Bureau of Safety and Environmental Enforcement

How Much is Enough? Planning Standards, Preparedness Research, and New Planning Tools for Measuring Response Equipment Capabilities

John Caplis
Oil Spill Preparedness Division (OSPD)
U.S. Bureau of Safety and Environmental Enforcement (BSEE)
john.caplis@bsee.gov

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European Commission/EMSA
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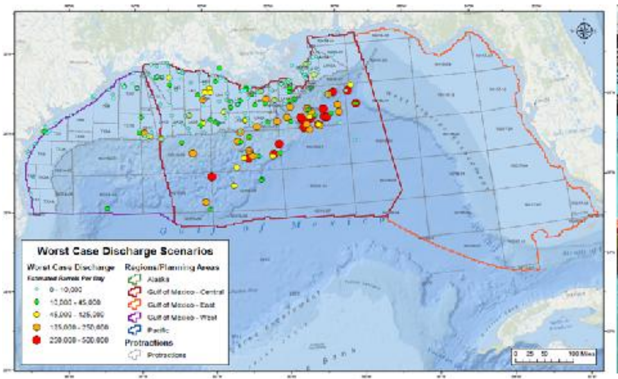
BSEE Mission Statement

"To promote safety, protect the environment and conserve resources offshore through vigorous regulatory oversight and enforcement."

OSPD Mission Statement

"To protect people and the environment from, and optimize responses to, offshore facility oil spills through research, regulatory oversight, and integrated government and industry preparedness"



2

Commonly used paradigm for evaluating the capacity of equipment in a oil spill response plan

Daily Recovery Capacity*
of Skimming Equipment

=

Volume of Oil Spilled

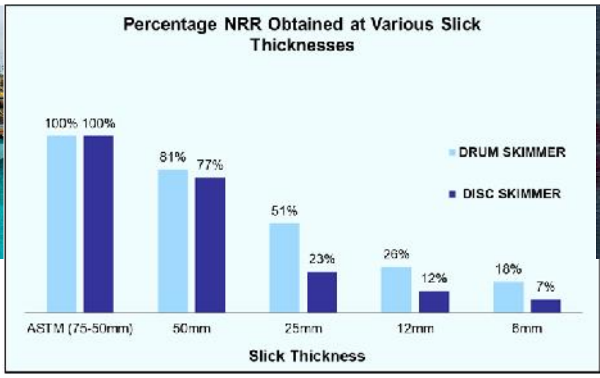
Recovery Capacity is based on throughput volume of skimmer and pump

3

Encounter Rate Issues with Volume-Based Metrics for Recovery Equipment (Slick Thickness and Spatial Distribution)

Impact of Oil Slick Thickness on Skimmer Nameplate Recovery Rates (NRR)

Ideal conditions used for ASTM testing of skimmer recovery rates

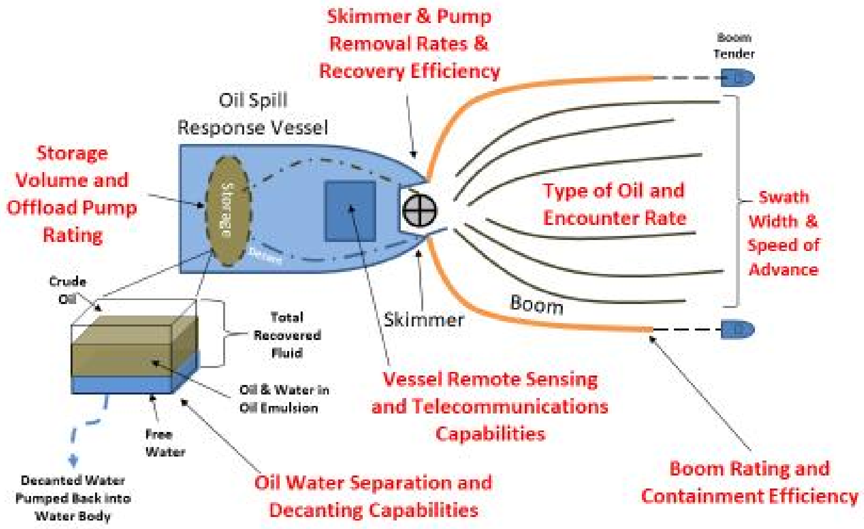


Actual skimming conditions

https://www.bsee.gov/research-record/evaluation-of-skimmer-performance-in-diminishing-oil-thicknesses

4

System Components That Affect the Capacity of an Advancing Mechanical Recovery System



5

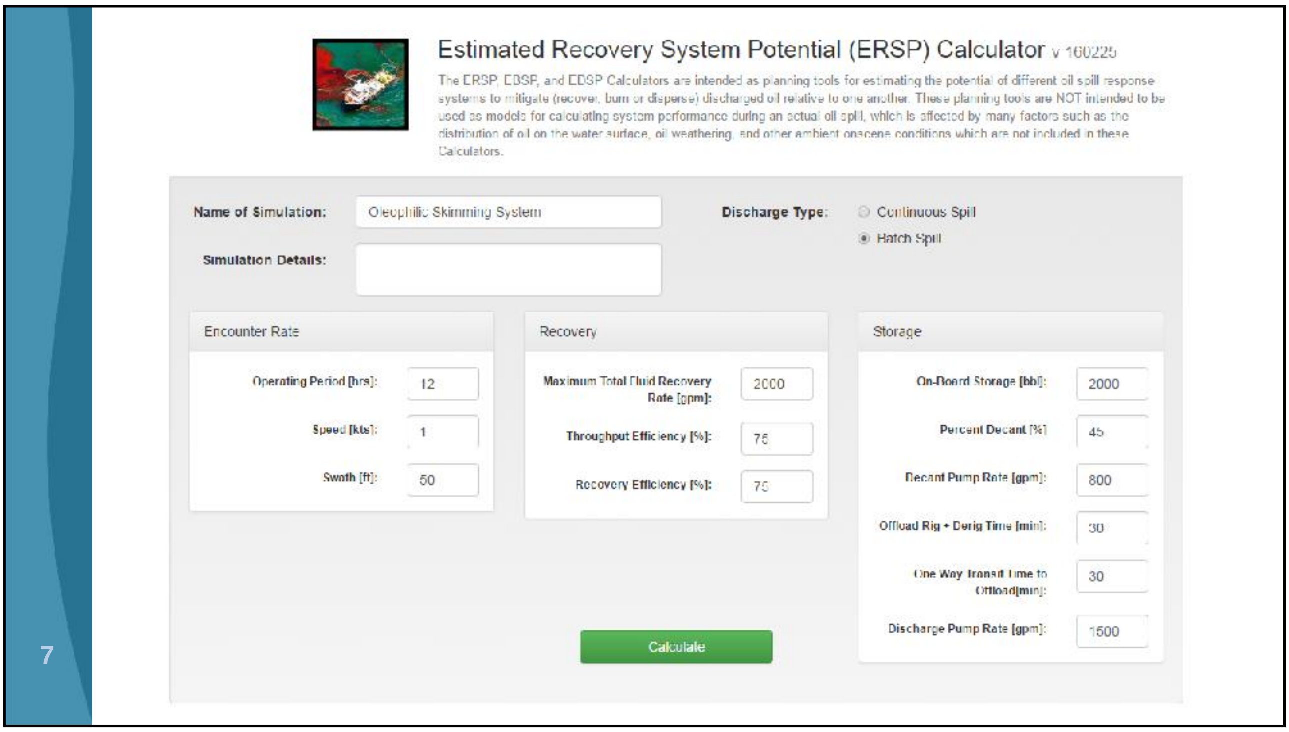
Response Calculators & User Manuals

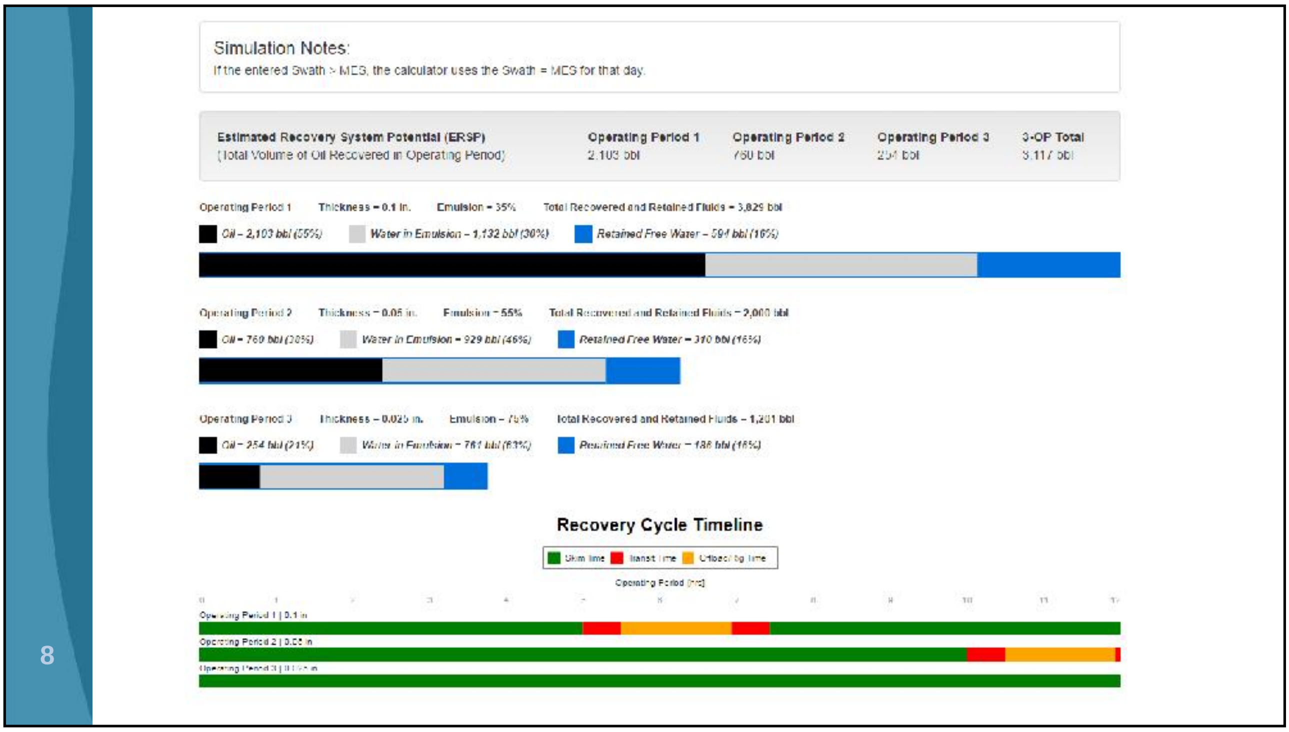


- Calculators Estimate Potential Response Capabilities
  - Encounter Rate, Systems-Based Metrics/Tools
  - Address both areal coverage and volume
  - Allow comparisons between different systems and/or countermeasures
  - Afford opportunities to optimize existing systems
  - Provide incentives to improve/invest in future systems

https://www.bsee.gov/what-we-do/oil-spill-preparedness/response-system-planning-calculators

6


Estimated Recovery System Potential (ERSP) Calculator v 160225
The ERSP, EBSP, and EDSP Calculators are intended as planning tools for estimating the potential of different oil spill response systems to mitigate (recover, burn or disperse) discharged oil relative to one another. These planning tools are NOT intended to be used as models for calculating system performance during an actual oil spill, which is affected by many factors such as the distribution of oil on the water surface, oil weathering, and other ambient onscene conditions which are not included in these Calculators.
Name of Simulation:
Oleophilic Skimming System
Discharge Type:
Continuous Spill
Batch Spill
Simulation Details:
Encounter Rate
Operating Period [hrs]:
12
Speed [kts]:
1
Swath [ft]:
50
Recovery
Maximum Total Fluid Recovery Rate [gpm]:
2000
Throughput Efficiency [%]:
75
Recovery Efficiency [%]:
75
Storage
On-Board Storage [bbl]:
2000
Percent Decant [%]
45
Decant Pump Rate [gpm]:
800
Offload Rig + Derig Time [min]:
30
One Way Transit Time to Offload[min]:
30
Discharge Pump Rate [gpm]:
1500
Calculate
7


Simulation Notes:
If the entered Swath > MES, the calculator uses the Swath = MES for that day.
Estimated Recovery System Potential (ERSP)
(Total Volume of Oil Recovered in Operating Period)
Operating Period 1
2,103 bbl
Operating Period 2
760 bbl
Operating Period 3
254 bbl
3-OP Total
3,117 bbl
Operating Period 1 Thickness = 0.1 in. Emulsion = 35% Total Recovered and Retained Fluids = 3,829 bbl
Oil – 2,103 bbl (55%)
Water in Emulsion – 1,132 bbl (30%)
Retained Free Water – 594 bbl (16%)
Operating Period 2 Thickness = 0.05 in. Emulsion = 55% Total Recovered and Retained Fluids = 2,000 bbl
Oil = 760 bbl (38%)
Water in Emulsion = 929 bbl (46%)
Retained Free Water = 310 bbl (16%)
Operating Period 3 Thickness = 0.025 in. Emulsion = 75% Total Recovered and Retained Fluids = 1,201 bbl
Oil = 254 bbl (21%)
Water in Emulsion = 761 bbl (63%)
Retained Free Water = 186 bbl (16%)
Recovery Cycle Timeline
Skim time
Transit time
Offload time
Operating Period [hrs]
Operating Period 1 | 0.1 in
Operating Period 2 | 0.05 in
8

Operating Period Encountered Product (Oil/Emulsion) Thickness % of Water in Oil/Water Emulsion	Op. Period 1 0.1 in 35%	Op. Period 2 0.05 in 55%	Op. Period 3 0.025 in 75%
Encounter Rate Results			
Maximum Effective Swath (MES)	317 ft	634 ft	1,267 ft
Swath Used For Calculation	50 ft	50 ft	50 ft
Oil/Emulsion Encounter Rate	316 gpm	158 gpm	79 gpm
Areal Coverage Rate	0.12 acres/min	0.12 acres/min	0.12 acres/min
Area Covered in Operating Period (Acres)	67 acres	70 acres	84 acres
Area Covered in Operating Period (Sq. Miles)	0.1 sq mi	0.11 sq mi	0.13 sq mi
Recovery Results			
Total Fluid Recovery Rate	316 gpm	158 gpm	79 gpm
Free Water Recovery Rate	79 gpm	39 gpm	20 gpm
Oil/Emulsion Recovery Rate	237 gpm	119 gpm	59 gpm
Water in Emulsion Recovery Rate	83 gpm	65 gpm	44 gpm
Oil Recovery Rate	154 gpm	53 gpm	15 gpm
Storage Results			
Water Retained Rate	43 gpm	22 gpm	11 gpm
Decant Rate	30 gpm	18 gpm	9 gpm
Time to Fill Onboard Storage	5 hr	10 hr	19.99 hr
Total Offload Cycle Time for Full Tank(s)	2.43 hr	2.43 hr	2.43 hr
Time for One Full Cycle (skimming, transit, ng + derig, offload, transit)	7.43 hr	12.43 hr	22.42 hr
Skimming Time in Operating Period	9.57 hr	10 hr	12 hr
Skimming Time in Operating Period (%)	80 %	83 %	100 %
Total Number of Fills in Operating Period	1.9	1	0.6
Volume Results			
Total Volume Oil/Emulsion + Free Water Retained in Operating Period	3,829 bbl	2,000 bbl	1,201 bbl
Total Volume of Free Water Recovered & Retained in Operating Period	594 bbl	310 bbl	108 bbl
Total Volume of Oil/Emulsion Recovered in Operating Period	3,235 bbl	1,690 bbl	1,014 bbl
Total Volume of Water in Emulsion Recovered in Operating Period	1,132 bbl	930 bbl	761 bbl
ERSP – Total Volume of Oil Recovered in Operating Period	**2,103 bbl**	**760 bbl**	**254 bbl**

9

Response Modeling for Worst Case Discharges

(BSEE Oil Spill Response Equipment Capability Analysis)

Lease Block	Water Depth (ft.)	Distance from Shore (NM)	WCD Daily Flowrate (bbls/day)	Oil Name/°APIGravity[b]
Gulf of Mexico OCS Region				
Mississippi Canyon (MC807)	3,030	46	449,000	South Louisiana Crude / 34.5
West Delta (WD28)	35	5.6	97,000	
West Cameron (WC168)	42	25	26,400	South Louisiana Condensate / 57.5
High Island East (HIA376)	334	112	77,000	South Louisiana Crude / 34.5
Keathley Canyon (KC919)	6,940	217	252,000	
DeSoto Canyon (DC187)	4,490	101	241,000	
Pacific OCS Region (Southern California Planning Area)				
Santa Maria (SM6683)	1,073	8	5,200	Point Arguello Light Crude / 30.3
Alaska OCS Region (Chukchi Sea Planning Area[a])				
Posey (P6912)	150	60	25,000	Alaskan North Slope Crude / 30.9
Alaska OCS Region (Beaufort Sea Planning Area[b])				
Flaxman Island (FL6610)	120	1 to 4	16,000	Prudhoe Bay Crude / 24.8

[a] For each of the two Arctic locations, there are two seasonal scenarios – one early and one late season, the latter of which may involve ice.

[b] An alternative measure of density of oil; the higher the °API, the lighter the oil.

https://www.bsee.gov/what-we-do/oil-spill-preparedness/worst-case-discharge-scenarios-for-oil-and-gas-offshore-facilities-and-oil-spill-response

10

Response Countermeasures Modeling

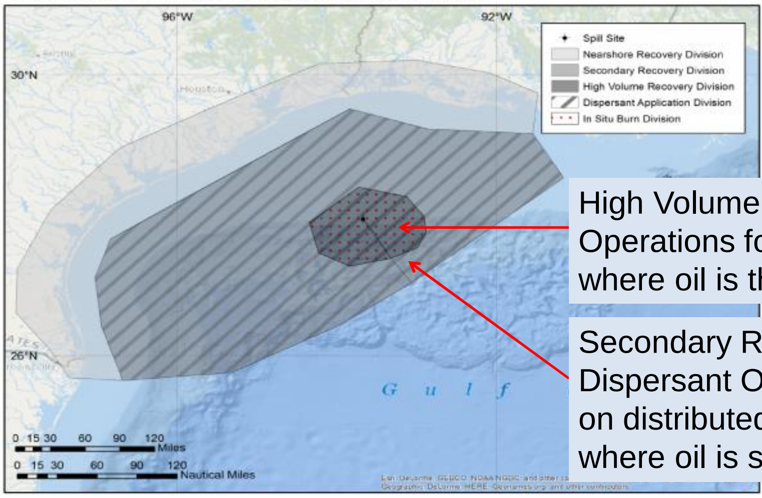
Stochastical and Deterministic Simulation Sets for Each WCD Scenario

Worst Case -- No Response	Source Control Only	Source Control with Additional Surface Response Options			Source Control with Subsea Dispersant and All Surface Response Options
		Mechanical Recovery	Mechanical Recovery Dispersants	Mechanical Recovery Dispersants In Situ Burning	

11

Offshore Response Concept of Operations

High Island 376 - Countermeasure Response Divisions



High Volume Removal Operations focused on areas where oil is thickest and fresh

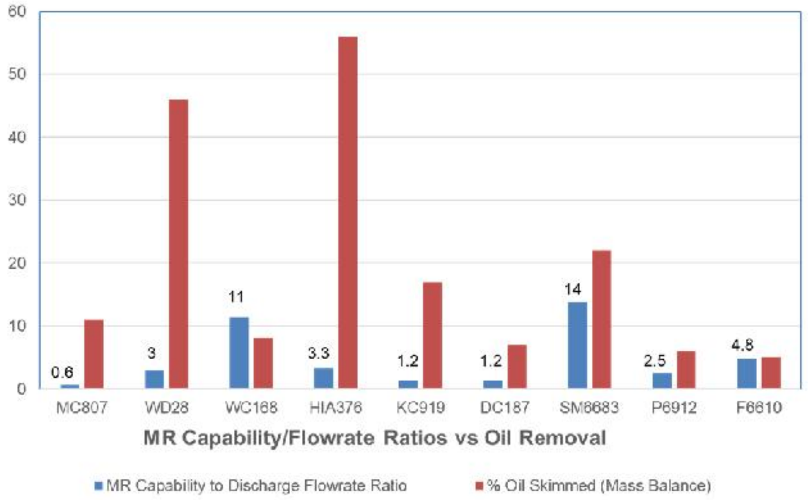
Secondary Recovery and Dispersant Operations focused on distributed patches of oil where oil is still fresh

High Island Scenario Response Divisions based on Oil Weathering and Trajectories

12

Mechanical Recovery (MR) Capacity Versus Oil Spill Volume

Is *matching the volume of oil spilled (in barrels) with a commensurate level of recovery capacity* a reliable means to ensure there is sufficient equipment to remove the discharge?



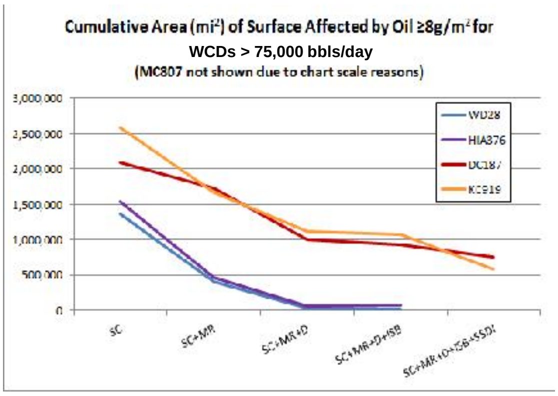
Response modeling did not show a consistent relationship between mechanical recovery capability employed and the oil removal that was achieved from scenario to scenario

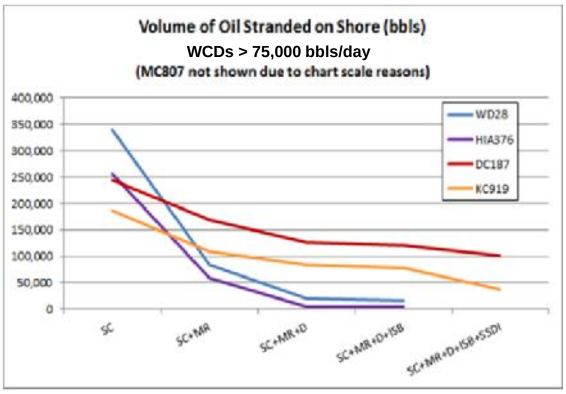
13

WCD Response Modeling & Oiling Contact With Environment

Region & Scenario		Ratio of Mechanical Recovery Capacity to Daily Spill Flowrate Volume	Percentage of Oil Spilled Removed by Mechanical Recovery Equipment	Oil Contact with the Environment		
				Cumulative Area of Ocean Surface Oiled (>8 g/m^2) (square miles)	Volume of Oil Stranded on Shorelines (barrels)/ Percentage Oil Stranded	Length of Shoreline Oiled (>1 g/m^2) (miles)
GOM	MC807	0.6	11 %	6,269,404	1,103,124 (5 %)	2,206
	WD28	3	46 %	406,291	83,674 (4 %)	815
	WC168 (Condensate)	11	8 %	2,276	2100 (0.4 %)	115
	HIA376	3.3	56 %	469,034	59,371 (4 %)	613
	KC919	1.2	17 %	1,670,216	109,040 (1 %)	899
	DC187	1.2	7 %	1,723,599	168,067 (2 %)	935
CA	SM6818	14	22 %	2,662	8,565 (16 %)	547
Arctic	P6912	2.5	6 %	586,816	12,739 (4 %)	211
	FL6610	4.8	5 %	133,573	68,764 (31 %)	347

14





WCD response modeling showed that the use of multiple countermeasures, in particular the combined use of mechanical recovery and dispersants, lead to significant reductions of overall oiling.

15

Evaluating Plan Capabilities Based on Spill Response Modeling for Reduced Oil Contact With the Environment

Region & Scenario		Reduction in Oil Contact with the Environment From Baseline*			
		+ Mechanical Recovery (MR)		MR + Dispersants	
		Cumulative Area of Ocean Surface Oiled (>8 g/m²) (square miles)	*Volume of Oil Stranded on Shorelines (barrels)*	Cumulative Area of Ocean Surface Oiled (>8 g/m²) (square miles)	*Volume of Oil Stranded on Shorelines (barrels)*
GOM	MC807	-46 %	-41 %	-52 %	*-47 %*
	WD28	-78 %	-82%	-98%	*-96%*
	HIA376	-79 %	-89 %	-97 %	*-98%*
	KC919	-68 %	-88 %	-79 %	*-90 %*
	DC187	-62%	-89 %	-78%	*-92%*
CA	SM6818	-95%	-83%	-95%	*-84%*
Arctic	P6912	-42 %	-66 %	-54 %	*-70 %*
	FL6610	-68 %	-53 %	-73%	*-56%*

LEGEND

Surface Area Oiling Reduction
- < 50%
- > 50%

Shoreline Oiling Reduction
- < 75%
- > 75%

16

*Baseline reflects the worst case simulation for shoreline oiling without temporary source control or spill mitigation countermeasures employed (i.e. an ongoing discharge occurring until a relief well can be drilled).

Summary Points

1. Matching the total volume of recovery rates for equipment in a plan against the worst case discharge volume is a poor planning standard that ignores the areal aspects of an oil spill.
2. Use a systems-based approach to evaluate the potential capabilities of response equipment. The response calculators are excellent tools for evaluating each system's limitations and potential.
3. Consider response times, anticipated periods of down time, and the areal coverage rates of equipment to encounter oil when determining the size of the stockpiles.
4. Consider how changing oil properties due to weathering will impact the effectiveness of the response systems. Completing oil characterization and weathering studies as part of an contingency plan can significantly inform strategies for the employment of response equipment.
5. Significantly more removal capabilities will be required than the WCD volume in order to achieve a desirable outcome in most cases. Stockpiles and strategies that employ both mechanical recovery and dispersants is likely to be more successful at minimizing the levels of oil contact.
6. Even in cases with desired response outcomes, significant amounts of oil contact with the environment should be expected.
7. Consider requiring scenario-based modelling in contingency plans in order to evaluate the capability of the contracted response resources to reduce oil contact with the environment.

17