

Obstacles to Implementing Working with Nature Concepts

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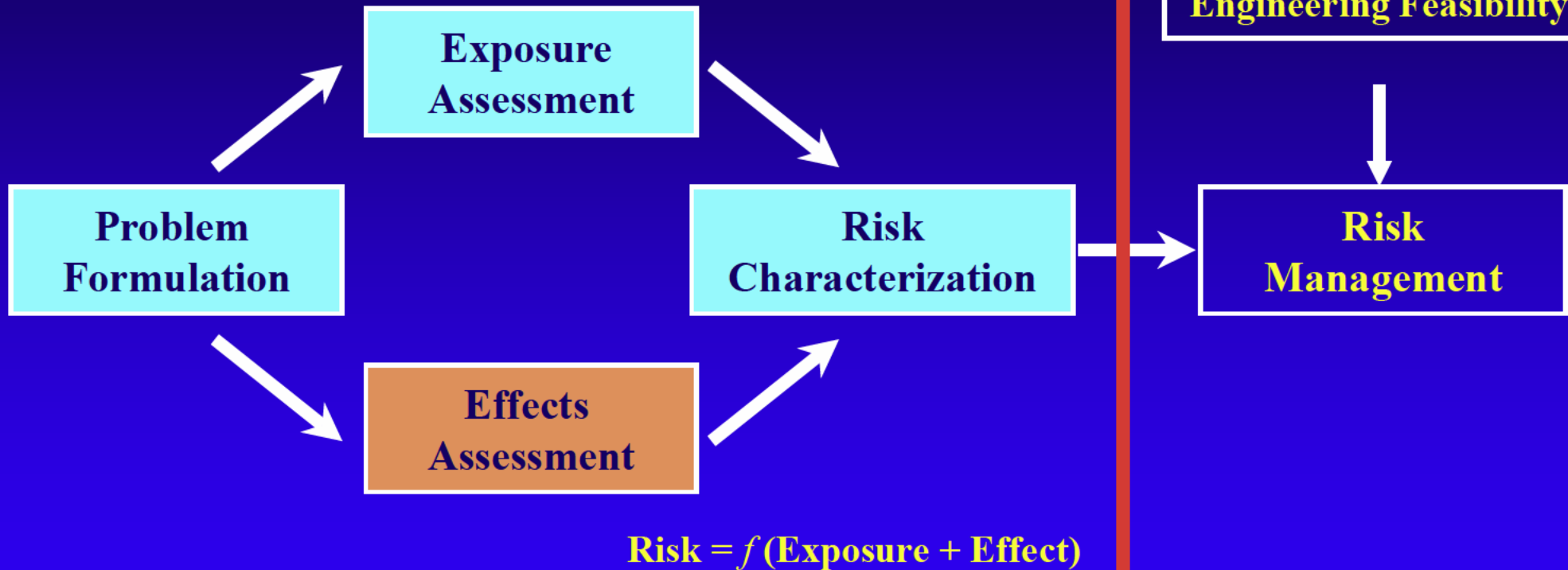
Obstacles

- **Institutional constraints**
 - Sponsorship, cost sharing, stakeholder “buy in”
 - Regulatory authorities
- **Perceptions and concerns of resource agencies**
 - Water quality issues (e.g., DO, nutrients, ammonia, sulfides, etc.)
 - Turbidity and suspended sediment
 - Underwater noise associated with the dredging process



RISK FRAMEWORK

RISK ASSESSMENT PARADIGM



Concerns Related to Resuspension

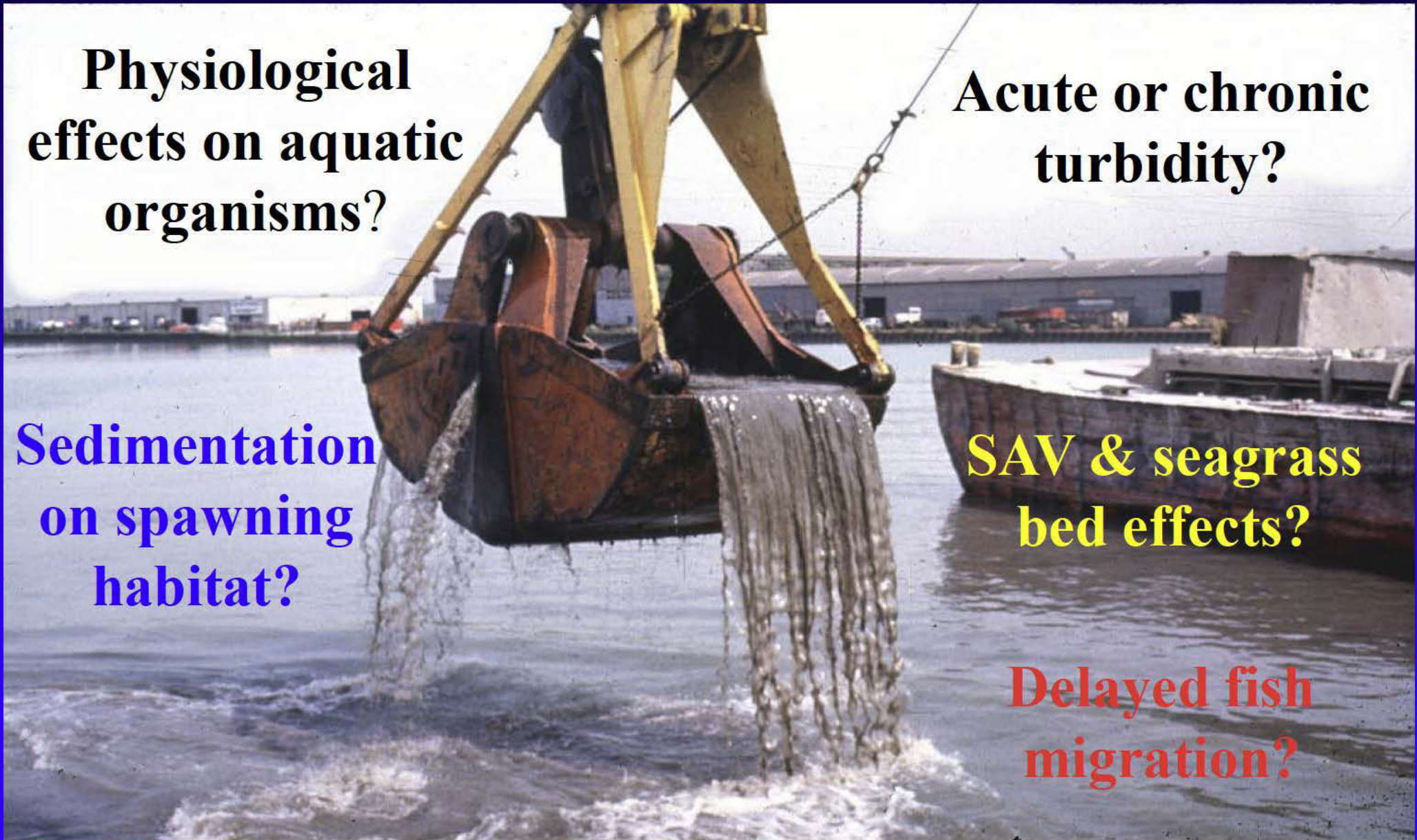
Physiological effects on aquatic organisms?

Acute or chronic turbidity?

Sedimentation on spawning habitat?

SAV & seagrass bed effects?

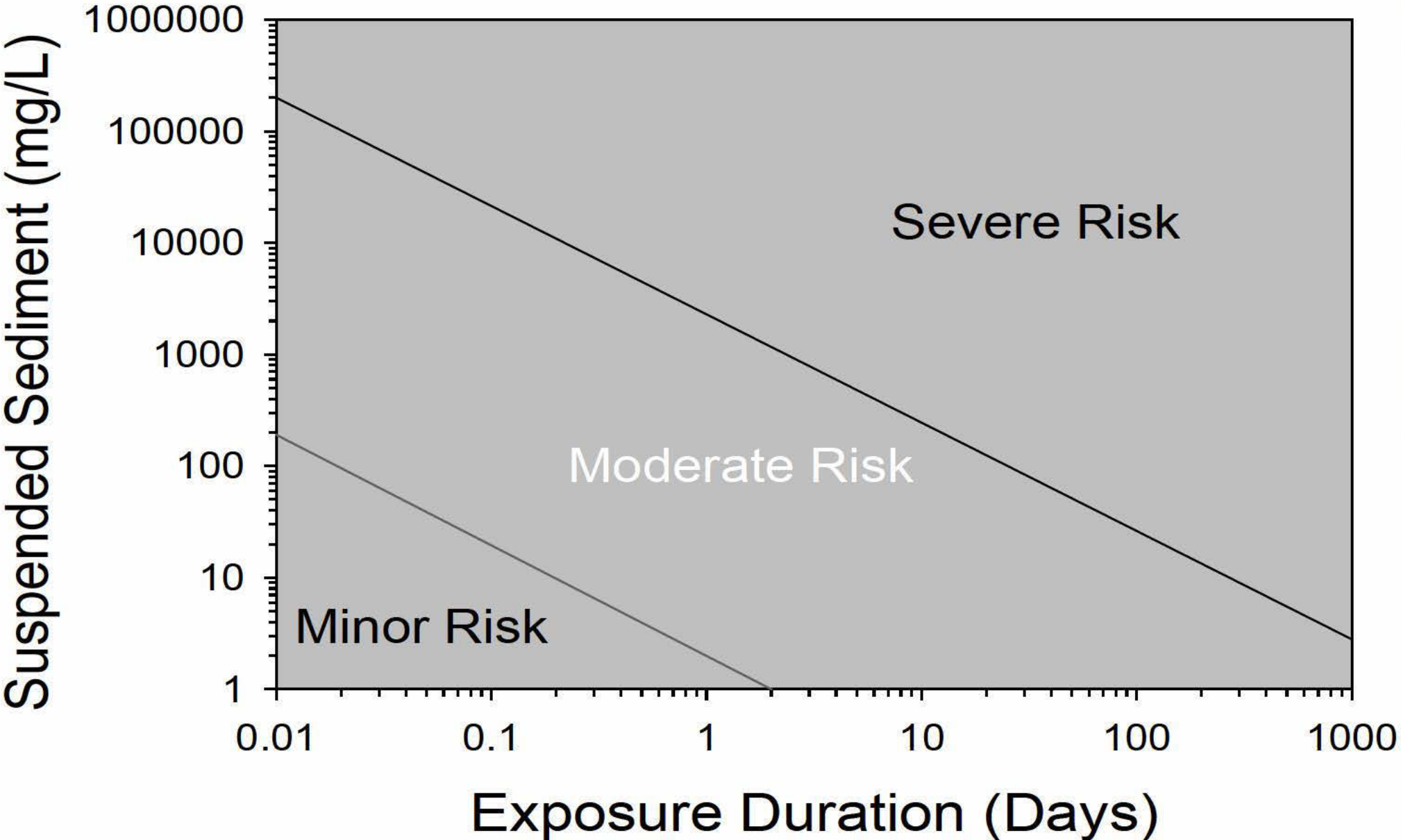
Delayed fish migration?



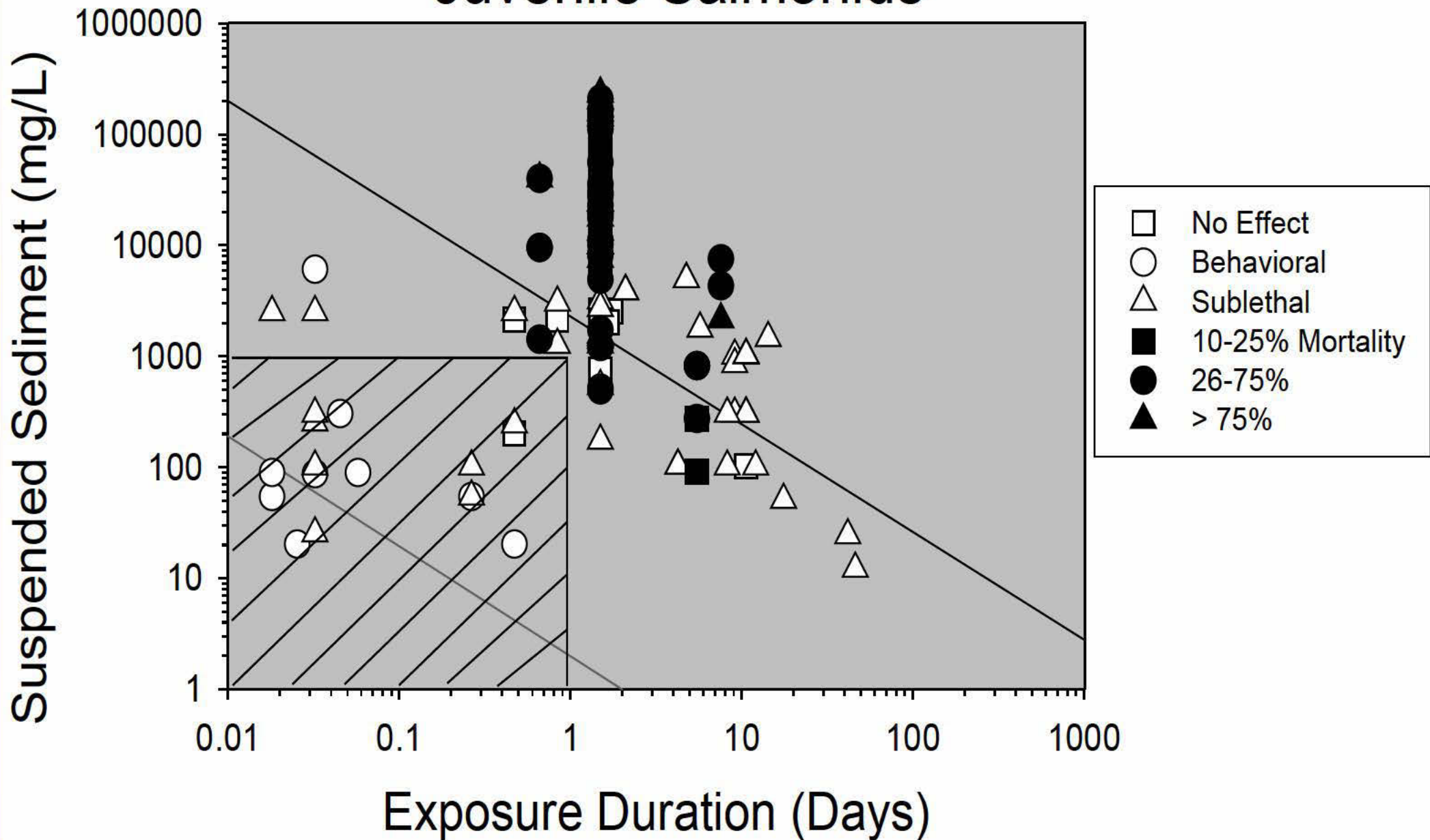
SEVERITY	EFFECT
0	No effects
1	Alarm reaction
2	Abandonment of cover
3	Avoidance response
4	Short-term reduction of feeding rate or success
5	Minor physiological stress; coughing or increased respiration rate
6	Moderate physiological stress
7	Moderate habitat degradation or impaired homing
8	Major physiological stress; long-term reduction in feeding rate or success
9	Reduced growth rate; delayed hatching; reduced fish density
10	0-20% mortality; increased predation; severe habitat degradation
11	>20-40% mortality
12	>40-60% mortality
13	>60-80% mortality
14	>80-100% mortality

(based on Newcombe and Jensen 1996)

Juvenile Salmonids



Juvenile Salmonids



Dredge Sounds Characterization

- **An opportunity to take a proactive approach before the issue is prematurely entrenched in the regulatory arena**
- **Environmental concerns related to underwater noise are emerging**
- **Few data on dredging-induced sounds exist**
- **Characterizations required to assess risk to specific biological resources**



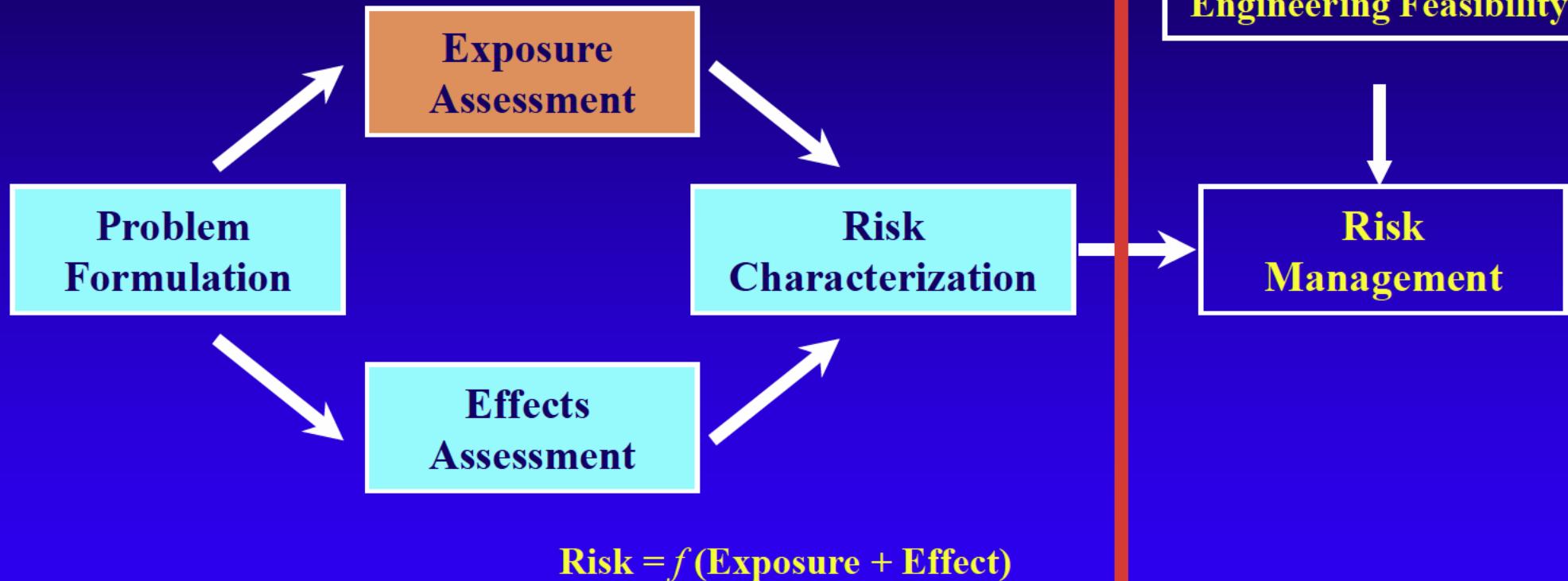
R&D Thrust

- **Add to library of dredging process sound characterizations**
 - **Different dredge types**
 - ◇ Dominant sound sources
 - ◇ Sound attenuation rates
 - **Different dredge sizes**
 - **Dredging in different substrates**
- **Place dredging sounds into perspective with ambient sound fields and other natural and anthropogenic sources**
- **Provide theoretical groundwork for assessments of dredging sound impacts on key species**

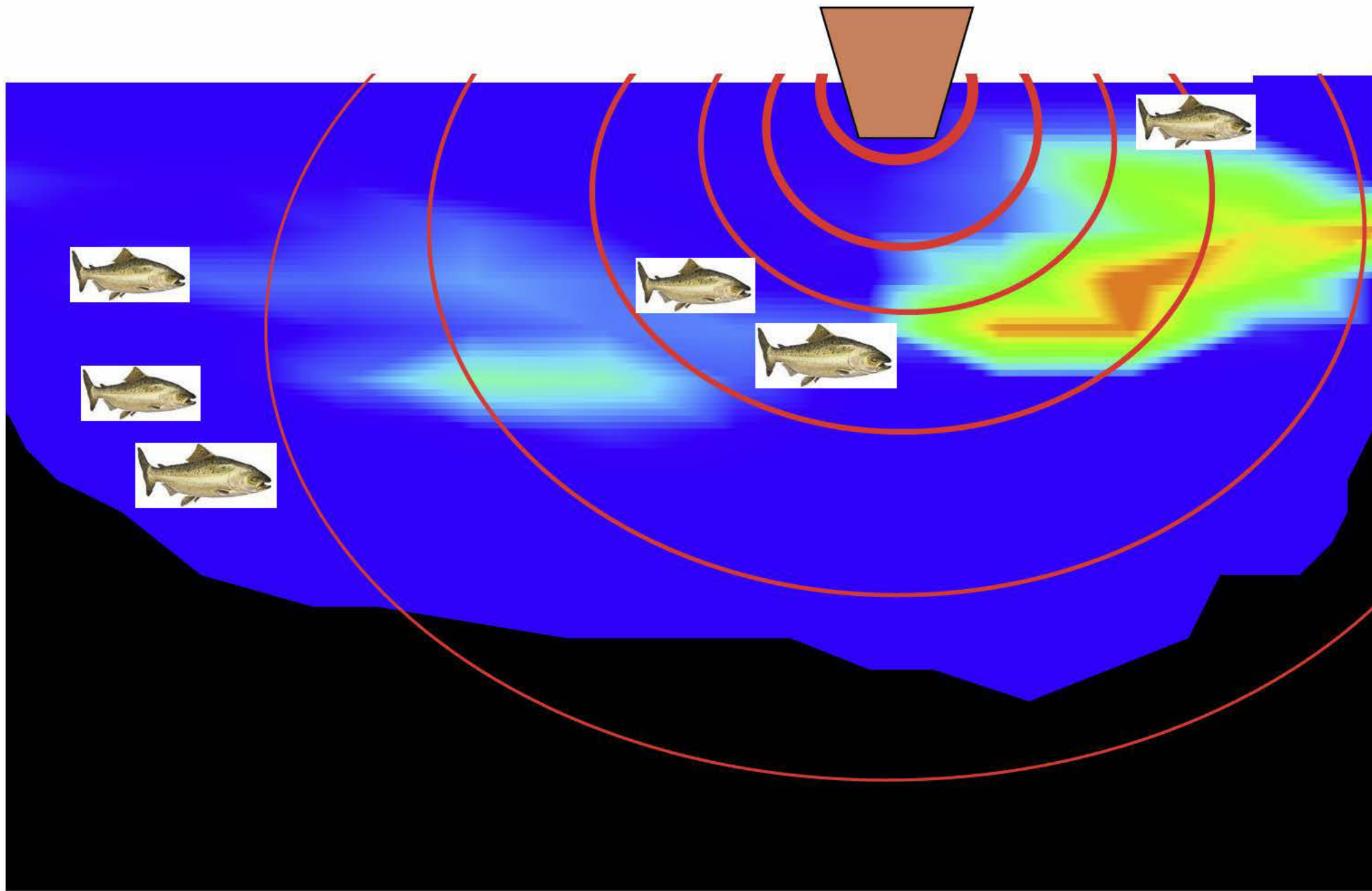


RISK FRAMEWORK

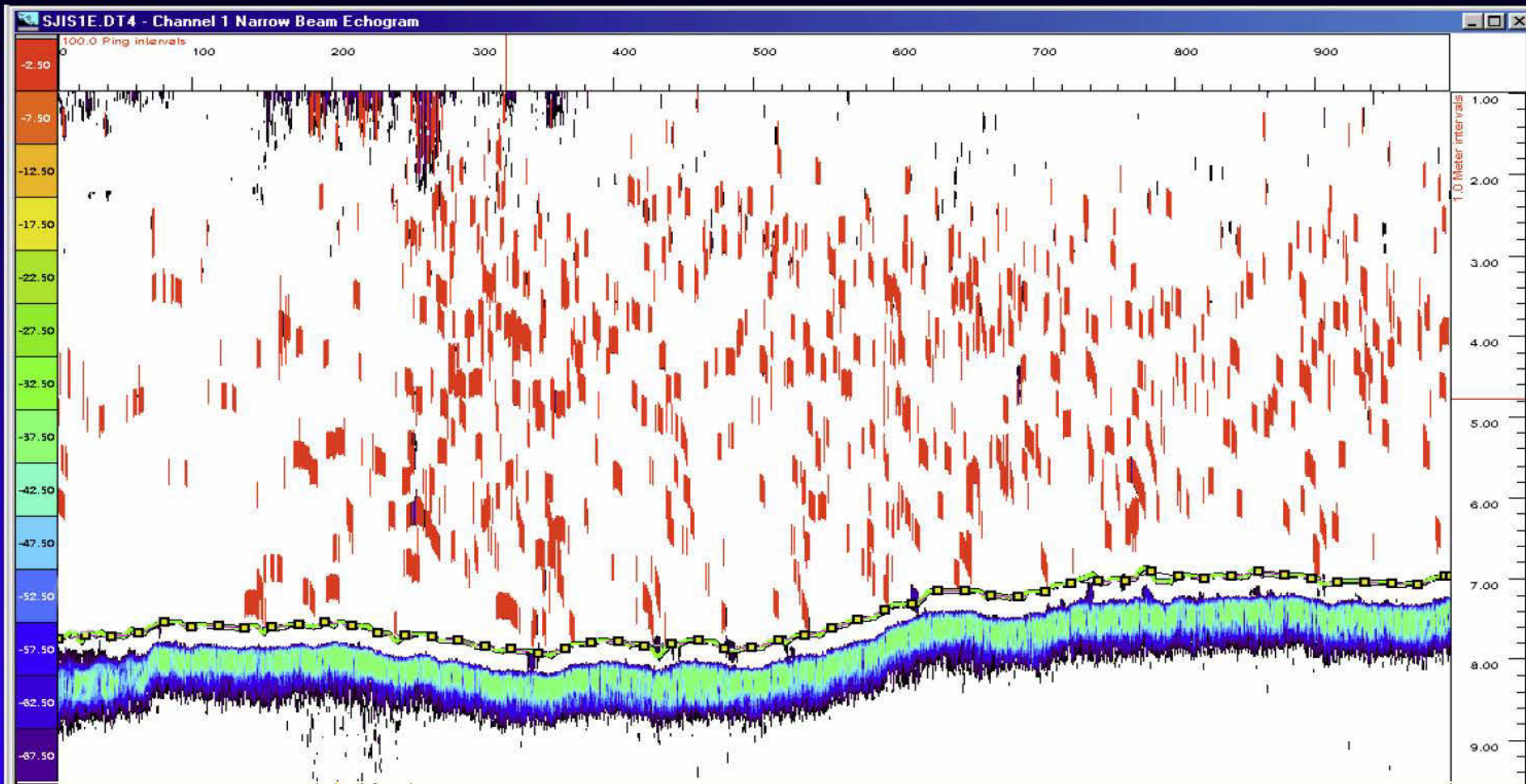
RISK ASSESSMENT PARADIGM



Depth (m)



Cross-section Distance (m)



30 m



Increasing Distance from Dredge

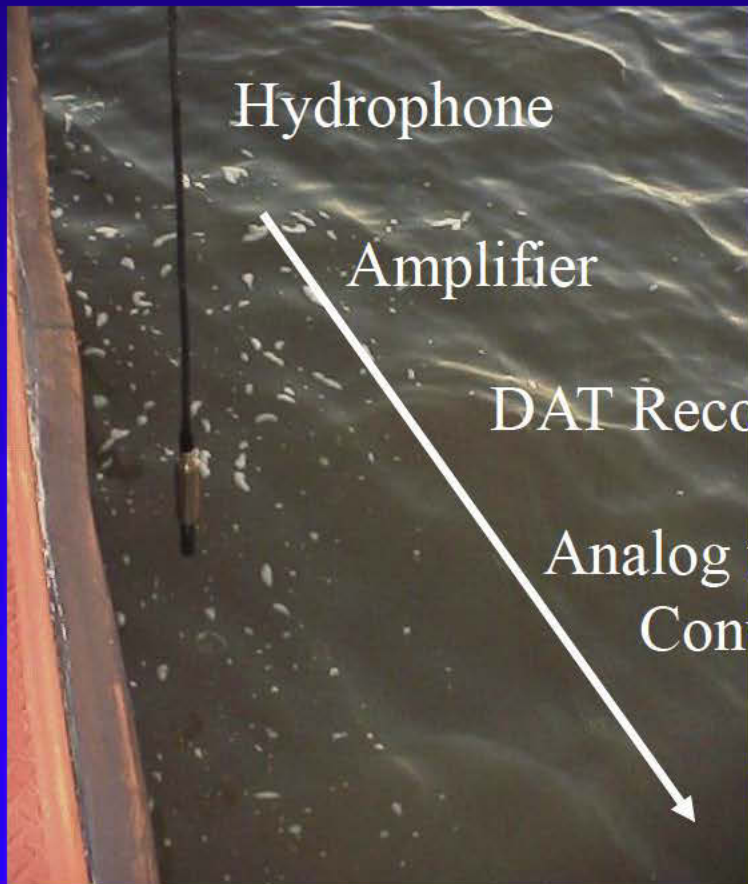


**DREDGE
LOCATION**

RECORDING UNDERWATER SOUNDS



Hydrophone



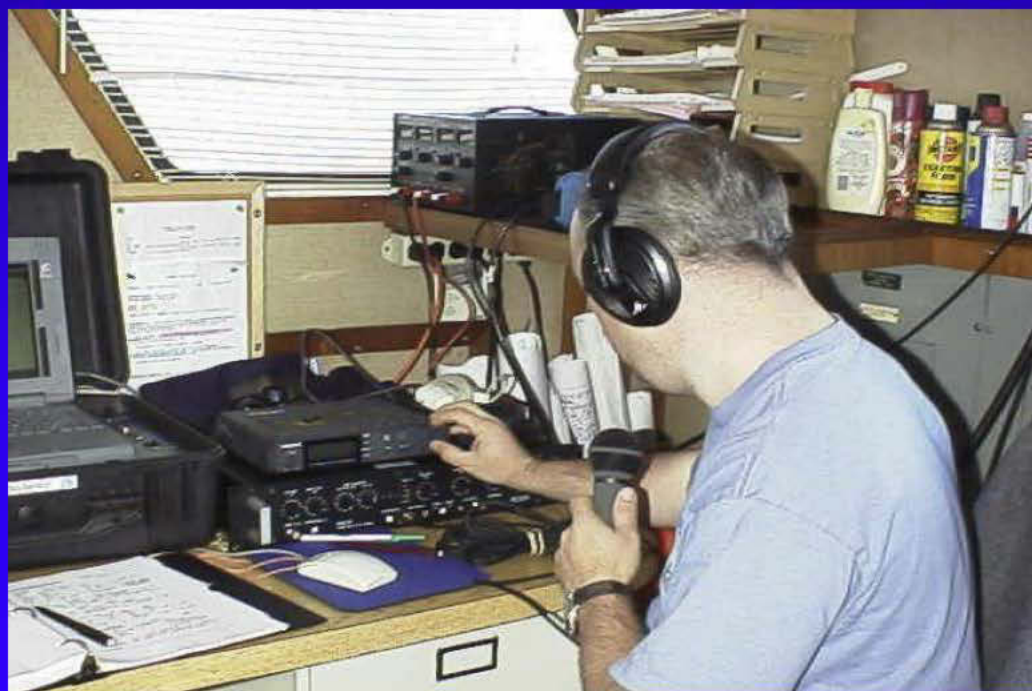
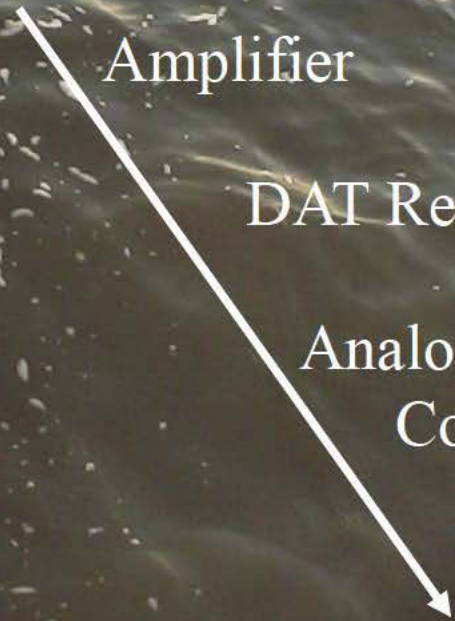
Hydrophone

Amplifier

DAT Recorder

Analog to Digital Converter

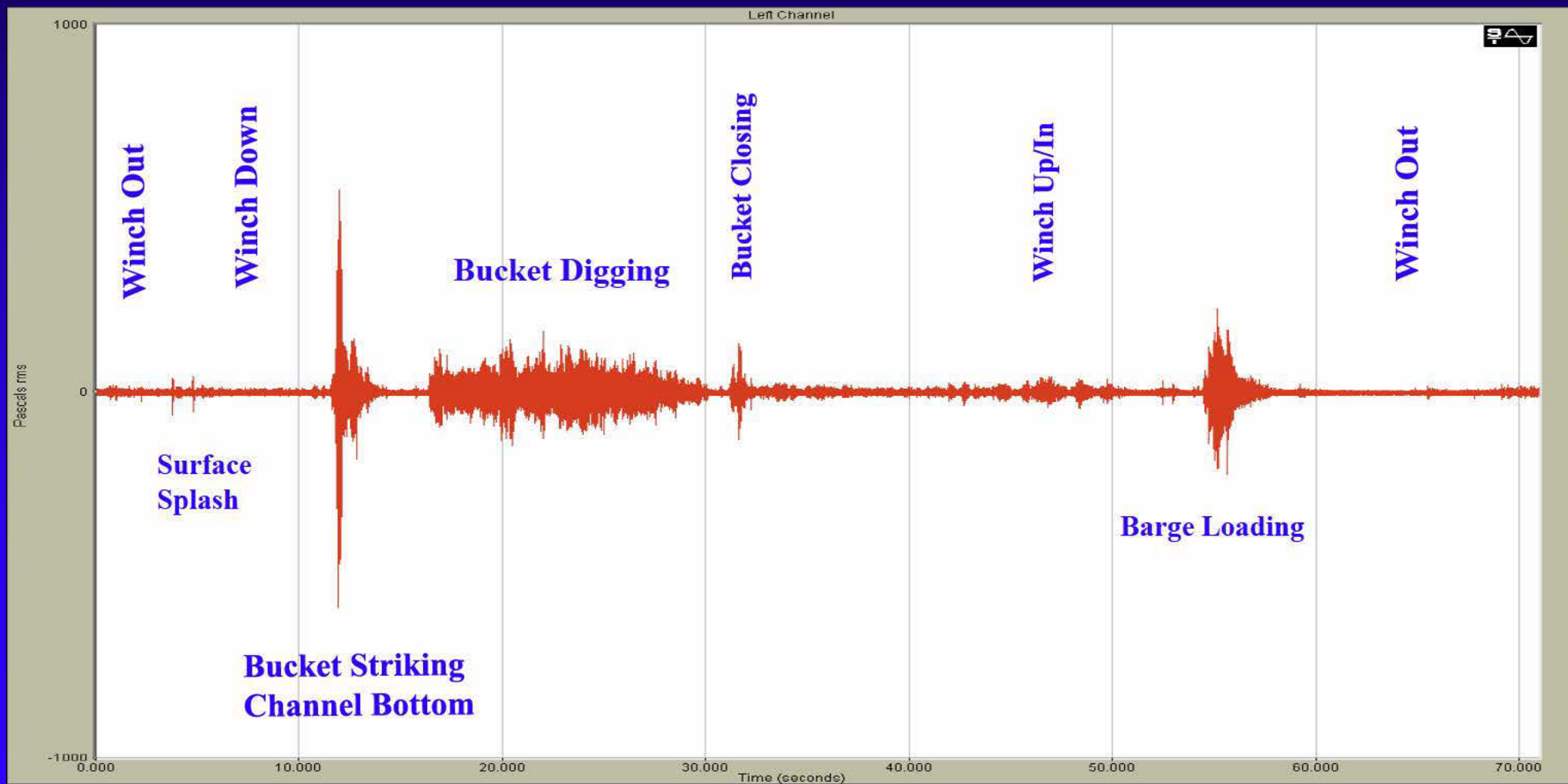
Spectralab Analysis



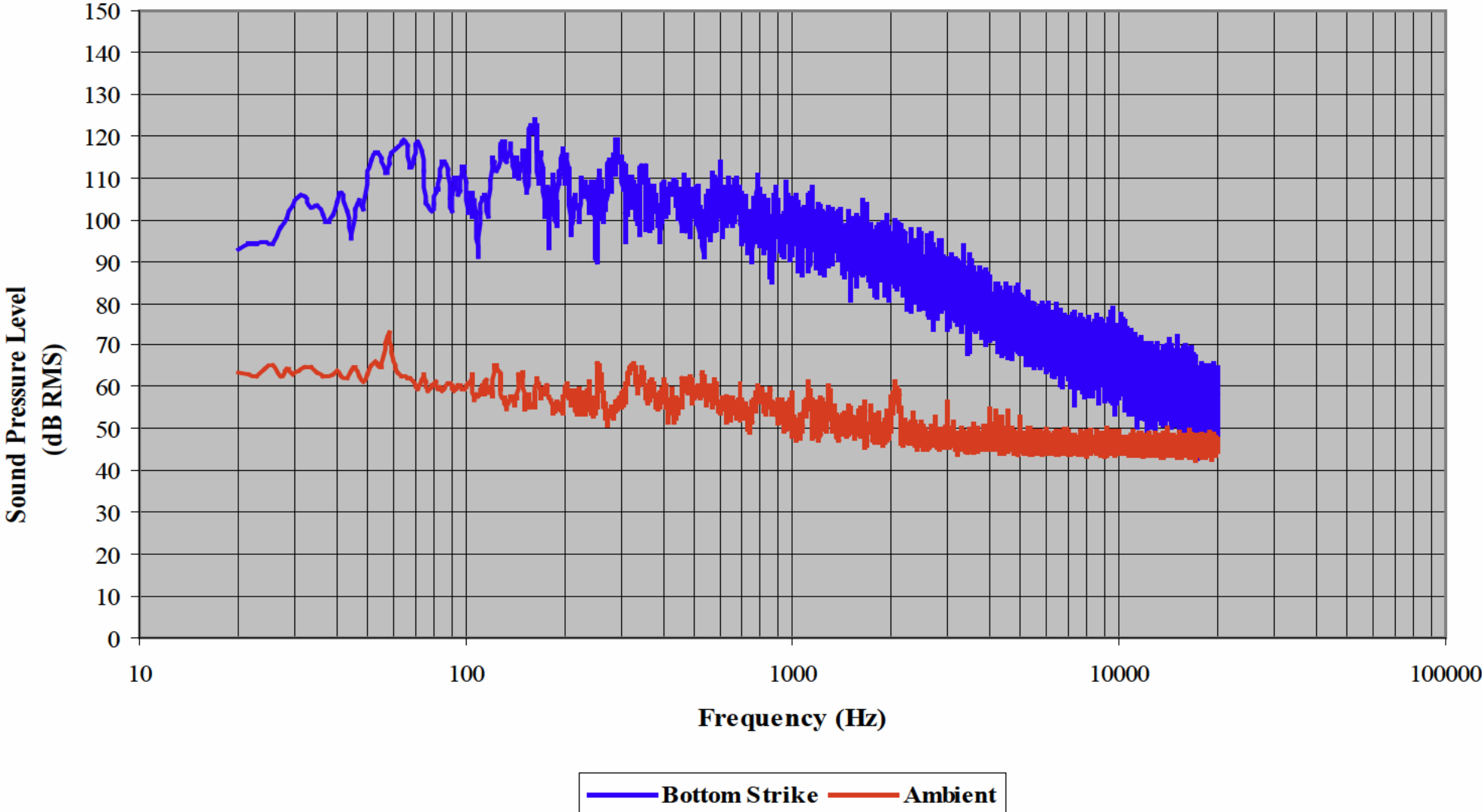


Manson Bucket Dredge *Viking* (1,500hp, 10cyd) Operating in Cook Inlet, Alaska

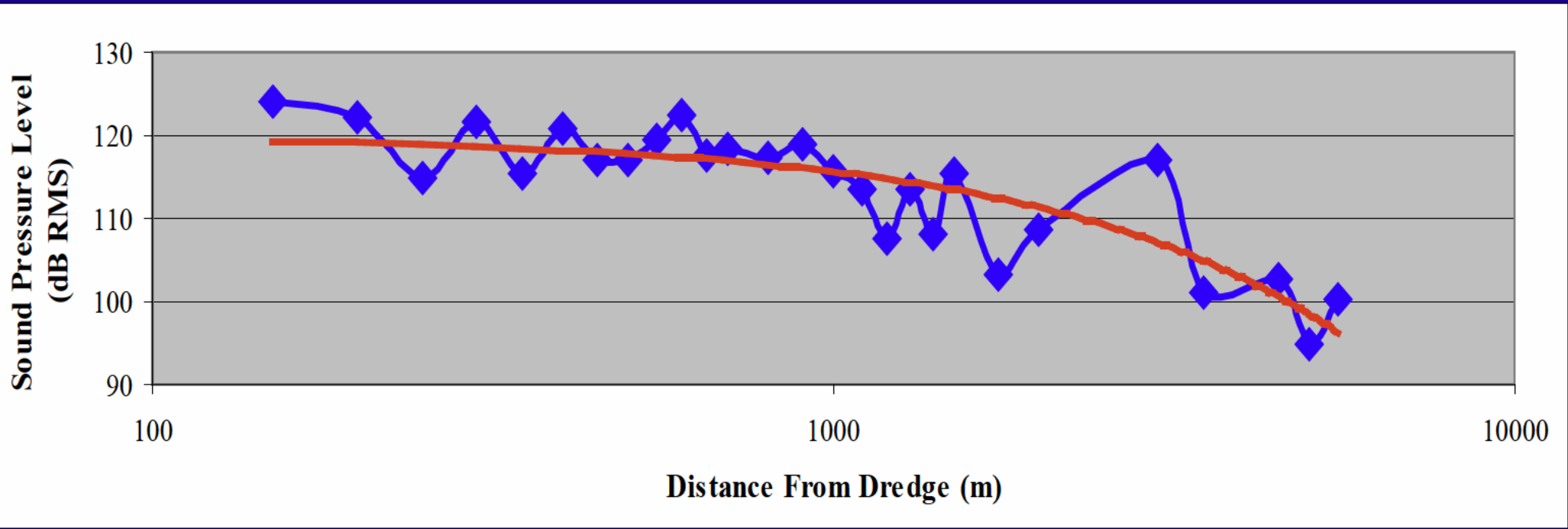
Pressure Waveform for a Typical Bucket Deployment & Retrieval Cycle



Sound Pressure Levels for Bucket Striking Bottom



Sound Pressure Attenuation with Distance from Bucket Dredge – Sound of Bucket Striking Channel Bottom



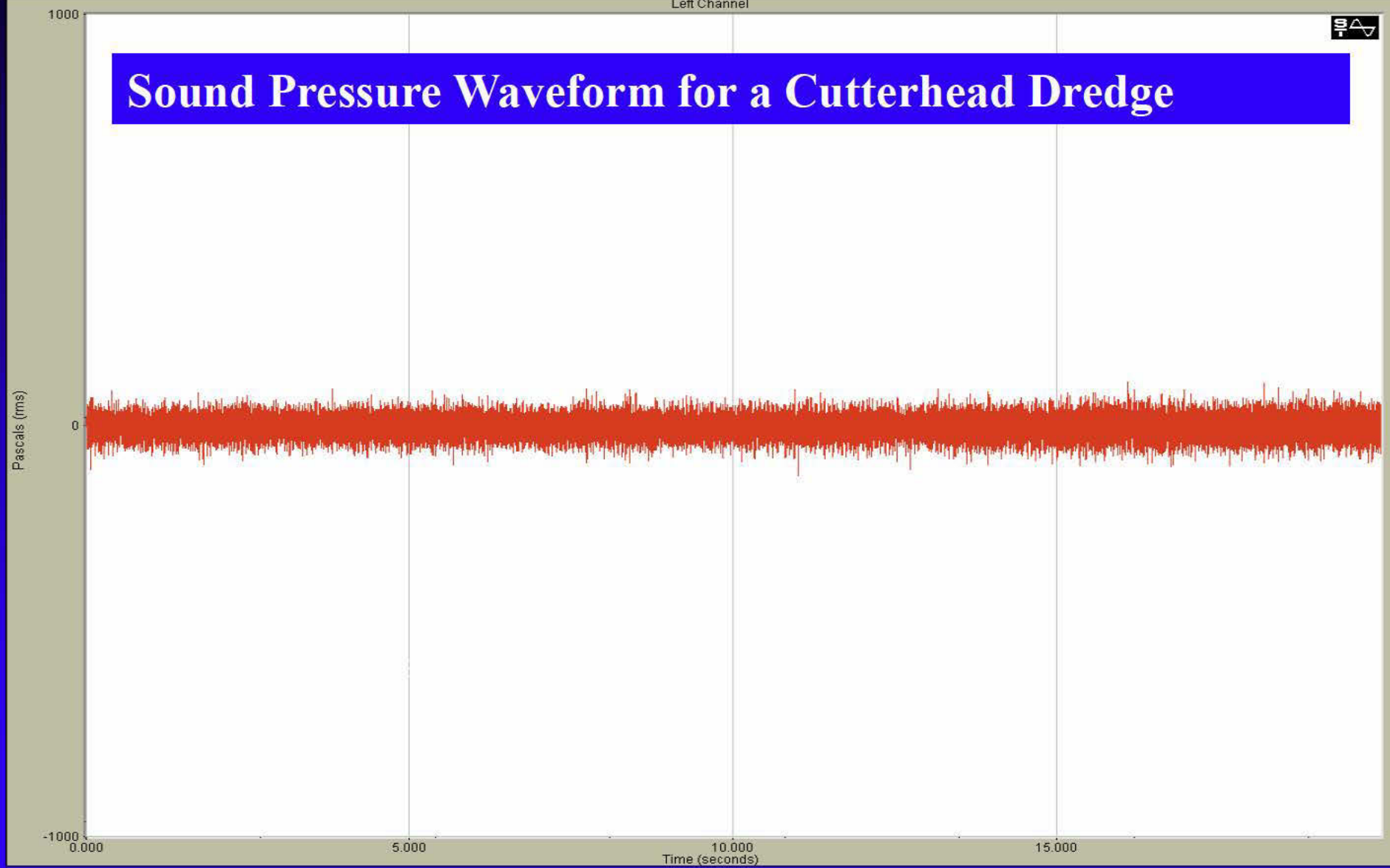


**LMC Hydraulic Cutterhead Dredge *James B* (24",
10,000hp) Operating in Mississippi Sound off Gulfport, MS**

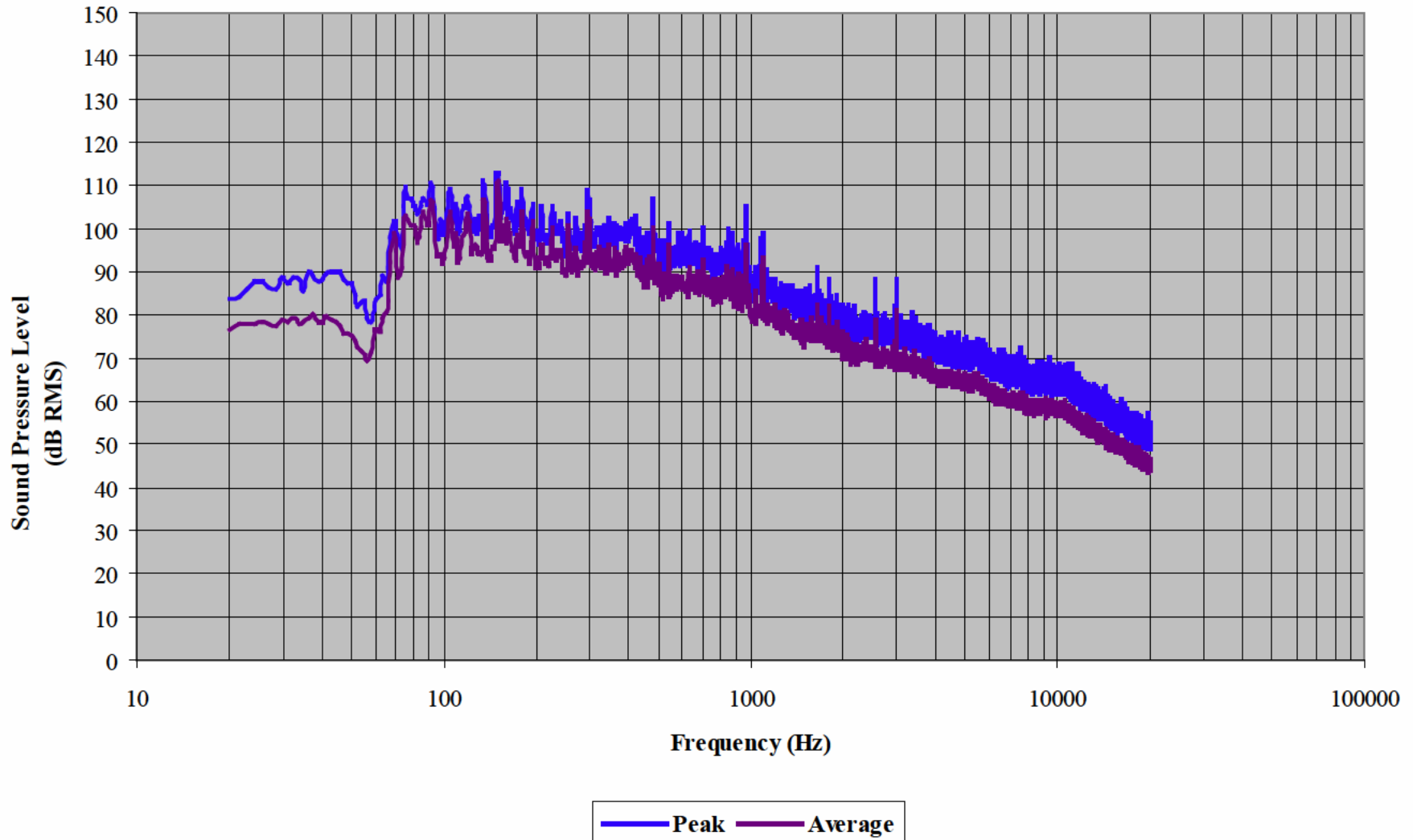
Left Channel



Sound Pressure Waveform for a Cutterhead Dredge



Cutterhead Sound Pressure Levels



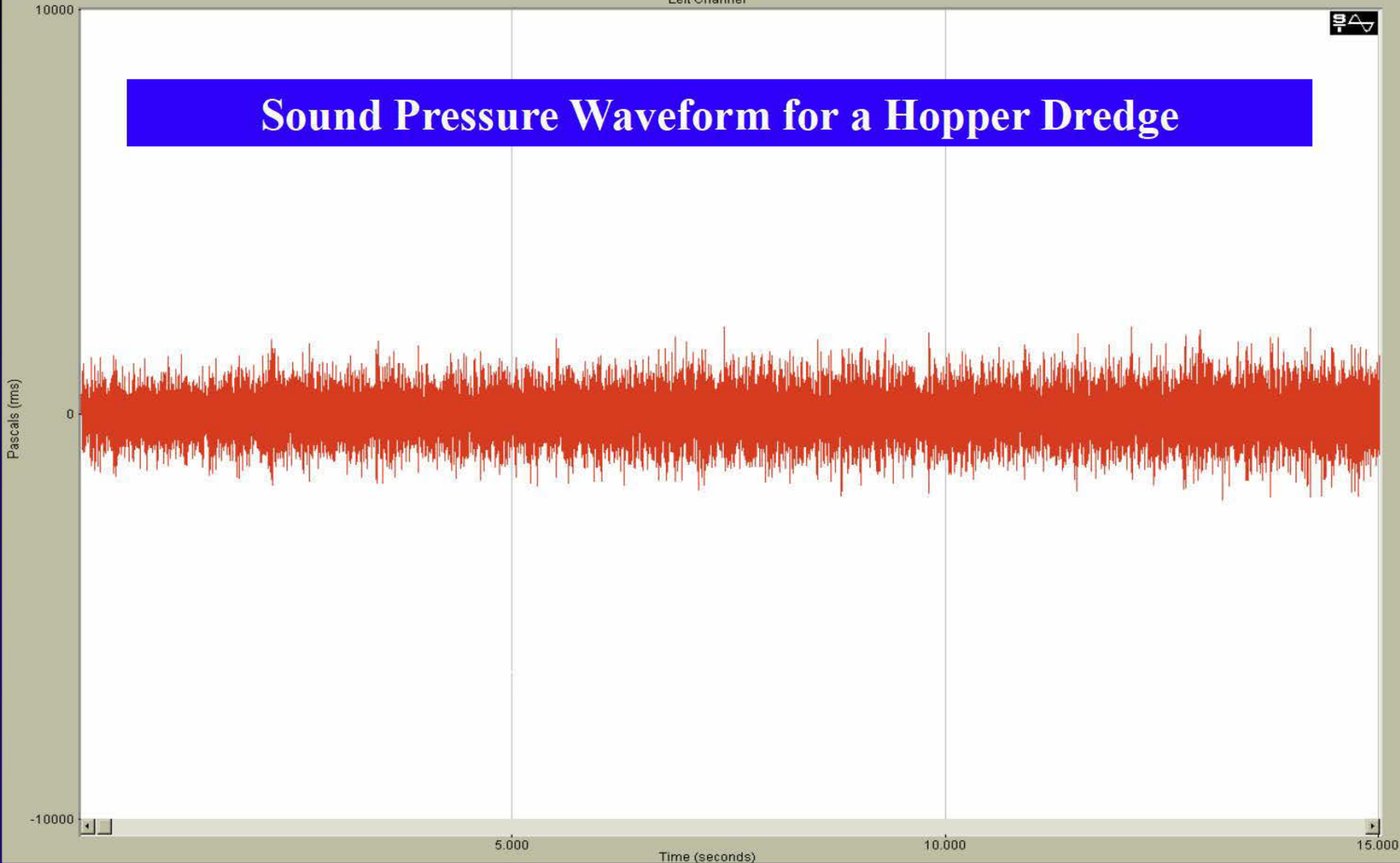


Bean Stuyvesant Hopper Dredge *Stuyvesant* (15,000hp, 11,140 cyd)
Operating in Mobile Bay, Alabama

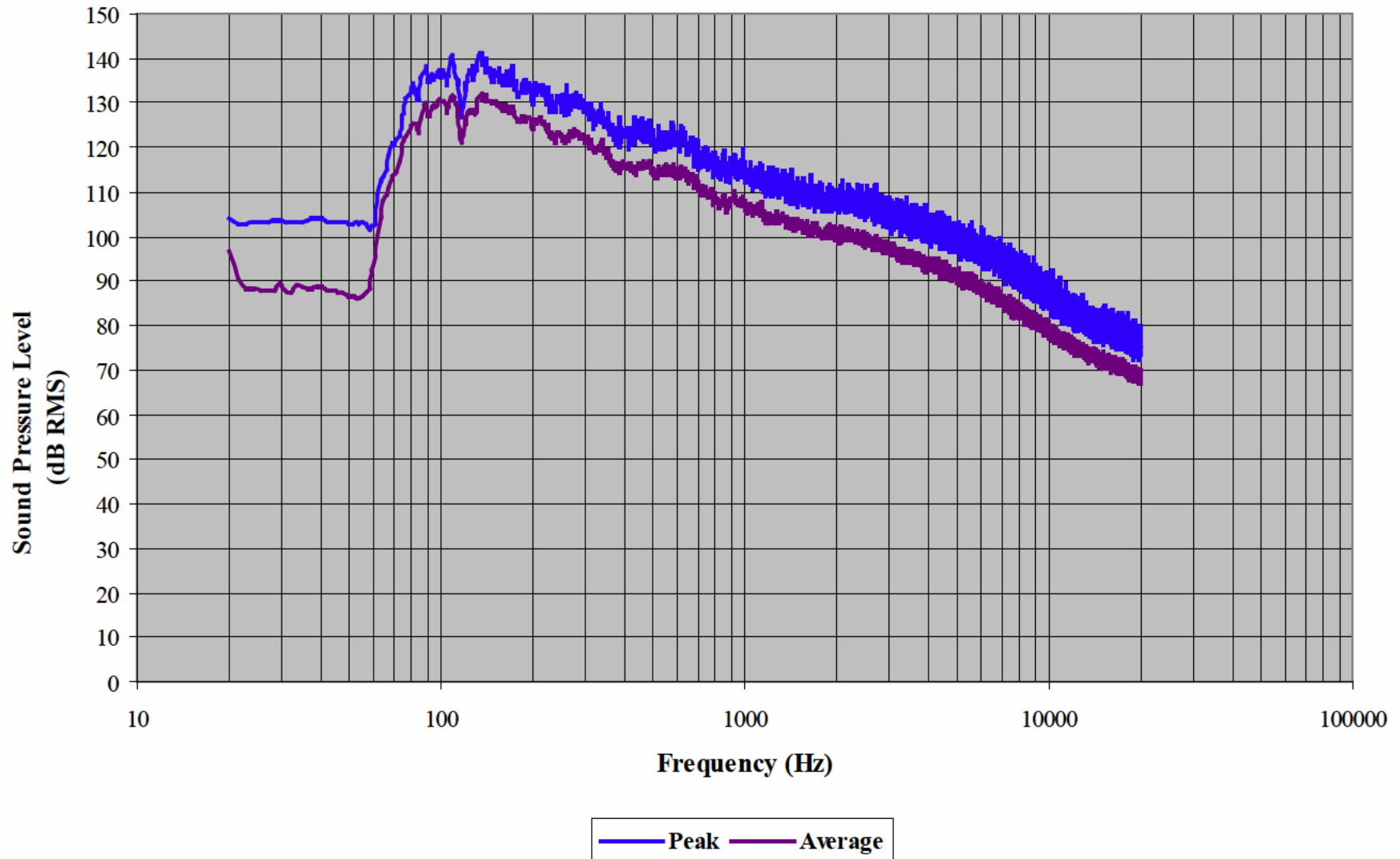
Left Channel



Sound Pressure Waveform for a Hopper Dredge



Hopper Dredge Sound Pressure Levels



Cutterhead vs. Hopper Dredge

- **24" Cutterhead at 68m**
 - Peak frequency ~ 150 Hz
 - Peak amplitude ~ 110 to 115 dB rms
 - Total power ~ 120 to 125 dB rms
- **15,000hp Hopper at 50m**
 - Peak frequency ~ 136 Hz
 - Peak amplitude ~ 132 to 145 dB rms
 - Total power ~ 148 to 155 dB rms



Preliminary Conclusions

- **Bucket dredge**

- **Sounds cyclic**
- **Pressure levels largely dependent on substrate type, site conditions, and dredge operator**



- **Hopper Dredge**

- **Sounds continuous**
 - **Draghead and propulsion components**
- **Comparatively intense, low frequency sounds**

- **Hydraulic cutterhead dredge**

- **Sounds continuous**
- **Generally low intensity, low frequency**

EXCAVATOR DREDGE *NEW YORK*

WORST CASE SCENARIO?



Recommendations

- **Build library of dredge process sounds representative of common dredging processes and scenarios**
- **Communicate findings with agencies and stakeholders before criteria are prematurely set**
- **With respect to turbidity/suspended sediment, shift emphasis from exposure assessment to effects assessment**

