WEDA
Western Dredging Association
DREDGING SUMMIT & EXPO '17

Full-Depth, Bottom-Sealed Filter Barriers and Their Place in Comparison with Other Means of Sediment / Turbidity Control in Dredging Projects

A.J. McCusker, J. Johnson, M. Hamlin and C. Guelke

MACKWORTH-ENVIRO
Aquatic Barrier & Screening Solutions

WHAT DO YOU DO FOR SEDIMENT CONTROL IF…

You are Designing a Remedial Action for Contaminated Sediment Removal at a former MGP Site along the shore of a southern Maine Harbor?

And, the contaminated sediment extends to both the intertidal and shallow subtidal zones.

Also, by the Way:

- Depth ranges to 35 ft & Tides range to ~14 ft
- The narrow navigation channel is less than 150 ft away and tugs pass and oil tankers pass by regularly
- There is a winter flounder protection season

MACKWORTH-ENVIRO
Aquatic Barrier & Screening Solutions

OR, WHAT IF…

You are Designing a Tidal Creek Habitat Creation Project through a Fine-Sediment Marsh and Opening into a Canal off of a Marine National Park in southeastern Florida?

And, the National Park doesn't allow <u>any</u> (measurable) increase in turbidity (e.g., <1 ntu) into the Bay.

Also, by the Way:

- Clay Particles – Extremely Dispersible, Uncannily So
- High Flows – Sudden and Significant when the canal berm is breached after the creeks are constructed
- There will be <u>three</u> creeks! And,
    - There are likely to be crocodiles!

MACKWORTH-ENVIRO
Aquatic Barrier & Screening Solutions

OR, HOW ABOUT IF…

You are Responsible for Design of a Remedial Action to Remove Contaminated Sediment from within a Sheet-Pile Enclosed Large Vessel Dry Dock in a British Columbia Harbor?

The Area Outside the SPW has previously been remediated so Contaminated Sediment Release is Not an Option

- Existing SPW to Low Tide Height Only
- Design Challenges:
  - Wall-Top Design
  - High Flows
  - Filtration Effectiveness

MACKWORTH-ENVIRO
Aquatic Barrier & Screening Solutions

AND, FINALLY, HOW ABOUT IF…

You are designing a project to include demolition of large concrete bridge piers and dredging in a Southern California tidal harbor with a 78 ft channel to be maintained between two of the piers?

And constraints include:

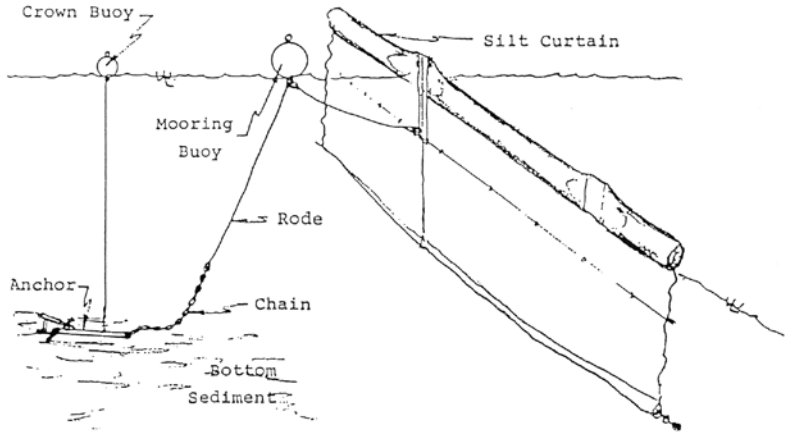
- Stringent Water Quality Objectives
- Urgency to quickly obtain regulatory approvals and implement approved turbidity control so the demolition can proceed

MACKWORTH-ENVIRO
Aquatic Barrier & Screening Solutions

FOR YOUR FOUR PROJECTS, WHAT ARE YOUR CONTAINMENT OPTIONS FOR SUSPENDED SEDIMENT?

- SILT CURTAINS?
- SHEET PILE WALLS/COFFERDAMS?
- "OTHER"?

ARE BOTTOM-SEALED FILTER BARRIERS AN OPTION?



MACKWORTH-ENVIRO
Aquatic Barrier & Screening Solutions

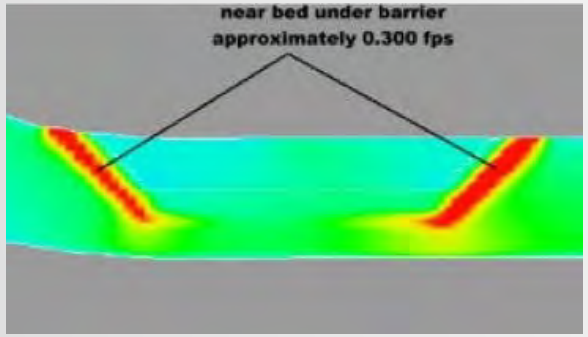
WHAT IS BOTTOM-SEALED FILTER BARRIER TECHNOLOGY?

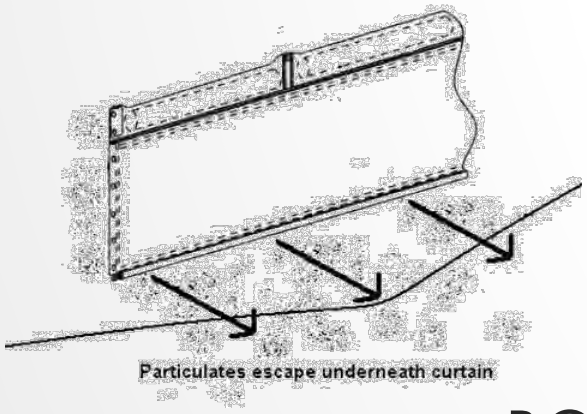
- Floating filtering curtain that includes seal to the bottom and completely enclosing the area of sediment disturbance
- Have been applied for various purposes since 1990s
- Recent sediment control applications

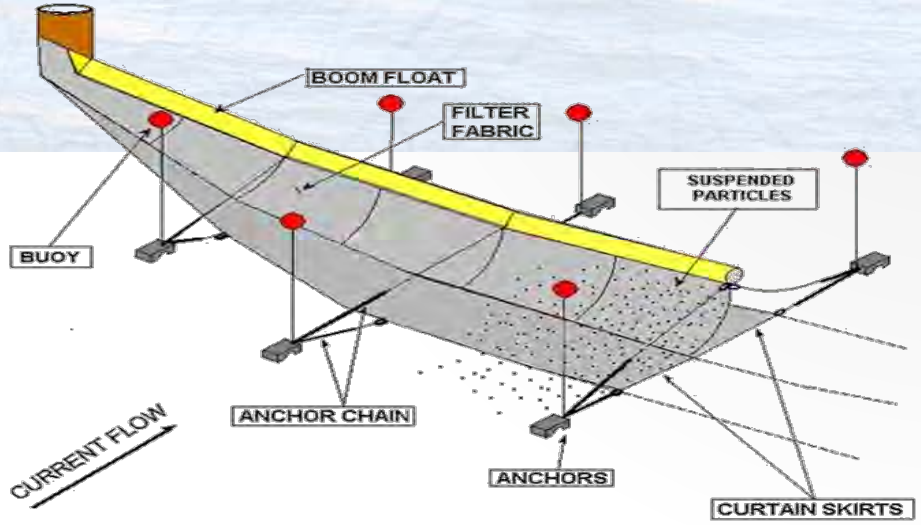
  in diverse circumstances have met challenges:
  - High velocity and bi-directional currents
  - Deep water
  - Large tidal ranges
  - Restrictive Water Quality Objectives

MACKWORTH-ENVIRO
Aquatic Barrier & Screening Solutions

BOTTOM-SEALED FILTER BARRIER VS. SILT CURTAIN – DIFFERENCES







SILT CURTAIN

- Flotation, Curtain, Ballast
- Anchored the surface
- Generally 1+ ft from the Bottom
- Bottom can move with water flow
- Primary Issue- If water movement, particulates pass under the curtain

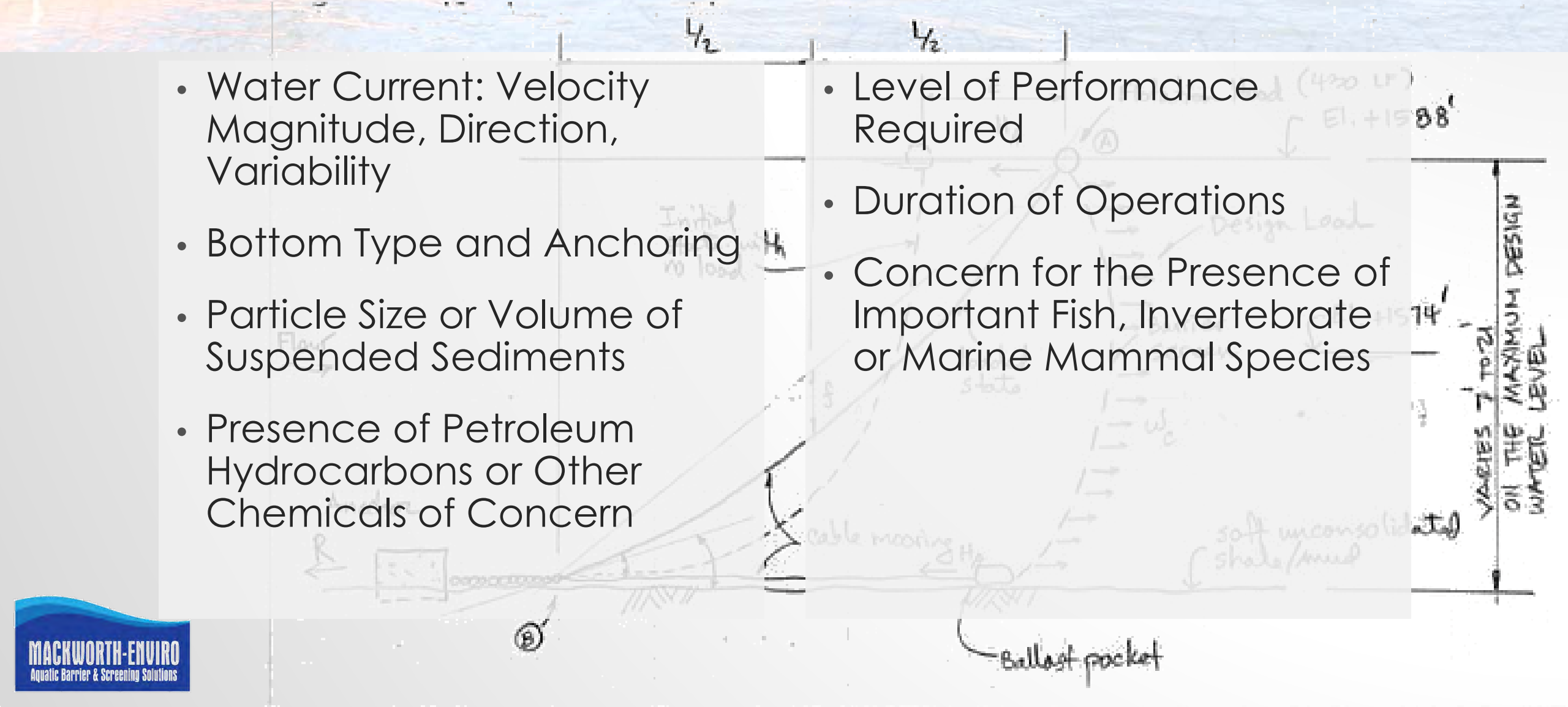
BOTTOM-SEALED FILTER BARRIER

- Sealed – Bottom, Top and Sides
- Anchored – Top and Bottom
- Durable, Able to Handle Loads
  - Curtain Geotextile Options
    - Permeable or Impermeable
    - Single- or Multi- Layered
    - Selected for Environment and Specific Control

MACKWORTH-ENVIRO
Aquatic Barrier & Screening Solutions

IMPORTANT PARAMETERS FOR DESIGN

- Water Current: Velocity Magnitude, Direction, Variability
- Bottom Type and Anchoring
- Particle Size or Volume of Suspended Sediments
- Presence of Petroleum Hydrocarbons or Other Chemicals of Concern
- Level of Performance Required
- Duration of Operations
- Concern for the Presence of Important Fish, Invertebrate or Marine Mammal Species



MACKWORTH-ENVIRO
Aquatic Barrier & Screening Solutions

SO, WHAT WAS SELECTED FOR THESE FOUR PROJECTS AND HOW SUCCESSFUL WAS THE SELECTED TECHNOLOGY

1. Contaminated Sediment Removal – Onshore and Near-Shore Subtidal

AMEC FW SELECTED BOTTOM SEALED BARRIER

2. Turbidity Control System to Achieve 0 NTU Increase into Adjacent Waters

AECOM RECOMMENDED BOTTOM-SEALED FILTER BARRIER

3. SPW-Mounted (Bottom-Sealed) FB

ANCHOR QEA RECOMMENDED BOTTOM-SEALED FILTER BARRIER

4. Bridge Pier Demolition and Sediment Removal

CALTRANS RECOMMENDED BOTTOM-SEALED FILTER BARRIER

MACKWORTH-ENVIRO
Aquatic Barrier & Screening Solutions

CONTAMINATED SEDIMENT REMOVAL ONSHORE AND NEAR-SHORE SUBTIDAL

Voluntary Coal Tar Remediation - Site of Former MGP – Intertidal Excavation

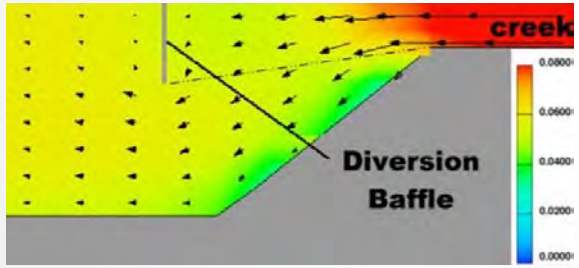
- Substantial Savings to Costs and Schedule Over Cofferdam
- Silt Curtain was not an option due to
  - large amount of water exchange
  - strong tidal currents and vessel wave impacts
  - need for protection of spawning winter flounder
- Design Elements Included:
  - 3 Layers for Strength/Filtration, Plus Sorbent
  - Helical and Rock Anchors Secured

MACKWORTH-ENVIRO
Aquatic Barrier & Screening Solutions

TIDAL CREEK CONSTRUCTION TO ACHIEVE 0 NTU INCREASE INTO ADJACENT WATERS

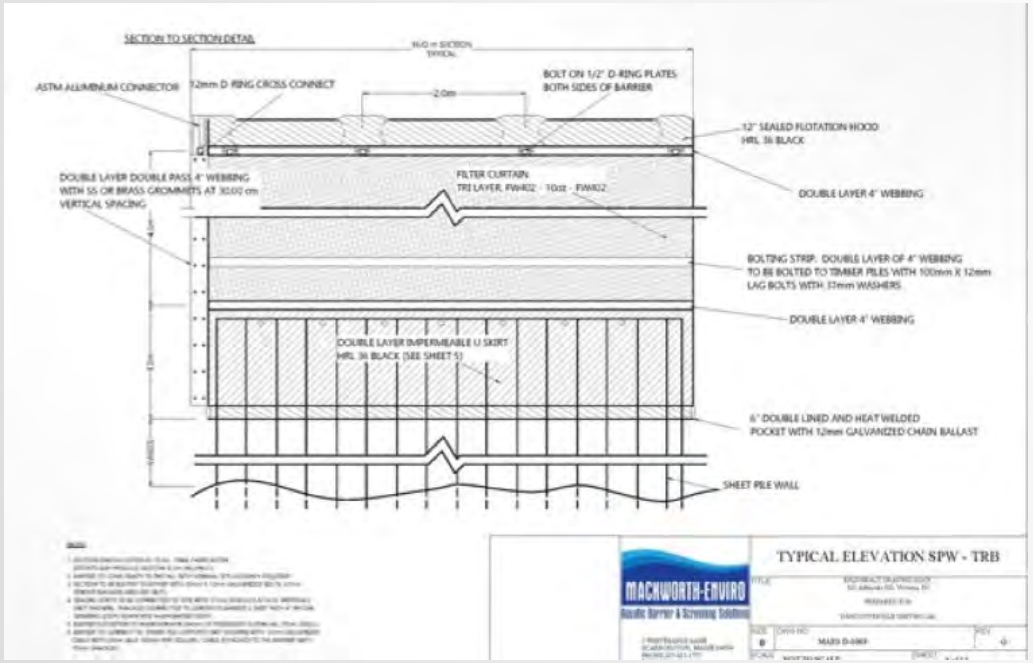
DESIGN:

- Process included CFD Modeling, Bench Testing
- 3 BARRIERS: Diversion, Filter and Silt
- Ability to Reef, Move and Re-use



MACKWORTH-ENVIRO
Aquatic Barrier & Screening Solutions

SPW-MOUNTED (BOTTOM-SEALED) FILTER BARRIER



Big Challenge!

Success!

MACKWORTH-ENVIRO
Aquatic Barrier & Screening Solutions

BRIDGE PIER DEMOLITION AND SEDIMENT REMOVAL

Full-Depth Filter Barriers Installed Where SPW Infeasible and Silt Curtains Inadequate

- Urgency- Award to Initial Installation ~3-4 mos
- Design Process Included CFD Modeling
- Diver-Installed Reinforcements To Address Damage from Demolition Debris and Chafing
- Meeting Stringent WQ Objectives for Project

MACKWORTH-ENVIRO
Aquatic Barrier & Screening Solutions

APPLICATION EVALUATION: BOTTOM-SEALED FILTER BARRIER VS. SILT CURTAIN

Conditions where project costs can go up without bottom sealing and anchoring, and where FBs may be more advantageous include:

- Dynamic Water Conditions –
  SCs can require excess hours for maintenance, restoration of position or replacement due to damage
- Water Quality Performance Requirements –
  Sediment releases that exceed water quality performance criteria and cause operations to be suspended creates additional costs, or compromises continuity of operations, with associated issues of potential permit violations

MACKWORTH-ENVIRO
Aquatic Barrier & Screening Solutions

APPLICATION EVALUATION: BOTTOM-SEALED FILTER BARRIER VS. SHEET PILE WALL

- SPW cofferdams utilized for contaminated sediment removal can provide very effective containment
- There may be a concern about releases from SPW removal
  - This may be addressable by locating the SPW away from the contaminants or sometimes addressed with Silt Curtains
- There may be too much area to contain, or the water is too deep or other factors impede the use of SPWs.

MACKWORTH-ENVIRO
Aquatic Barrier & Screening Solutions

SHEET PILE WALL APPLICATION ASPECTS

- Used at many environmental dredging sites where the superior containment of SPWs relative to silt curtains has justified the substantially higher cost
- Most significant consideration is cost
- Secondary considerations
  - Impact to project schedule
  - Potential contaminant release issues during removal
- Other unforeseen issues, such as having to cut at mudline if cannot remove

MACKWORTH-ENVIRO
Aquatic Barrier & Screening Solutions

BOTTOM-SEALED FILTER BARRIERS WHERE SPW INFEASIBLE OR NON-ECONOMIC

Where feasible in a location, a Bottom-Sealed FB can provide control for a project for less time and cost than a SPW.

Key Questions:

- Will the FB be adequately effective as an alternative?
- Will the FB cause any scouring or other adverse impacts that may not result from use of a SPW?

There are few situations where a SPW could be deployed for containment that a bottom-sealed barrier cannot

- Excessive currents, e.g. > 3 fps
- Very toxic contaminants requiring a de-watered SPW

MACKWORTH-ENVIRO
Aquatic Barrier & Screening Solutions

CONCLUSIONS

	Silt Curtains	Sheet Pile Walls	Filter Barriers
COST	Lowest	Very High	Moderate
TIME TO IMPLEMENT	Short	Very Long	Short
EFFECTIVENESS	Acceptable	Excellent	Excellent
	↓ *Depending on currents and water quality goals*		

- Silt curtains are effective for turbidity control and containment in limited situations
- A primary consideration with SPWs is the cost and impact to project schedules.
- Bottom-sealed FB systems can, in many circumstances, achieve the objectives of SPWs and their cost can be 70% less.

MACKWORTH-ENVIRO
Aquatic Barrier & Screening Solutions

MACKWORTH-ENVIRO
Aquatic Barrier & Screening Solutions