JOB AIDS FOR SHORELINE PROTECTION ON BEACHES AND TIDAL INLETS

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API SHORELINE RESPONSE

- As part of the American Petroleum Institute (API) Joint Industry Task Force (JITF) on Oil Spill Preparedness and Response, a Shoreline Protection and Cleanup R&D Technical Working Group (TWG) was set up in 2011
- Seven projects already funded through this TWG, two of which are described in this presentation.

Shoreline Protection

The focus of these two studies is to create best practice guidelines and Job Aids for shoreline protection. The guidelines focus on strategies and tactics to:

a. contain oil as it washes ashore on beaches,
b. intercept, divert or contain oil at tidal inlets.

In both cases, the objectives are to prevent oil impacting potentially highly sensitive upper beach or back-barrier environments, such as wetlands (mangroves and marshes), estuaries and lagoons.

Guiding Concepts

- Response options in these dynamic environments predicated on "***good science***"
- Actions versus ***consequences***
- Potential to ***success***fully meet objective (s)
- ***Job Aids*** for decision makers and responders
- Identify ***Best Management Practices***

A. Onshore Strategies and Tactics

BARRIERS - DAMS

- Berms and Ridges
- Sand Bags
- Solid Barriers

FLOATING BARRIERS

- Shore seal boom
- Sorbent boom
- Snare boom

SUMPS

- Ditches and trenches

Barriers and Dams – Berms & Ridges

Simple, mechanically constructed berms using *in situ* sand

JOB AID helps answer

"Where does this strategy apply ?"

Barriers and Dams – Berms & Ridges

HESCO Bastions filled with imported river sands (insufficient local sand)

Consequences ………

Barriers and Dams – Sand Bags

Super Sacks

Barriers and Dams – Solid Barriers

Water-filled Tiger Dams anchored to the beach

Barriers and Dams – Solid Barriers

Plastic sheets

Solid sheet pile bulkheads

SUMPS – Ditches and Trenches

collection and recovery

Barriers and Dams – Berms & Ridges

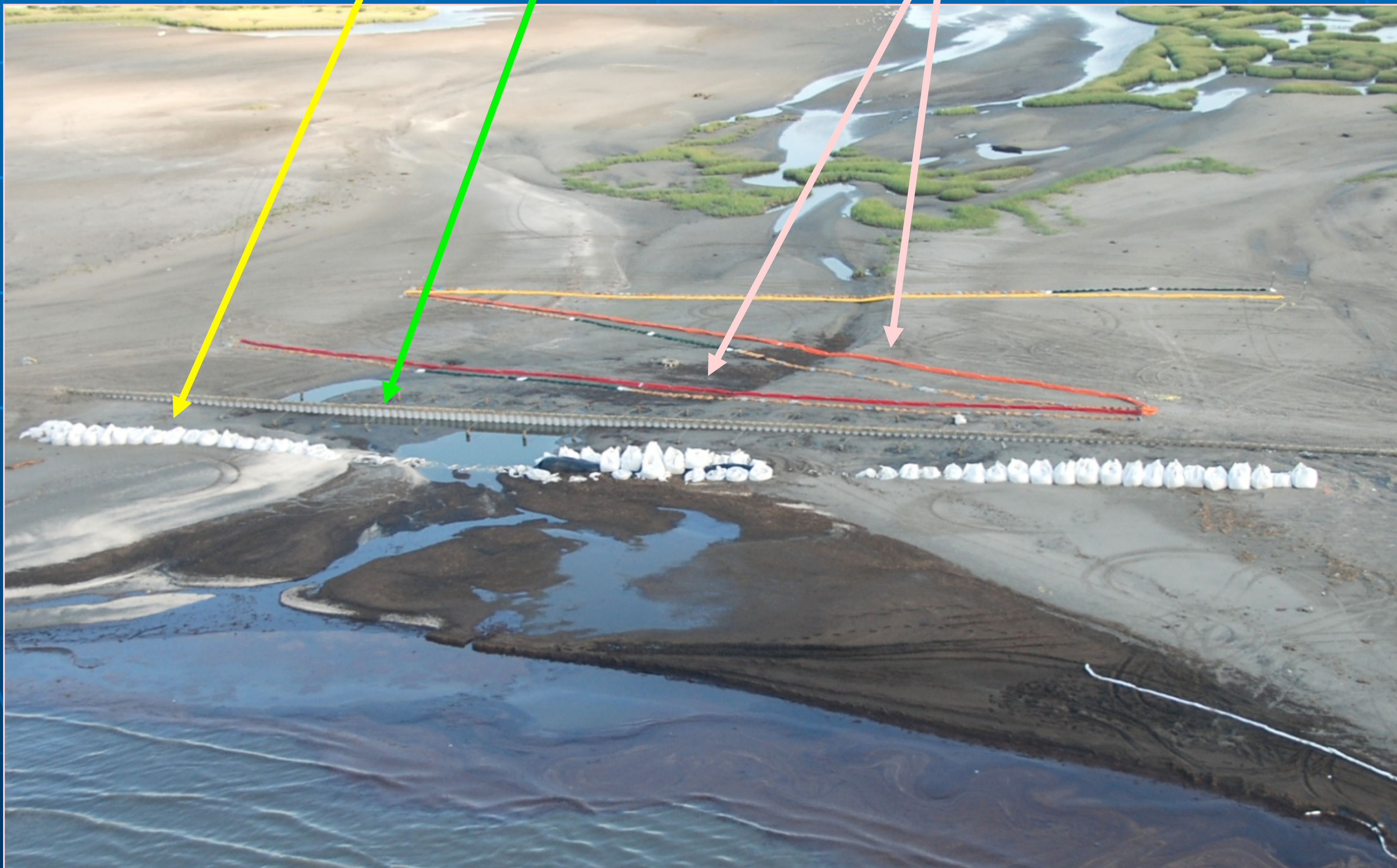
Dams constructed across ephemeral tidal channels using *in situ* or imported materials

JOB AID helps answer

"What are the impacts of blocking the flow ?"

Barriers and Dams

Combination of Super sacks and Tiger Dams prior to construction of solid sheet bulkhead



JOB AID helps answer

"What are the appropriate tactics in this situation ?"

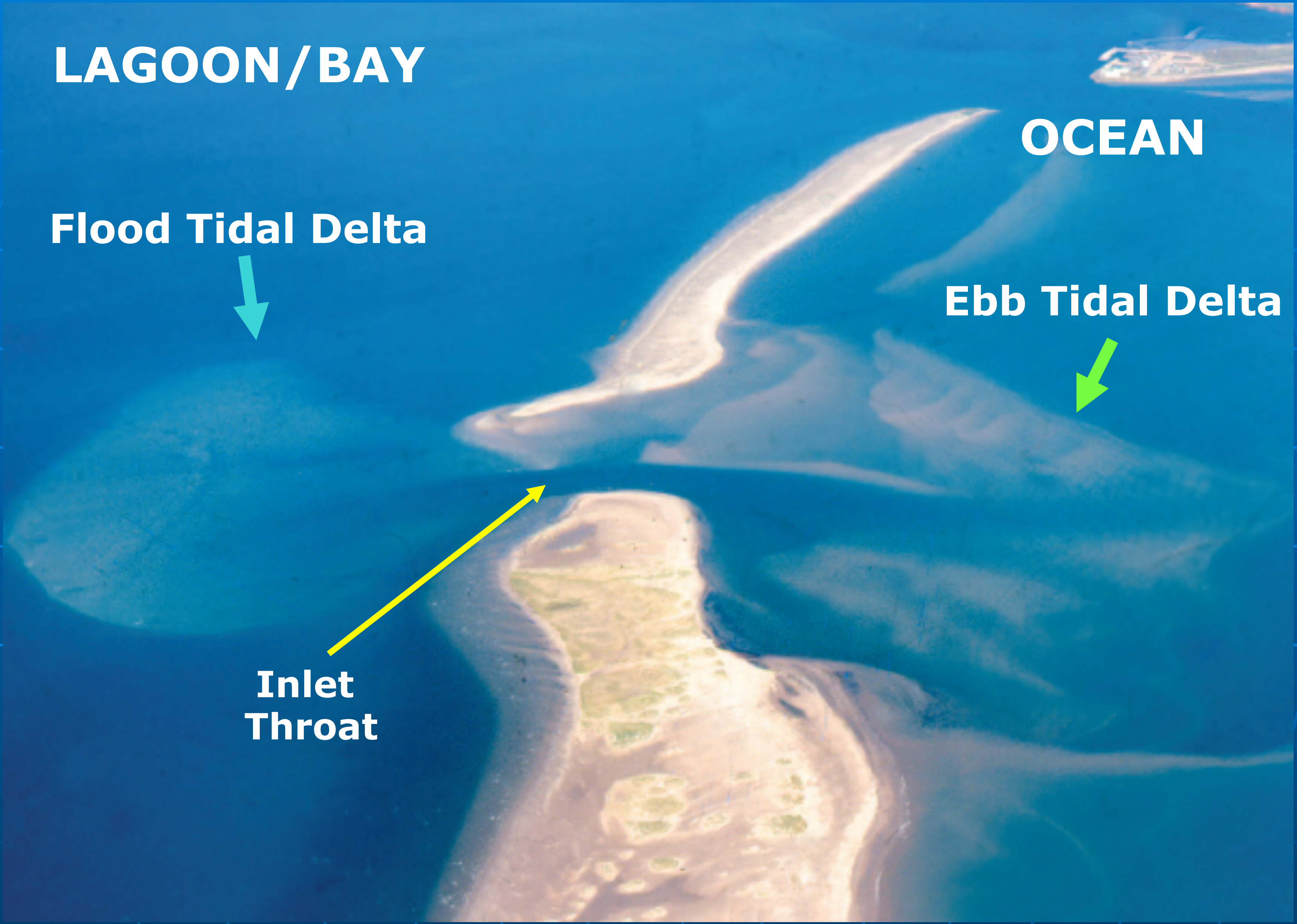
- Some protection strategies and tactics are straightforward or obvious (e.g. sand berms across an overwash channel, or sumps at the swash line)
- but are the potential consequences when a proposed strategy alters the shape of a beach or changes water flow patterns?
- the guidelines identify when and how proposed actions can potentially cause more harm than good ("**best practices**")

Best Practices Guidelines

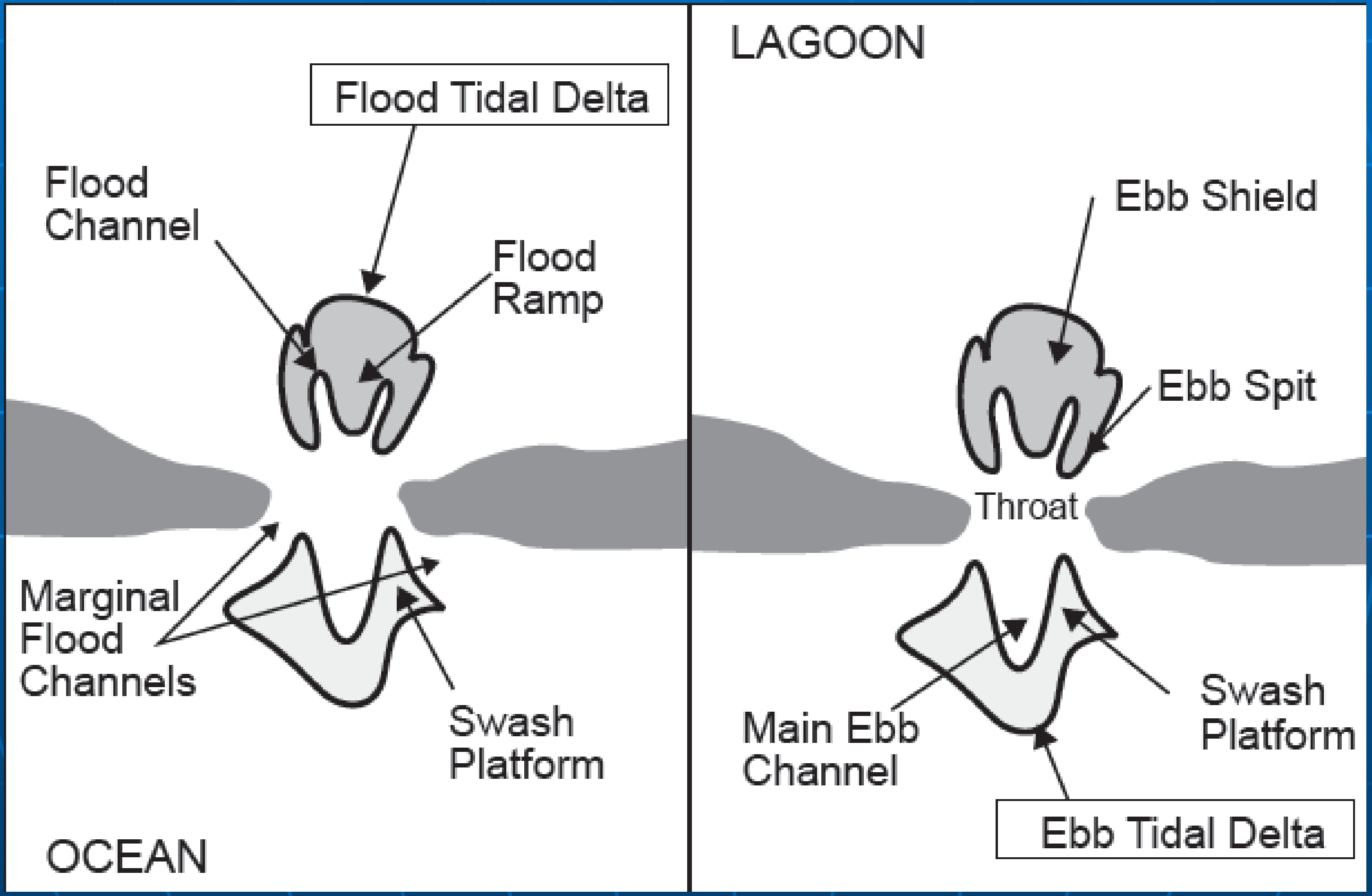
- Sediment transport
- Berm/barrier materials
- Circulation
- Vegetation
- Wildlife
- Human use activities
- Archaeological and cultural resources

B. Tidal Inlets

- All tidal inlets have a set of common features in term of shape and processes (currents)
- Flood currents expand on the lagoon side of the inlet causing slower velocities and sediment deposition to create a "**flood tidal delta**"
- Ebb currents expand on the ocean side of the inlet causing slower velocities and the deposition of sediments to create an "**ebb tidal delta**"
- *Need to "go with flow !!!"*


LAGOON/BAY
OCEAN
Flood Tidal Delta
Ebb Tidal Delta
Inlet
Throat

- Sediments are deposited on either side of an inlet as currents expand and velocities slow.
- This creates flood-tidal and ebb-tidal deltas



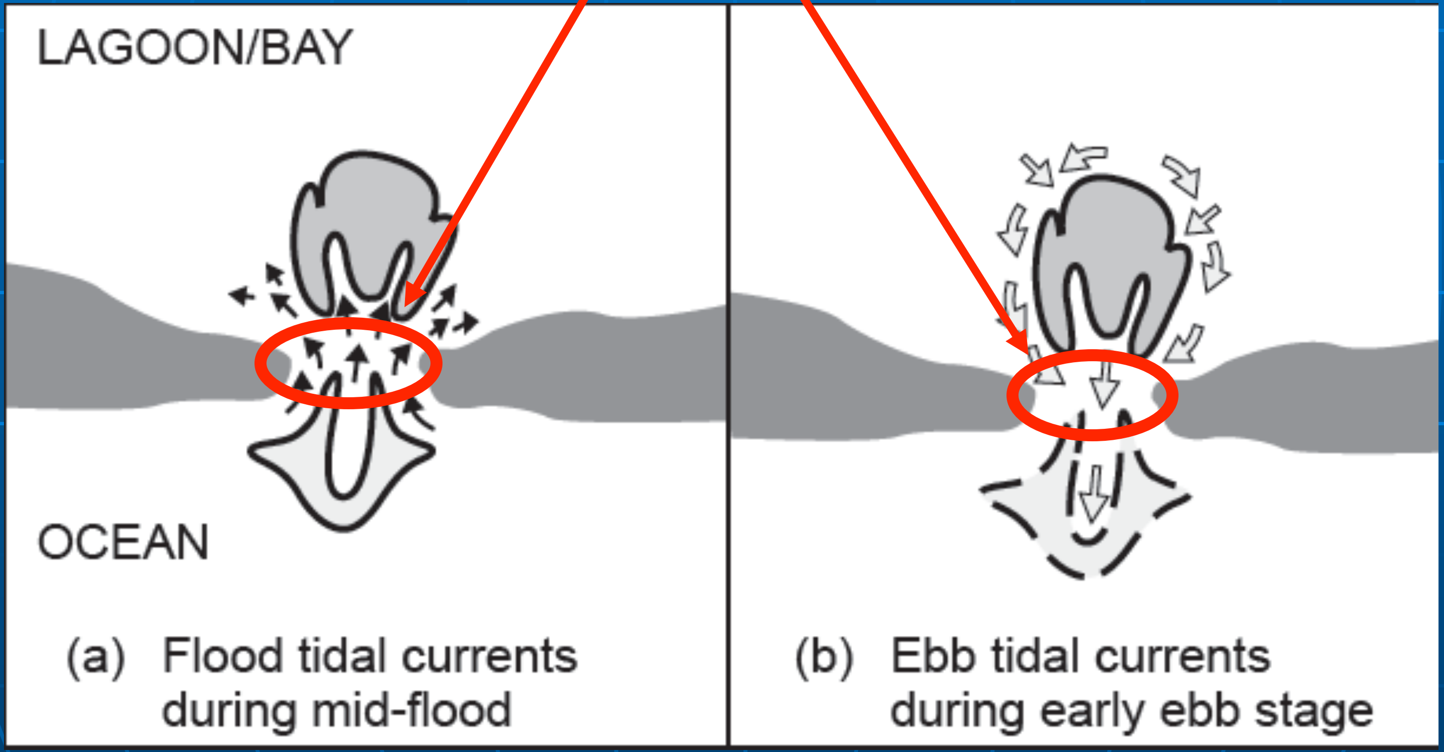
Tidal Inlet Protection Strategies (TIPS)

The key to a successful protection strategy at inlets is to understand:

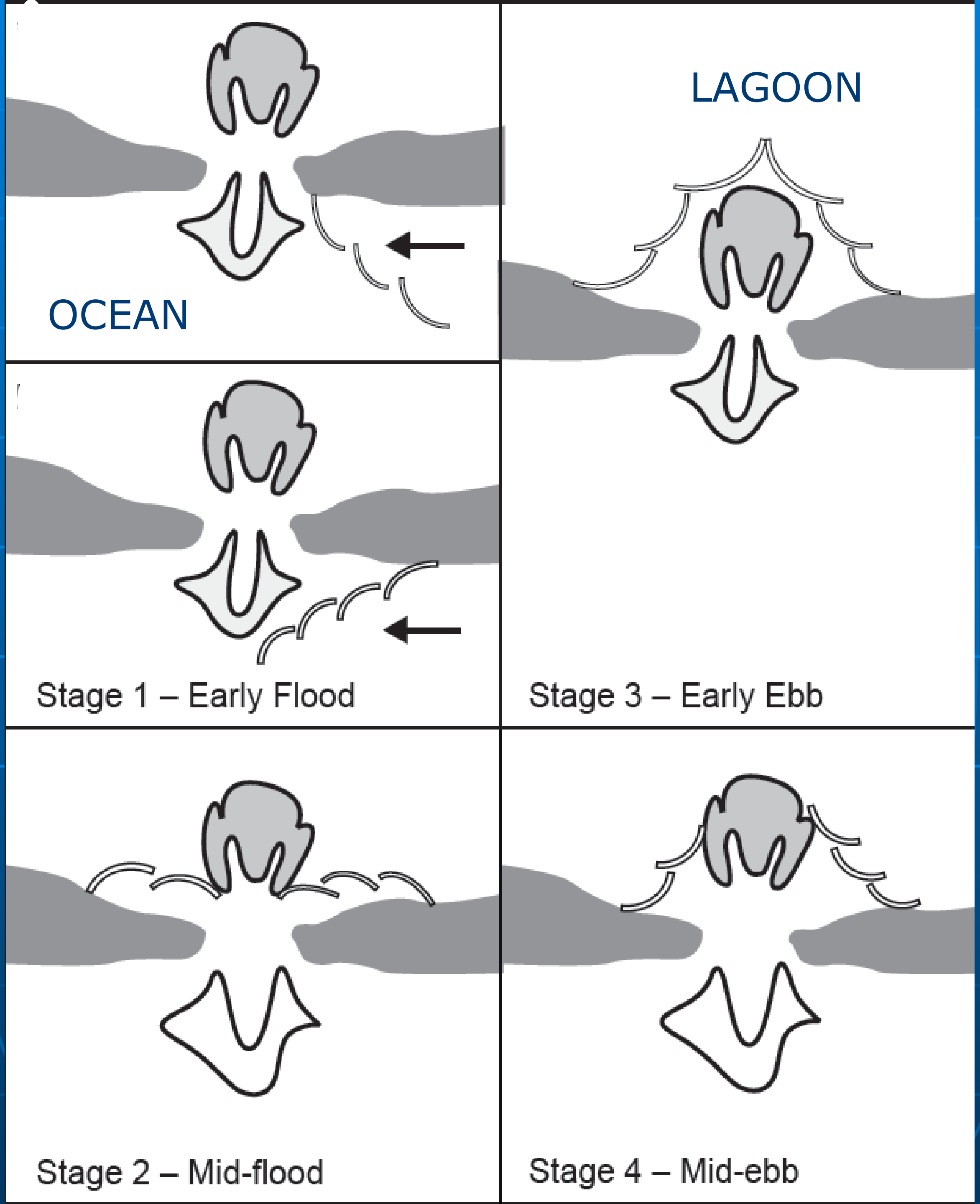
- the **changing current patterns** with
- **changing water depths**

as the tides ebb and flood.

- **Currents are strongest in the constricted inlet throat**
- **So, simply avoid placing boom at the inlet throat**

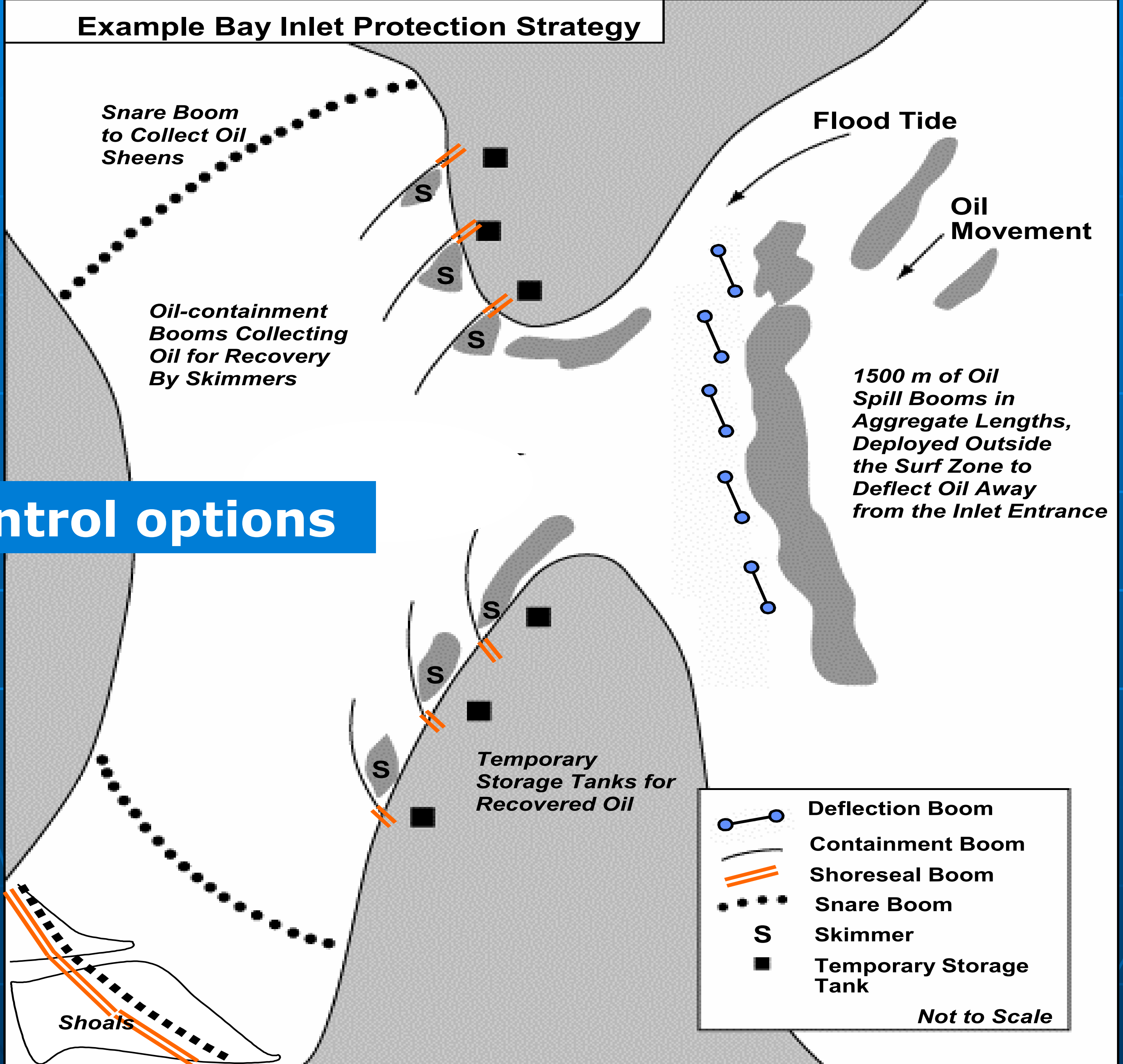


Strategy for oil on the ocean moving toward inlet on a **flooding** tide

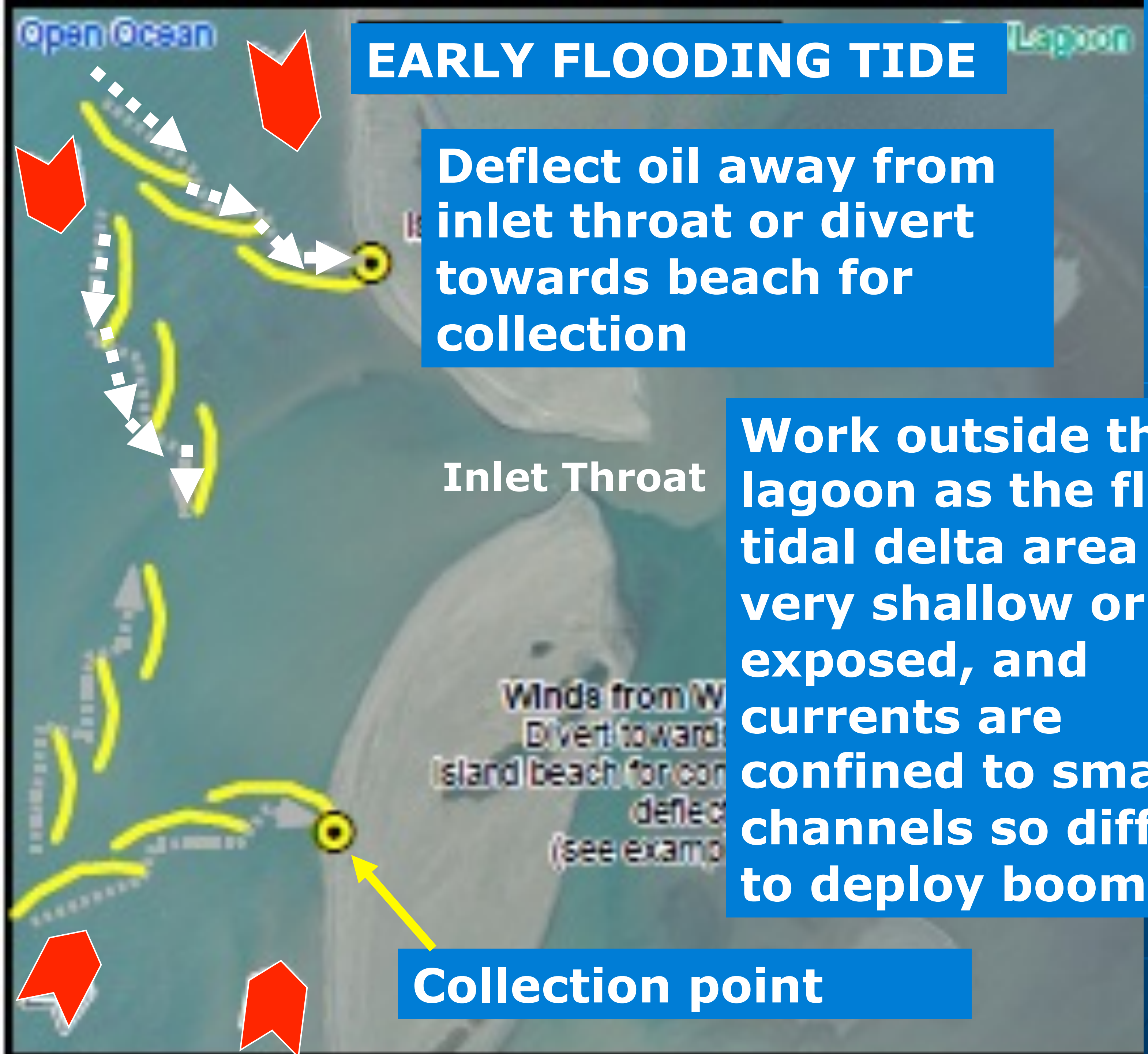


Strategy for oil inside the lagoon moving toward inlet on an **ebbing** tide

Control options



EARLY FLOODING TIDE

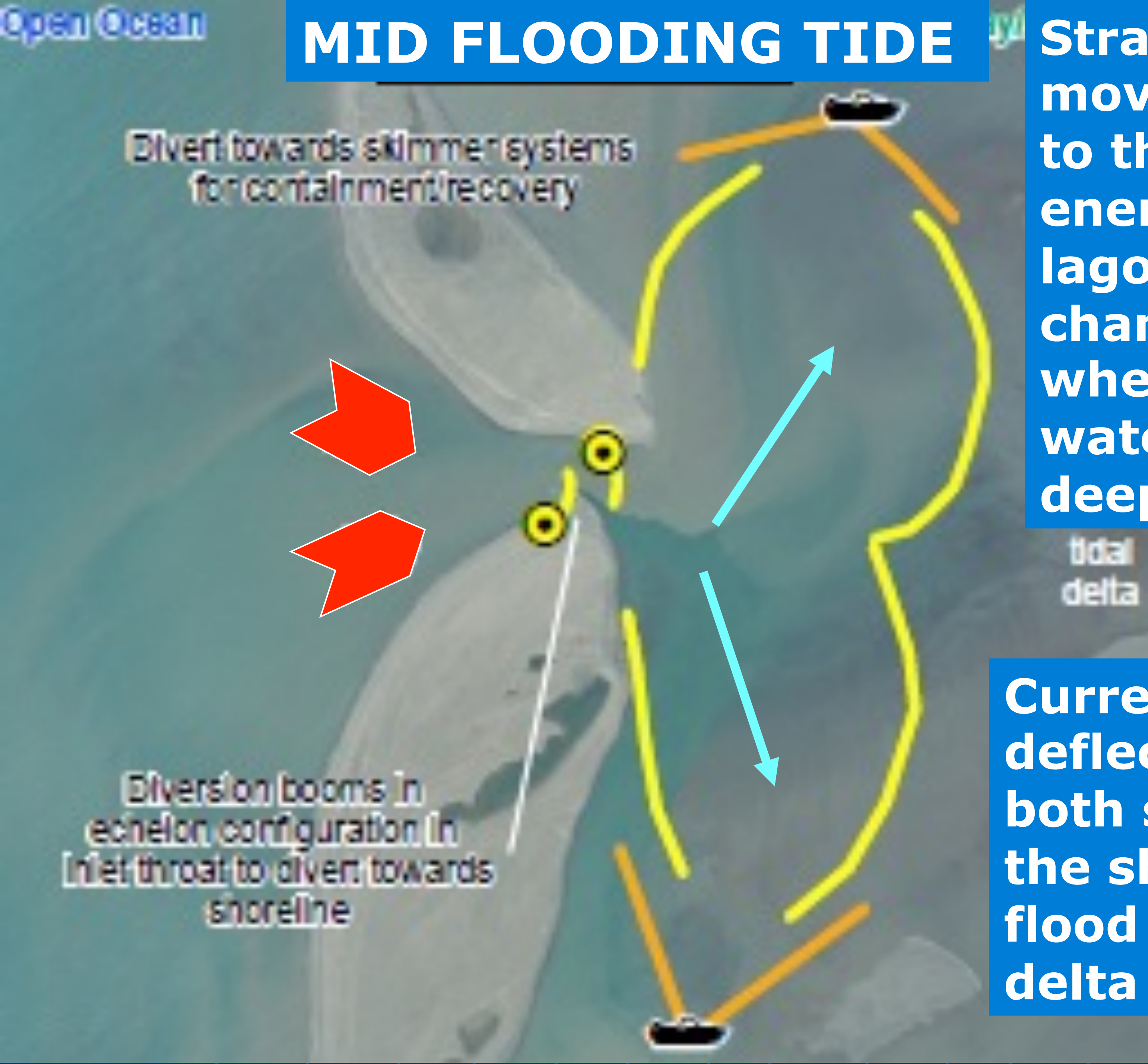


Deflect oil away from inlet throat or divert towards beach for collection

Work outside the lagoon as the flood tidal delta area is very shallow or exposed, and currents are confined to small channels so difficult to deploy boom

Collection point

MID FLOODING TIDE



Strategy moves inside to the low energy lagoon channels where the water is now deeper

Currents are deflected to both sides of the shallow flood tidal delta

Booming strategies can be effective event if current velocities are high

Collection point is a low energy site

Tidal Inlets

- Initially they often appear complex
- Actually, all very similar and have similar current patterns
- Does not mean that containment and control are easy, but need to work with the tidal current pattern, not against the waves and currents
- Even wide, deep inlets with strong currents have low energy areas

Tidal Inlet Protection Strategies (TIPS)

Objective:

- Provide easy-to-follow guidelines for responders to develop strategies and tactics to successfully protect lagoons and bays
- Apply what we understand about tides and changing current velocities and water depths
- Focus on operational feasibility

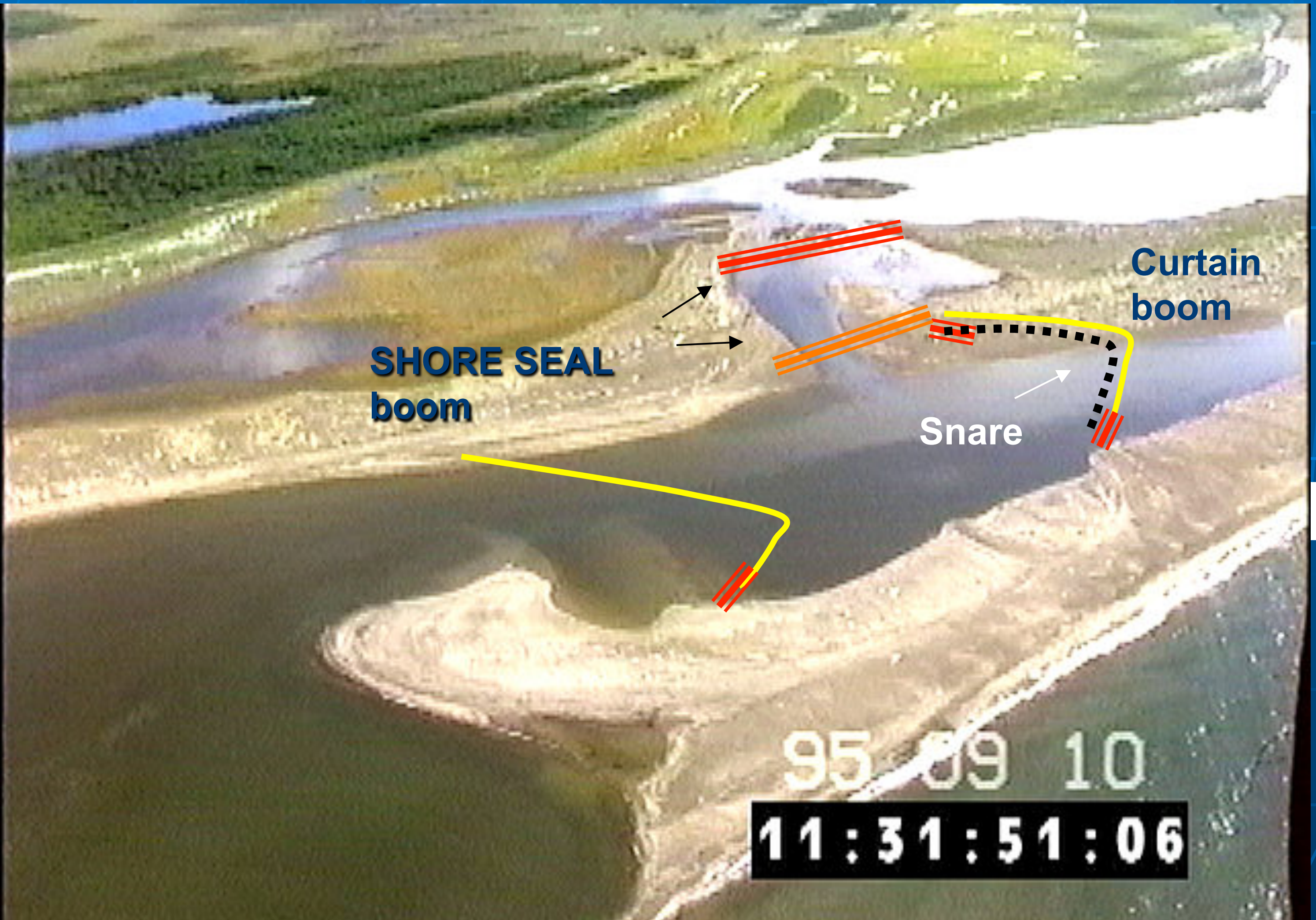
Inlet Categories Based on Feasibility

OPERATIONAL DIFFICULTY	INLET WIDTH	INLET DEPTH	TIDAL PRISM	TIDAL CURRENTS	BACK BAY CHARACTER	WAVE EXPOSURE
VERY DIFFICULT limited potential for success	Wide	Deep	Large	Strong (>1 knot: 0.5 m/s)	Wetlands	Exposed ocean shore
DIFFICULT some potential for success	↕	↕	↕	↕	↕	↕
LITTLE DIFFICULTY good potential for success						
NOT DIFFICULT very good potential for success	Narrow	Shallow	Small	Weak (<0.5 knot: 0.25 m/s)	Sand beaches	Sheltered ocean shore

Strategic Concepts

- Strategies vary with each type of inlet
- For a small inlet may be able to use an exclusion strategy or can divert away, but ….
- most diversion strategies should involve a shoreline or on-water collection and recovery site

Typical Deployment Strategy for Protection of Small Tidal Inlet "Not Difficult")



Shore Seal Boom

Floating Curtain Boom

Snare Boom

Example of TIPS Tactics Sheet

PHYSICAL CHARACTERISTICS

Overlapping tidal inlet formed by the growth of a barrier spit to the NE at the mouth of the Kuk River.

- Inlet open on 1976 overflight, 1993 and 2001 video surveys, Google Earth™ July 2006 image, and 2008 CPAI photography.
- Large ebb-tidal delta (See Page 20).
- Overlap channel is approximately 1500 m long and between 150 and 350 m wide, inlet widens towards the lagoon.

RESPONSE OBJECTIVES AND STRATEGIES

A. Prevent oil from entering Wainwright inlet

- Winds from the N to NW: Divert towards adjacent beach for containment and recovery, and deflect away from the inlet seaward.
- N-NE winds are more likely to cause drain down from the lagoon. The best strategy during these winds is to deflect seaward.
- Winds from the SW to W: Divert towards adjacent beach for containment and recovery, and deflect away from the inlet seaward.

B. Redirect and contain oil in inlet throat

- Use echelon booming configuration to divert oil to both the east and west shorelines for containment and recovery.
- Currents will most likely override winds in terms of oil transport direction.
- Current will slow as inlet widens so boom is likely more effective in southern half of the inlet.
- U-boom configuration behind inlet for additional containment and recovery.
- Boom and shoreline recovery locations must be adjusted for flood and ebb currents.

LOGISTICS

PRS #: 2 FS #: 175 NOAA Chart #: 16085

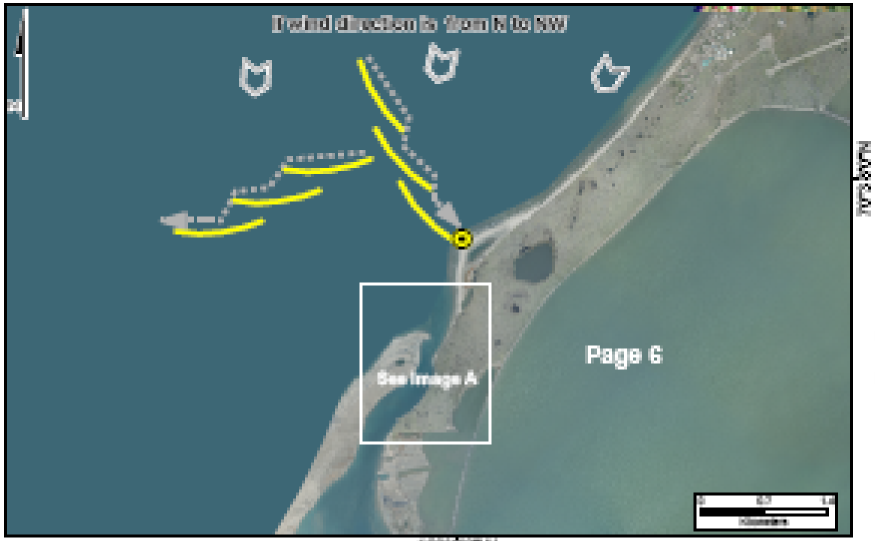
Airport: Wainwright 1370 m (4494 feet) gravel runway

Distance - Air

Barrow - 150 km / 95 miles

Point Lay - 150 km / 95 miles

The strategies illustrated on this page do not necessarily reflect actual amounts or types of equipment that might be used in a given response incident.

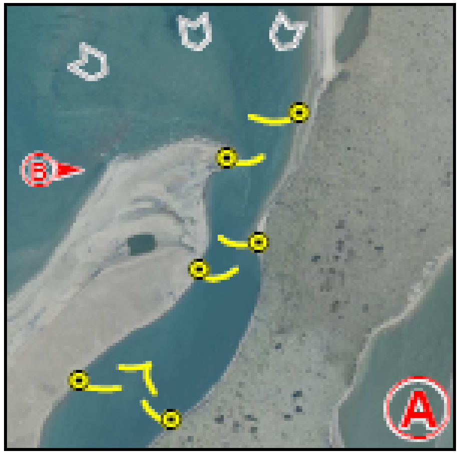


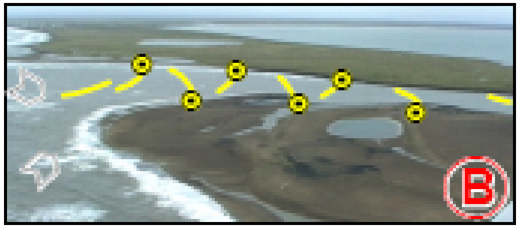
Legend:

- Diversion Boom
- Shoreline collection/recovery area
- U-boom Configuration
- Potential slick approach direction
- Detailed image and direction

CPAI imagery acquired in 2008

Oblique video frame acquired July 29, 2001.





Shoreline Protection Job Aids

- Aim is to help responders make good decisions ("best practices")
- Take what we know about coastal dynamics and apply to guidelines so that protection strategies:
  - can be successful
  - do not do more harm than the oil

Summary

- Enable response options to be evaluated in terms of "***good science***"
- Help understand the ***consequences o***f proposed options
- Evaluate potential to ***success***fully meet objective(s)
- ***Job Aids*** translate and simplify sometimes complex issues for decision makers and responders
- Identify ***Best Management Practices*** (NEB)