



Submerged Oil Recovery Techniques in Fresh Water

Case Study – Lake Wabamun

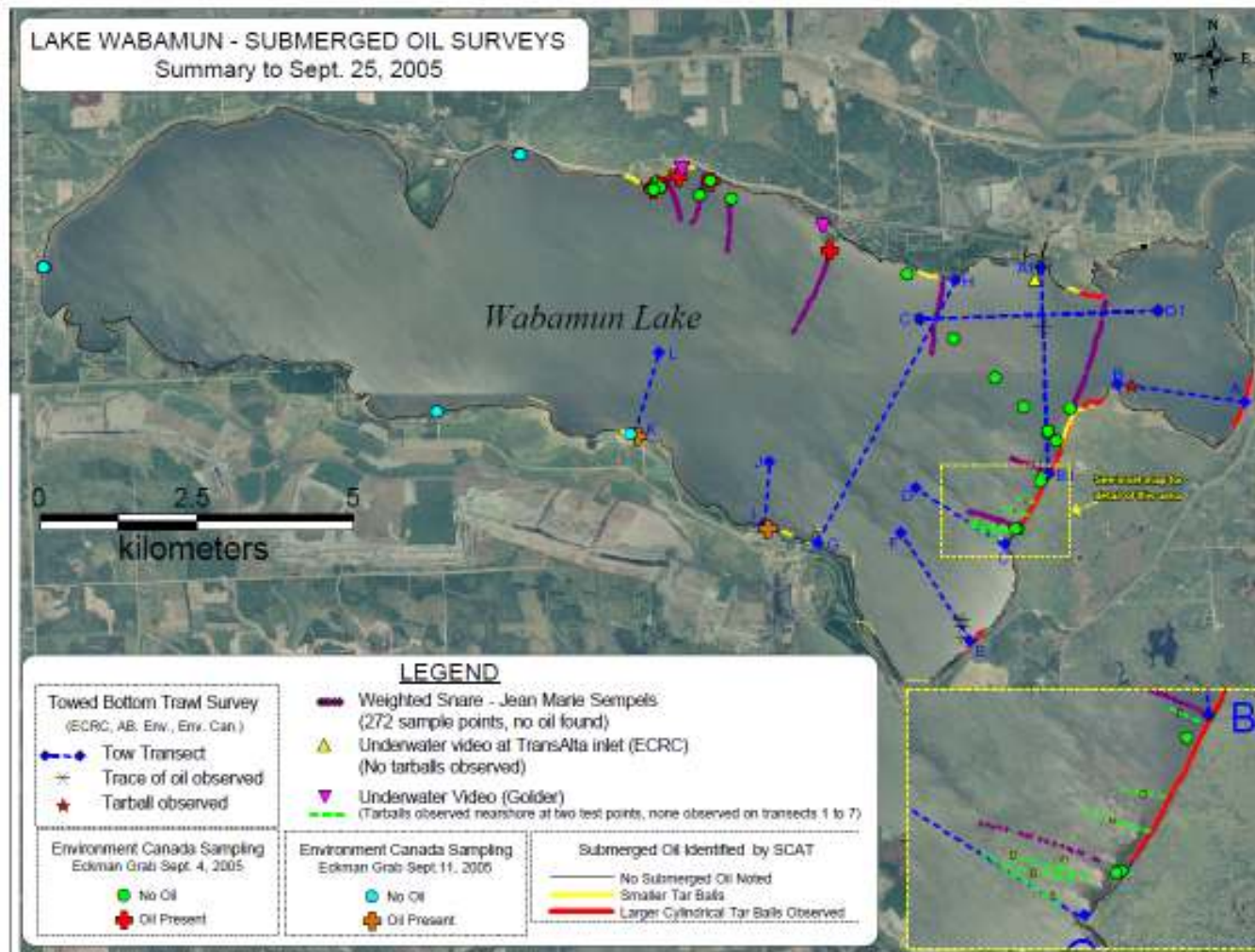
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Spilled Oil Properties

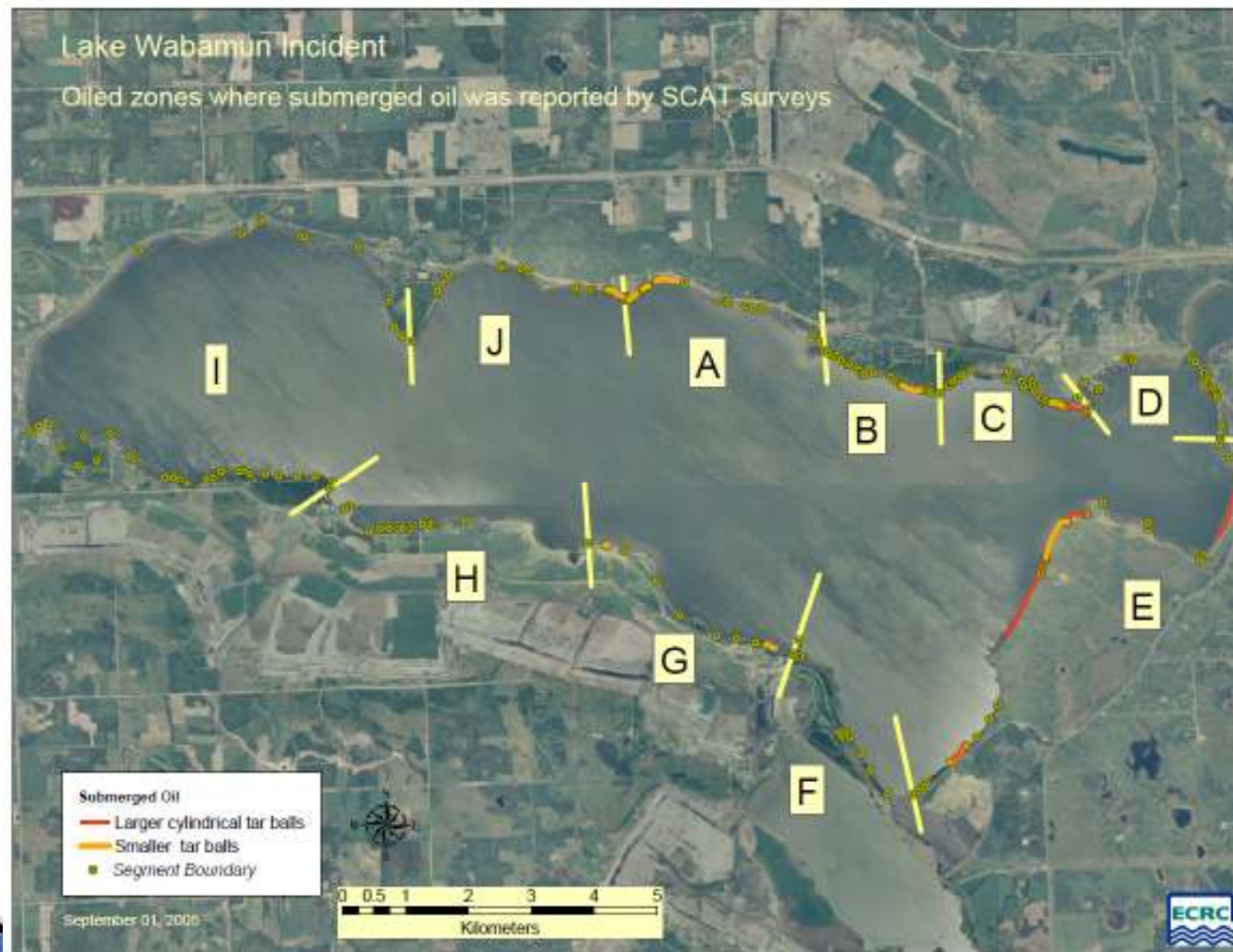
- 712,117 litres of Bunker C (No. 6 Fuel Oil)
- Heated prior to transport in rail cars (typically transported at 70^o -75^oC – cools slowly during transport)
- Spilled oil ran over the ground and spilled into a freshwater lake



Location, Location, Location



Location, Location, Location



Submerged Oil - SCAT Survey Team



Survey & SCAT Results

Subsurface oil was found in the lake:

- Submerged
 - Neutrally or slightly negatively buoyant tar balls



Survey & SCAT Results

Subsurface oil was found in the lake:

➤ Submerged

- Coating the stems of reeds below the waters surface



Survey & SCAT Results

Subsurface oil was found in the lake:

- Sunken – amongst reed beds
 - On reed chaff
 - Sand & sediment bottoms



Survey & SCAT Results

Subsurface Oil was found in the lake:

- Sunken – on non-vegetated sand & sediment bottoms



Submerged Oil Characteristics

Several distinct forms of the submerged oil encountered most likely all derivatives of tar balls:

- Small flakes of oil
- Medium to large tar balls (sizes up to grape fruit and melon sized)



Submerged Oil Characteristics

Several distinct forms of the submerged oil encountered most likely all derivatives of tar balls:

- Tar mats
- Tar logs or rolls



Submerged Oil Characteristics

Refloating of some of the submerged oil was observed on a regular basis. The oil would tend to rise from the bottom in small globules (like a lava lamp), break free, surface, and create a sheen. This phenomenon was most noticeable in the afternoons in shallow waters.

There are three theories to explain the mechanism by which this occurred:

1. **Downward sand migration** through the oil allowed portions of the submerged oil to become lighter and refloat. The oil/sand mixture could, over time, separate and allow the oil to refloat.
2. Increased sun angle and higher temperatures caused **oil heating** and refloat in the shallow waters.
3. **Increased water column mixing or turbulence** refloating the neutrally buoyant oil because of waves or upwelling from the sun heating the water.



False Sightings - Nostoc



False Sightings - Coal Beach



False Sightings - Algal Blooms



Containment

- Submerged and Surface oil containment of:
 - Mobile tar balls
 - Sheens and oil released from resurfacing product
- Achieved using solid flotation booms, silt fence booms, fine mesh netting and / or sorbent booms



Containment



Containment

- Sunken oil containment where possible achieved by silt boom and silt fencing



Containment – Silt Curtain Boom



Silt Curtain Boom



Containment - Nets



Containment - Barrier



Recovery Techniques

- Several recovery techniques recommended to Treatment **A**dvisory **G**roup (TAG = REET).
- Onsite tests conducted to determine effectiveness and net environmental benefit.
- TAG approved use of treatment methods site by site.
- Many areas required the removal of reeds to facilitate treatment.



Reed Harvesting

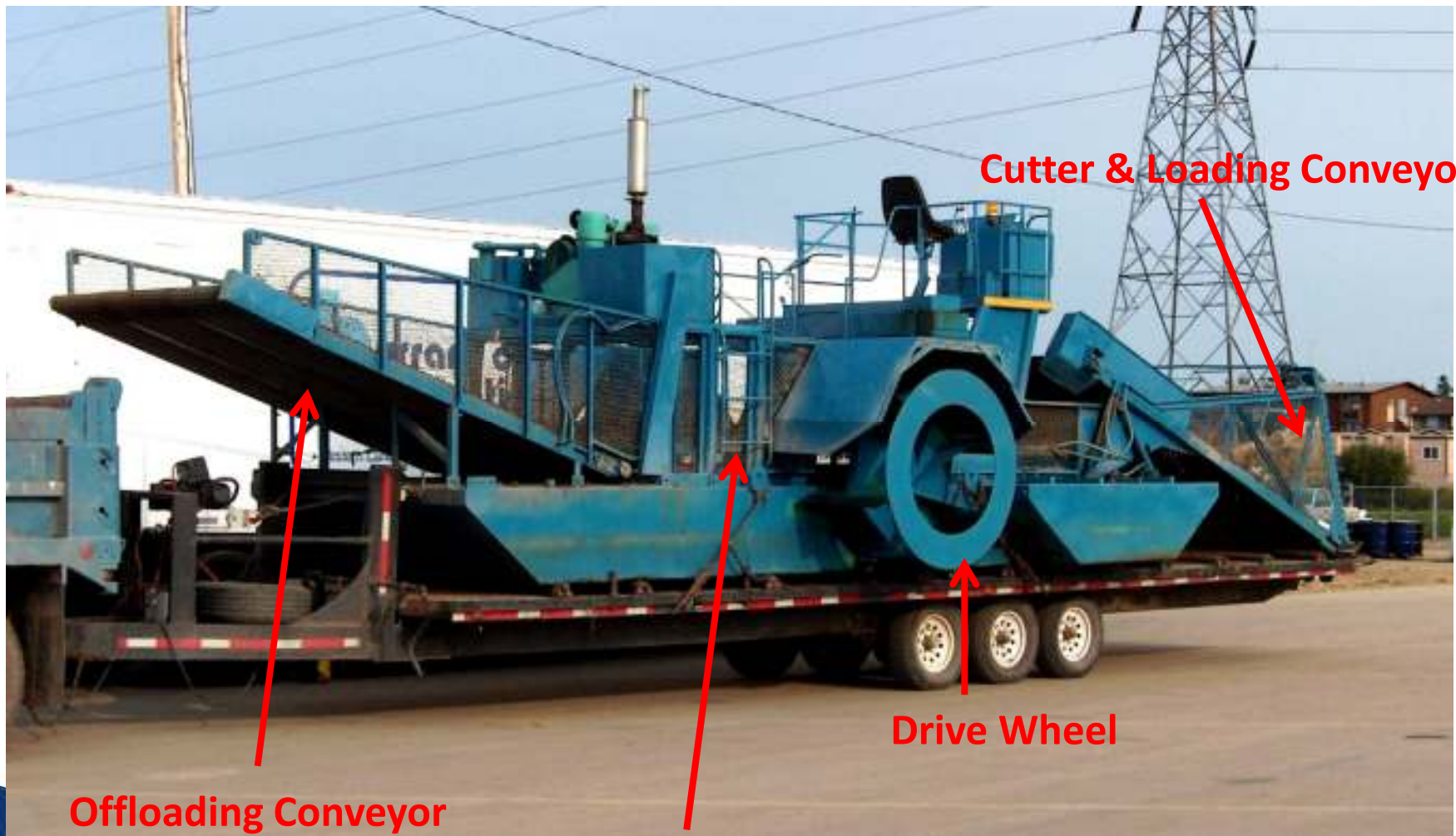
- Done Manually & by Floating Harvester
 - Served as both a technique to
 - Recover oiled reeds
 - Facilitate submerged oil recovery



Manual Reed Harvesting



Reed Harvester



Offloading Conveyor

Storage Bin

Drive Wheel

Cutter & Loading Conveyor

Reed Harvester

Cutting



Storing



Harvester
Offloading




SEATRUCK OFFLOADING



SEATRUCK OFFLOADING



Recovery Methods

- ✓ **Manual** pickup of balls and patties on the bottom by workers wading in shallow water.
 - ✗ **Agitation** (“wet tilling”) using chains suspended from a towed floating bar in non-vegetated near shore waters adjacent to lake-front properties.
 - ✓ **Agitation** (“wet tilling”) using low-pressure water flushing from a boat in fringing vegetated areas adjacent to lake-front properties.
 - ✓ **Vacuum** removal of balls and patties on the bottom by workers wading in shallow water or from a boat in deeper waters.
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Manual Removal



Nostoc

Tar Balls



Manual Recovery



Walking Manual Recovery



Manual Recovery & Containment Cells



Manual Recovery & Containment Cells



Manual Recovery & Containment Cells



Manual Recovery Results



Wet Tilling

- Low pressure flushing

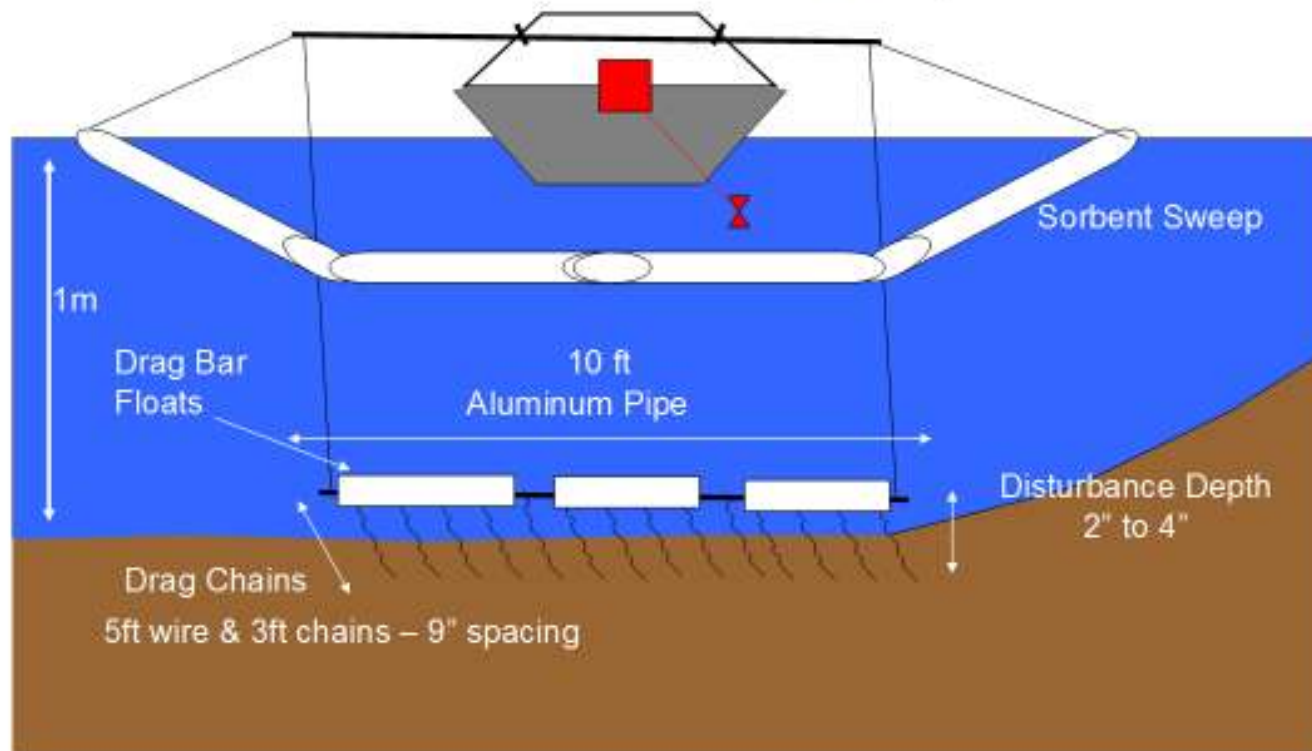


Wet Tilling – Towed Chain Agitation

Bottom Disturbance – Wet Tilling

Vessel Mounted Drag Bar

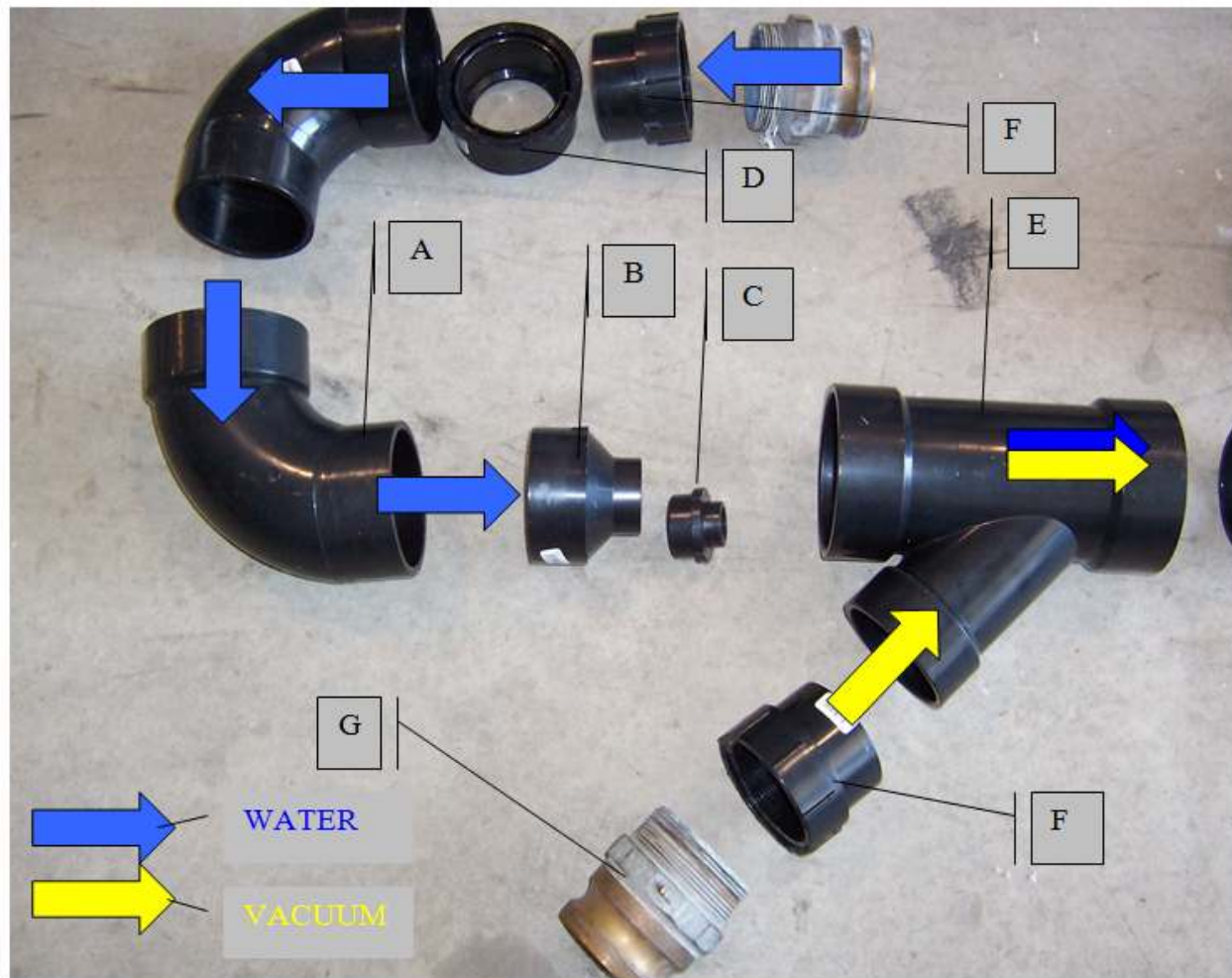
Aluminum Spreader Bar



Wet Tilling Test Results



Vacuum Removal - Manifold



Vacuum Recovery Technique



Vacuum Recovery Technique



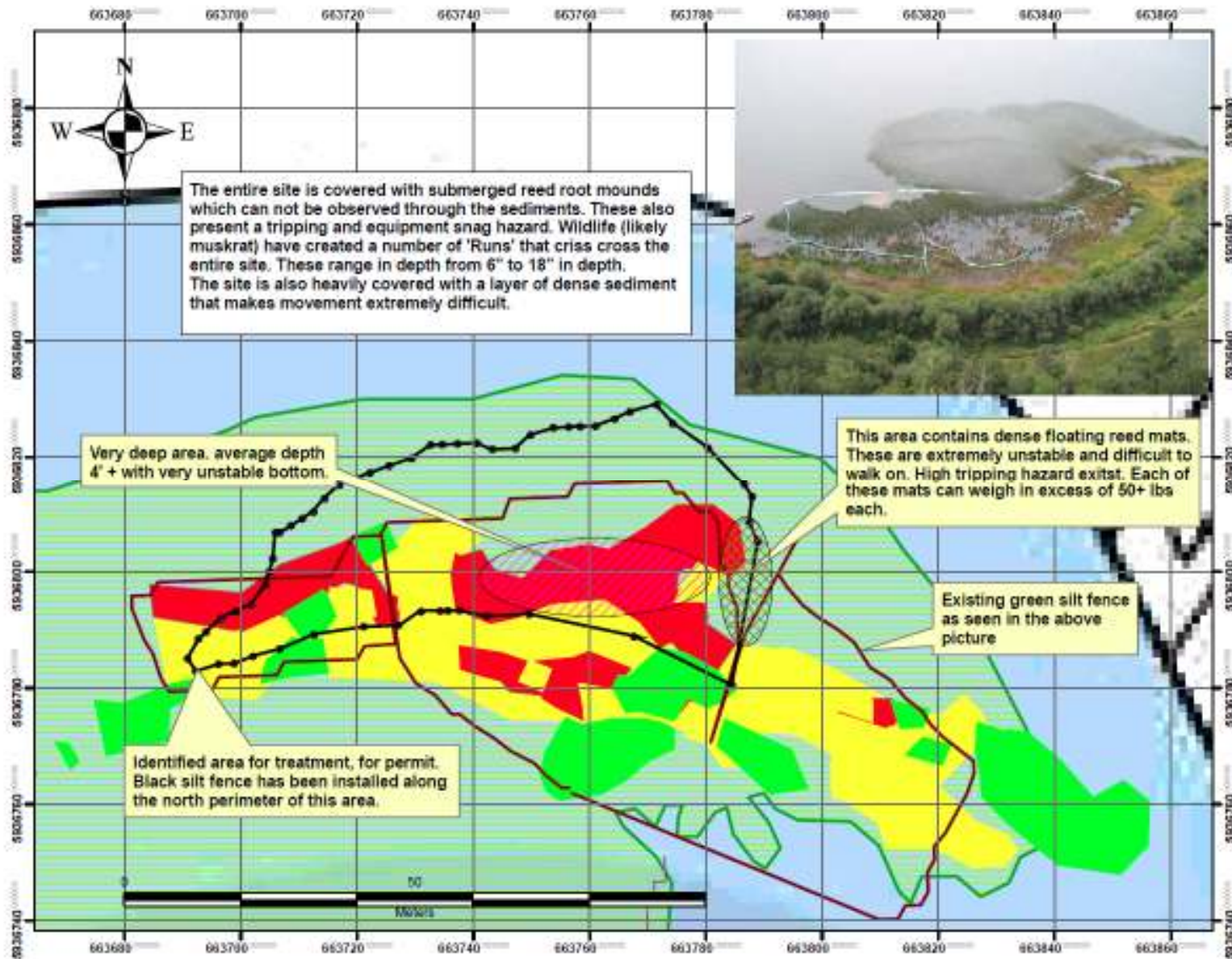
Vacuum Recovery Technique



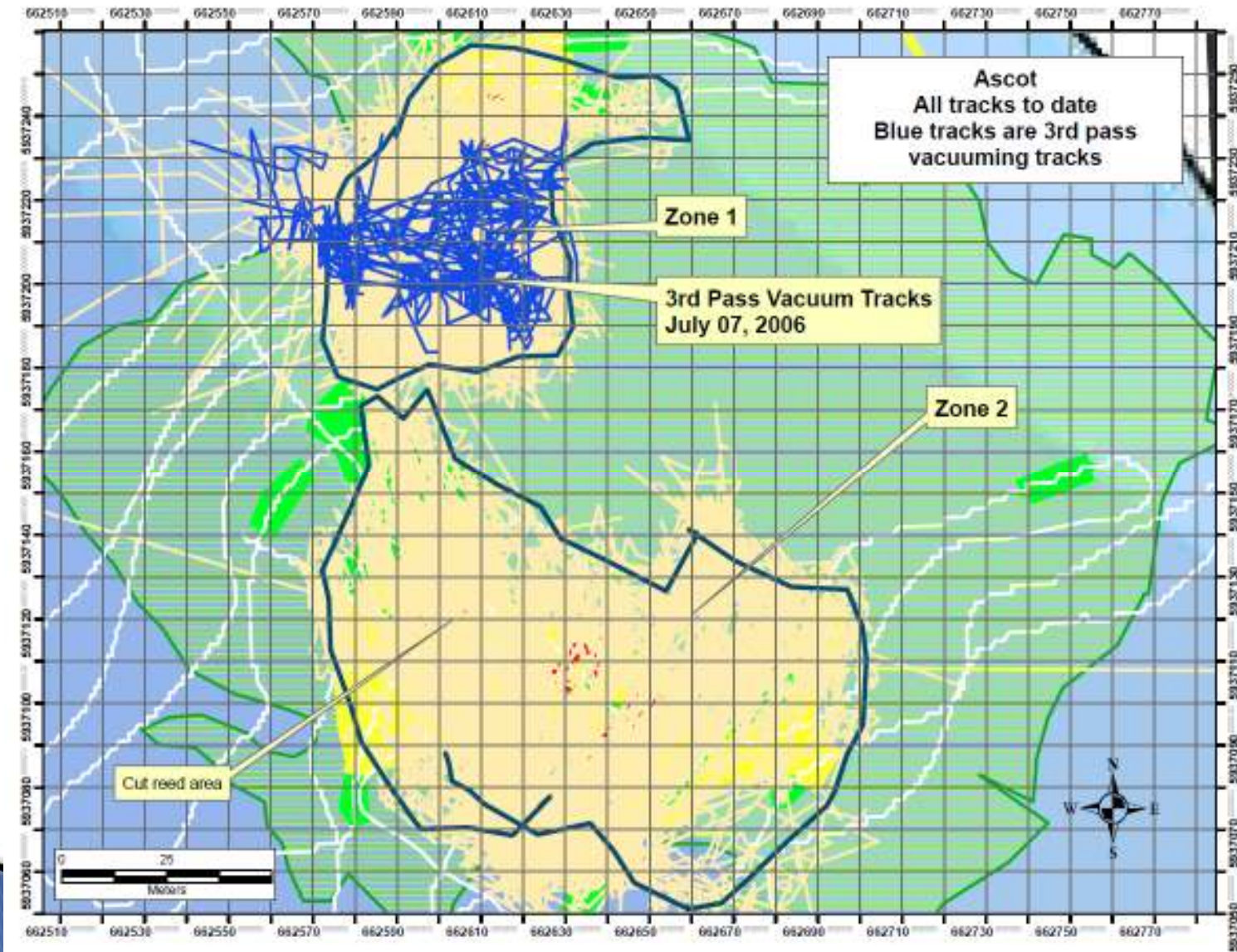
Vacuum Recovery Technique



Operations Guided by SCAT Surveys



GPS Tracking of Operations



Conclusion

- Subsurface Oil located by SCAT surveys
- Recovery Methods
 - ✓ Developed
 - ✓ Tested
 - ✓ Approved by agency for use
 - ✓ Implemented & adjusted as necessary



Questions?

