Act Section 10 authorization	3 months to 1 year
USACE	Section 408 of the Rivers and Harbors Act of 1899 authorization	4 months to 1 year
USFWS	USACE consultation under Section 7 of the Endangered Species Act	Concurrent with USACE review
SHPO	USACE consultation under Section 106 of the National Historic Preservation Act	Concurrent with USACE review
MPCA	CWA 401 Water Quality Certification (WQC)	Not applicable for Nationwide or Regional General Permits 1 year for an individual WQC for a Standard Permit
MPCA	Dredge Materials Management SDS Permit	6 months to 1 year
DNR	Public Waters Work Permit	3 to 6 months
DNR	NHIS Review and Takings Permit for Threatened/Endangered Species	2 months

# Barr's study shows BAFF cost will be between \$8-16 million

	Item	Estimate of Probable Construction Cost	Notes
1	Engineering	\$468,000	8% of items 2-8 (excluding BAFF furnished cost); includes engineering, survey, geotech investigation, and construction observation
2	Mobilization and Demobilization	\$800,000	Includes mobilization of contractor, dive crew, barges and crane
3	BAFF Components & Initial Installation	\$7,242,000	BAFF enclosure and foundation, wiring to BAFF system, compressed air lines
4	Compressor Shed	\$290,000	Pre-engineered building, compressor, HVAC, finishes
5	Electrical Shed	\$141,000	Pre-engineered building, electrical panels, HVAC, finishes
6	Utilities and Power	\$235,000	Transformer, generator, propane, electrical service
7	Contractor Overhead	\$871,000	10% of items 2-6
8	Contingency	\$1,741,000	20% of items 2-6
	Total:	\$11,788,000	
	Lower Range (-30%)	<b>\$8,252,000</b>	
	Upper Range (+40%)	<b>\$16,503,000</b>	

## Notes:

- 1) Cost estimate based on AACE (17R-97, Class 4, -30%/+40%)
- 2) Costs are based on conceptual 10% level of design
- 3) Budgetary quotes were supplied for the FGS BAFF system, compressor and shed enclosure
- 4) All numbers rounded to nearest thousand

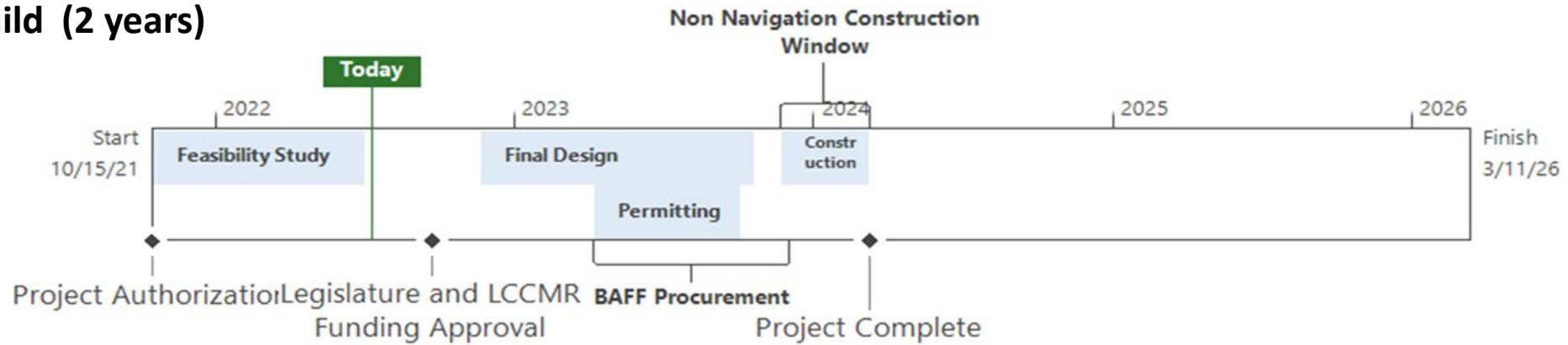




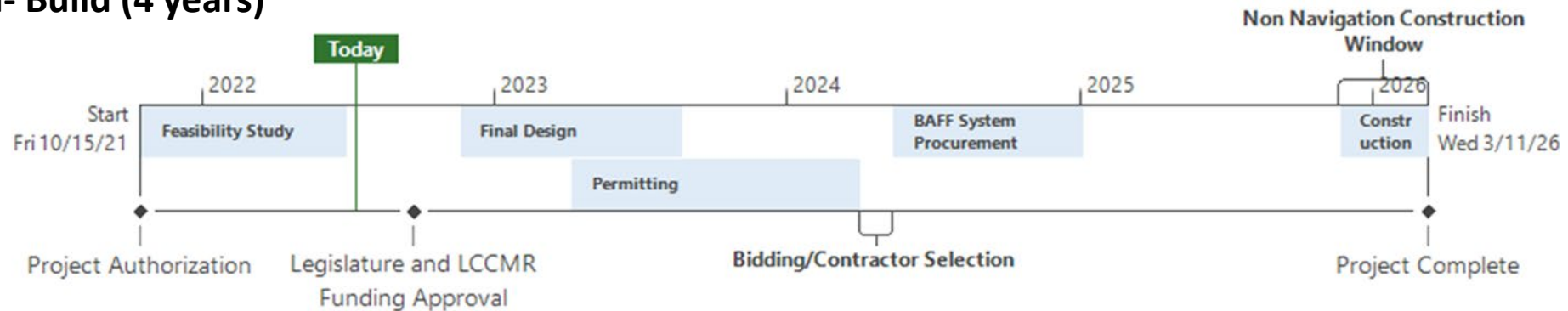
# Barr's study shows it will take 2-5 years to install a BAFF

*5 years is just enough time based on carp passage rates and experience at LD19  
MN DNR must make a decision in 2022*

## Design- Build (2 years)



## Bid-Design- Build (4 years)



# Summary

- Invasive carp are here! It's **now or never** to take action to stop them.
- Using a **combination of 3** available techniques at LD5 we could **stop over 99% of Bigheaded Carp** passage right now in MN/WI, sparing Lake Pepin, and the St Croix River
- **No single technique, many options—but a BAFF lock deterrent is key.**
- Carp control can be achieved with **little effect on native game fishes** in the river, in fact it **may allow restoration upstream if fishway installed**
- **A decision needed in 2022 to start in 2023**
- Recommended Next Steps:
  - Expedited decision by the DNR to get the BAFF into biannual budget
  - Funding for 60% design ( )



**Thank You!**

**QUESTIONS?**