



# Asian Carp Control Technology Development and Potential Applications

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Great Lakes Panel on Aquatic Nuisance Species

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U.S. Department of the Interior  
U.S. Geological Survey



# USGS/ACRCC Objectives Guiding Our Progress

- Developing new management tools to control or remove carp
- Building a framework for tool development
  - Standardizing creation of methods and tools which can then be tailored and applied to control other invasive species
- Working toward direct transferability of invasive species control technology and methods outside the Great Lakes basin (e.g. Mississippi, Ohio, Missouri River basins)



# USGS Research Approach

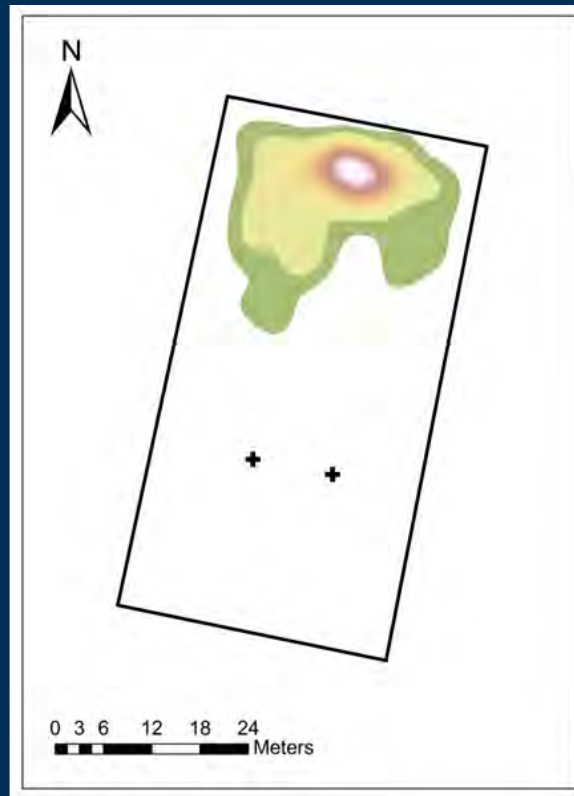
- **Understanding Life History and Behavior**
- **Understanding Hydrologic Requirements**
- **Early Detection**
- **Control Technologies**



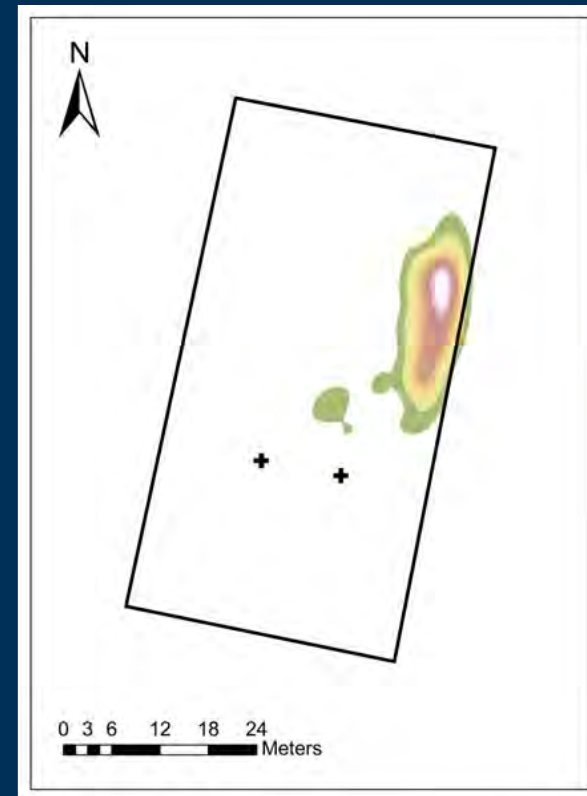
# Asian carp response to water gun operation (pond study)



Pre firing



Firing



Post firing



# Waterguns - 2013 Field Trials

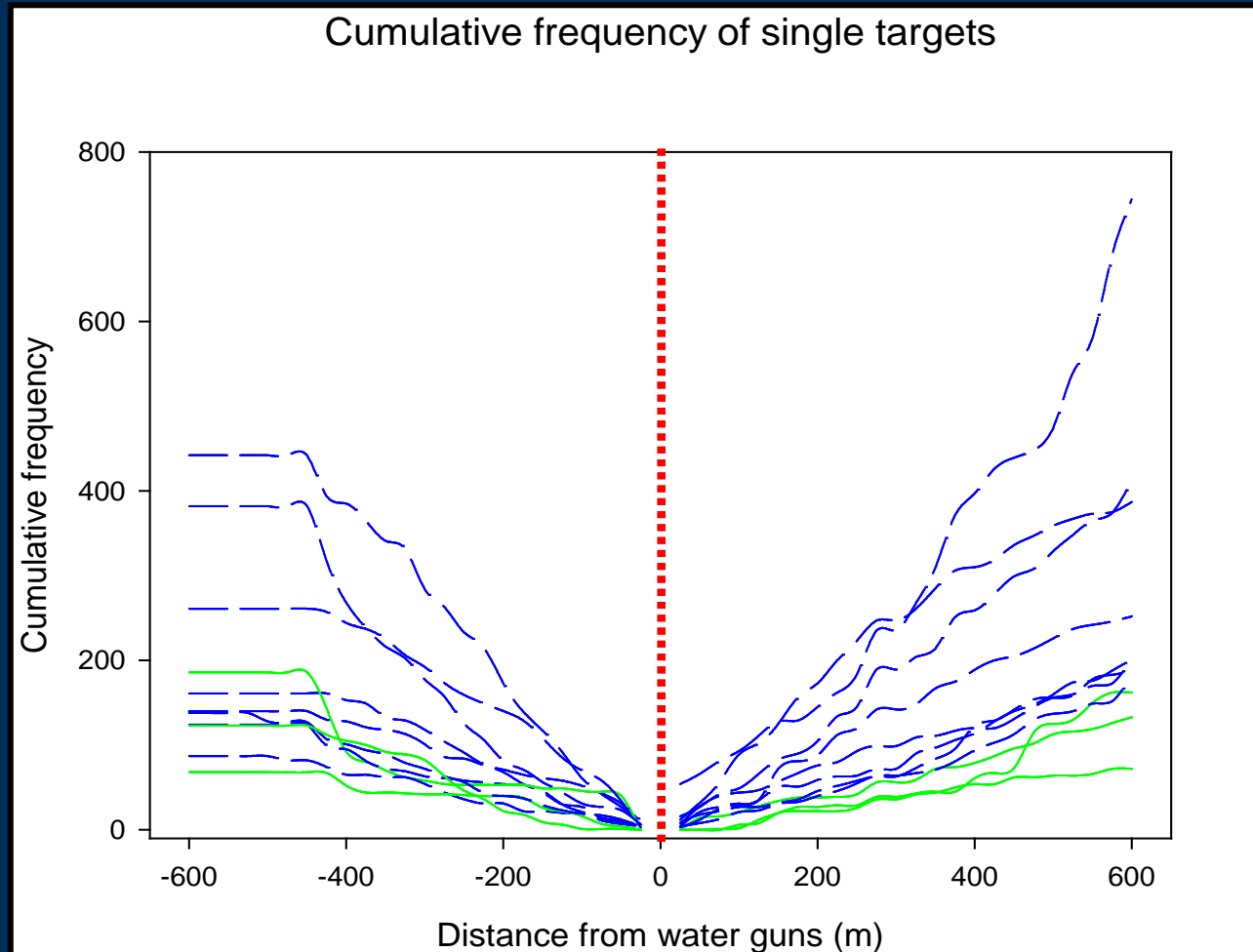
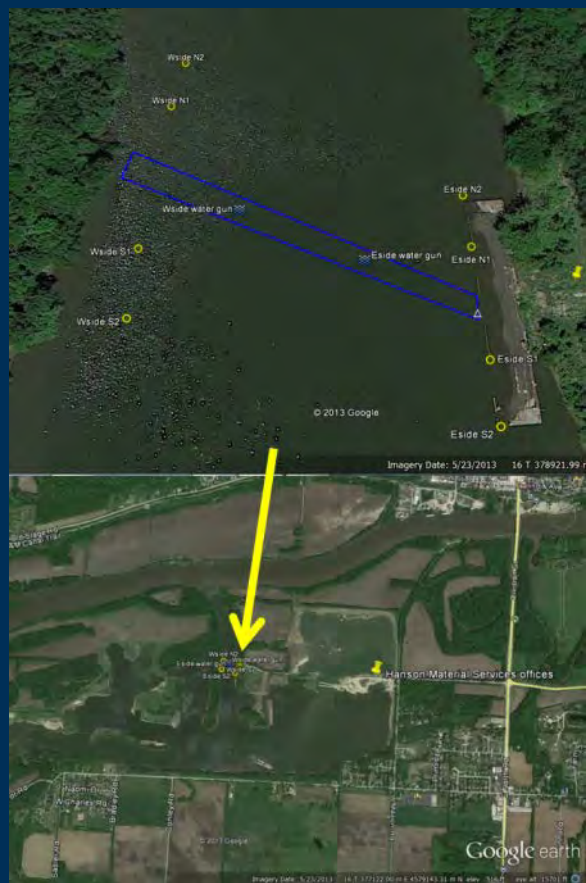
## Part of IPM Approach



- **IL DNR, SIU and USGS collaboration**
  - Used algal attractants to lure carp to a location
  - Waterguns used to create barriers and move carp
  - Commercial fishing to deplete carp
- **Watergun Results:**
  - Substantially reduced number of large fish to a distance of ~25 m
  - Altered distribution of large fish to a distance of ~600 m
  - Native fish mortality (predominantly gizzard shad)



# Response of fish to water gun operation in the field, 2013





# Water guns: Plans for 2014

- Integrate in IPM trials (Illinois R.; Wabash R. [habitat restriction])
- Support GLMRIS efforts through evaluations at Brandon Road
- Collaborate with USACE to complete structural trials
- Collaborate with resource managers to identify deployment locations
- Assess impact to native mussels





# CO<sub>2</sub> Gas as a Candidate Barrier Chemical

- Adding CO<sub>2</sub> – effects on water chemistry:
  - Reduction in pH (formation of carbonic acid)
  - Elevation of dissolved CO<sub>2</sub>
- Fish have specialized receptors in the gills used to detect CO<sub>2</sub>
  - Increased CO<sub>2</sub> concentrations are detected and avoided
  - Detection based on presence of CO<sub>2</sub>, not pH change





## Other Key Points about CO<sub>2</sub>

- Dissolved CO<sub>2</sub> - does not function as a 'bubble curtain'
- Response to CO<sub>2</sub> is not associated with hypoxia
- Change in pH associated with elevated CO<sub>2</sub> is not sufficient to cause fish to move
- Response to CO<sub>2</sub> does not appear to be species specific



# Preliminary Results

## UIUC, IL DNR, USGS

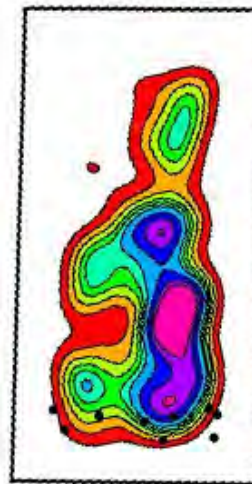
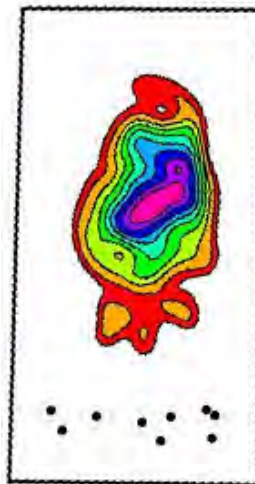
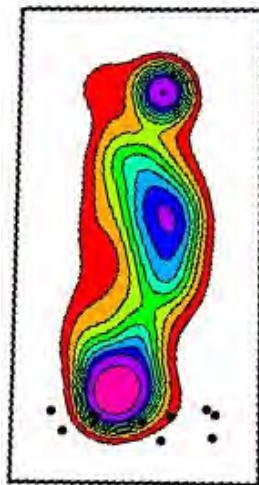
- Elevated CO<sub>2</sub> acts as a non-physical barrier to deter the movement of fishes
  - 8-d old fry (~7 mm) experience significant physiological disturbances similar to adult fishes
  - Small (2-4") fish avoided CO<sub>2</sub> in laboratory exposures
  - In 0.5 acre pond, 6-10" fish detected and avoided areas of elevated CO<sub>2</sub>



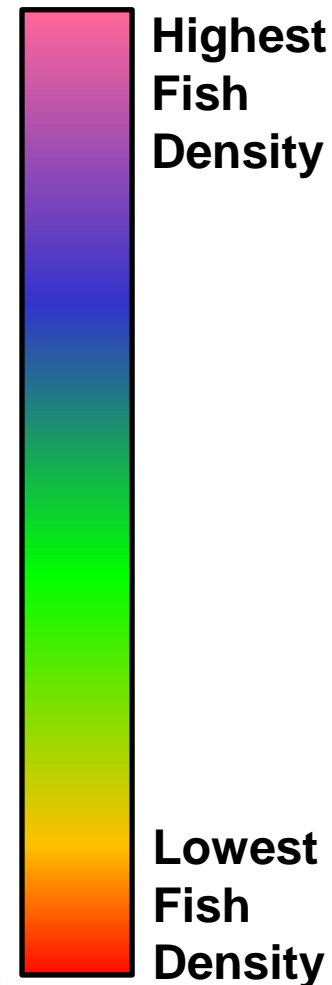
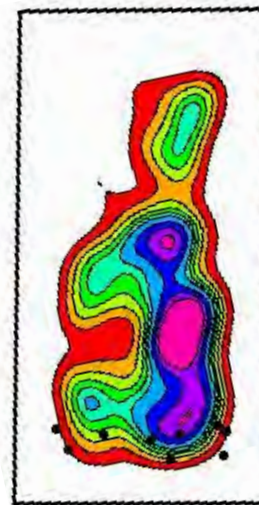
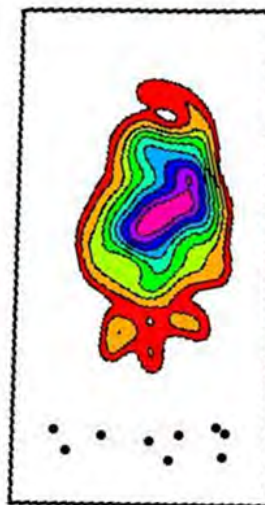


# Response of Asian carp to elevated CO<sub>2</sub>

Bighead  
carp



Silver  
carp



before

during

after pond mixing



# Field deployment of carbon dioxide barrier to deter Asian carp – Led by IL DNR and UIUC in 2013

- Alternative barrier systems can provide redundant systems to existing barriers and could be deployed where electrical barriers or water guns cannot
- USGS worked with UIUC and IL DNR to test CO<sub>2</sub> barriers in our outdoor experimental pond complex.
- Demo at UMESC completed in summer 2013
- UIUC, IL DNR and USGS collaborated to provide methods/procedures to natural resource agencies to deploy barriers
- If classified as a pesticide, could require EPA FIFRA registration



# Plans for 2014

- Complete large-scale field evaluation of a CO<sub>2</sub> barrier to deter Asian carp (in Illinois R. backwater)
- Evaluate the feasibility of using a CO<sub>2</sub> barrier in/near lock chambers (USACE collaboration)
- Support GLMRIS through focus on Brandon Road Lock
- Initiate registration reviews with EPA and FWS
- Evaluate the response of native mussels to CO<sub>2</sub>
- Meet with USEPA on Registration Process April 1

# Food stimuli are being evaluated as attractant lures for Asian Carp

- Laboratory studies examining Asian Carp behavioral attraction to algal food stimuli and characterizing the feeding response
- Pond mesocosm studies to determine magnitude and duration of behavioral attraction to algal food stimuli
- Field studies to develop protocols for conditioning wild fish to the algal stimulus and to determine the magnitude and duration of behavioral attraction to the stimuli at sites along the Missouri River

# Studies in Progress

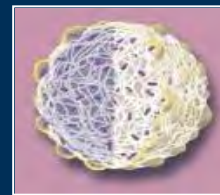
- Investigating the impact of ambient algal communities on attraction to the algal food stimulus
- Investigating the response of other fish species to the algal food stimulus
- Develop protocols for effective application of algal stimulus to attract wild Asian carp under a variety of field conditions and habitats
- Chemical analysis of algal stimulus
- Physiological observations of olfactory and taste sensitivity to algal stimulus and component amino acids
- Combine chemical attractant and micro-particle bait methods





# Targeted Toxic Microparticles

- Target Asian carp, avoid harming native species
- Final Results of Microparticle Design Research:
  - Selective agent /toxin – Antimycin
  - Selective uptake by AC – Identified preferred food size
  - Selective release – Determined intestines as best place for release of toxin and the enzyme trypsin to trigger release



Microparticle

Bioactive released in intestine



Bioactive passes through stomach unaltered



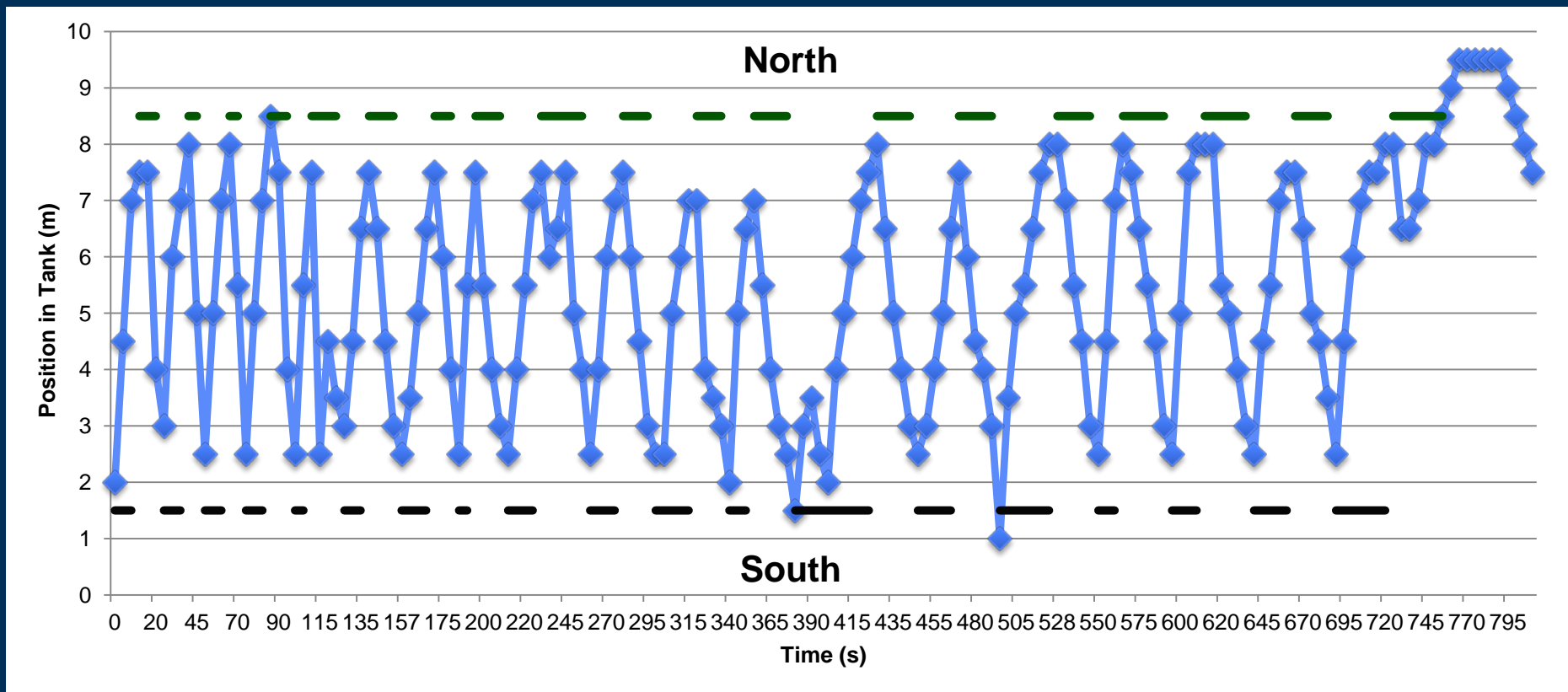


# Plans for 2014 and Beyond

- **Field testing of microparticle (spring/ summer)**
  - **Streamside trailer using river water flow-through at IL River backwater**
- **Antimycin particles could be available 18-24 mo after final formulation**
  - **Need to solve leaching issue**
  - **Registration required**
- **USGS particle preparations**
  - **Assess alternate particle preparation methods**
  - **Eugenol – decrease net avoidance**



# Integrating tools – Effects of sound



- Response of silver carp to recordings of a boat motor
- Nearly identical response to 38 applications of the same stimulus

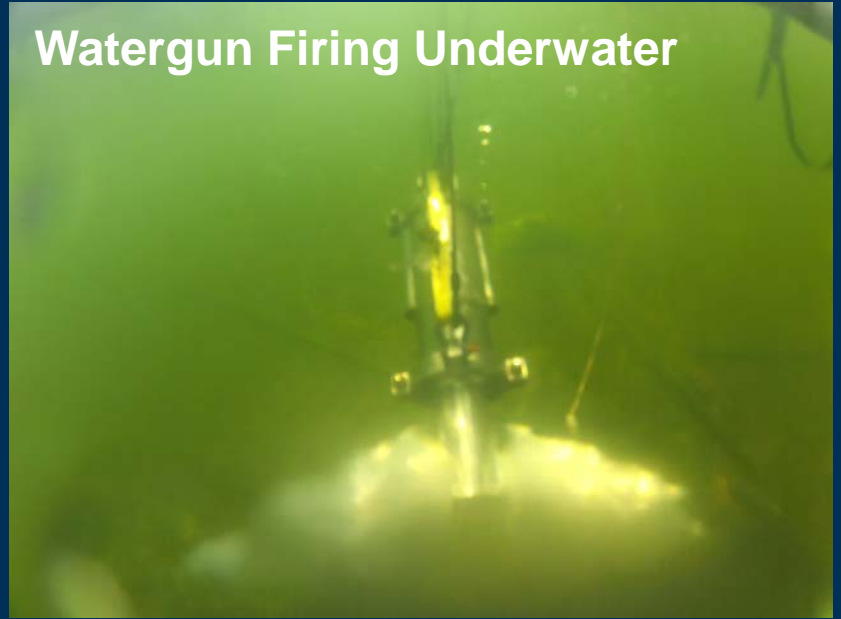
# IPM: Integrated Control Tool Field Trials

## IL DNR/USGS/Southern IL U. Collaboration - 2014

Algal Attractant Setup



Watergun Firing Underwater



Commercial Fishermen







# Questions?



# USGS activities at Brandon Road

- Structural testing of water gun – Spring 2014
- Before other activities – Meet with partners to finalize scope
- Potential Activities:
  - Velocity Mapping/Boundary Conditions
  - Mixing evaluation – dye study
  - Water-Quality variations
  - Flood Inundation
  - Native Mussel Survey
  - Monitor detailed fish movement
  - CO<sub>2</sub> impacts on structures



Approximate  
Area of Water  
Gun Structural  
Testing

0 100 200ft



Possible  
Water Gun  
Deployment

or

Possible  
CO<sub>2</sub>  
Deployment

# Conceptual Potential Deployments

0 150 300ft