# Rock Blasting

## Columbia River Channel Improvements
## (Channel Deepening)


**Karen Garmire, P.E.**
**Resident Engineer**

Total Awarded Contract - $51,960,502

(Rock Blasting $30,000,000)

Nov 2009 – Feb 2010

**Prime Contractor**

J.E. McAmis

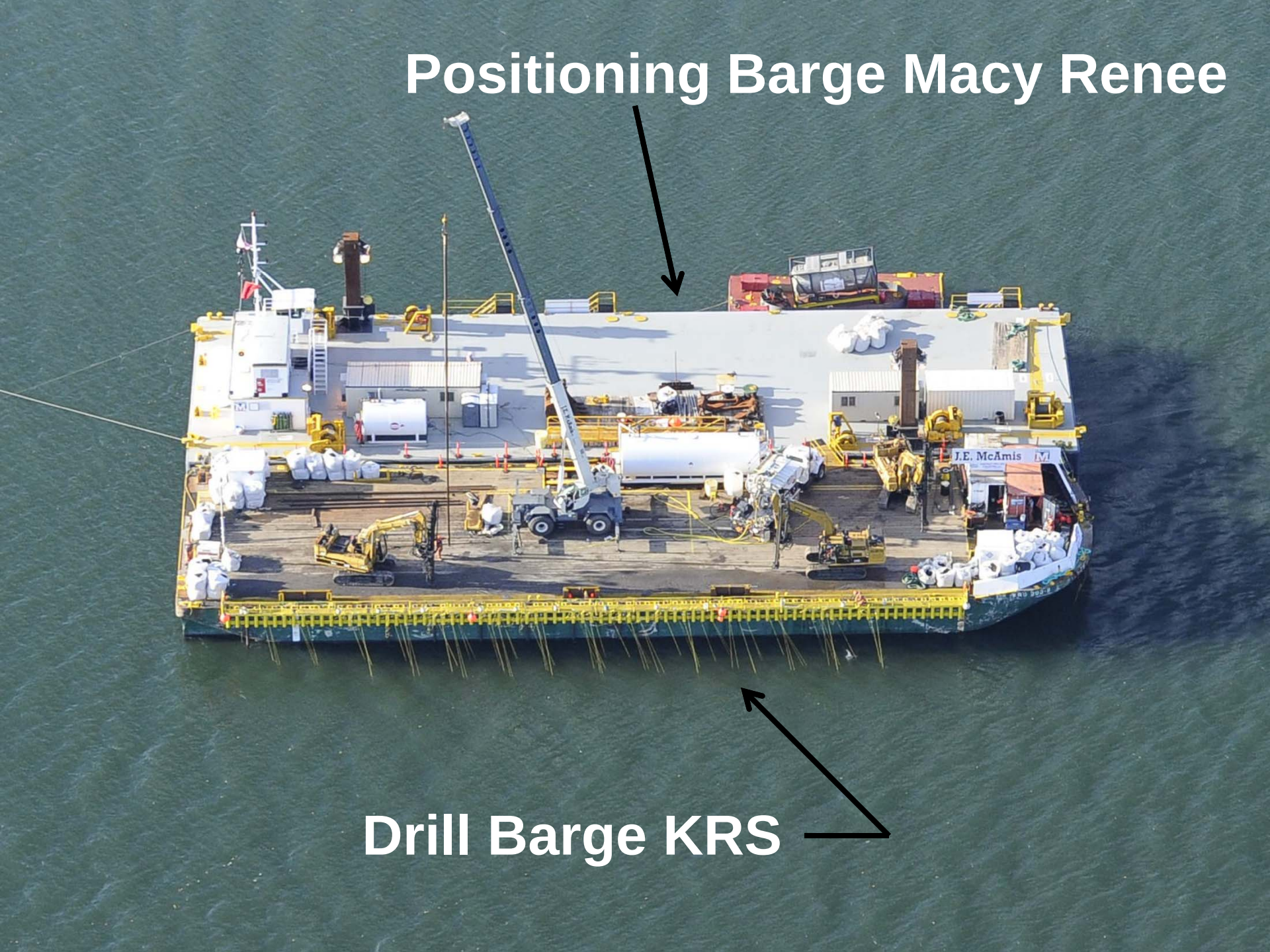
**Major Subcontractors:**

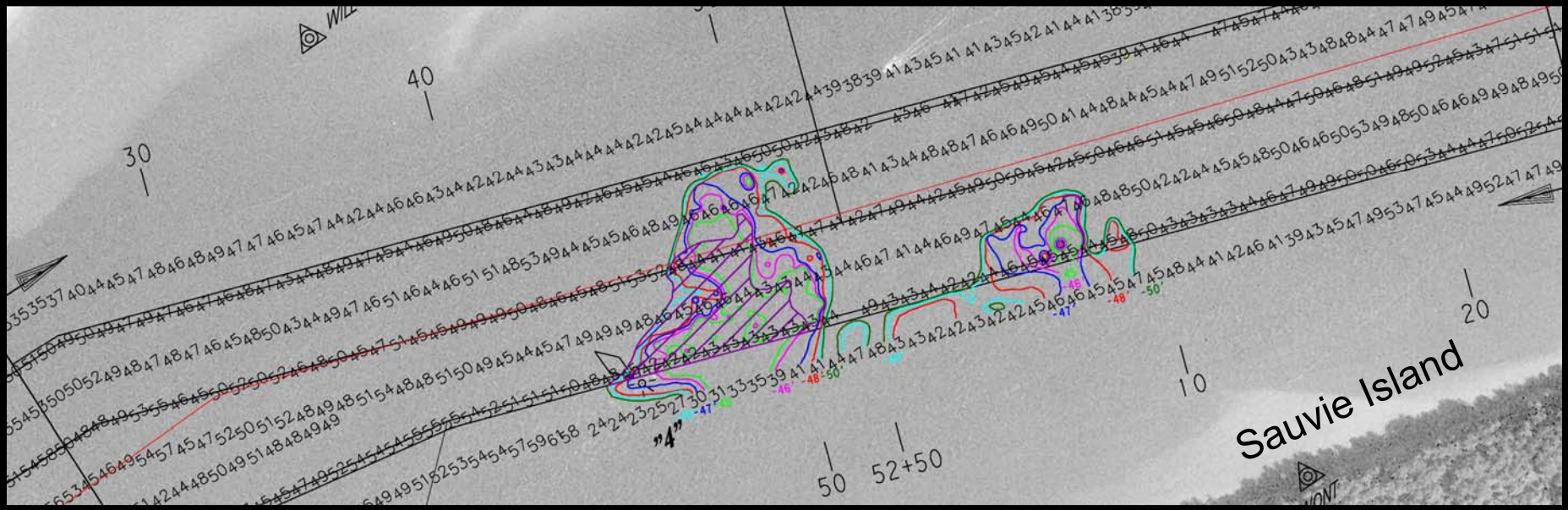
Contract Drill and Blast – Blasting Operations

Aimone-Martin Associates – Overpressure Monitoring

Dutra Dredging – Dredging

# Columbia River Navigation Channel

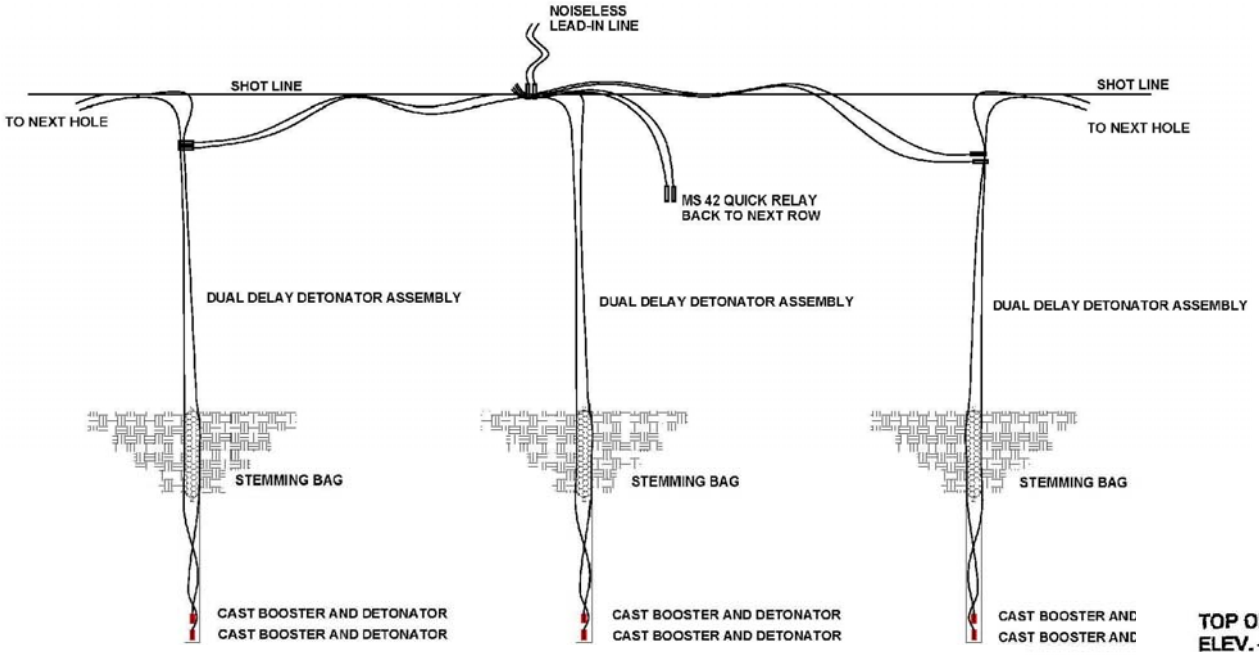

Positioning Barge Macy Renee
J.E. McAmis
Drill Barge KRS




# Rock Contours

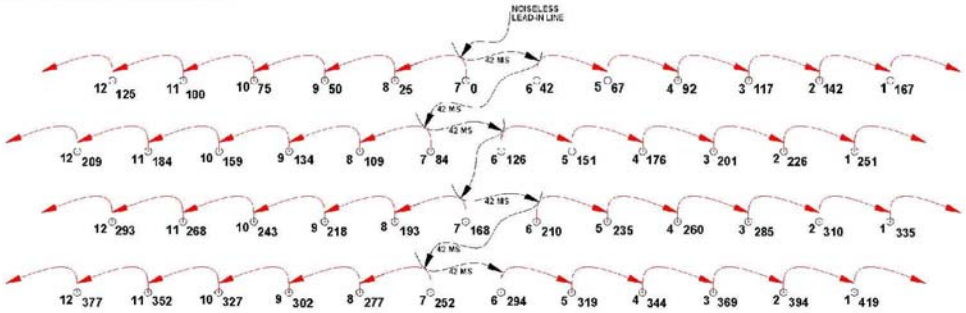
# River Mile 88+00

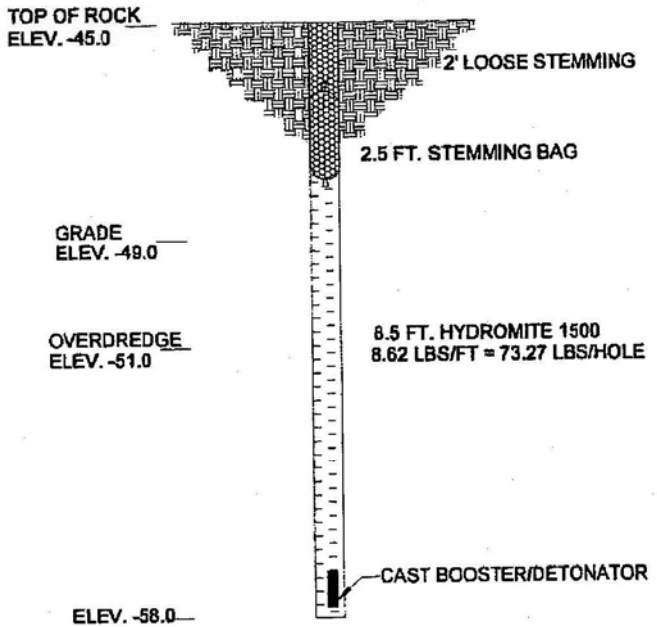
# Typical Blast Pattern And Hole Configuration



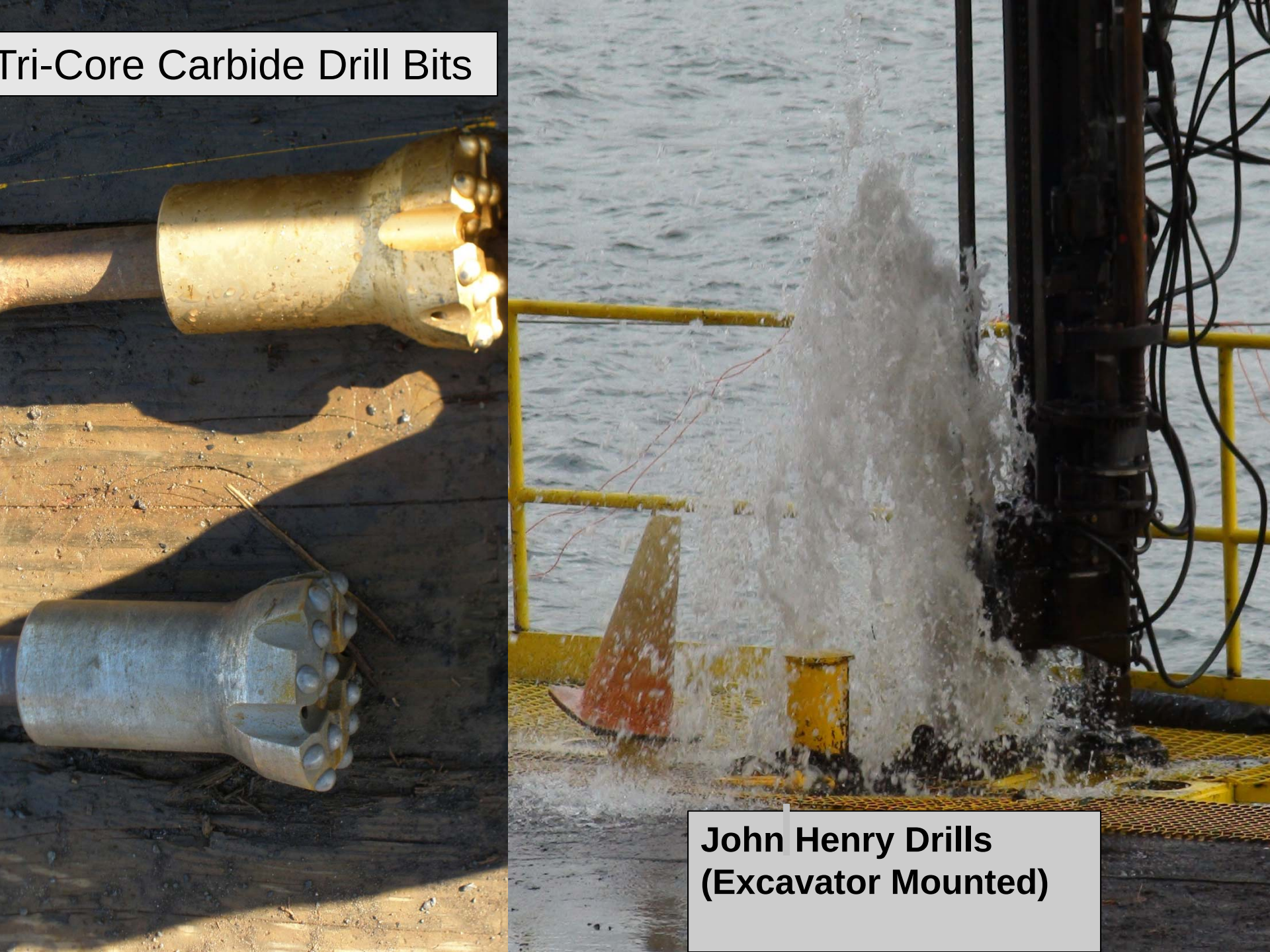

10 FT. SPACING
10 FT. BURDEN
TO
12 FT. SPACING
12 FT. BURDEN
AS DETERMINED BY TEST BLASTS

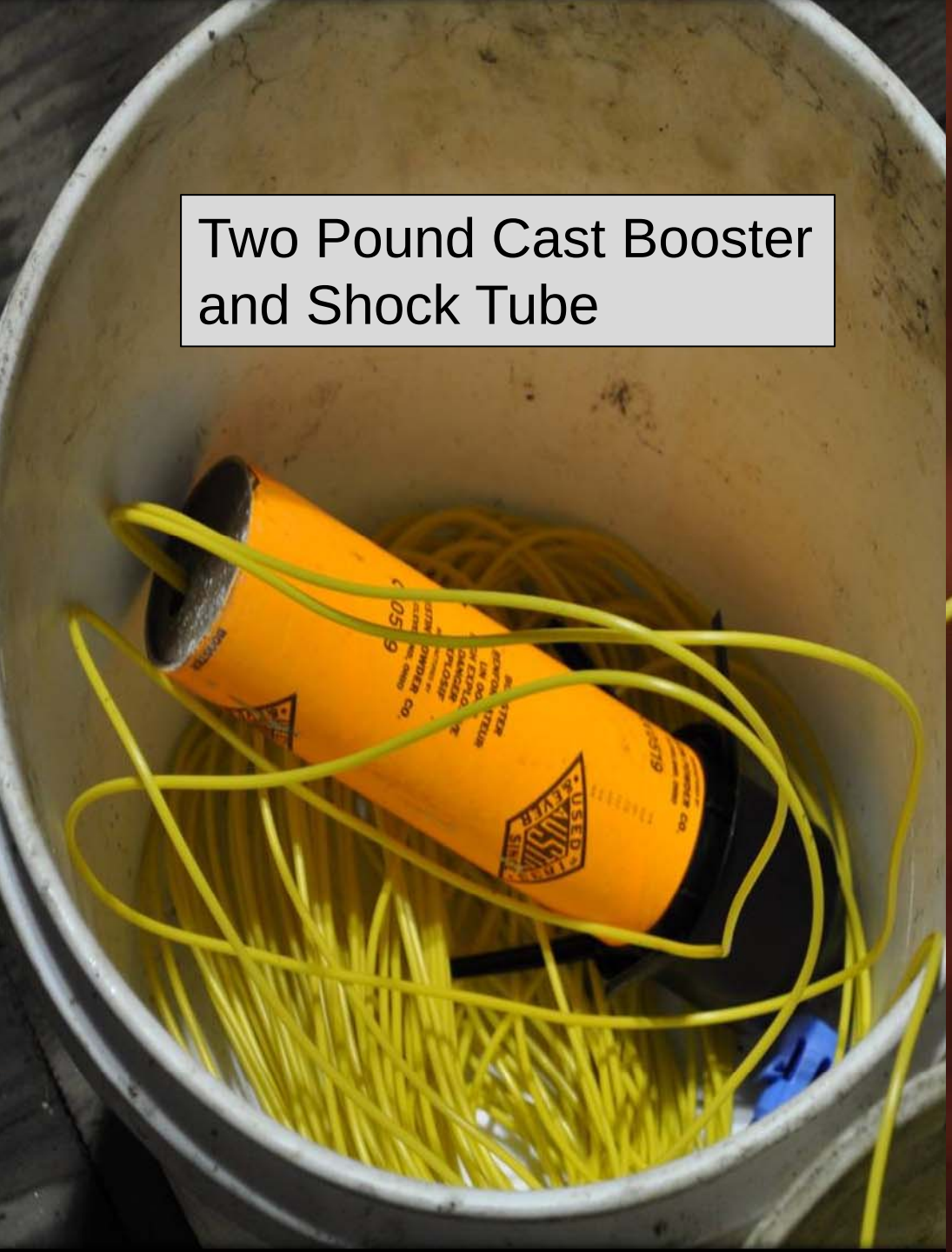
TYPICAL BLAST PATTERN




Drill Template
Telescoping
Steel Casing


Tri-Core Carbide Drill Bits
John Henry Drills
(Excavator Mounted)


Two Pound Cast Booster
and Shock Tube


Down Hole
Detonator

# Explosives Barge with Liquid Emulsion Storage Tank

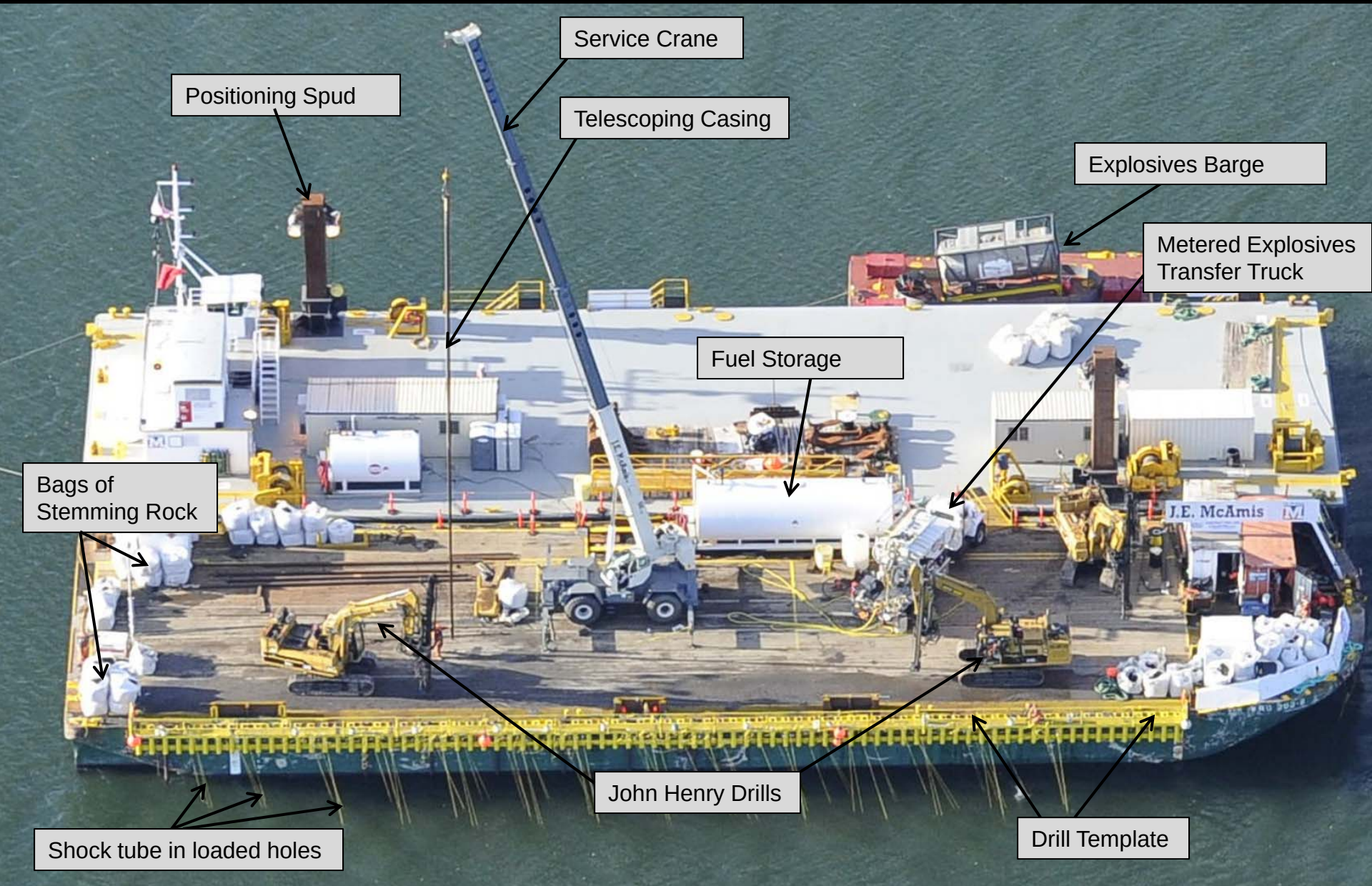

# Metered Liquid Emulsion Transfer Truck

# Loading Holes with Explosives

# Stemming


Tying shot together with
surface detonators and delays

# Drill Barge Layout



# Blasting


Post Shot Removal
of Shock Tube

BUILDING STRONG®

# Biological Monitoring




Allowable “Take”

-50 Juvenile ESA-listed Salmon

-10 Adult ESA listed Salmon

-0 Marine Mammals

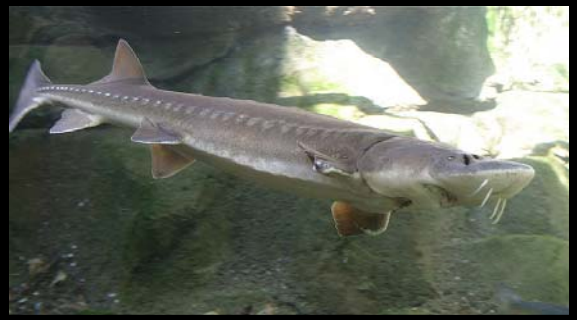
-6 Sturgeon

# Marine Mammals (observation by boat)

# Sturgeon Monitoring

(pre-blast video monitoring for fish in the area and post blast observation via boat)



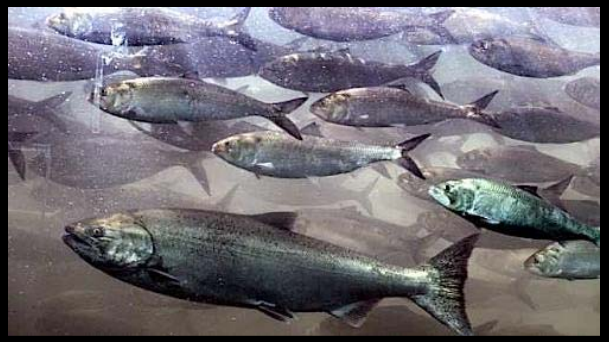


# Overpressure Monitoring

# ESA Listed Salmonids

## Fish "TAKE" was based on theoretical/calculated take

- **Adult Fish**
  - **Peak Blast Pressure** was the critical paramater for adult fish
- **Juvenile Fish**
  - **Blast Energy** was the critical parameter for juvenile fish



# Results

- No marine mammals killed
- The estimated “take” for adult ESA-listed fish was less than one fish due to the low number of fish in the area.
- The estimated “take” for juvenile ESA-listed fish was zero because all blasted was completed before the juvenile winter out migration began.
- Four sturgeon were “taken” on two separate days with none over 47-inches.

# Dredge *Megan Renee*

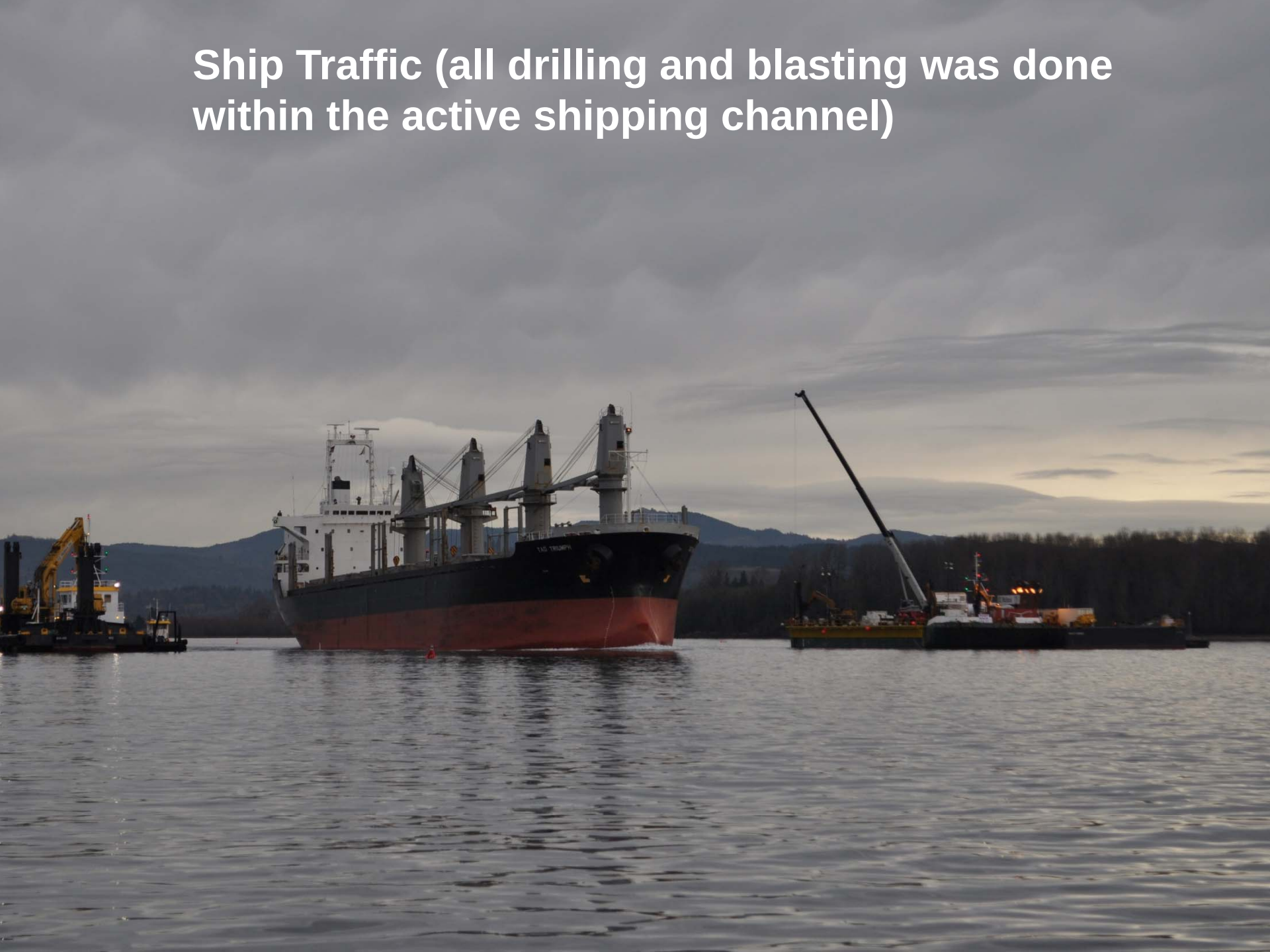
# Blasted Rock

# Challenges????

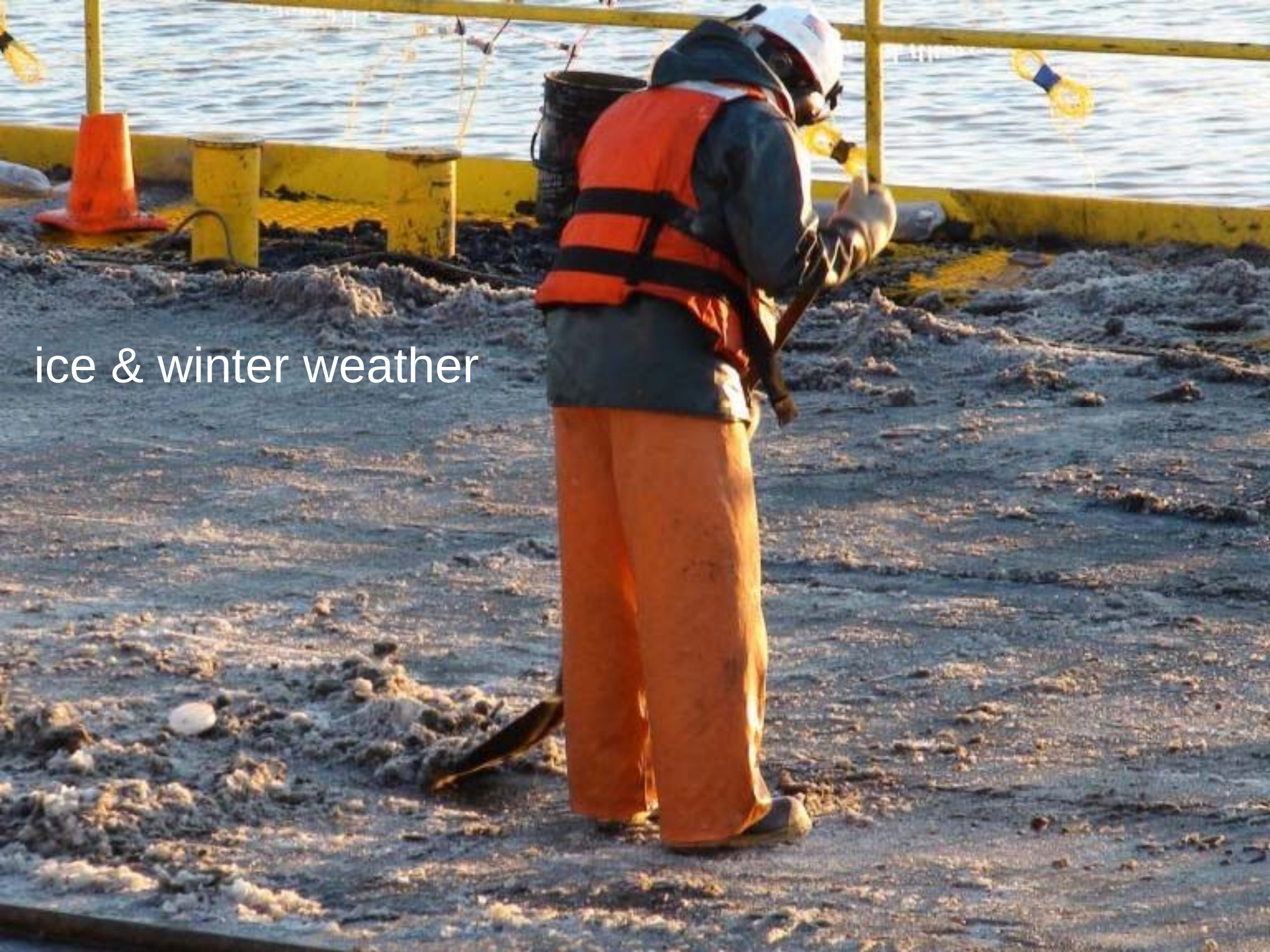

YES!!

# Small Boat Traffic operating within the Blast Zone


**Traffic Control**

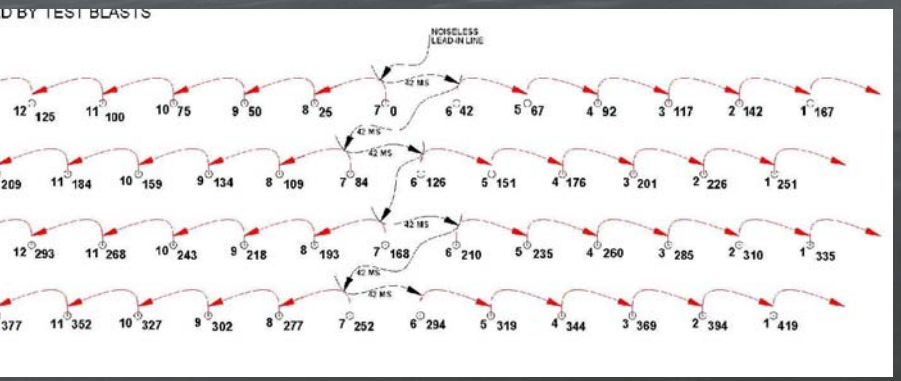

Ship Traffic (all drilling and blasting was done within the active shipping channel)


Night Operations
•24/6  drill/blast schedule
•24/7 dredging schedule
CAT


ice & winter weather

# Explosives Transfers

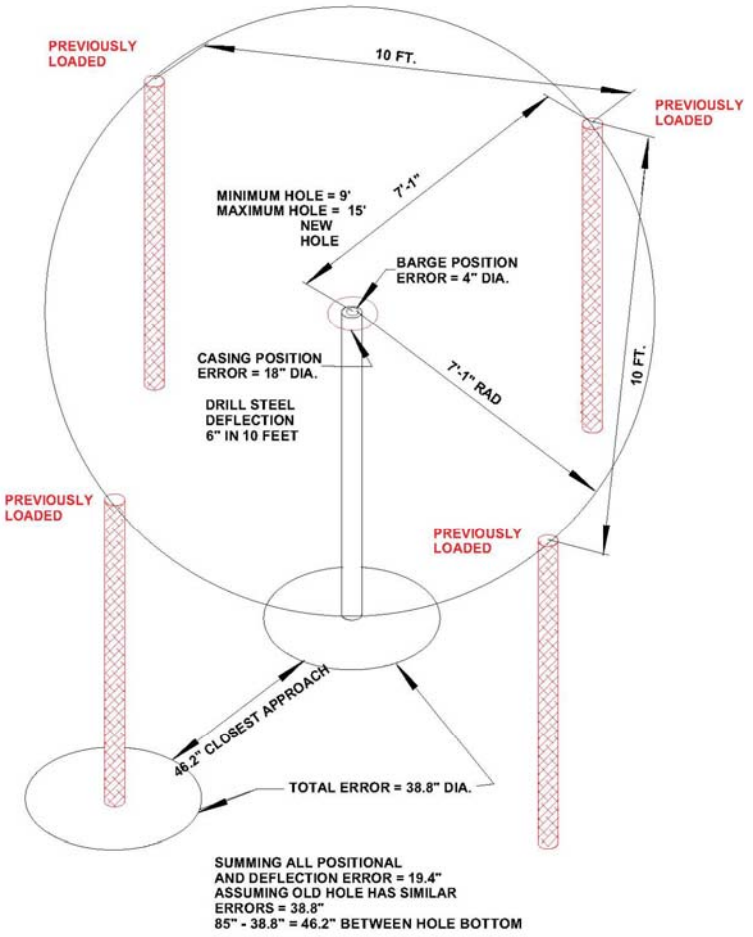
# 36 Holes failed to detonate on Dec 1st





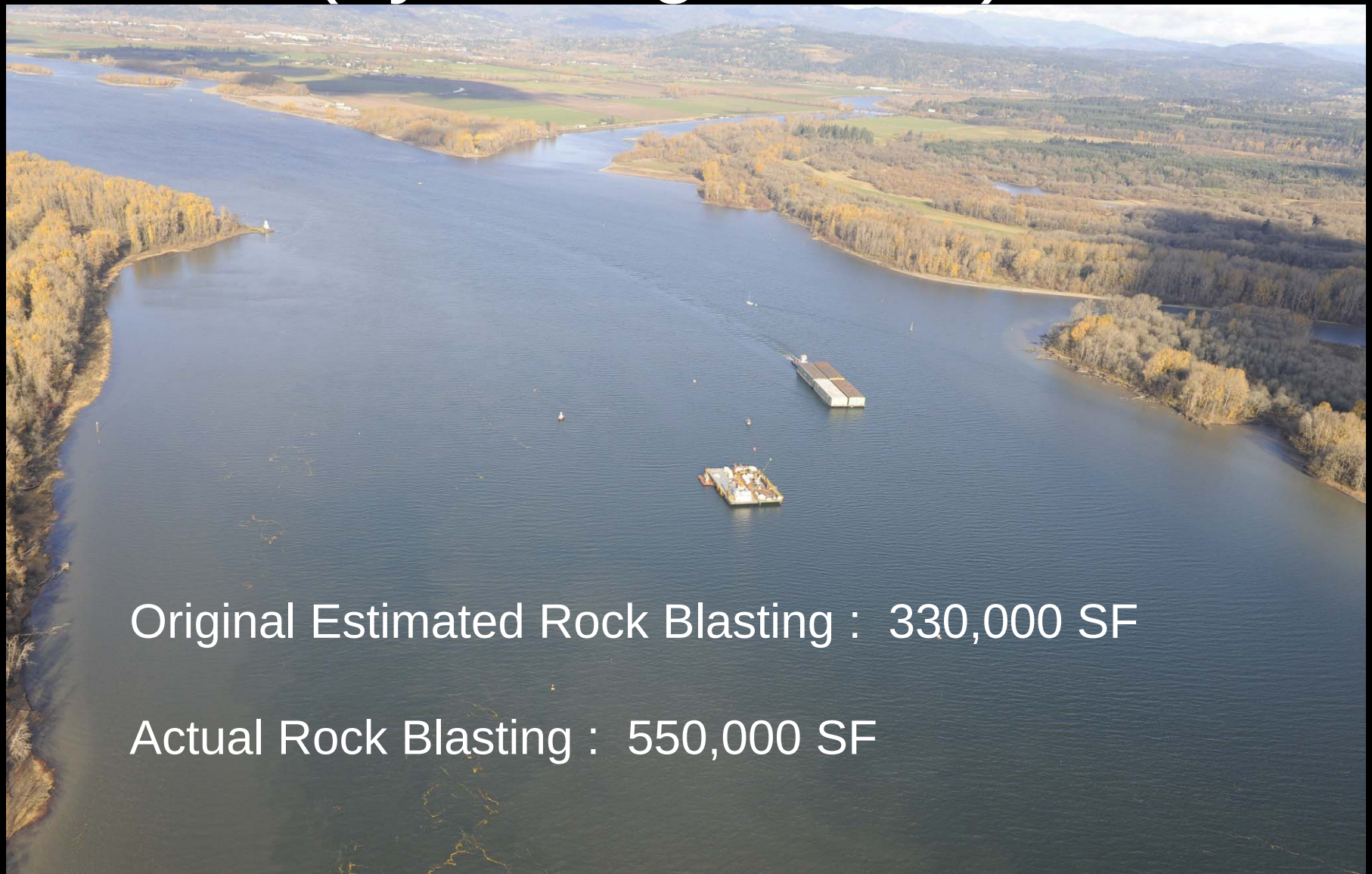
EM 385-1-1 -29.J.07(a): "…a minimum of 8 feet between the one being drilled and the loaded hole."

Unexploded booster
in dredged material




# Safety Manual Variance
# (drilling offset between loaded holes)

# Additional Rock Blasting (by change order)



Original Estimated Rock Blasting :  330,000 SF

Actual Rock Blasting :  550,000 SF

# Blasting Trivia

- 90 blasts were set off during a 90 day period
- 4,000 holes were drilled
- 250,000 pounds of explosives were used
- 51 contractor employees were on site daily
- 1,000,000 LF of shock tube was used (roughly two miles per shot)
- 4,000 research fish were used in caged fish experiments

# Questions?


Karen L. Garmire, P.E.
Resident Engineer

## Blasting Video

BUILDING STRONG®