


Sunken Oil Removal Techniques and Data Gaps

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Recovery of Oil on Bottom

- Suction Dredge
- Diver-Directed Pumping and Vacuuming
- Mechanical Removal
- Sorbent/V-SORs
- Trawls and Nets
- Manual Removal
- Agitation/Refloat

Suction Dredge

Advantages	Disadvantages
Suction Dredge with Cutter/Auger Head Attachment	
- Common piece of equipment, readily available, easy to transport - Little to no modifications required for sunken oil recovery - Can cover large areas quickly with 5 to 8 feet swath width - Ability to pump/transport great distances - Ability to pass large solids, i.e., rocks and debris - Self-propelled or guide-cable operation - Adjustable “cut” depth allowing the removal of +/- 1 inch to several inches in one pass - Can track and document progress with GPS - Low manpower requirement to operate - Amphibious models can operate from 0-20 feet depth for small units and up to 40 feet for large units	- Generates large amounts of water and sediment requiring dewatering, handling of solids, and water treatment - Only suitable for protected waters - Non-discriminate recovery, cannot tell the difference between oil and water/sediment - High rpm pump has the potential to create issues with turbulence that results in oil emulsification and shearing - Not allowed to work in areas with pipelines, cables, or other obstructions

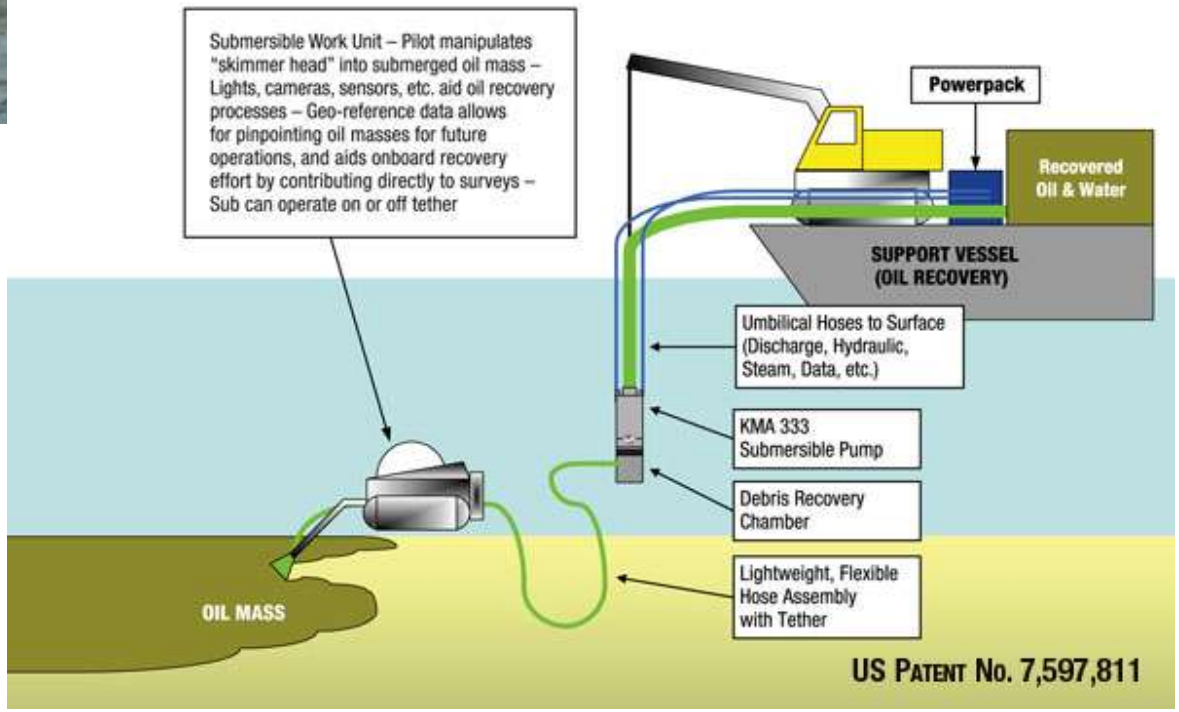
Suction Dredge

Creates a lot of water and sediment for handling, treatment, and disposal

Diver-Directed Pumping

Advantages	Disadvantages
Diver-directed Vacuuming	
— Vacuum trucks readily available. — Portable Vacuum Transfer Units (VTUs), while not as prolific as vacuum trucks, are available. — Ability to regulate flow. — Minimal mixing of recovered fluids and solids. — Ability to pass some solids (i.e. rocks and debris). — Can handle high viscosity. — Selective recovery provided diver has visibility.	— Rapid loss of effectiveness due to hose distance. — Large, heavy units. — Requires larger vessel or barge if unprotected water. — Small coverage area.
Diver-directed Pumping with Centrifugal Pump	
— Lightweight and portable. — Can pump long distances. — High head pressure, can pump several hundred feet up. — Easily modified to protect from rocks with a “rock box”. — Ability to regulate flow. — Selective recovery provided diver has visibility. — Can introduce steam or hot water to reduce viscosity. — Ability to pass some solids (i.e. rocks and debris).	— Not readily available; must locate from dive or dredge contractor, some oil spill response organizations. — Generates large amounts of water and sediment requiring dewatering, handling of solids, and water treatment. — High rpm pump has the potential to create issues with turbulence, emulsification, and shearing. — Cannot handle viscous oil other than small amounts moved in large amounts of water. — Small coverage area.

Other Mechanical Pumping

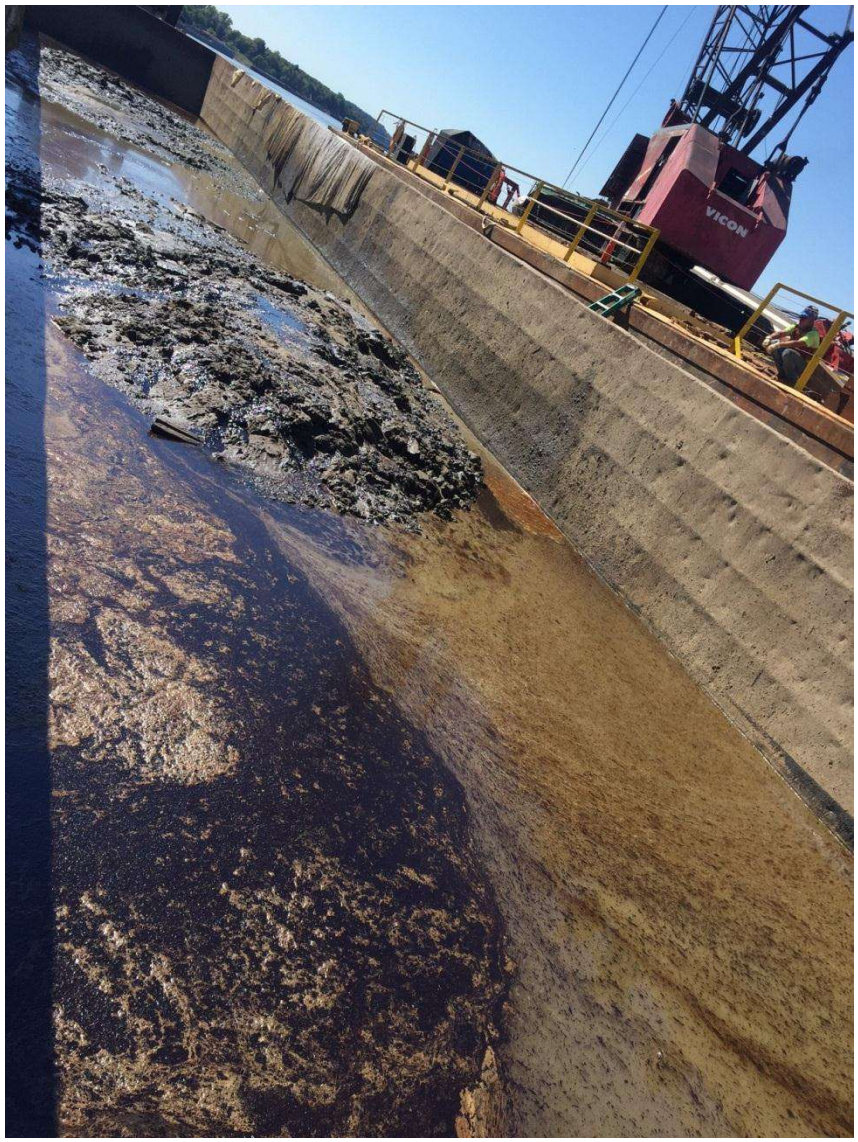


Mechanical Removal: Excavator

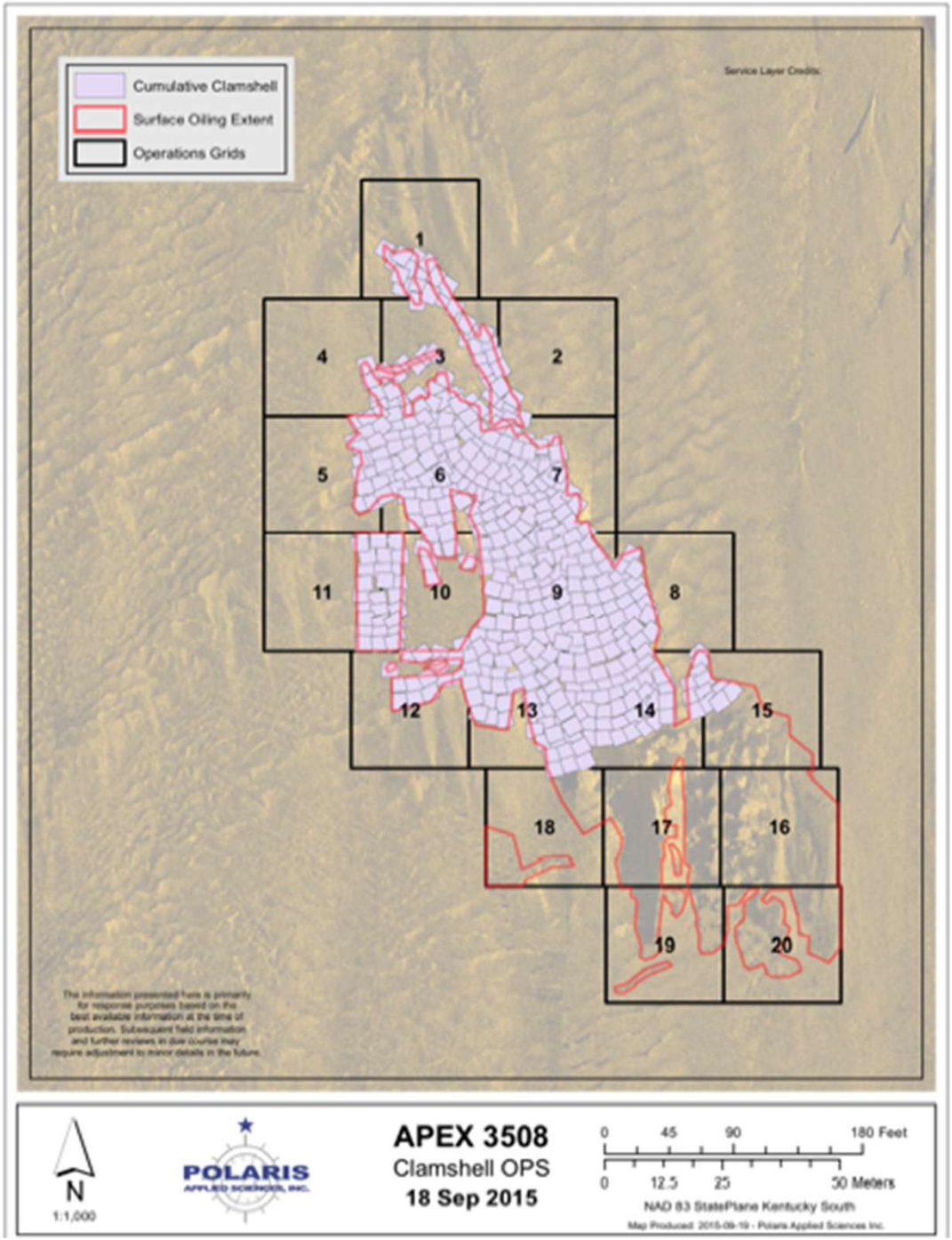
Advantages	Disadvantages
Excavator	
- Readily available in varying sizes - Can work from shore for nearshore work - Can work from vessel or barge - Amphibious models available though not as prevalent - Can scoop sunken oil with bucket - Easy addition of a thumb attachment for recovering solid or semi-solid sunken oil - No issues with rocks or debris - Can track progress with geo-referenced data	- Limited to +/- 20 feet of water - Difficult to be selective, resulting in additional sediments - Difficult to manage liquid flowing from bucket during lift - Large, heavy units - Requires larger vessel or barge if unprotected water - Small coverage area

Mechanical Removal: Environmental Clamshell Dredge

Advantages	Disadvantages
Environmental Clamshell Dredge	
- Available from dredge, construction. and environmental engineering contractors - Can work from shore for nearshore work - Can work from vessel or barge - No issues with rocks or debris - Water-tight seal greatly reduces liquid leakage during recovery operations - Can track progress with geo-referenced data	- Not as prevalent as conventional clamshell - Small coverage area



Apex 3508 Removal


Cumulative Clamshell
Surface Oiling Extent
Operations Grids
Service Layer Credits:
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The information presented here is primarily for response purposes based on the best available information at the time of production. Subsequent field information and further reviews in due course may require adjustment to minor details in the future.
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POLARIS
APPLIED SCIENCES, INC.
APEX 3508
Clamshell OPS
18 Sep 2015
0 45 90 180 Feet
0 12.5 25 50 Meters
NAD 83 StatePlane Kentucky South
Map Produced: 2015-09-19 - Polaris Applied Sciences Inc.

Sorbents

Advantages	Disadvantages
Sorbents/V-SORS	
- Can be used in active vessel traffic lanes - Track lines can be recorded with the vessel's GPS to provide actual survey lines - Could detect both pooled and mobile oil moving above the bottom, but won't differentiate between them - Relatively efficient in that large areas could be surveyed - Readily available; can be sized for the task - Low tech; easy to train crews - Can vary the length of the trawl to refine spatial extent	- Time and labor intensive for deployment, inspection, and replacement - Susceptible to snagging on the bottom - Cannot determine where along the trawl the oil occurred - Difficult to calibrate the effectiveness of oil recovery - In deeper water, requires a vessel with a boom/pulley and adequate deck space on the stern for handling, inspection, and replacement - Best suited for recovery of small amounts of oil

Nets

Advantages	Disadvantages
Towed Nets or Trawls	
- Readily available in areas with commercial fisheries - Experienced operators (fisherman) with vessels capable of effectively towing	- Difficult to specify size of net openings, have to use what is available - Leakage of oil through net may occur and hard to monitor - Cannot be cleaned and returned for intended purpose, thus most likely will be a one-time use - Will require support to handle and dispose of oiled nets - May have issues with debris - May snag on rocks or obstructions

Manual Removal

Advantages	Disadvantages
Manual Recovery Shallow Water	
- Low tech, only requires labor force and hand tools - Selective recovery, limiting co-collection of water and sediment	- Slow and labor intensive - Requires proper PPE - Restricted to shallow water <5 ft - Waves and currents will limit operations - Requires relatively good water clarity for visibility - Severe weather will suspend operations
Manual Recovery with Divers	
- Relatively low tech, requires divers and hand tools - Selective recovery, limiting co-collection of water and sediment	- Slow and labor intensive - May require extensive logistical support if based off vessel or barge - Requires contaminated-water dive gear - Requires proper decontamination of dive gear - Requires relatively good water clarity for visibility - Severe weather will suspend operations

Agitation/Refloat

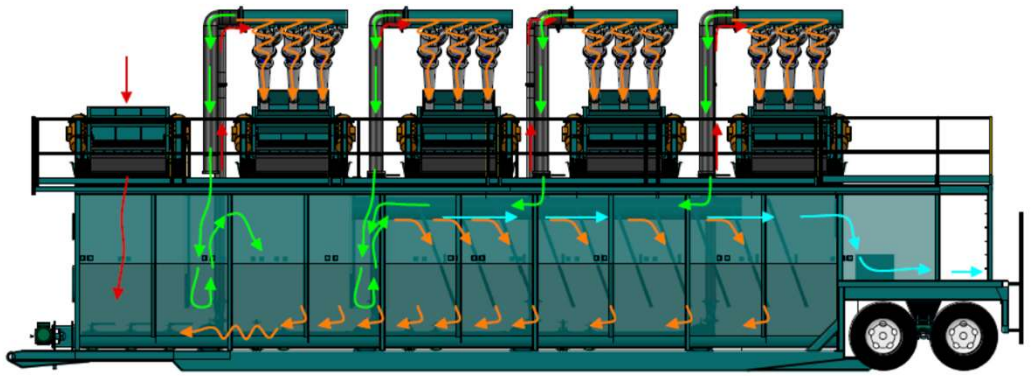
Advantages	Disadvantages
Agitation/Refloat	
— Off the shelf items such as pumps and rakes can be used. — Aerators designed for waste water treatment or fish ponds can be modified for sunken oil recovery. — Selective recovery limiting associated recovered water and sediment.	— Slow and labor intensive. — Small coverage area. — Restricted to shallow water <8 feet and relatively low water velocity. — Suspended oil can remain mixed with the sediments and resettle to the bottom after agitation. — Mixes remaining oil deeper into the sediments. — Only effective with liquid oils that are loosely adhered to the sediment and will re-float when separated from the sediment, and where complete containment of the resuspended oil is possible. — Generates high turbidity that can spread downstream.

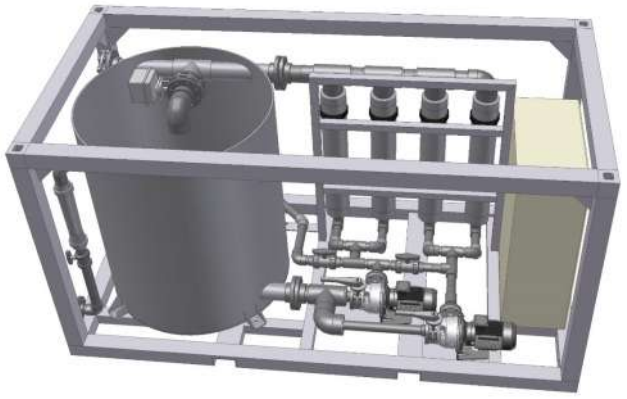
Recovery of Oil on Bottom:
Decanting Systems

- Always *ad hoc*, under designed, lots of trial and error

Recovery of Oil on Bottom:
Decanting Systems

- Need guidelines and calculation tools
- Consider droplet size, flow rates, and oil behavior
- Advances in off-the-shelf systems
- Problems when used offshore–unstable platforms





Sunken Oil Recovery Data Gaps

- Optimization of Nozzle and Stinger Designs to Minimize Water and Sediment Removal During Vacuuming and Pumping Operations
- Evaluate the Performance of Wastewater Treatment Systems for Effluents Typical in Content and Variability from Sunken Oil Recovery Operations–including offshore conditions
- Guidelines for cleanup endpoints