Risk Management Thru Engineering and Operational Controls

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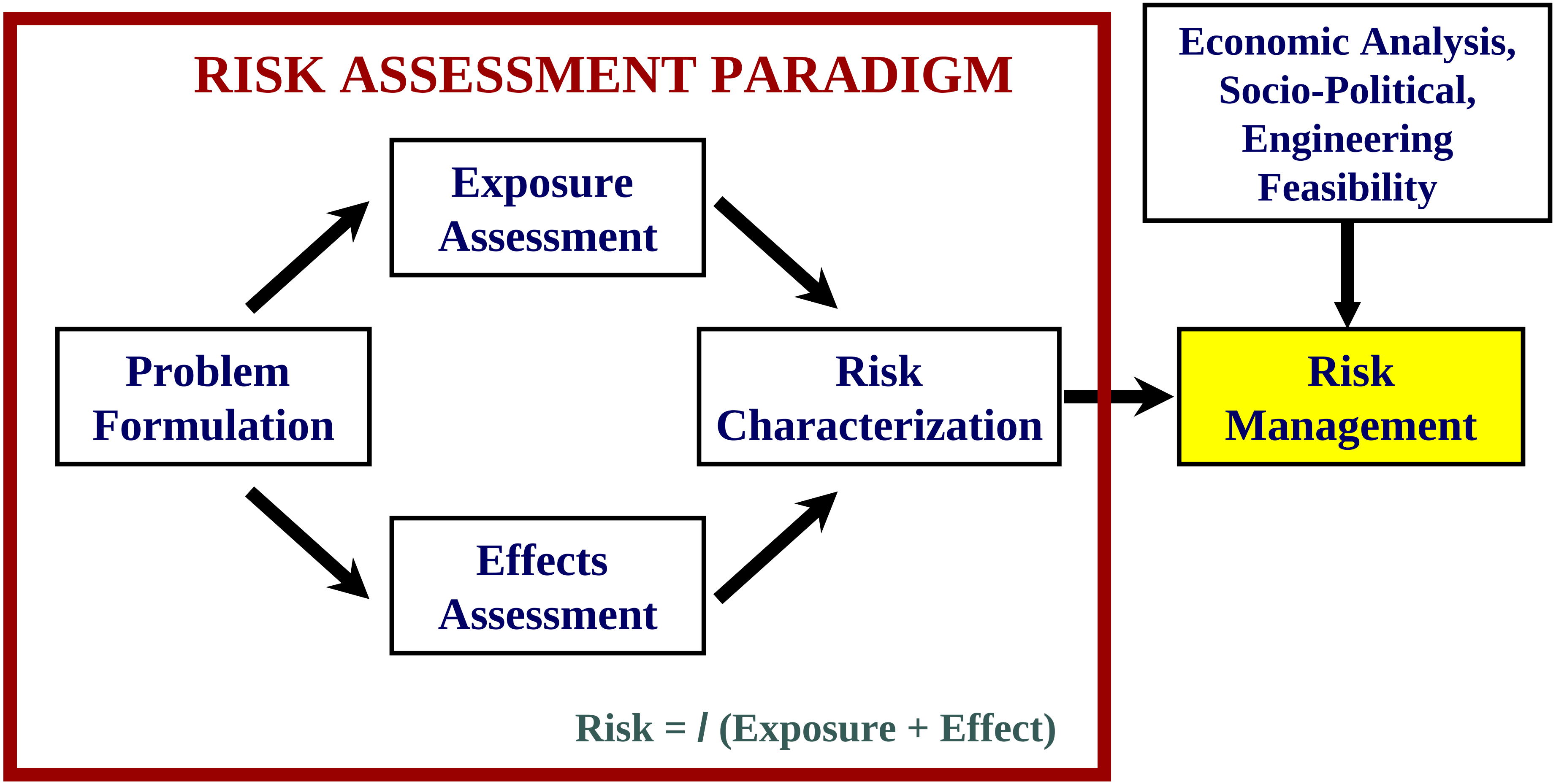
RISK FRAMEWORK



Presentation Objective

Risk Management –

Reduce sediment resuspension risks (where unacceptable) to acceptable levels by use of engineering controls, and/or use of operational controls.

Concept

- **Risk is managed by managing the exposure.**
- **Exposure can be managed by controls that:**

  - reduce the source concentration,

  - alter the source location,

  - reduce total mass of sediment resuspended in the water column,

  - alter transport of resuspended sediment,

  - increase settling.

Engineering Control

Definition: Requires a physical construction technology or modification of the physical dredge plant to cause the desired change in conditions.

Source: Geotechnical Supply Inc

Operational Control

Definition: Action that can be undertaken by dredge operator to reduce unacceptable risks of the dredging operations.

If it is determined that unacceptable risk(s) exist

Engineering and/or operational controls must be evaluated for effectiveness for the site and sediment conditions.

Control Applications

Changes in dredging equipment and/or operations can modify:

- the resuspended sediment concentration at source,
- total mass of sediment resuspended in the water column,
- the release points,
- transport of resuspended material.

Control Applications

But changes in dredging equipment and/or operations involves tradeoffs:

- dredge production rates,

- project duration,

- costs,

- etc.

Tradeoffs

- Are involved with the use of engineering and operational controls as risk reduction solutions.
  - Big hopper dredges can cost approximately $85K/day.
  - Big Cutterheads approximately $45K-$55K/day.

Selection of Dredging Equipment

- Physical characteristics of material to be dredged
- Quantities of material to be dredged,
- Dredging depth,
- Distance to disposal area,
- Physical environment of the dredging and disposal areas,
- Contamination level of sediments,
- Method of disposal,
- Production required,
- Type of dredges available
- Cost.

Factors Influencing Sediment Resuspension

Mechanical versus hydraulic issues.

- **Magnitude of resuspension,**
- **Location of resuspension in water column,**
- **Strength of resuspension,**
- **Continuous or intermittent.**

Relative performance is a function of site specific conditions.

Engineering Controls
Type of Dredge

- **Empirical Solids Releases**

Resuspension of fine-grained mass of dredged sediment to water column

- ➢ Mechanical dredges
  - – Open or watertight ➔ 0.2 to 9%, typically 0.5 to 2%
  - – Environmental ➔ 0.1 to 5%, typically 0.3 to 1%
- ➢ Hydraulic dredges ➔ 0.01 to 4%, typically 0.2 to 0.8%

Engineering Controls
Size Matters

- **As size increases:**

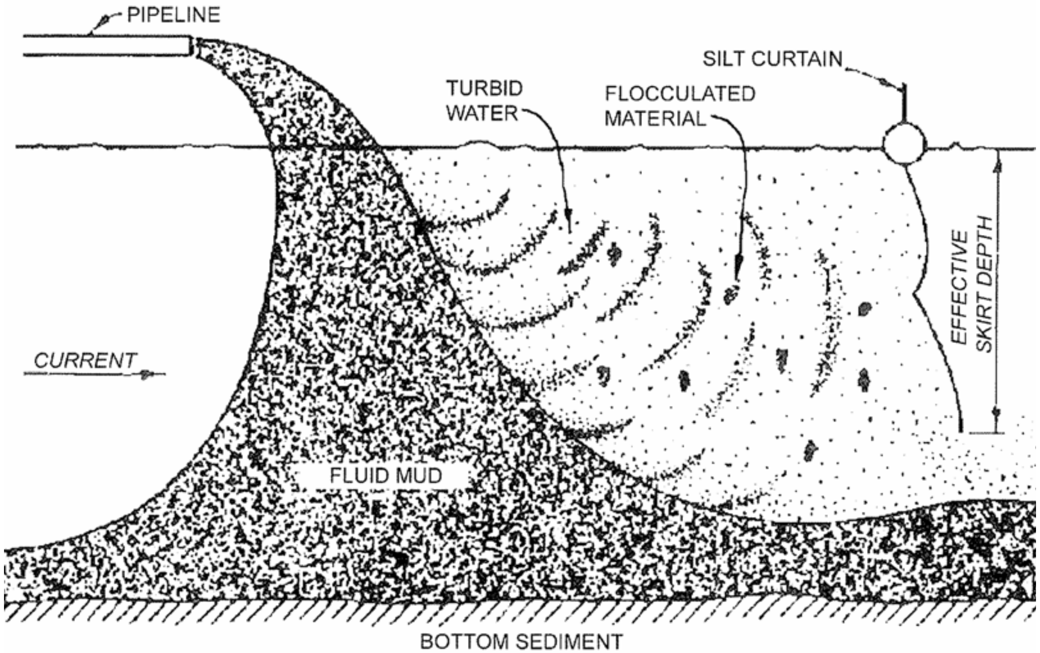
  - Production rate increases,

  - Resuspension rate and therefore strength (concentration) of resuspended sediment increases,

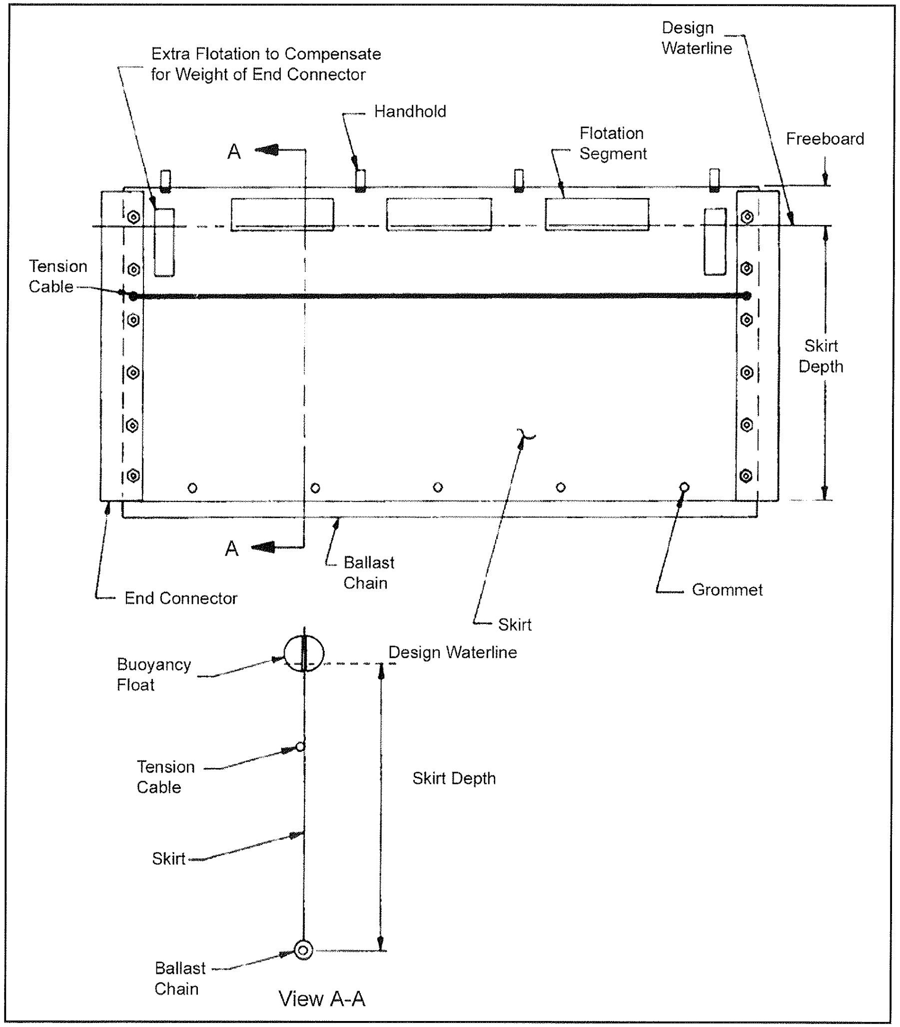
  But, exposure time is decreased because the dredge is operated for a shorter amount of time and total mass of sediment resuspended is decreased.

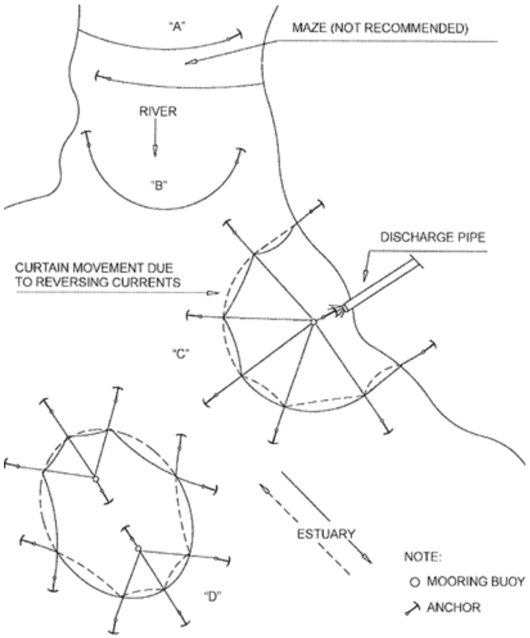
Engineering Controls
Silt Curtains

Silt curtains are devices designed to control suspended solids and turbidity in the water column generated by dredging and disposal of dredged material.

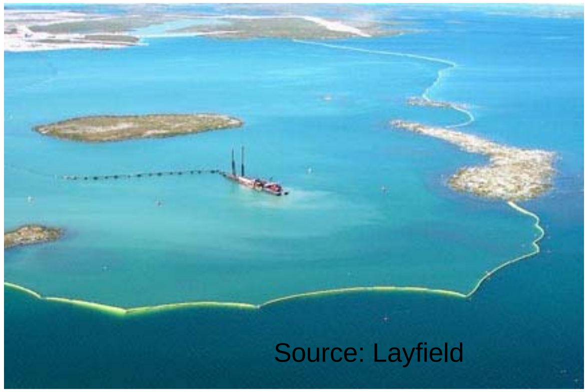


Components of a Silt Curtain





Effectiveness of Silt Curtains



Depends on:

- Nature of operation,
- Quantity and type of material in suspension,
- Characteristics, construction, and conditions,
- Method of deployment,
- Hydrodynamics.

Silt Curtains "Lessons Learned"

- Used at various sites with various degrees of success.
- Should not be considered a "one-solution-fits-all" type of BMP.
- Are highly specialized, temporary-use devices that should be selected only after careful evaluation.
- Requires knowledge and practical experience for successful applications.

Silt Curtain "Lessons Learned"

- Deploying in currents > 1 to 1 ½ knots problematic.
- Low current/high current conundrum.
- In general, should be used in slow to moderate currents, stable water levels, and relatively shallow water depths.
- Selection/use is extremely site-specific (not a silver bullet).

http://el.erdc.usace.army.mil/dots/doer/pdf/doere21.pdf

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Silt Curtains as a Dredging Project Management Practice

INTRODUCTION: Environmental windows are imposed on many U.S. Army Corps of Engineers (USACE) dredging projects in both coastal and inland waterways. Over 83 protected or sensitive species that have been identified fall into at least 20 general categories of concern for potentially negative impacts from dredging and disposal operations. One of the most frequently cited reasons for establishing an environmental window is impacts from turbidity and suspended sediments (Reine, Dickerson, and Clarke 1998). Over the past 15 to 20 years there have also been increased concerns regarding the potential impacts that dredging of contaminated sediments may have on nearby environmental resources.

In response to the need to protect sensitive environmental resources, silt or turbidity curtains have been designated a "best management practice (BMP)" by the Corps of Engineers, other Federal Agencies, and state regulatory authorities. Silt curtains are devices that control suspended solids and turbidity in the water column generated by dredging and disposal of dredged material. Consequently, silt curtains are considered an integral and necessary part of the regulatory strategy for many dredging projects. Unfortunately, factors contributing to the effectiveness of silt curtains under different circumstances are poorly understood by dredging project regulators and the public alike. Dredging contractors attest to the fact that, in their experience, silt curtains do not work under many of the site conditions encountered in navigation and environmental dredging projects. The published literature contains few comprehensive studies that demonstrate how effective silt curtains have been in meeting the intended project objectives (Johanson 1976, 1977; JBF Scientific Corporation 1978; Lawler, Matusky and Skelly Engineers 1983).

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Engineering Controls

Hopper Dredge Anti-Turbidity Valve "Green Valve"

Source: Ofuji, 1976

Operational Controls

Operational Controls
Slow Down

- **Slowing operation can decrease strength but may increase total mass of resuspension.**
- **Slowing operation would change exposures - turbidity,**
  - net deposition,
  - deposition rate
  - and potential dose.

Operational Controls
Mechanical Dredges

- Varying the bucket descent speed
- Varying the bucket ascent speed
- Varying the slewing speed
- Barge overflow/no overflow

Operational Controls
Mechanical Dredges

Varying Bucket Speeds

Mechanical Dredge Bucket Size yd3 (m3)	Bucket Cycle Time sec	Bucket Ascent & (Descent) Velocity m/s (m/s)	Instantaneous Production Rate m^3/hr	Mass Resuspension Rate g/s	Percent Resuspension	Project Duration Days*
4.0 (3.0)	50	1.06 (0.8)	184	217	0.72	27
4.0 (3.0)	75	0.5 (0.37)	122	142	0.71	39
4.0 (3.0)	100	0.32 (0.24)	92	123	0.81	50
30.0 (23.0)	50	1.06 (0.8)	1408	1432	0.61	4
30.0 (23.0)	75	0.5 (0.37)	938	977	0.63	5
30.0 (23.0)	100	0.32 (0.24)	704	843	0.73	6

*Based on 100,000 m^3 project

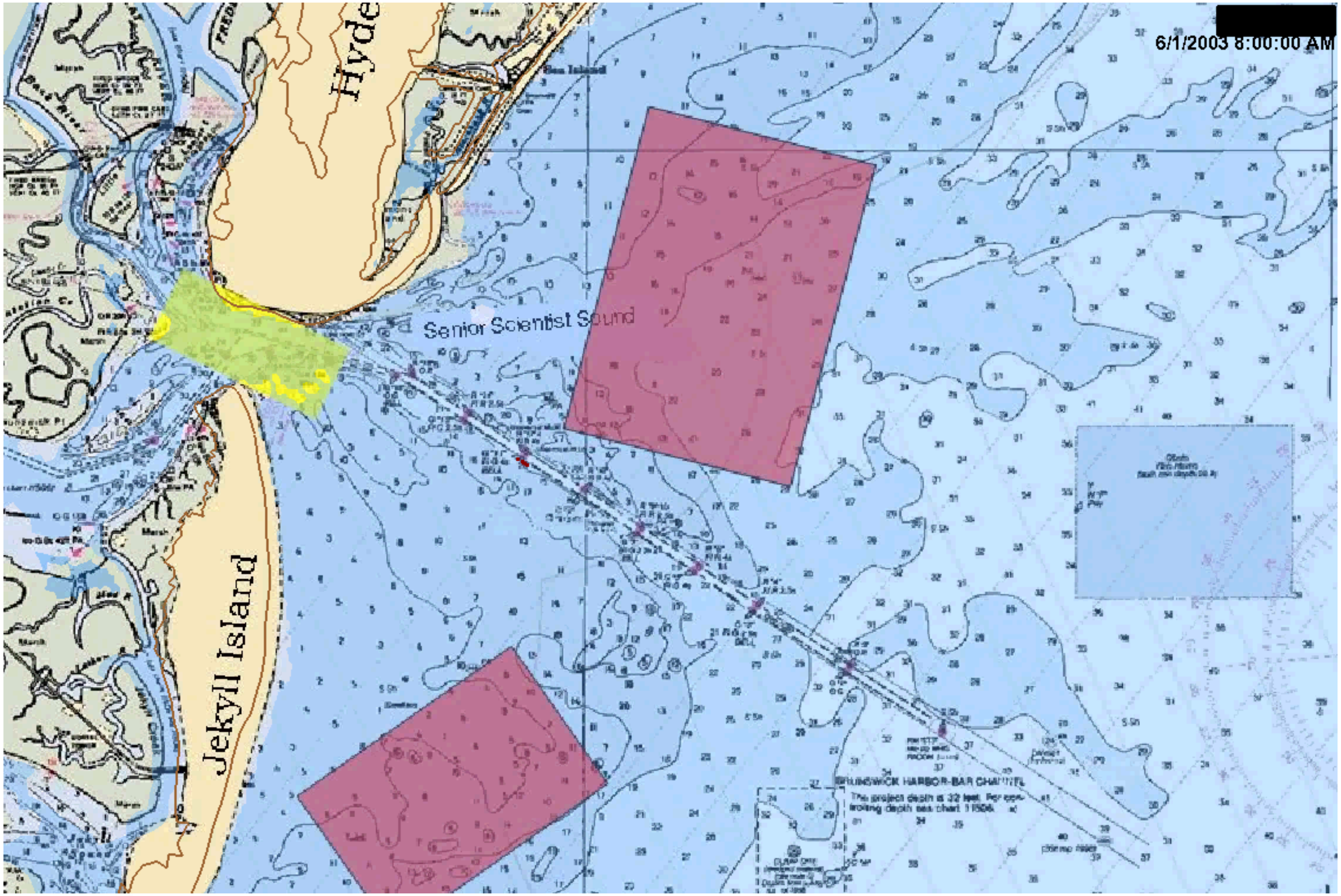
Operational Controls
Cutterhead Dredges

- Using different cutterhead rotation speeds
- Using different swing speeds
- Varying the suction velocity
- Varying the cut height and step length
- Varying the direction of cut

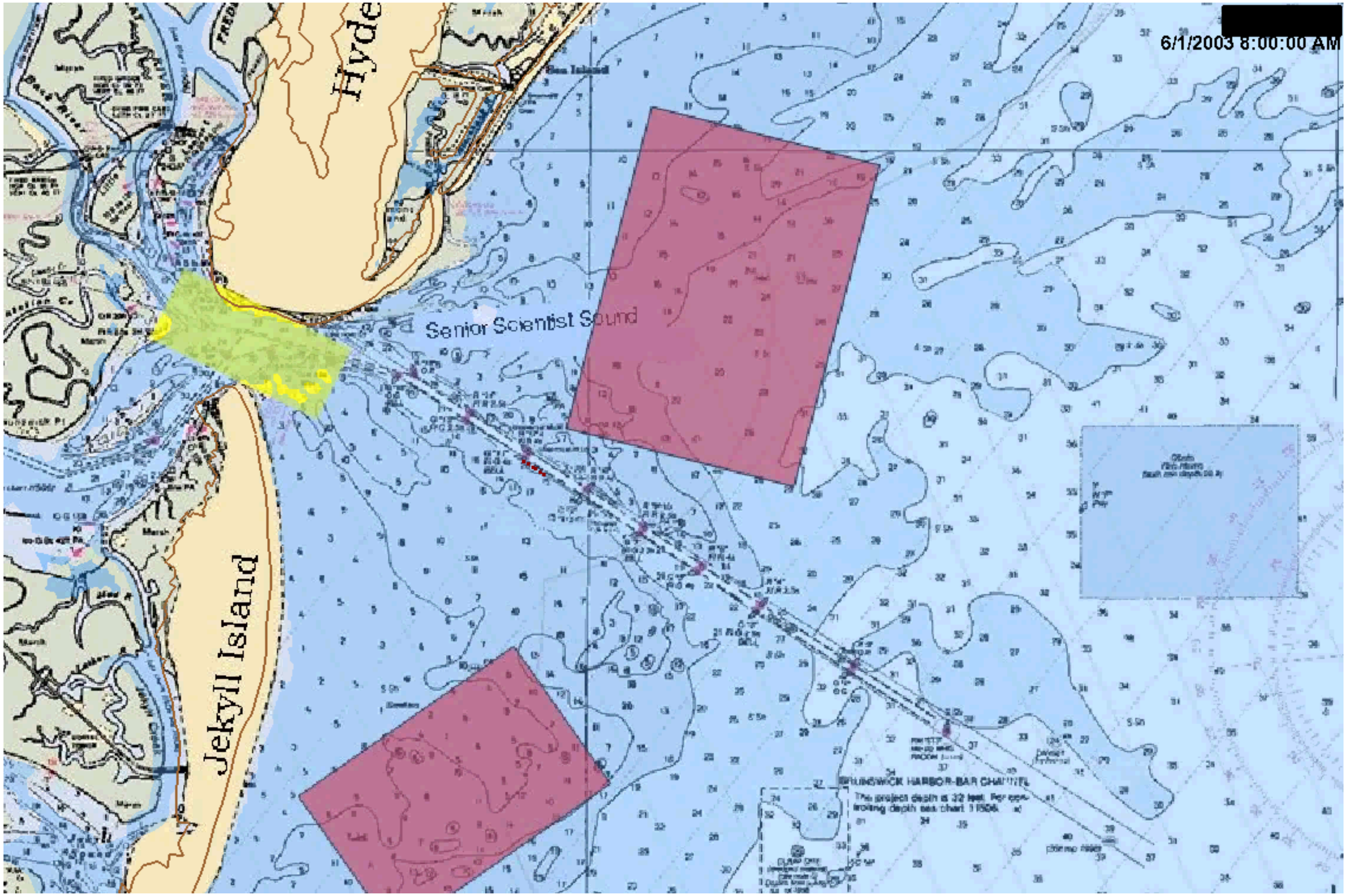
Operational Controls
Hopper Dredges

- Changing the suction pipe velocity
- Varying the trailing speed
- Loading with one suction pipe instead of two
- Allowing overflow, not allowing overflow
- Vary draghead operation

Hypothetical Example: Operational Controls
With Overflow

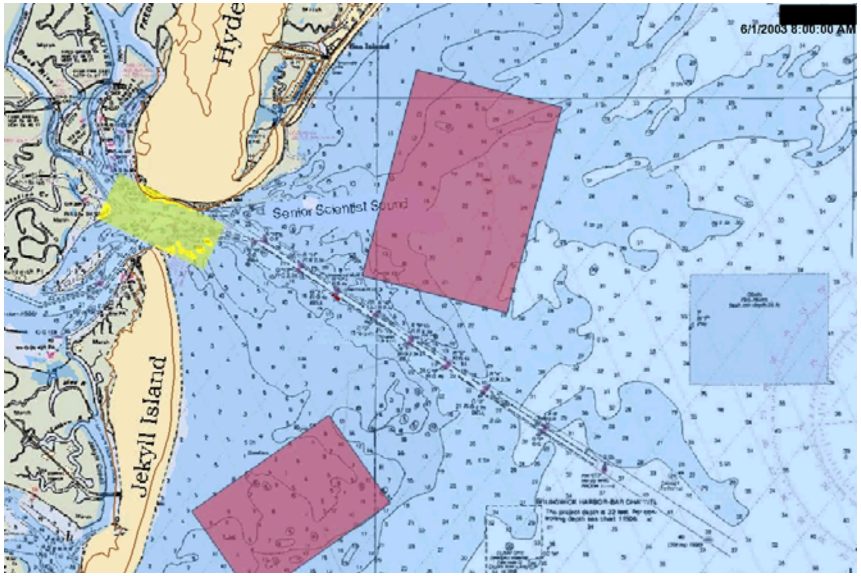


Hypothetical Example: Operational Controls
Without Overflow

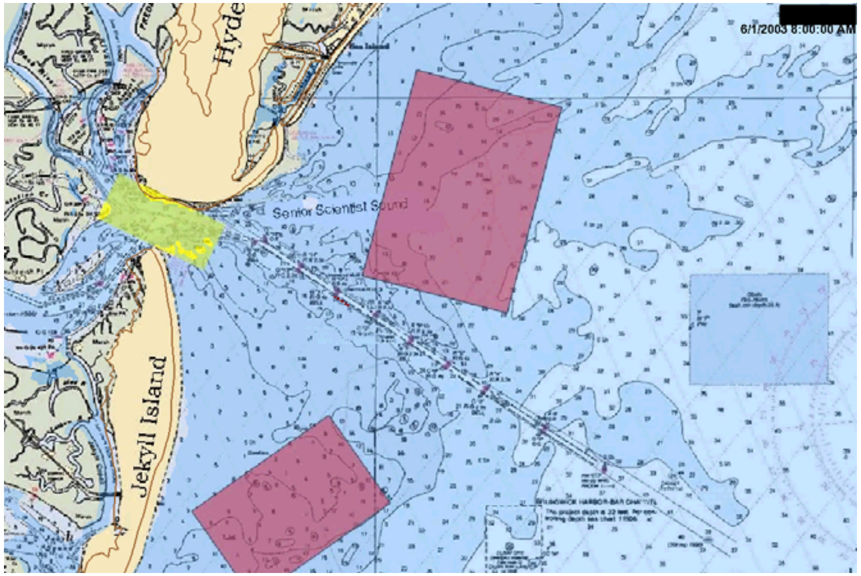


Hypothetical Example: Operational Controls

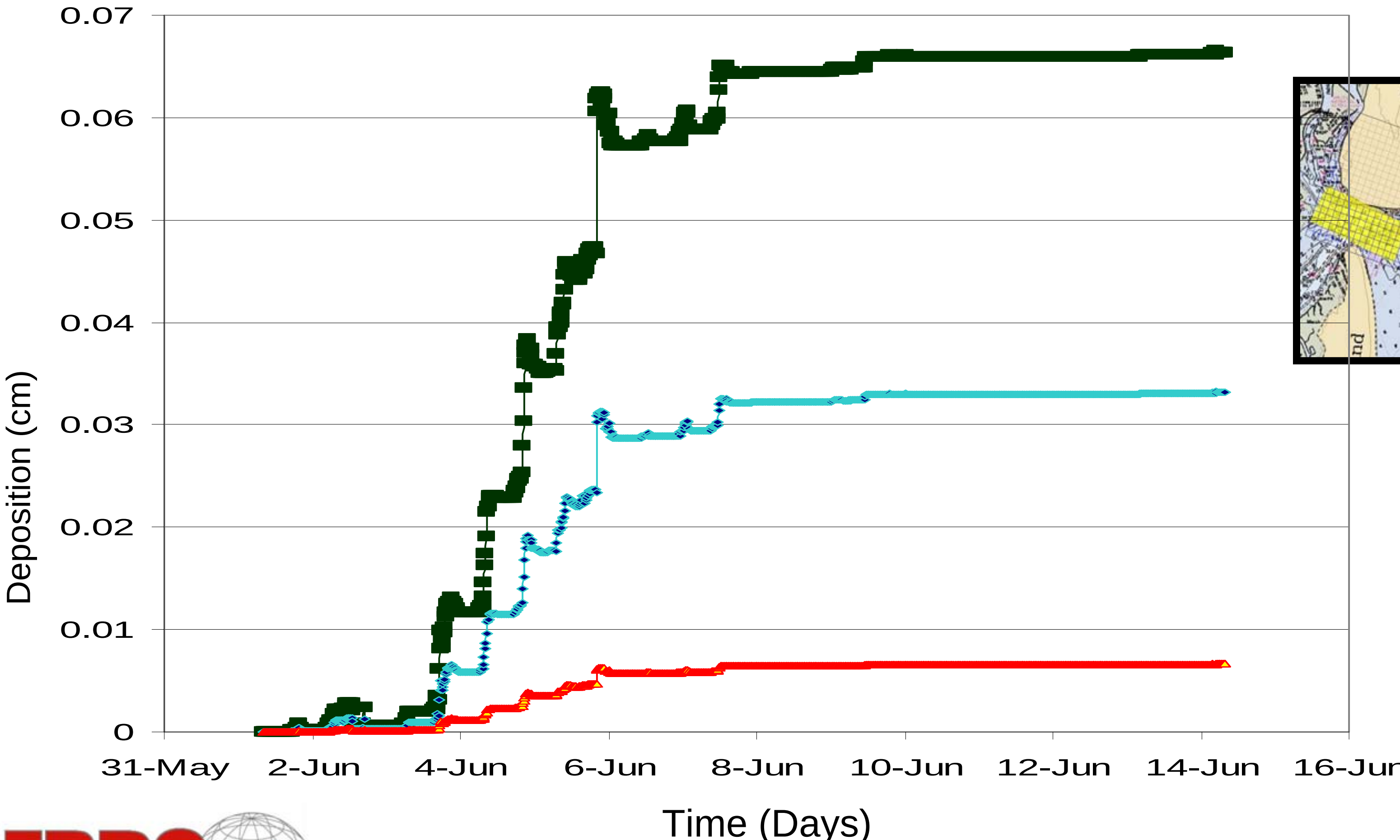
With Overflow

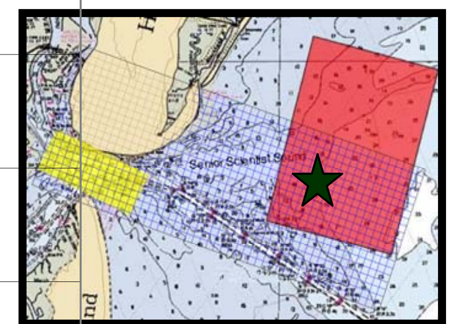


Without Overflow



Time Series of 0, 15, and 30 Minute Overflow Deposition





Hypothetical Example Dredging Scenarios

Dredging Scenario	Production Per Day	Dredging Duration (Days)	Approximate Project Dredging Cost*
Without Overflow	32,000 m^3	219	$13,140,000
With 15 Minutes Overflow	48,000 m^3	146	$8,760,000
With 30 Minutes Overflow	57,600 m^3	122	$7,320,000

*Assume $2,500/hr dredge rental cost

Questions?