

**PHASE 1: INITIAL CLEAN-UP (1/3)**

<i>Techniques / objectives / procedures</i>	<i>Equipment needed</i>	<i>Factors to be considered</i>
<b>1. Pumping at the water's edge and on the water</b> <span style="border: 1px solid black; padding: 2px;">►Datasheet n°02</span> <i>Aim: to recover large accumulations of pollutant by promoting its concentration and improving selectivity and yield</i>		
(a) Develop the storage site (liquid to slightly viscous pollutants) <ul style="list-style-type: none"> <li>- to facilitate sorting</li> <li>- to reduce volumes for evacuation</li> <li>- to restrict the spreading of the pollution</li> </ul>	<i>(should be adapted to suit the pollutant and the site)</i> <ul style="list-style-type: none"> <li>- area, trenches, (watertight) bunds, skips, tanks</li> <li>- drainage (rainwater overflow)</li> <li>- screening, sorting</li> <li>- earthmoving equipment (digging)</li> <li>- protective membranes and geotextile</li> </ul>	<ul style="list-style-type: none"> <li>- ecological sensitivity</li> <li>- accessibility of site</li> <li>- transfer of the pollution (watertight storage, decontamination of trucks)</li> <li>- traffic (should be channelled)</li> </ul>
(b) Concentrate slicks on the beach <ul style="list-style-type: none"> <li>- deflect the pollutant towards the beach (floating boom in a staggered configuration along large beaches positioned against the flow of longshore drift)</li> <li>- where possible, block the pollutant trapped in creeks (retention boom)</li> <li>- stop the slick from stranding (case of low tidal range) using a longitudinal boom positioned at the water's edge (pump pollutant over the boom)</li> </ul>	<ul style="list-style-type: none"> <li>- floating booms</li> <li>- shore-sealing booms</li> </ul>	<ul style="list-style-type: none"> <li>- personal health and safety (protective clothing, masks), decontamination</li> <li>- accessibility of the coast</li> <li>- agitation of the water body (currents, swell, wind)</li> <li>- tidal range</li> </ul>
(c) Contain and reconstitute the slick near the pumping/skimming means: <ul style="list-style-type: none"> <li>- by trawling (worksite boom, sorbent boom)</li> <li>- by scraping (planks, scrapers, brushes)</li> <li>- by hosing</li> </ul>	<ul style="list-style-type: none"> <li>- worksite booms</li> <li>- conditioned sorbents</li> <li>- planks, scrapers, hoses</li> <li>- small boat</li> </ul>	<ul style="list-style-type: none"> <li>- accessibility of the coast</li> <li>- agitation of the water body (currents, swell, wind)</li> <li>- tidal range</li> </ul>
(d) Pump <ul style="list-style-type: none"> <li>- stop obstruction of the pumps: anticipate screening or another way of retaining diverse debris</li> </ul>	<ul style="list-style-type: none"> <li>- skimming/pumping equipment (skimmer, pump, vacuum truck or other transfer system)</li> <li>- grating, filter baskets</li> <li>- storage capacities and transfer means</li> </ul>	<ul style="list-style-type: none"> <li>- nature (emulsion, viscosity) and evolution of the pollutant according to the temperature</li> <li>- presence of solid debris</li> <li>- draught of skimmers and compatibility with depth of water</li> </ul>
(e) Separate <ul style="list-style-type: none"> <li>- promote the separation of water and oil: emulsion breaking, settling</li> <li>- evacuate the products recovered</li> </ul>	<ul style="list-style-type: none"> <li>- settling tanks/separator</li> <li>- transfer pumps</li> <li>- demulsifier</li> <li>- trucks suited to the pollutant</li> </ul>	<ul style="list-style-type: none"> <li>- recovery of liquids from settling</li> <li>- ecological sensitivity and accessibility of the site</li> <li>- traffic lanes</li> </ul>

**PHASE 1: INITIAL CLEAN-UP (2/3)**

<i>Techniques / objectives / procedures</i>	<i>Equipment needed</i>	<i>Factors to be considered</i>
<b>Recovery on beaches (1/2)</b> <i>Aim: to recover large accumulations of pollutant by promoting its concentration and improving selectivity and yield</i>		
<p><i>Prior operation:</i></p> <ul style="list-style-type: none"> <li>• <b>Development of the storage site</b></li> <li>- to facilitate sorting</li> <li>- to reduce volumes for evacuation</li> <li>- to stop the pollution from spreading (overflow, leaks, infiltration etc.)</li> </ul>	<p><i>(should be adapted to suit the pollutant and the site)</i></p> <ul style="list-style-type: none"> <li>- areas, trenches, bunds, skips (watertight)</li> <li>- tanks, containers etc.</li> <li>- drainage (rainwater overflow)</li> <li>- screening, sorting</li> <li>- earthmoving equipment (digging)</li> <li>- protective membranes and geotextile</li> </ul>	<ul style="list-style-type: none"> <li>- ecological sensitivity and accessibility of the site</li> <li>- transfer of the pollution (watertight storage, decontamination of trucks)</li> <li>- traffic (should be channelled)</li> </ul>
<p><i>Prior operation:</i></p> <ul style="list-style-type: none"> <li>• <b>Recovering solid waste:</b> (removal or temporary movement to the upper beach where it will be out of the reach of the sea)</li> <li>- Mechanical recovery</li> <li>- Manual recovery</li> <li>- Disposal</li> </ul>	<ul style="list-style-type: none"> <li>- farm machinery (forks...)</li> <li>- earthmoving equipment (loader, shovel, bulldozer...), specialised means (sand screeners, mechanical rakes...)</li> <li>- forks, rakes, brushes, bins, bags</li> <li>- farm, earthmoving and mining equipment (loaders, skips, dumper, trailer etc.)</li> </ul>	<ul style="list-style-type: none"> <li>- accessibility of beach to mechanical equipment</li> <li>- organisation of workforce (large number of responders)</li> <li>- selectivity: avoid removing too much sand in a bid to immediately obtain an apparently clean beach</li> </ul>
<p>2. <b>Scraping the layer of oil</b> deposited on the sand  <span style="border: 1px solid black; padding: 2px;">➤ Datasheet n°04</span>                      (towards accumulation areas, then pumping or recovery by shovel)</p>	<ul style="list-style-type: none"> <li>- earthmoving equipment: loader or rubber blade</li> <li>- manual: planks, scrapers (as using in pig sties), hoses</li> </ul>	<ul style="list-style-type: none"> <li>- personal health and safety (protective clothing, masks)</li> <li>- selectivity (layer thickness)</li> <li>- procedure: methodical progression</li> </ul>
<p>3. <b>Pumping on the foreshore</b>  <span style="border: 1px solid black; padding: 2px;">➤ Datasheet n°03</span></p> <ul style="list-style-type: none"> <li>- promote the concentration of slicks and improves yield</li> <li>- stop obstruction of the pumps: anticipate screening or another way of retaining diverse debris</li> <li>- reduce volumes for evacuation: promote the separation of oil and water (emulsion breaking, settling)</li> </ul>	<ul style="list-style-type: none"> <li>- worksite booms</li> <li>- skimming/pumping equipment (skimmer, pump, vacuum truck or other transfer system)</li> <li>- screens, filters etc.</li> <li>- storage capacities and transfer means</li> <li>- settling tanks/separator</li> <li>- transfer pumps</li> <li>- demulsifier (+ injector)</li> <li>- trucks suited to the pollutant</li> </ul>	<ul style="list-style-type: none"> <li>- personal health and safety (protective clothing, masks)</li> <li>- nature (emulsion, viscosity) and evolution of the pollutant according to the temperature</li> <li>- agitation of the water body and tidal range</li> <li>- presence of solid debris</li> <li>- draught of skimmers and compatibility with depth of water</li> <li>- recovery of liquids obtained after settling</li> <li>- ecological sensitivity and accessibility of the site</li> <li>- traffic lanes</li> </ul>
<p>4. <b>Sand screening</b>  <span style="border: 1px solid black; padding: 2px;">➤ Datasheet n°08</span>  <i>Aim: to screen the sand in order to extract clusters of viscous pollutant</i></p> <ul style="list-style-type: none"> <li>- follow procedures (selectivity) and environmental recommendations</li> </ul>	<ul style="list-style-type: none"> <li>- sand screeners: adaptations may be necessary</li> <li>- tractor with loader for waste disposal</li> </ul>	<ul style="list-style-type: none"> <li>- solid waste (should be removed beforehand)</li> <li>- favourable characteristics of sand: dry, fine and homogeneous</li> <li>- potentially high impact at the foot of dunes.</li> </ul>

**PHASE 1: INITIAL CLEAN-UP (3/3)**
**Recovery on beaches (2/2)**
*Aim: to recover large accumulations of pollutant by promoting its concentration and improving selectivity and yield*

<i>Techniques / objectives / procedures</i>	<i>Equipment needed</i>	<i>Factors to be considered</i>
<b>5. Removal using rollers</b> ► <b>Datasheet n°07</b> <i>Aim: to selectively remove the pollutant stranded on the surface of the beach</i>	- rollers (various models with various types of tractors)	- solid waste (should be remove beforehand) - favourable characteristics of sand: saturated with water, hard and homogeneous sufficiently viscous, sticky, fresh oil
<b>6. Manual recovery</b> ► <b>Datasheet n°09</b> <i>Aim: to recover accumulations of pollutant</i> - by direct collection - by concentration: scraping and raking - by screening	- manual tools: forks, various rakes and brushes, picks, sieves etc. - bins, bags - mechanical support: farm, earthmoving and mining equipment (loaders, skips, dumper, trailer etc.), quad bikes	- personal safety: protective equipment - organisation of workforce (large number of responders) - selectivity: avoid removing too much sand in a bid to immediately obtain an apparently clean beach - accessibility of beach to mechanical equipment
<b>7. Flushing</b> ► <b>Datasheet n°12</b> <i>Aim: to displace fluid pollutant stranded on the beach</i> - low pressure, high speed washing with water	- fire or impact hose - pumps (3 to 8 bars, 25 to 30 m <sup>3</sup> /h) - flat rather than solid water jet	- seawater supply: tidal range, agitation of the water body - risk of penetration of the pollutant into the depths of the substrate
<i>Systematic complementary operation:</i> <ul style="list-style-type: none"> <li> <b>effluent recovery</b>  <i>Aim: to stop the pollution from spreading by installing a recovery system</i> <ul style="list-style-type: none"> <li>on the water ► <b>Datasheet n°14</b></li> <li>on the foreshore ► <b>Datasheet n°15</b></li> </ul> </li> </ul>	<i>(should be adapted to suit the pollutant and the site)</i> - containment equipment: floating or shore-sealing booms, bunds, pits etc. - recovery and evacuation means: pump, sorbents etc. - settling and storage tanks	- tide - agitation of the water body

<b>PHASE 2: FINAL CLEAN-UP (1/1)</b>		
<i>Techniques / objectives / procedures</i>	<i>Equipment needed</i>	<i>Factors to be considered</i>
<p><b>1. Surfwashing</b> <span style="border: 1px solid black; padding: 2px;">➤ Datasheet n°10</span></p> <p><i>Aim: to complete clean-up or separate residual pollutant either in the form of micro tar balls (as an alternative to screening) or fluid pollutant (stained sand)</i></p> <ul style="list-style-type: none"> <li>- send polluted sediments to the lower foreshore</li> <li>- recover any freed clusters of pollutant</li> </ul>	<ul style="list-style-type: none"> <li>- tracto-loader, loader on wheels, bulldozer, trucks</li> <li>- recovery equipment: nets (heavy fuel oil), sorbent materials, manual recovery, rollers</li> </ul>	<ul style="list-style-type: none"> <li>- ecological sensitivity: geomorphological characteristics (consult a geomorphologist)</li> <li>- tidal conditions</li> </ul>
<p><b>2. Flushing</b> <span style="border: 1px solid black; padding: 2px;">➤ Datasheet n°12</span></p> <p><i>Aim: to wash surfaces with a large quantity of water</i></p> <ul style="list-style-type: none"> <li>- move fluid residual oil towards a collection point</li> <li>- recovery of effluents</li> </ul>	<ul style="list-style-type: none"> <li>- fire hose, impact hose + low pressure pump</li> <li>- light boom, sorbent + pumps, skimmers, sorbents</li> </ul>	<ul style="list-style-type: none"> <li>- water supply</li> <li>- direction and pressure of water jet (avoid solid water jets, position the jet at an angle)</li> <li>- temporary quicksand</li> </ul>
<p><b>3. Drainage</b> <span style="border: 1px solid black; padding: 2px;">➤ Datasheet n°18</span></p> <p><i>Aim: to promote the run-off of pollutant in areas of emergence of ground water</i></p> <ul style="list-style-type: none"> <li>- dig oblique draining trenches, towards a ditch at the lower end of the beach</li> <li>- recover effluents</li> </ul>	<ul style="list-style-type: none"> <li>- tractor + plough with 2 ploughshares for drainage trenches</li> </ul>	<ul style="list-style-type: none"> <li>- emergence of ground water</li> <li>- fluidity of oil</li> <li>- repeat the operation</li> </ul>
<p><b>4. Tilling</b> <span style="border: 1px solid black; padding: 2px;">➤ Datasheet n°17</span></p> <p>(1) underwater</p> <p><i>Aim: to cause fluid oil trapped in the sand to be placed in suspension and recovered at the water surface</i></p> <ul style="list-style-type: none"> <li>- operation conducted in shallow waters at rising tide (0.20 to 30 cm)</li> <li>- recovery of floating effluents</li> </ul> <p>(2) on land</p> <p><i>Aim: to promote the aeration of sand polluted by a fluid pollutant (stained sand)</i></p>	<ul style="list-style-type: none"> <li>- tractor + harrow or claw, or scarifier or rotocultivator (1 and 2)</li> <li>- recovery of effluents on water (worksite boom, sorbents, landing nets, skimming) (1)</li> </ul>	<ul style="list-style-type: none"> <li>- tidal conditions</li> <li>- homogeneous sediments</li> <li>- repeat the operation</li> </ul>
<p><b>5. Underwater agitation</b> <span style="border: 1px solid black; padding: 2px;">➤ Datasheet n°16</span></p> <p><i>Aim: to cause fluid oil trapped in sand or stones to be placed in suspension and recovered at the water surface</i></p> <ul style="list-style-type: none"> <li>- scour the polluted sand at high tide</li> <li>- recover floating effluents</li> </ul>	<ul style="list-style-type: none"> <li>- fire or impact hose</li> <li>- low pressure pump</li> <li>- light boom, sorbent</li> <li>- pumps, skimmers, sorbents</li> </ul>	<ul style="list-style-type: none"> <li>- repeat the operation</li> <li>- fluidity of oil</li> <li>- temporary quicksand</li> </ul>
<p><b>6. Sand screening</b> <span style="border: 1px solid black; padding: 2px;">➤ Datasheet n°08</span></p> <p><i>Aim: to remove residual small tar balls</i></p> <ul style="list-style-type: none"> <li>- proceed methodically by slowly screening in strips</li> </ul>	<ul style="list-style-type: none"> <li>- large and small sand screeners</li> <li>- manual screening (may be necessary in vegetated areas): sieves</li> </ul>	<p>(sand screener)</p> <ul style="list-style-type: none"> <li>- nature of substrate: fine-grain, dry, homogeneous sand, slight slope</li> <li>- potential ecological impact for vegetation at the foot of dunes</li> <li>- selectivity: risk of large-scale removal of clean sand</li> </ul>
<p><b>7. Bioremediation</b> <span style="border: 1px solid black; padding: 2px;">➤ Datasheet n°29</span></p> <p><i>Aim: to accelerate natural breakdown of oil by bacteria and other micro-organisms</i></p> <ul style="list-style-type: none"> <li>- spread bioremediation agents</li> </ul>	<ul style="list-style-type: none"> <li>- bioremediation agents</li> <li>- spreader</li> </ul>	<ul style="list-style-type: none"> <li>- implementation: only on very light or residual pollution on a sheltered site (assess according to procedures defined by experts)</li> <li>- efficiency and toxicity of the product</li> <li>- set up a monitoring initiative.</li> </ul>