ALTERNATIVE COUNTERMEASURES PLAN

Revision: 1

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ABBREVIATIONS

ACP	Alternative Countermeasures Plan
API	American Petroleum Institute
BC	British Columbia
BCMoE	British Columbia Ministry of Environment & Climate Change Strategy
EC	Environment Canada
ECCC	Environment and Climate Change Canada
GAR	Geographical Area of Response
GRS	Geographic Response Strategy/Strategies
IAP	Incident Action Plan
ICP	Incident Command Post
ICS	Incident Command System
IMT	Incident Management Team
IOGP	International Association of Oil & Gas Producers
IPIECA	International Petroleum Industry Environmental Conservation Association
ISB	In-Situ Burning
m	Metres
NEB	National Energy Board
NEBA	Net Environmental Benefit Analysis
NEEC	National Environmental Emergencies Centre
OSC	On-Scene Commander
OSRP	Oil Spill Response Plan
PPE	Personal Protective Equipment
RO	Response Organization
SCAT	Shoreline Cleanup Assessment Technique
SIMA	Spill Impact Mitigation Assessment
SRM(s)	Spill Response Manager(s)
SRP(s)	Strategic Response Plan(s)
TC	Transport Canada
WCMRC	Western Canada Marine Response Corporation

STRATEGIC DOCUMENT CONNECTIVITY

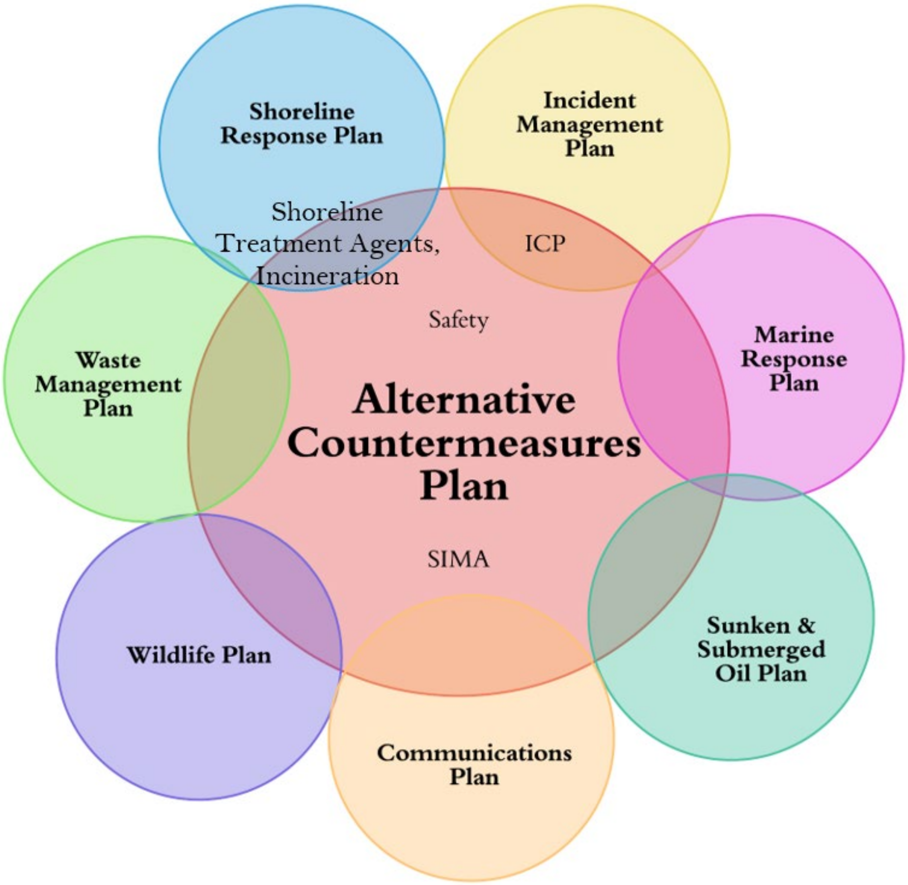

Figure 1 – Representation of the connections between strategic plans and their association to the central plan

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1. INTRODUCTION

This plan is one of multiple Strategic Response Plans (SRPs) which Western Canada Marine Response Corporation (WCMRC) has developed to support its operations, namely:

- Marine Response Plan
- Shoreline Response Plan
- Waste Management Plan
- Wildlife Response Plan
- Sunken & Submerged Oil Plan
- Communications Plan
- Surveillance Plan
- Alternative Countermeasures Plan
- Convergent Volunteer Plan
- Decontamination Plan
- Coastal Response Program
- Vessel of Opportunity Program
- Staging Area Program
- Tier 5 Operational Response Plan

These plans cover all major areas of response operations and aim to support WCMRC in identifying:

- The appropriate incident management structure and response organization for the applicable response strategy
- The likely resource requirements
- The likely logistical and support requirements.

As illustrated by Figure 2, all SRPs listed above are underpinned by the principles and response methodology outlined in the WCMRC Incident Management Plan (IMP) and wider response fundamentals outlined in the WCMRC Oil Spill Response Plan (OSRP).

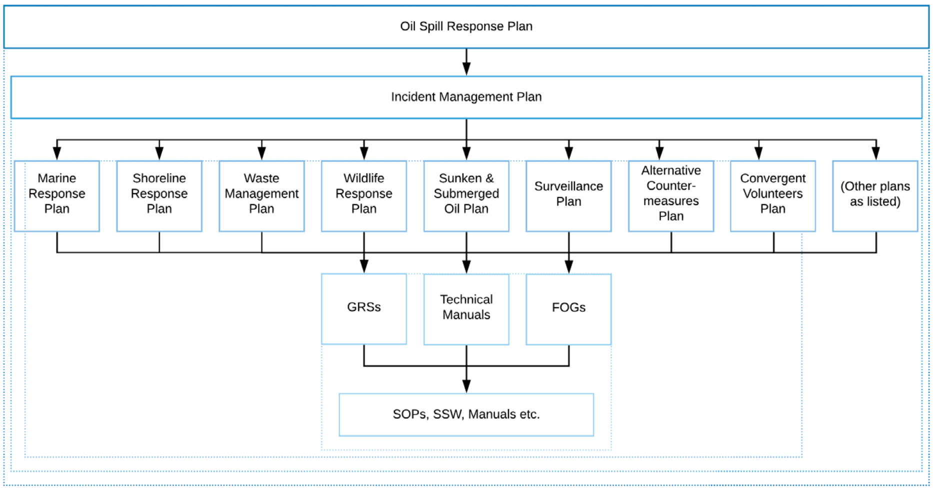

Figure 2 – WCMRC response documentation framework and hierarchical plan linkage

There are also a number of technical manuals in place which assist with implementing the strategies outlined in each SRP. The following technical manuals are relevant to this strategic response plan and are used by WCMRC to enact the measures outlined in this plan:

- Dispersants and In-Situ Burning (tactics not currently undertaken by WCMRC)
- Inland Response
- Environment Canada Guide to Shoreline Clean Up Response

Additional technical manuals which may be referred to in support of operations are:

- Spill Impact Mitigation Assessment [SIMA] (previously Net Environmental Benefit Analysis (NEBA)
- Logistics
- Surveillance
- Waste Management

1.1 PURPOSE

This purpose of this Alternative Countermeasures Plan (ACP) is to demonstrate that WCMRC use a combination of industry best practice, specialist equipment and guidance documentation to consider the most effectible means of responding to a spill incident, where conventional response strategies are not achievable.

In order to evidence the importance of alternative countermeasure response, this ACP describes the rationale and methodology WCMRC will use when choosing strategies, tactics and resources to respond to a spill, based on the circumstances, environment and conditions at the time of the incident.

All response operations conducted by WCMRC will place an emphasis on safety, which remains the highest priority throughout the duration of an incident.

All strategies, tactics and resources deployed in response to a spill incident will be done so with the sole purpose of mitigating the impact of any spill on the environment, taking into account the net environmental benefit of intervention and the justifiable limit at which to cease operations.

1.2 USE

This plan should be used by WCMRC personnel to, as effectively and efficiently as possible, establish and enact alternative countermeasure strategies appropriate to the requirements of the incident and in line with National Energy Board requirements.

This Alternative Countermeasures Plan is applicable to all WCMRC response personnel at strategic level and above and is shared internally as ‘required reading’. This ensures all response personnel are aware of the procedures and guidance which have been put in place to ensure any response is conducted in accordance with that described in the OSRP.

1.3 BACKGROUND

As a Response Organization (RO), WCMRC are called upon by organisations who, in the event of an oil spill incident, require specialist pollution response and expertise. ‘Oil spill response’ is a complex and multifaceted discipline which requires careful planning, assessment and execution in an attempt to respond in the most efficient way possible to a variable and challenging scenario.

WCMRC's operational oil spill response priorities are:

1. **Contain** (the pollutant to minimize its impact)
2. **Recover** (as much of the pollutant as feasibly possible)
3. **Store** (the recovered pollutant safely prior to responsible disposal)
4. **Protect** (people, the environment and property from the pollutant)

These priorities frame all aspects of WCMRC's strategic decision making with regards to oil spill response. All SRPs and the response principles herein have been developed in accordance with these overarching priorities.

A large portion of WCMRC's geographical area of response (GAR) is made up of open, unsheltered water extending up to 200 nautical miles offshore. The Designated Port (Vancouver) and Improved Response Area (Salish Sea) covered by WCMRC demonstrates the importance of a robust and efficient response strategies and operational capability.

WCMRC's primary strategies and tactics to achieve these operational goals revolve around mechanical containment and recovery techniques, as described in the Marine Response Plan and other strategic plans. Due to the limitations and constraints around safely and effectively undertaking these strategies in exposed or unsheltered areas, an Alternative Countermeasure response is potentially an important part of WCMRC's response capability. As such, the organization holds strong relationships with other response providers so that equipment can be mobilised and dispatched across the GAR if appropriate to do so, to support various locations dependant on the requirements of that area at the time.

This plan acknowledges that only certain alternative countermeasure response strategies may form part of an Incident Management Team's (IMT) Incident Action Plan (IAP) should a new environmental benefit analysis (NEBA) / spill impact mitigation assessment (SIMA) deem them appropriate, pending governmental recommendation and approval by Unified Command (UC) and relevant government agencies.

2. ESTABLISHING THE RESPONSE

WCMRC's process for considering alternative countermeasure operations and the overriding factors which influence decision making at subsequent stages of the process:

- **Safety:** The safety of responders, the public and anyone impacted by the spill and/or ACM operations will always be WCMRC's primary concern. The decision therefore to use alternative countermeasures will be made with people as the number one priority.

- **Practicality and feasibility:** The initial circumstances of the spill and how a proportional response can be applied, considering resource availability, the scale of the incident and any influencing factors. This will vary on the nature of the spill, however in some instances the sea state may be too rough for containment and recovery operations to be successful. Therefore, dispersant could be considered and by its very nature successful due to requirement of wave energy to increase the mixing energy of dispersant into the oil.

- **Net environmental benefit:** Analysis and comparison of the impact of response operations against the impact of the spill. This should be considered at the start of any oil release and continue through the response. In some instances, there may be a large volume of oil on water with the potential to impact sensitive shoreline environments and alternative countermeasures may be required to complement the response. Due to the nature of containment and recovery, once temporary storage is filled, skimming operations will have to cease and therefore alternative response strategies may be required to combat the oil, e.g., dispersant application or in-situ burning. Decanting may also be considered in order to increase storage availability.

Within these overriding considerations is the operational process WCRMC follows when conducting ACM operations.

2.1 DECISION MAKING PROCESS BEHIND ALTERNATIVE COUNTERMEASURES

2.1.1 REGULATIONS

There are currently no specific regulations or authorities that govern the decision making process for the use of ACM strategies. Approval for use does however consider the Fisheries Act when assessing the impact of deleterious substances into the water, and therefore applications will be submitted to the relevant government agencies such as DFO, ECCC and CCG, who share a common interest in the protection of the marine environment.

2.1.2 DECISION MAKING PROCESS

The following decision trees will be used to determine if the alternative countermeasure strategy should be requested as a response tool, and to obtain approval from the relevant regulatory agencies for their application.

2.1.2.1 DISPERSANT APPLICATION

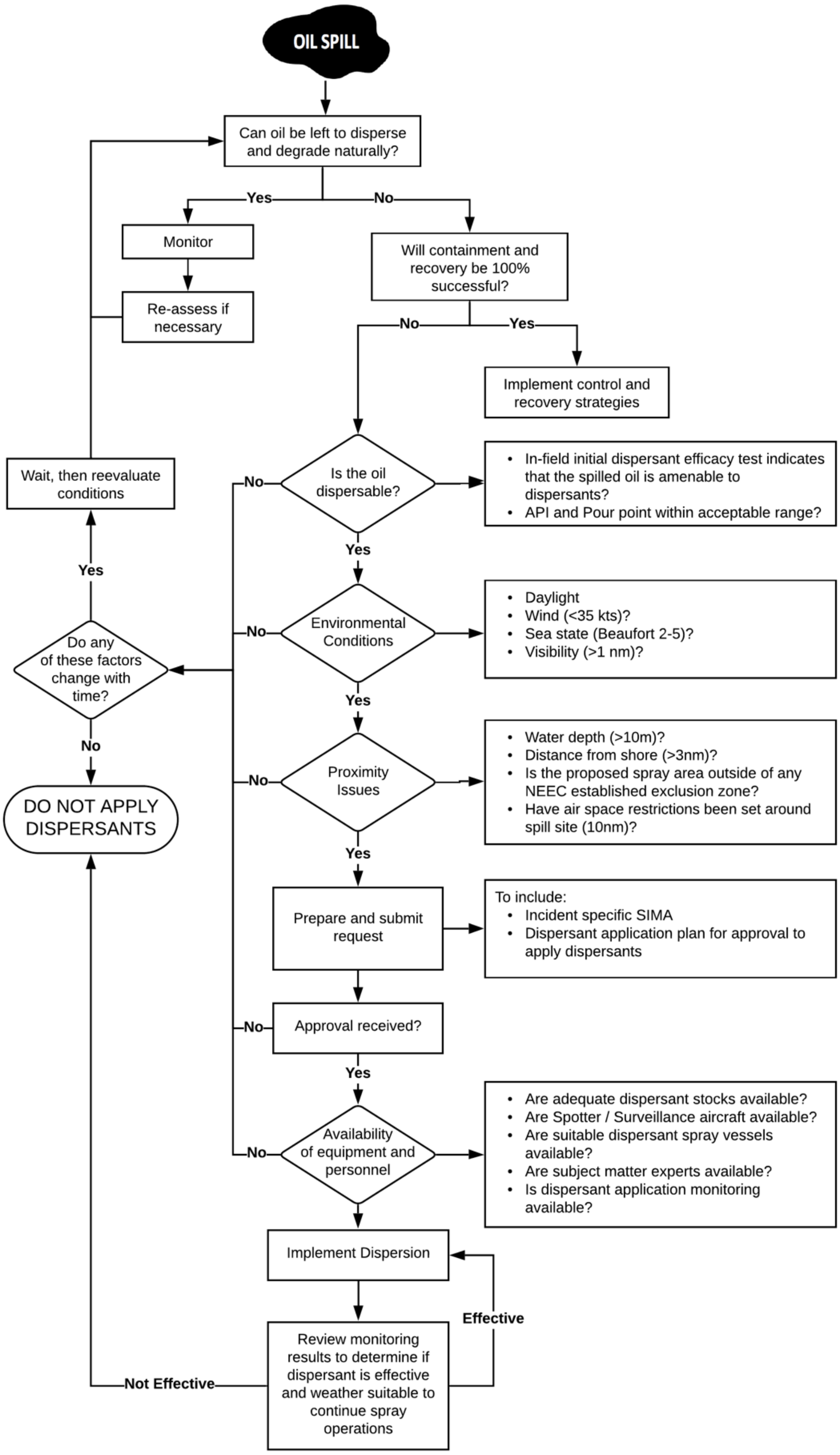

Figure 3 - Dispersant Application Workflow

2.1.2.2 SHORELINE TREATMENT AGENTS

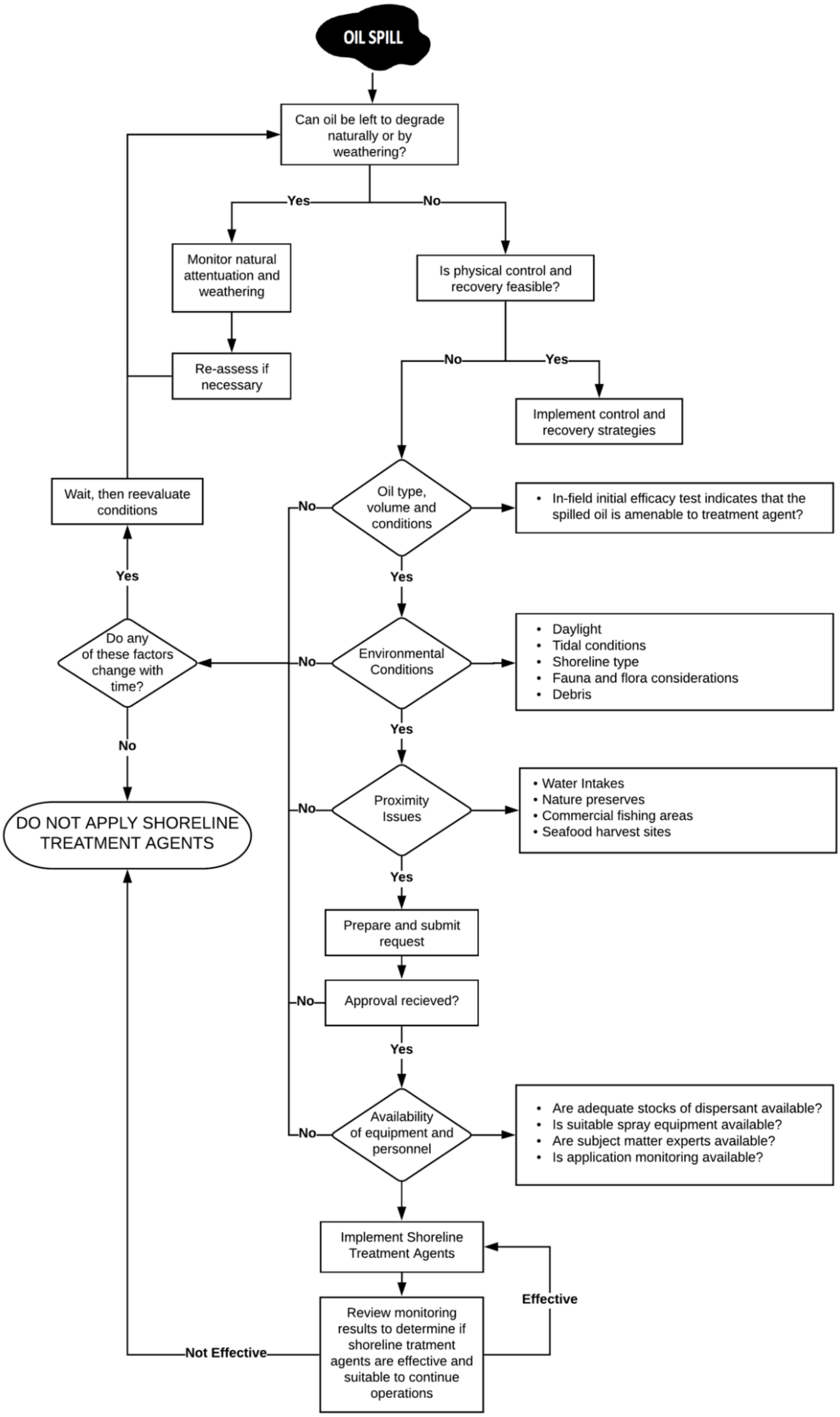

Figure 4 - Shoreline Treatment Agent Application Workflow

2.1.2.3 IN-SITU BURNING ON WATER

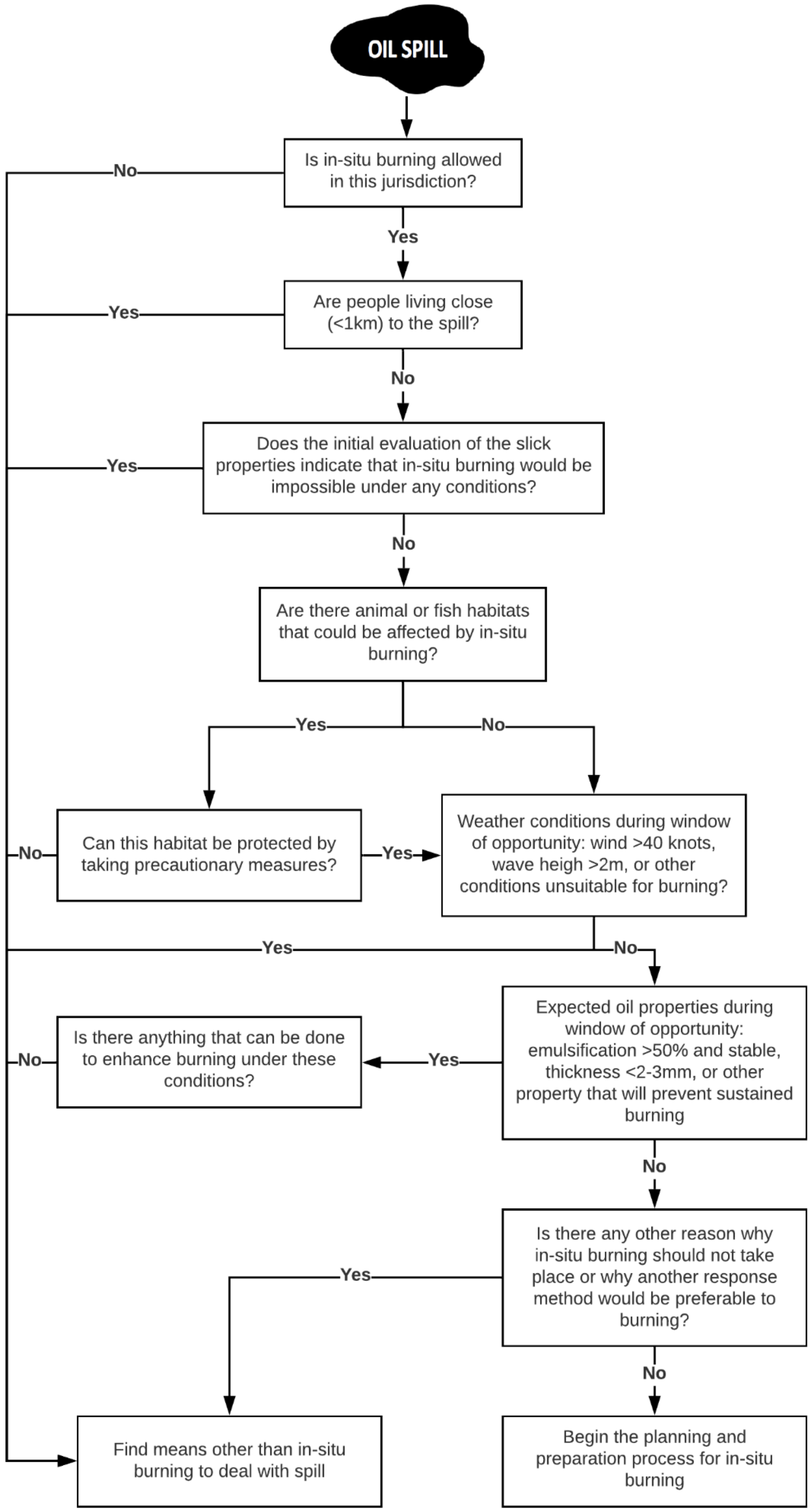

Figure 5 - In-Situ Burning Workflow

2.1.2.4 SHORELINE BURNING

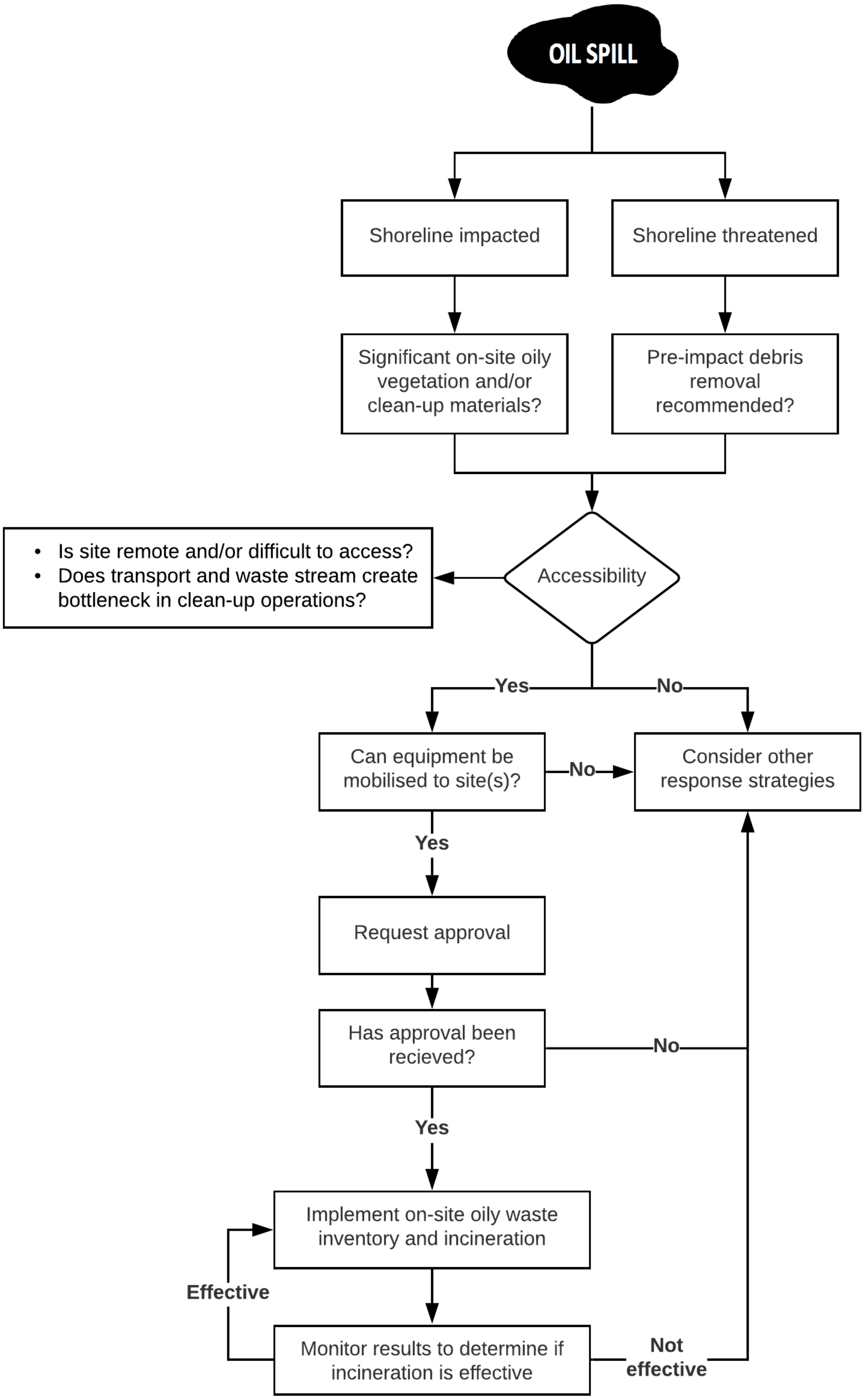

Figure 6 – Shoreline Burning Workflow

2.1.2.5 DECANTING

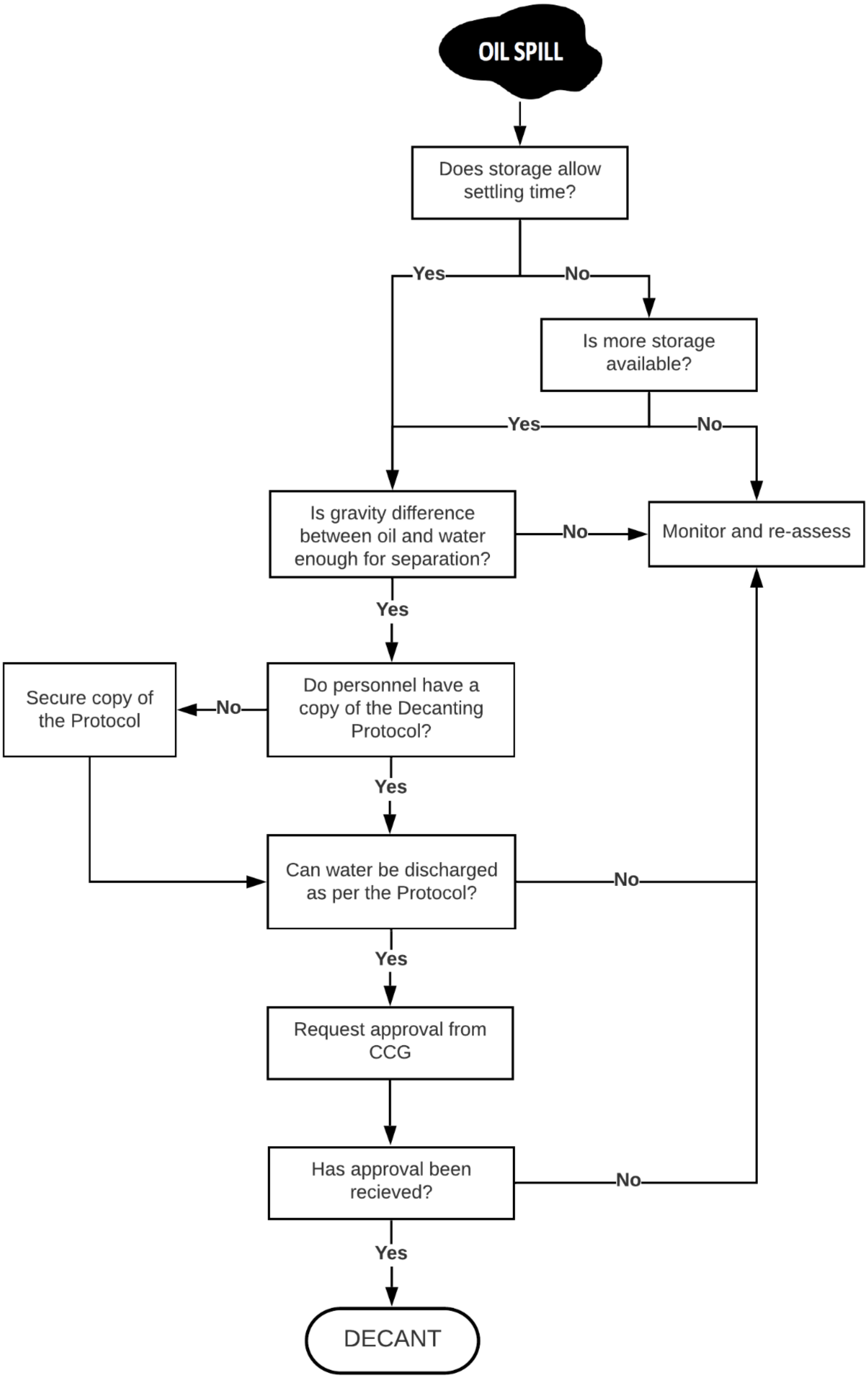

Figure 7 - Decanting Workflow

3 RESPONSE STRUCTURE

3.1 IMT ROLE

In the initial stages of a response, WCMRC will use the methodology outlined in the IMP to assess the requirements of the incident and select the appropriate response level based on incident complexity and Polluter requirement.

Generally speaking, for small scale and less complex incidents a core 'Level 1' response organization (Figure 6) is sufficient in meeting the requirements of the incident.

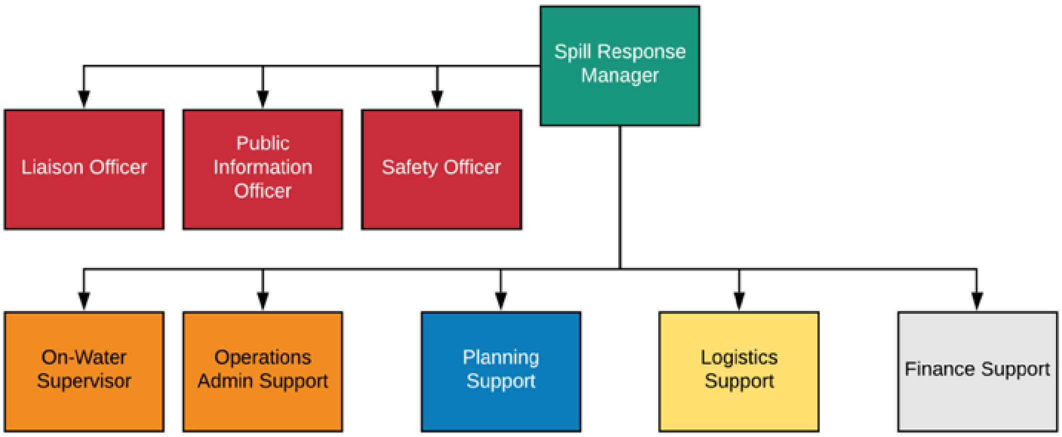

Figure 8 – Recommended Initial IMT Organization: Essential Response ('Level 1')

For larger and more complex incidents, a 'enhanced' or 'expanded' response organization (Figure 7) is likely to be required. Given the additional complexity factors, Polluter requirements and/or limitations and constraints which impact the required scale of response, IMS functions specific to the nature of the incident will be required. It is within these 'enhanced' and 'expanded' response organizations that functions specific to Alternative Countermeasures response will be established.

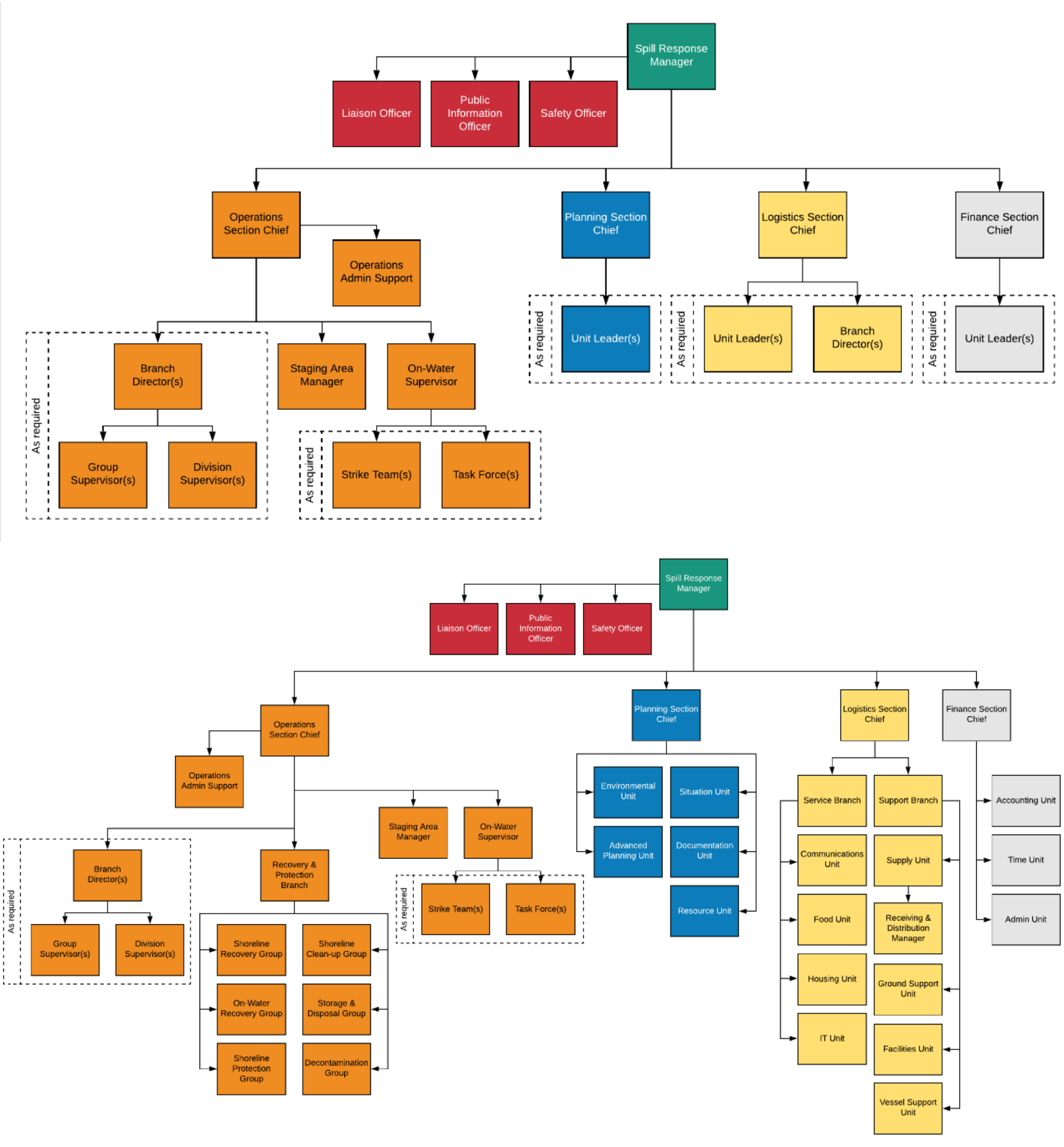

Figure 9 - Recommended Initial IMT Organizations: Enhanced Response ('Level 2') and Expanded Response ('Level 3')

3.2 USE OF GROUPS AND DIVISIONS

When implementing ACM (in particular, ISB and Dispersant) there will be a requirement to organise the activities into groups or divisions to ensure adequate oversight & accountability.

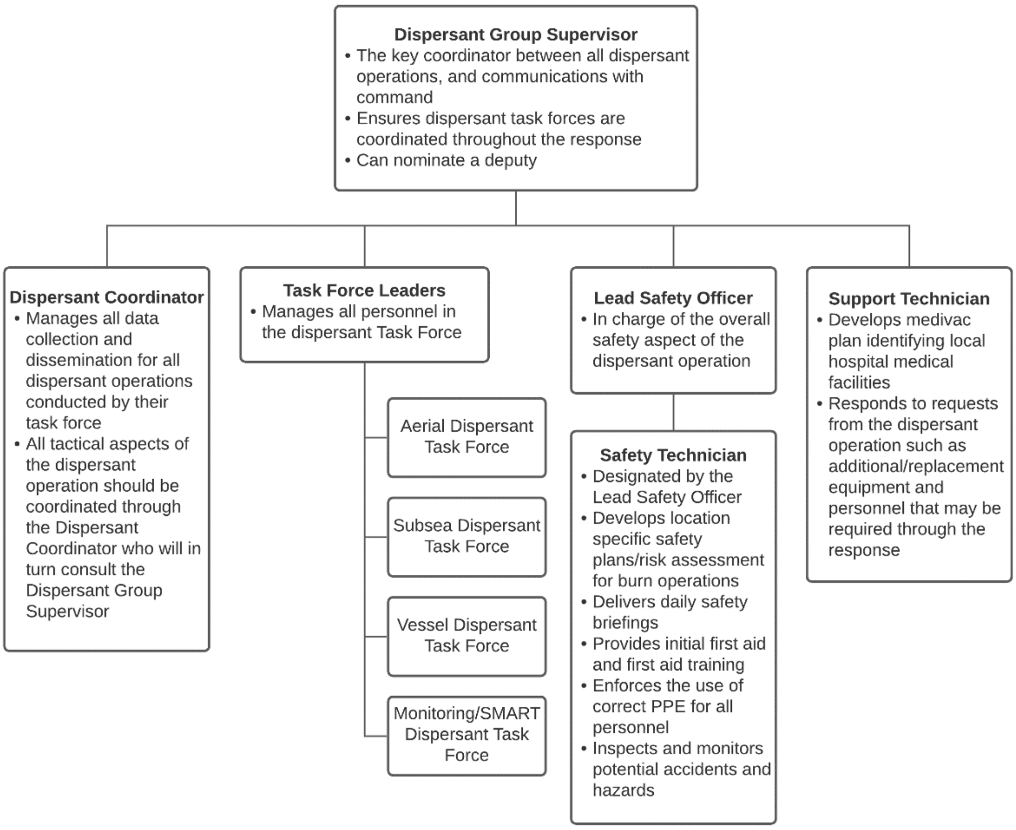

Figure 10 - Dispersant Group

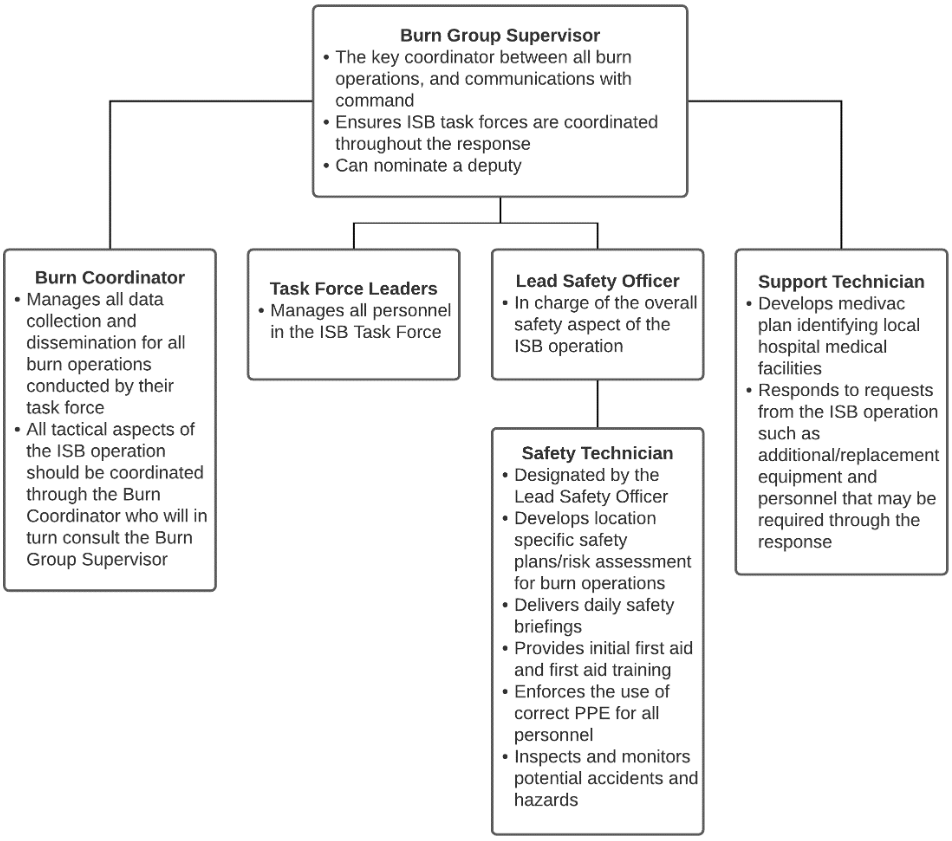

Figure 11 - In-Situ Burning Group

3.3 IMT FUNCTIONS FOR ALTERNATIVE COUNTERMEASURES

The Incident Command System (ICS) Functions outline in Table X are key to conducting successful ACM operations and are therefore likely to be required as part of an enhanced or expanded response organization.

Complete job aids and checklists for all IMT functions listed in Table X are contained within tactical plans and supporting documenting (e.g., 'handbooks') as part of the WCMRC document hierarchy outlined in Section 1.

Alternative Countermeasure operations are under the control of the Operations Section Chief based in the Incident Command Post (ICP) as part of the IMT. Task Forces are dispatched to the scene of the spill and provided with a safety and operational briefing based on their response assignment. Each Task Force is managed by a Task Force Leader (TFL) and all subsequent commands from the Operations Section to the Task Force are via the TFL, who provides feedback on the conditions in the field, safety concerns and operational information. The Operations Section Chief (OSC) then updates to the Spill Response Manager and/or Incident Commander on the progress and effectiveness of the chosen alternative countermeasure, thus informing the choice of strategies for the following operational periods.

Table 1 - Key IMT Functions for Alternative Countermeasure Response

Position/Section	Alternative Countermeasures Role
Operations Section	
Site Safety Assistant	Ensure that all appropriate actions are taken to protect the health and safety of on scene response personnel
Staging Area Manager	Manage staging areas for equipment to be used for alternative countermeasure response
Operations/Environment Unit (OPS/EU) Liaison	Act as a liaison between the Operations Section and Environment Unit to ensure effective lines of communication
Air Operations Branch Director (AOBD)	Responsible for ensuring that adequate aerial surveillance is mobilised to assess the extent and severity of oiling and thereafter effectively support recovery operations
Recovery & Protection Branch Director	Oversee and implement the alternative countermeasure response activities established in the IAP
Unsheltered Water Recovery Group	Supervise tactical response operations within the unsheltered water operating environment
Sheltered Water Recovery Group	Supervise tactical response operations within the sheltered water operating environment
Shoreline Protection/Recovery Group	Responsible for the deployment of containment, deflection, and adsorbent/absorbent materials in designated locations
Task Force(s)	Location specific resources (of different kinds and types) with common communications and leader, carrying out assignments in a safe fashion and in a manner consistent with directions received from the Group Supervisor
Planning Section	

Environment Unit	Assessment of environmental implications of response options/strategies
Environment Unit Leader	Determines the need (or potential need) to implement and subsequently monitor alternative countermeasure strategies
Monitoring Group	Implementation of on-scene monitoring and sampling. Establishes wildlife monitoring and coordinates protection and rehabilitation
SCAT Coordinator	Ensure SCAT/uSCAT surveys are conducted in appropriate locations and a timely manner followed by assessment of the information provided
Resources Unit	Maintaining the status of all assigned tactical resources and personnel
Situation Unit	Ensure all spill information is recorded to facilitate spill decision making
Technical Specialists	Provide specialist advice as required, such as: • Resources at Risk and Wildlife • Permitting/Compliance • Historical/Cultural Resources
Logistics Section	
Service Branch	Management of all service activities (e.g., communications, food, medical provision etc.)
Supply Unit	Ensure distribution of all supplies for the incident and maintaining an inventory
Faculties Unit	Ensure set-up, maintenance and demobilization of incident facilities
Vessel Support Unit	Responsible for implementing the Vessel Routing Plan for the incident and coordinating transportation on the water and between shore resources
Ground Support Unit	Repair of primary tactical equipment, vehicles, mobile ground support equipment and fuelling services; transportation of personnel, supplies, food and equipment in support of incident operations
Finance Section	
Accounting Unit	Ensure all costs recorded

3.4 REPORTING AND MONITORING

ACMs can be seen as contentious response strategies, therefore the IMT must ensure adequate reporting and monitoring is conducted in order to satisfy HSE and Environmental requirements. For ACMs, in particular dispersant and in-situ burning, Special Monitoring of Applied Response Technologies (SMART) protocol is used to collect real-time data, for monitoring the operational effectiveness of the strategy application.

3.4.1 DISPERSANTS

For dispersant use, the SMART protocol has three tiers of monitoring as described below:

- Tier 1: Visual monitoring by a trained observer, using photographic job aids or advanced remote sensing instruments to assess dispersant efficacy.
- Tier 2: Combines visual monitoring with on-water teams conducting real-time water column monitoring (using a fluorometer) at a single depth with water sample collection for later analysis.

- Tier 3: Expands on Tier 2 water monitoring to meet the information needs of the incident. This may include monitoring at multiple depths (using the fluorometer), as well as taking water quality measurements or more extensive water samples.

3.4.2 IN-SITU BURNING

For in-situ burning, SMART is conducted when there is concern that the general public may be exposed to smoke from the burning oil. Monitoring requirements are dependent on the predicted trajectory of the smoke plume and whether it will reach population centres and exceed safe levels of smoke particulates at ground level.

For large-scale burns, the SMART protocol recommends the deployment of multiple monitoring teams at designated areas of concern to determine particulate concentrations prior to the burn, and to conduct sampling after the burn and smoke plume have dissipated.

3.5 SAFETY CONSIDERATIONS

3.5.1 NOTAM'S

To safety conduct operations consideration must be given to users of airspace with the area a Notice to Airmen should strongly be considered.

A NOTAM is an aviation notice distributed by means of telecommunication- containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations. In particular a FIR (Flight Information Region) NOTAM file can be used. NOTAM of general interest to a FIR. This category includes NOTAM not associated with a specific aerodrome or those encompassing several sites in the same FIR

3.5.2 SAFETY ZONES

There may be the need to establish safety zones for reasons such as:

- To grant full geographical access control to the IMT, maximising response operations using platforms in the area.
- To prevent secondary contamination of vessels.
- To prevent secondary contamination of areas as vessels transit through the affected area.
- Protection of personnel from poisonous or explosive vapours.

Aerial safety zones will be established by NAVCANADA and marine safety zones by the Canadian Coast Guard.

3.5.3 SIMOPS

Simultaneous operations (SIMOPS) refers to conducting two or more operations at the same time, in the same place (or immediately adjacent), where there is potential for interaction and/or conflict between multiple operations. SIMOPS may result in potential safety hazards, logistical conflicts, operational conflicts and the need to schedule activities in a certain order.

SIMOPS involves multiple entities and multi-disciplined workforces engaging in a variety of 24-hour activities, therefore clear separation of tactical operations is essential.

- Use of division maps etc.
- Planning meeting
- Clear roles and responsibilities
- The use of work Assignments (ICS204)

3.5.4 PUBLIC MESSAGING

It is essential that the public are notified during the planning phase of any alternative countermeasure strategy. The purpose of the response, the net environmental benefits of the strategy in comparison to alternatives, and the safety precautions that are in place to protect the public, the responders and the environment must be communicated to the public.

It is crucial that all surrounding communities are alerted to the planned response, particularly in the case of dispersants and in-situ burning. The Public Information Officer (PIO) and Joint Information Centre (JIC) should work together closely to liaise with the public to provide clear, consistent and up-to-date information.

Notification and public education can be accomplished through several means, including press releases, press conferences, public meetings and radio broadcasts. An FAQ sheet should be developed for handing to the public to provide guidance and direct toward further information.

4 RESPONSE STRATEGIES

4.1 DISPERSANT APPLICATION

4.1.1 HISTORY

Dispersant is an effective way of minimizing the overall ecological and socio-economic damage of spilled oil, by preventing oil from reaching coastal habitats and shorelines and enhancing the natural biodegradation processes that break down oil.

In Canada, dispersants have been recognized since the 1960s as an effective oil spill countermeasure. Environment Canada's Environmental Emergencies Branch was established in 1972 and adopted the "Guidelines on the Use and Acceptability of Oil Spill Dispersants" in 1973. For many years, some regulators interpreted Section 36 of the Fisheries Act, which prohibits deposit of any deleterious substance into the Canadian Marine environment, to prohibit the use of dispersants in the event of a marine oil spill. However, legislative changes introduced in February 2014 facilitate approval for dispersant use in consultation with Federal authorities, where there is a net environmental benefit.

The early use of dispersant in an incident is essential to the efficiency and success of the response particularly in the first 24-72hrs. It is important to have the ability to make quick decisions, enabled by the establishment of the necessary capability and regulations prior to a spill. Section 4.1.10 describes the successful impact that this early response methodology had in responding to the Sea Empress oil spill (1996). As dispersant policies and regulatory requirements had already been established, the UK Maritime and Coastguard Agency (MCA) were able to respond quickly without the additional costly time of awaiting a case-by-case approval.

4.1.2 SCIENCE

Dispersants are chemical agents comprised of surfactants and solvents, sprayed onto marine oil spills to enhance natural dispersion of the oil into the upper metres of the water column. The solvent increases the viscosity of dispersants for spraying and helps surfactant molecules penetrate the oil slick.

Surfactant molecules have a hydrophilic (water-seeking) headgroup and an oleophilic (oil-seeking) tail group, orientating themselves at the oil/water interface so that the tail group attaches to the oil and the headgroup is pulled to the water. This reduces surface tension so that when wave energy is added, very small droplets break away from the slick, stay suspended and spread beneath the surface. The mechanism of how dispersants work is demonstrated in Figure 4.

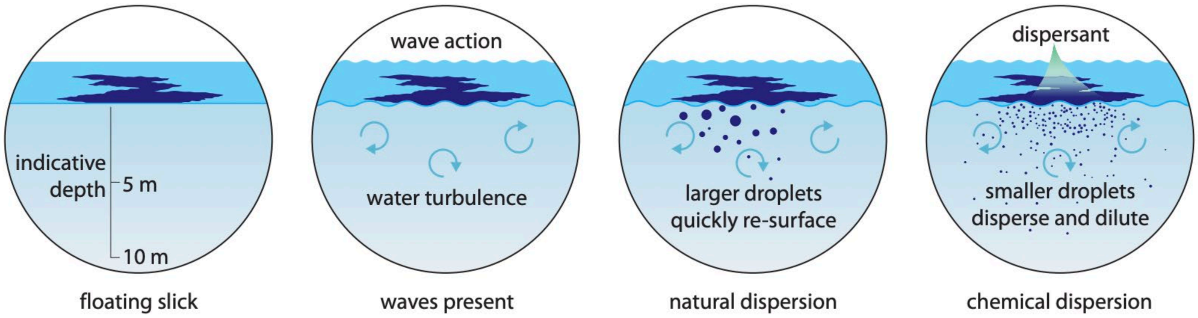

Figure 12 - The different stages of oil dispersion

4.1.3 STRATEGY (WINDOW OF OPPORTUNITY)

There is a limited window of opportunity where dispersant use is a viable response option and therefore the decision to apply dispersants must be made quickly. It is generally recognised that this window is between 24 – 72 hours, unless it is a continuous release of fresh oil.

The effectiveness of dispersants is a function of the density, pour point, and viscosity of the oil. Dispersants have little effect on oils of a high viscosity, as they tend to run off the oil into the water before the solvent can penetrate. They are also unsuitable for dealing with viscous emulsions (mousse) or oils which have a pour point near to or above that of the ambient temperature; even those oils which can be dispersed initially become resistant after a period of time as weathering processes make the oil more viscous. For most crude oils, dispersants begin to lose their effectiveness after 24 hours and most oils will no longer disperse after 4-5 days.

Weathering not only causes an increase in the viscosity of oil, but also raises its pour point, and increases the water content and the degree of stability of an emulsion. All of these changes tend to make an oil less dispersible as the viscosity of the oil or emulsion approaches its limiting value. This limiting viscosity depends on the type of spilled oil, the prevailing environmental conditions and chemical composition of the product used. An oils asphaltene and wax content are major factors that impact emulsification, chemical reactions and dispersant effectiveness.

4.1.4 APPROVALS

The On-Scene Coordinator (OSC), in consultation with appropriate agencies and personnel, will determine the priorities for protection in each spill incident. Except in emergencies where there is an imminent threat to human life, chemical dispersants should be used only with the approval of Environment Canada and may be subject to the requirements of British Columbia (BC) legislation. Dispersant chemicals can then be used under competent direction in accordance with recommended techniques. Only dispersants satisfying criteria for effectiveness and toxicity may be used and all uses of chemical dispersants should be documented.

Under guidelines defined by EC, dispersants may be used to prevent or reduce hazard to human life or safety, reduce substantial hazard to property or minimize the overall environmental impact of an oil spill to aquatic life or habitats, taking into account that trade-offs may be necessary.

The short-term impact of dispersed, but possibly toxic, oil in the water column should be evaluated against the longer-term impacts of stranded oil, beach clean-up, and the effects of oil slicks on marine birds and mammals. Dispersants should not be used in waters containing major fish or shellfish populations, or in waters that are key breeding, feeding, or migrating areas for aquatic life which may be damaged or reduced in market value by exposure to dispersants and/or dispersed oil.

Dispersants should not be used in any waters where such use may adversely affect surface water usage or under conditions where they would be ineffective. Use is also restricted where eventual dilution of the dispersed oil is limited, either because the water exchange is slight or because the total volume of water is relatively small.

As this response strategy can have an impact on the environment, approval from the National Environmental Emergencies Centre (NEEC) is required prior to implementation.

4.1.5 APPLICATION METHOD/EQUIPMENT

Dispersants can be applied by a variety of methods. In general, spraying dispersant from vessels and small aircraft or helicopters is more suitable for treating smaller spills and nearshore areas, whereas large aircraft are best equipped for handling larger offshore spills. The key to successful chemical dispersion is the ability to target the thickest part of the oil slick in a timely manner, before weathering inhibits the efficacy of the response.

4.1.5.1 VESSEL SPRAYING

Dispersants are applied from vessels equipped with specialised spray arms, fire hoses or monitors, that are sometimes used to apply diluted concentrate dispersants. However, the very high flow rate makes it difficult to achieve optimum dilution of the dispersant and uniform application of the dispersant is challenging.

Vessels offer certain advantages for dispersant spraying. They are usually readily available and are easy to load and deploy, have cost advantages over aircraft and can apply dispersant relatively accurately to specific areas of a slick. However, vessels can have serious limitations, particularly for larger spills. The area of oil that can be treated and the rate of dispersant application are both relatively low in comparison to larger aircraft, and it can be difficult to locate the heaviest concentrations of oil from the bridge of a vessel.

4.1.5.2 AERIAL SPRAYING

Aircraft allow a rapid response, good visibility, high treatment rates and optimum dispersant use, and are available for use to treat spills further offshore. Dispersant can be applied from specially designed aircraft, or from agricultural or pest control spray planes which require minor modification. Several types of helicopter have also been adapted to spray dispersants, and most are able to carry spray systems without modification. Aircraft selection will depend on the size and location of the spill, although local availability will often be the crucial factor. The endurance, fuel consumption, turnaround time, payload, and ability to operate from short or improvised landing strips are all important factors when considering aerial dispersant application.

4.1.5.3 NEAT SWEEP APPLICATION SYSTEM

The Elastec NeatSweep is a boom-based system, towed by a vessel to sweep and funnel oil into the Dispersant Application Zone (DAZ) where the dispersant is applied undiluted and mixed with the oil. A monitoring processor controls the rate of dispersant application by sensing the speed of the system and adjusts the rate of spray accordingly. This increases the accuracy of the application, reducing the amount of dispersant that would be wasted through evaporation, misting, and miss-targeting. The dispersant is applied hundreds of meters behind the vessel, decreasing the risk of exposure to response personnel. The NeatSweep allows large payloads to be delivered as the dispersant is carried on the towing vessel.

4.1.6 AREAS OF OPERATION

The map below indicates areas where the limitations and constraints on mechanical containment and recovery would lead to thorough consideration by WCMRC for the use of dispersants, if appropriate for the situation on a case-by-case basis, using the protocols outlined in this plan. The scenarios indicated are drawn from risk assessments conducted by government and industry, and are not necessarily specific scenarios which would call for dispersant use, but meant as illustrative examples of areas where use should be considered.

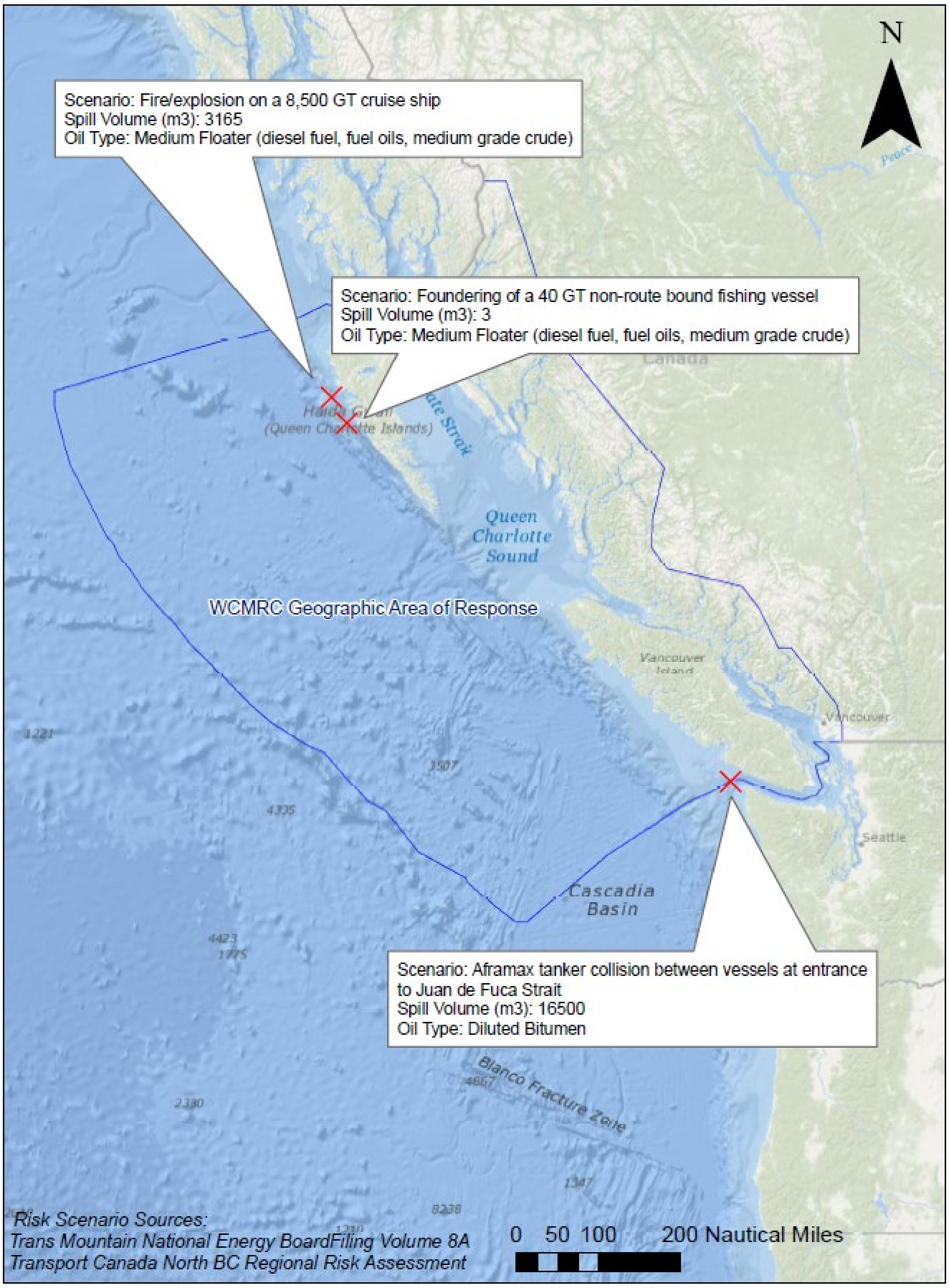

Figure 13 - Dispersants Area of Operations Map

4.1.7 MONITORING

It is essential that the effectiveness of chemical dispersion is monitored continually, and dispersant use terminated as soon as it is no longer effective. Visual observation of effectiveness from a vessel or aerial platform is key, but may be difficult in poor weather conditions, in waters with high sediment content, when dispersing light oils or out of daylight hours.

Effectiveness can also be monitored using Ultra-violet fluorometry (UVF) to provide real-time data on the concentration of dispersed oil in the water column. However, it should be used in combination with visual observations to decide whether dispersant application is providing a worthwhile response.

The SMART protocol provides a suitable approach for practical monitoring of dispersant effectiveness in the field. In many cases, monitoring will be limited to visual observations from vessel or aircraft, possibly supported through remote sensing. Monitoring should include representations from relevant authorities and be carried out on a regular basis to ensure that the dispersant remains effective on weathering oil.

SMART Monitoring for dispersant uses the following tiered system:

- Tier 1: Visual Observation
- Tier 2: Fluorometer takes readings at 1m, and water samples are taken.
- Tier 3: Fluorometer takes readings at 1 and 10m, a portable water laboratory provides data on water temperature, pH, conductivity, dissolved oxygen, and turbidity.

4.1.8 WASTE MANAGEMENT

As a response strategy, dispersant application does not typically generate a lot of oiled waste to manage. The main waste output of dispersant is considered to be PPE used during application, such as Tyveks suits, gloves and safety goggles. Some solid waste may be created as a result of waste storage, e.g. IBCs and barrels.

4.1.9 CASE STUDIES

Torry Canyon, UK, 1967

- 85,500 barrels of Kuwait Crude
- Used 6,000 barrels of chemical detergent to treat the spill
- Formed a stable ‘oil-detergent’ emulsion

Ixtoc 1, Gulf of Mexico, 1979

- Estimated 3.5 million barrels of oil
- Sprayed Corexit 9527
- Almost 500 aerial missions
- Treated 1,100 square miles

Macondo, Gulf of Mexico, 2010

- The USA have regional Tier 2 large dispersant aircraft
- 976,000 gallons of dispersant applied
- 90 days of continuous operations
- 61 days of spraying

- Using 20 aircraft (12 spray planes, 8 spotter planes)
- Conducting 412 Spray sorties
- 816 recon and spotter sorties

Sea Empress, UK, 1996

- The UK have regional Tier 2 large dispersant aircraft
- Dispersant prevented an estimated 57,000 to 110,000 tonnes of oil emulsion impacting the shoreline
- Dispersant trebled the rate of natural dispersion
- Increased the amount of oil dispersed by at least 18,000 tonnes, with each tonne of dispersant resulting in approximately 40 tonnes of oil being dispersed (1:40 ratio)
- Efficient response was possible directly due to the UK MCA having the necessary national capability and policies in place to facilitate quick decision making.

4.2 SHORELINE TREATMENT AGENTS

4.2.1 SCIENCE

Shoreline Treatment Agents (STA) have different properties from dispersants and are generally lower in aquatic toxicity. Typically applied on oil stranded on beaches during low-tide phases, the oil can then be removed using low-pressure water and directed toward an oil recovery area.

Shoreline treatment agents, or beach cleaners, are formulations of surfactants designed to remove oil from solid surfaces. As they are designed to remove oil rather than to disperse it, treatment agents contain surfactants with higher hydrophilic-lipophilic balance (HLB) than that of dispersants. Most treatment agents are formulated not to disperse oil into the water column, but to release oil from the surface where it floats. However, higher water flushing energy will typically result in some dispersion.

There are 2 types of Shoreline Treatment products:

- Non-emulsifying cleaning products which only contribute to loosening the pollutant without dispersing it, in order to recover it easily (using a skimming process with added sorbent).

- Emulsifying cleaning products which, beyond the cleaning operation itself, contribute to dispersing the pollutant in the water column with a view to facilitating its elimination or degradation by the environment. For ecological reasons, each use of this kind of product must consider the impact of dispersed hydrocarbons in the considered environment.

4.2.2 STRATEGY

Shoreline Treatment Agent is a final clean-up technique, typically used during phase three of the clean-up operation and in high-amenity areas. The use of STAs is usually in conjunction with moderate to high pressure washing, where supported by SIMA and permitted by national regulations.

STAs can achieve a high degree of cleanliness, and typical environments for use include:

- Boulder and bedrock areas

- Manmade structures
- Rocky foreshores with easy public access
- High amenity shorelines

Use of chemicals on shingle and cobble shorelines is not recommended since oil and/or chemical mixtures tend to penetrate deeper into the shingle where tidal flushing is likely to be less effective.

The use of dispersant may be more highly prescribed than STAs because the oil released by surface cleaners is recovered, whereas dispersants are intended to promote the dispersion of oil into nearshore waters. For that reason, their use should be restricted to areas where there is adequate water movement to bring about the rapid dilution of the dispersed oil.

4.2.3 APPROVALS

If the use of chemicals on shorelines is permitted, only those products approved for that purpose under national regulations should be used and only at recommended dose rates.

Currently, the only product approved by Environment Canada as a shoreline treatment agent is Corexit 9580. Its use is restricted to areas where conventional on-water recovery can be carried out, or the migration of oil and/or Corexit 9580 can be controlled by sorbents or other means.

Approval to use STAs usually includes constraints to limit potential impacts to sensitive areas, such as:

- On shorelines, there are usually restrictions of use at specified tidal elevations to prevent direct application of chemical agents onto unoiled intertidal biota and flushing of oil across sensitive substrates.
- Only those products that have been documented to be safe to use on vegetation should be applied in vegetated areas.
- Under no conditions should washwater from land surfaces be allowed to enter waterbodies without proper treatment.
- Lift and float products should be used on shorelines in open-water settings to allow oil recovery. An exception would be in high-energy environments where oil cannot be recovered (so it would be better to let the oil disperse rather than re-oil adjacent areas).

4.2.4 APPLICATION METHOD/EQUIPMENT

Once bulk oil has been removed from affected shorelines, shoreline treatment agents can be used during the final stages of a clean-up to remove the remaining oil from hard surfaces such as rocks, sea walls, and other man-made structures. STAs are typically used when oil cannot be collected, and for this reason, use on the shoreline is restricted to areas of low environmental concern but high amenity value.

Agents are applied directly on the stranded oils and left to penetrate, where oil is then flushed with water to direct it to a clean-up area. From there, the oil is removed with a conventional skimmer system. Since STAs are typically applied to a small expanse of oil at the upper or intertidal zone, they are applied manually using hand-held or backpack sprayers or using large vehicle or vessel-mounted sprayers.

Onshore, the product must be applied during low tide and the oil removed before the tide rises and the oil is no longer accessible. No extensive research or testing of application methods for treatment agents have yet been done.

There are two types of methodology for STAs:

1. STAs are applied to the surface for cleaning according to the manufacturer's instructions. The combined solvent-surfactant action of the surface cleaners reduces the viscosity of the oil and alters its surface tension to facilitate lifting the oil from the surface being cleaned. Crucially, unlike dispersant use, the intention is not to disperse the released oil but to collect it, either directly using sorbents, or by flushing it to a collection point for recovery by sorbents, pumps, or skimmers.
2. Where permitted, dispersants are applied to the oily surface and mixed into the oil with vigorous brushing. The oil/dispersant mixture is then flushed off. For planning purposes, an oil to dispersant ratio of 20:1 is used. An estimate is made of the average quantity of oil per unit area, based on the oil thickness, and the appropriate application rate for the area to be treated is determined. By way of illustration, an oil layer 2mm thick represents 2 litres of oil/m^2, calling for 2/20 litres of dispersant, or 1 litre of dispersant for each 10 m^2 of oiled surface.

4.2.5 WASTE MANAGEMENT

Where the site is accessible to equipment and the volume of oil released is large, skimmers can be used to collect left over waste from the site, however local conditions will determine if the water can be collected and treated or can be discharged safely. When the treated oil is dispersed or emulsified, all of the washwater must be contained and treated prior to discharge to wastewater treatment plants if the oil concentrations are low. For high oil concentrations, oil recovery can be increased with the use of emulsion-breaking agents.

4.2.6 CASE STUDIES

San Joaquin River, USA, 1994

- Crude oil
- Corexit 9580 used to clean riprap in front of an Exxon Facility

Morris J. Berman, Puerto Rico, 1994

- No. 6 fuel oil
- Corexit 9580 and PES-51 used to clean beach rock and riprap
- First-use monitoring showed low acute impacts

Julie N., USA, 1996

- >179,600 US gallons of IFO spilled
- Corexit 9580 used to clean salt marsh
- In tests, 50% oil removal from treated vegetation top surfaces

Marsh Clean-up Test, USA, 1996

- CytoSol and Corexit 9580 used on pickleweed, cord grass and tule
- Both products removed 90-95% of oil from vegetation

4.3 IN-SITU BURNING ON WATER

4.3.1 HISTORY

In-situ burning (ISB) provides an expanded response capability. As a result of several large-scale controlled burns in North America and internationally, and as scientific understanding of burning has developed over time, many environmental agencies and oil companies recognise and include in-situ burning as one of their spill response strategies. Initial work was completed in the 1970's, in support of exploration drilling in the Canadian Beaufort Sea where conventional mechanical and containment systems are in-effective for up to eight months of the year. The first ignition systems and fireproof booms were designed at this time. In 1993 a large-scale test burn was conducted off the coast of Newfoundland, Canada that yielded significant information on the efficacy of in-situ oil burning. The extensive analysis of the burn not only addressed oil ignition and control issues but resolved many environmental and health impact concerns.

It is important to emphasise that the combustion of spilled oil is not seen as a substitute for the containment and physical removal of spilled oil. Conventional booming and skimming operations will always be conducted wherever they can be implemented safely and with a reasonable degree of effectiveness.

4.3.2 SCIENCE

In-situ burning is the controlled combustion or burning of spilled oil's hydrocarbon vapours in place, and it is the oil vapours that provide the fuel to support combustion. The vaporisation process of oil must be sufficient to yield steady state burning, in which vaporisation and burn rates are similar. The burn rate is limited by the amount of oxygen available, and the heat radiated back to the oil, and will also rely on the type of oil and its degree of weathering. If vapours are insufficient, the oil will not ignite or will quickly extinguish once ignited. The amount of vapour produced is dependent on the amount of heat radiated back to the oil, which is estimated to be about 2–3% of the heat produced.

Fresh crude oil needs to be at least 1 mm thick to yield enough vapours to allow ignition on water, while oil that has undergone extensive weathering may need to be between 2–5 mm thick. Heavy fuel oils will need to be contained to maintain a slick thickness of around 10 mm before they can be ignited. Once ignited, the heat radiated back to a slick will usually be sufficient to allow the burn to continue until the oil slick is around 2–3 mm thick. As a slick thins, its insulating capacity weakens and more heat is lost to the water beneath, eventually resulting in insufficient heat to continue to vaporise the oil and sustain combustion. Weathered or emulsified oil can be difficult to ignite as a greater quantity of energy is needed to remove water before it is able to heat the oil; the addition of an accelerant or promoter may therefore be necessary to achieve ignition. Table 2 shows the typical ignition characteristics of different oil types.

Table 2 - Burning properties of various oils (IPIECA, 2016)

Oil	Overall burnability	Ease of ignition	Flame spreading speed	Burning rate (mm/min)	Sootiness of flame	Efficiency (%)
Gasoline	Very high	Very easy	Very rapid	4	Medium	95-99
Diesel fuel	High	Easy	Moderate	3.5	Very high	90-98
Light crude	High	Easy	Moderate to rapid	3.5	High	85-98
Medium crude	Moderate	Easy	Moderate	3.5	Medium	80-95
Heavy crude	Moderate	Medium	Moderate	3	Medium	75-90
Weathered	Moderate	Add promoter	Slow	2.5-3	Low	60-90

Crude oil with ice	Moderate	Difficult, add promoter	Slow	2	Medium	50-90
Light fuel oil	Moderate	Difficult, add promoter	Slow	2.5	Low	50-80
Heavy fuel oil	Moderate	Add promoter	Slow	2-3	Low	60-90
Diluted bitumen (Dilbit)	Moderate	Easy, if fresh	Moderate	2-3	Medium	40-60
Weathered dilbit	Moderate	Add promoter	Slow	2-3	Medium	50-70
Emulsified oil	Low	Add promoter	Slow	2-3	Low	30-70
Bitumen	Low	Add promoter	Slow	2-3	Low	30-50
Used oil	Very low	Add promoter	Slow	1-2	Medium	15-50

Please note that Table 2 relates to fresh oils versus emulsified / weathered oils.

4.3.3 STRATEGY (WINDOW OF OPPORTUNITY)

Trained responders and appropriate equipment necessary for ignition and containment will need to be ready and available within the narrow ISB window of opportunity.

Oil removal efficiency is a function of five main factors:

- Type of oil
- Weathered state of the oil
- Initial thickness of the slick
- Thickness of the residue remaining after extinction
- Areal coverage of the flame

On water, spilled oil rapidly spreads into very thin slicks that become too thin to burn. Therefore, unless the response is very rapid, the oil must be collected and concentrated into thicker slicks. If the oil is thick enough, it will act as insulation and will keep the surface at a high temperature by reducing heat loss to the underlying water. As the slick thins, increasingly more heat is passed through it until enough heat is transferred through to allow the temperature of the surface oil to drop below its fire point, at which time the burning stops. The oil may emulsify, and evaporation may remove most of the burnable contents, making burning of collected oil difficult or unachievable beyond the first 12-24 hours after it is spilled.

Flame spreading is a crucial aspect of effective ISB. If the fire does not spread to cover a large part of the surface of the slick, the overall removal efficiency will be low. Flame spreading speeds increase with increasing with slick thickness due to the insulating effect of the oil layer.

Secondary factors of ISB efficiency include environmental conditions, such as wind and current herding of slicks against barriers and oil weathering. Wind and current can herd a slick against a barrier, such as toward a boom, thus thickening the oil for continued burning. The detrimental effects of current can include entrainment of residue beneath a floating barrier as the residue density and viscosity increase during the burn process, and over washing of the burning slick, causing extinction of the flames. Excessive waves can also have a negative effect on the burning process.

4.3.4 APPROVALS

The authority to approve an in-situ burn rests with the lead government agencies responsible for establishing the response or for approving the response strategy of the Responsible Party (Polluter). The decision to burn must be made quickly and conform to the policy and decision guidelines developed under the authority of the Federal Fisheries Act, Canada Shipping Act, Canada Environmental Protection Act, and the provincial Environment Management Act, by Fisheries and Oceans Canada, Environment Canada, and the British Columbia Ministry of Environment, Lands and Parks, respectively.

Open ocean in-situ oil burning will comply with the 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, and will be conducted under the following articles of the Protocol:

- Article 8, Section 1, whereby the prohibition on incineration is lifted:
  - "So as to minimize the likelihood of damage to human or marine life".
- Article 8.2: "In emergencies posing an unacceptable threat to human health, safety or the marine environment and admitting of no other feasible solution".

The decision to burn will be based on the application outcome for ISB, that determines whether the permit is pre-approved, evaluated on a case-by-case basis or not allowed.

4.3.4.1 PRE-APPROVED

Pre-approved areas for ISB are specified distances offshore that have been established prior to response, based on the type of oil being burned, the volume of contained oil and calculated safe distances to protect public health. The closest allowable distance for an in-situ oil burn to any permanent residence, industrial facility, agricultural land, active bird or mammal colony is one kilometre (0.54 nm).

The primary condition for a pre-approved area burn is the submission of a burn application and supporting information, however situation-specific requirements from authorising agencies may still be required for ISB to be approved. Unless site-specific conditions are identified, pre-approved areas assume that no real-time air sampling of smoke particulates is needed as modelled/empirical data already reveal safe-levels or no exposure to the public would result, even with an on-shore wind.

4.3.4.2 CASE-BY-CASE

A case-by-case approval method is used when lead government agencies determine that the application for burning conforms with the policy health criteria and decision guidelines, as defined by British Columbia/Canada 2001, however the burn will occur within closer proximity to the shore than that of a pre-approved distance. Command will consult with environmental specialists and scientific experts to obtain weather data and information on the potential concentrations of pollutants that may reach the shore from both burn by-products and the oil itself. Approval to burn is then considered by the government, in co-operation with the Polluter and RO.

4.3.4.3 NOT ALLOWED

If the application to burn does not conform with the BC/Canada policy and decision guidelines, burning will not be approved. The decision can be re-assessed in the event of favourable weather changes. No ISB will be conducted within 5km (2.7 nm) of the US/Canada border without the approval of the US Unified Command.

4.3.5 APPLICATION METHOD/EQUIPMENT

For spills on water there are two main equipment requirements:

- Containment mechanisms to collect and maintain the oil at the required thickness for sufficient vapors
- Igniting devices to bring oil to ignition temperatures

Additionally, vessel and aerial support provides the opportunity to monitor the burn as well as collect air and water samples.

ISB is accomplished by two vessels towing fire-resistant boom around the spill for containment, igniting the oil and slowly towing the boom into the wind, to ensure the smoke trails behind. If the oil is continually leaking from a source, the fire-resistant boom can be positioned to capture the oil a safe distance from the source and the oil is burned as it accumulates inside the boom. Depending on how far offshore the burn is located, there may be a need for support vessels.

Skilled boat operators are needed to tow the boom in a "U" configuration at speeds that concentrate, but do not lose the oil by going too fast. After ignition, the burn can be controlled by towing the boom at the speed required to keep it at maximum thickness.

4.3.6 AREAS OF OPERATION

The map below indicates areas where the limitations and constraints on mechanical containment and recovery would lead to thorough consideration by WCMRC for the use of in-situ burning, if appropriate for the situation on a case-by-case basis, using the protocols outlined in this plan. The scenarios indicated are drawn from risk assessments conducted by government and industry, and are not necessarily specific scenarios which would call for in-situ burning use, but meant as illustrative examples of areas where use should be considered.

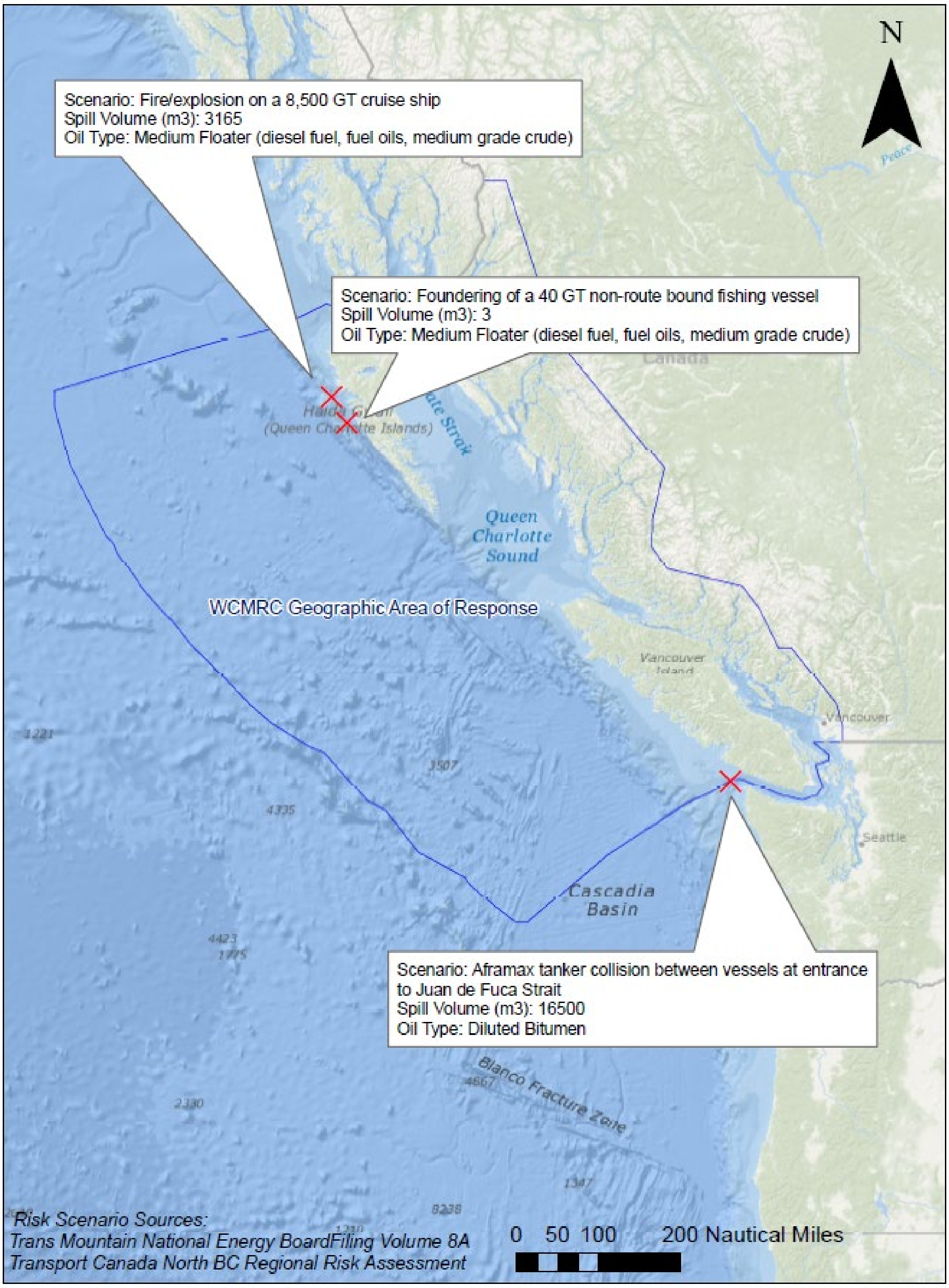

Figure 14 - In-Situ Burning Area of Operations Map

4.3.7 SAFETY

Full training and exercise of response personnel and the use of strict health and safety guidelines is essential to any ISB operation. Hazards to be aware of throughout an ISB response can be seen in Table 3.

A safety zone(s) should be defined for ISB personnel, as well as areas that are acceptable for ISB operations. The zones should also outline areas where ignition and sustained burning operations will not be permitted. Safety zones must be established with consideration for the key hazards for personnel involved in the response, including risk from flashbacks, secondary or unintentional fires, exposure to hear and smoke emissions.

Table 3 - Hazards of ISB operations

Hazard	Mitigation
Fire/Ignition	Aerial operations to ignite oil must be well-coordinated, weather and water conditions should be considered, and proper safety distances should be observed at all times. Communication with all personnel is essential. Crew onboard vessels involved in tow operations can be in danger of being exposed to fire or flames if the fire should move up the boom. In highly variable winds, caution must be taken to ensure that thick concentrations of oil are not encountered at low boom-tow speeds. Prior to the start of the burn the site should be surveyed to ensure that no one has entered the burn zone.
Vessels (vessels by themselves are not hazards)	ISB will involve several vessels working in relatively close proximity to each other or in poor-visibility conditions. Such conditions are hazardous by nature, and require practice, competence and coordination.
Extreme heat	Personnel involved in ISB may be exposed to extreme heat from the fire. A rule of thumb for responders is to stay back from a fire at a distance equivalent to four times the maximum flame height.
Particulate matter	The primary health concerns related to ISB arise from the emissions produced by a burn. The risk of exposure to smoke emissions should be minimal or non-existent by ensuring that all vessels and personnel are positioned upwind or crosswind to the target slicks, prior to ignition and throughout the burn.

4.3.8 MONITORING

Monitoring helps to provide information on the effectiveness of a burn and is an aid for vigilance regarding the safety of nearby responders and observation of fire control. Table 3 summarises the key aspects of a burn operation that should be monitored.

Table 4 - Aspects to be monitored during ISB operations

Aspect	Targets of observation	Interpretation
Fire Safety	Proximity of personnel to the burn	Danger to humans, infrastructure, and amenities
	Fire control and movement	
Fire boom containment integrity	Loss of a boom's ability to contain the slick	Provide early warning to vessel operators and responders
Burn effectiveness	Oiled area ignited and burning over time	Efficiency of oil removal; volume of oil removal

Burn emissions	Particulates	Monitor human exposure

4.3.8.1 PRE-BURN MONITORING

It is important to document the site conditions immediately before the burn, in order to correlate the burn conditions with the effectiveness of the response and the rate of the environmental recovery. Photographic evidence should be collected and recorded for the ISB site prior to the burn, with the approximate location and direction noted on a map to assist in taking comparative photographs following the response.

4.3.8.2 DURING THE BURN

During ISB, air quality monitoring is conducted when there is an associated human-health risk and concerns raised regarding the possible effects of particulate matter in the smoke plume on the general public downwind. The SMART monitoring protocols are applied and designed to address concerns regarding the use of ISB as a response tool and better aid decisions related to initiating, continuing or terminating the burn.

In general, SMART is conducted when there is concern that the general public may be exposed to smoke from the burning oil. Whether or not monitoring is required depends on the predicted trajectory of the smoke plume, and whether it will reach population centres and exceed safe levels of particulates at ground level. If impacts are not anticipated, monitoring is not required. However, since ISB has a narrow window of opportunity, it is imperative that monitoring teams are alerted of possible ISB and SMART operations as soon as burning is considered.

The fire should be monitored visually and with the use of particulate monitors, appropriate to the scale of the spill and burn and the weather conditions. Monitoring of on-water burns can be carried out from vessels or from aircraft.

4.3.8.3 IMMEDIATE POST-BURN MONITORING

As soon as it is safe, the burn should be inspected to record the effectiveness of the burn and assess any need for further action. To aid this assessment and compare to pre-burn conditions, photographic evidence should be collected for the ISB site following the burn.

4.3.9 WASTE MANAGEMENT

ISB does not remove all oil by combustion and results in residue and unburned oil after the fire is extinguished. The decision to recover the residue mechanically or leave it to break down biologically depends on the total volume, whether the residue is dense enough to sink and where it is expected to go if left alone. Other considerations include the immediate availability of equipment and personnel who may be deployed in other recovery efforts.

Residues vary depending on the type of oil – residues from burns of medium oils can form mats or sticky accumulations, while burns of lighter oils tend to form liquid residues. The residue from on-water burns of heavy oils can result in heavy residues which might sink.

Liquid or semisolid residues should be collected because they may pose a threat to wildlife and property. Residues that show signs of sinking should be collected out of concern for the benthic environment, mariculture installations and demersal fisheries. Liquid residues and unburned oil from on-water burns can be recovered using mechanical skimmers or sorbents. If the unburned oil can be collected into an ignitable thickness, then this unburned oil could be ignited.

4.3.10 CASE STUDIES

Mackenzie River, Canada, 1958

- First recorded controlled burn
- Broken pipeline resulted in crude oil release
- Containment method log booms
- Estimated 120tons removed from river

Exxon Valdez, USA, 1989

- 37,000 tons
- After burn, >700bbls
- Fire-resistant boom used
- Change in public perception of ISB

Newfoundland Offshore Burn Experiment, Canada, 1993

- Crude oil
- Two releases totalling 485bbls
- Experimental open water burns

New Carissa, USA, 1989

- Panamanian freighter ran aground during a storm
- 230 tons of HFO and diesel lost
- Burn estimated 200,000 gallons
- SMART Protocol applied

4.4 SHORELINE BURNING

4.4.1 SCIENCE

Shoreline or onshore burning is primarily used for oiled combustible materials, such as logs or debris, that can be collected and piled to facilitate burning. It can also be used when vegetation has been oiled, such as in a salt marsh or wetland. In limited circumstances, direct burning of oil on a beach can be carried out if the oil is pooled or concentrated by an onshore breeze, in sumps, trenches or other types of containers.

It is important to recognize that the term ‘incineration’ is also used in the oil spill response context, referring to a method of reducing waste generation during waste management planning, utilizing portable incineration equipment to deal with soiled debris, sorbents or PPE collected or otherwise generated during response operations. In the context of this document, shoreline burning should be taken to refer to a potential tactic applicable to shoreline response operations.

4.4.2 STRATEGY (WINDOW OF OPPORTUNITY)

Burning can be used for oiled logs and debris collected on any type of shoreline, or when oil has been collected in sumps or drums and can be ignited with sustained combustion. Burning is effective for directly removing oil from broken and solid ice, salt marshes and snow-covered shorelines.

Burning heavily oiled marsh vegetation when soils are dry can impact the root systems; burning on wet soil is favoured in order to protect the root from heat damage, so that recovery is more rapid.

Burning efficiency can be improved by using fans to provide wind on piles to be incinerated. Torches can be used to burn oil from hard substrates; however, it is labour intensive and uses large amounts of energy to remove small amounts of oil.

4.4.3 APPROVALS

Any onshore burning requires a permit and provincial approval, especially when planned on a larger scale. The application should be forwarded to NEEC where it will then be received by the appropriate provincial government (BCMoE) for consideration.

4.4.4 APPLICATION METHOD/EQUIPMENT

One of the devices developed to dispose of oil and debris in remote locations consists of a kiln which can be assembled on site from low-cost materials such as 45-gallon drums. Oil-contaminated beach materials are introduced manually at one end of the kiln at a rate of up to seven tonnes per hour and clean sand and pebbles are discharged at the other end. Combustion is self-sustaining if the feed material contains at least 25% oil and no more than approximately 50% water. A simpler portable burner for the small-scale burning of tar balls and debris can be constructed from a single open 45-gallon drum. Air is supplied from a suitable compressor or fan blower to support combustion.

Several portable incinerators have been developed which contain the oily waste and facilitate the high temperatures necessary for total combustion. The rotary kiln and open-hearth types are the most appropriate for oils with a high solid content. (Are any of these available in BC?)

4.4.5 SAFETY

When standard safety precautions are observed, generation of smoke from the burning of oiled debris is not a health or safety issue.

4.4.6 WASTE MANAGEMENT

The use of onshore burning can greatly reduce the cost and effort to package, transport, and dispose of oily waste materials.

All handling of the oily waste stream requires careful documentation. This is necessary so that estimates of the amount of oil recovered from clean-up operations can be adequately assessed. Records of waste type, segregation, and estimated oiling concentrations should be prepared prior to conducting any onshore burning.

4.5 DECANTING

The use of decanting is an effective way to maximise the oil recovered water during mechanical containment and recovery. It greatly simplifies the logistical requirements. It is recommended that dialogue on the use of decanting is entered into with regulators and stakeholders at the earliest opportunity. The use of pro-forma permits for pre-approval of decanting operations is also recommended, following discussion with, and approval by, regulators, and the incorporation of these permissions and conditions of use into the contingency plan should be considered. This can significantly improve the speed and efficiency of response operations. The use of emulsion breakers should be limited to application during transit to the intermediate/final storage facility, rather than during operations at sea.

4.5.1 SCIENCE

Whilst the type of skimmer, the local sea and weather conditions and the fate of the oil will affect the amount of waste recovered during containment and recovery operations, it is inevitable that a certain amount of water, both in the form of free water and water combined with the oil, will also be recovered.

Approval to decant recovered water frees up valuable storage capacity in the temporary storage device, which would otherwise have to be emptied before response operations can continue. Decanting the recovered water can serve to increase the temporary storage space available by up to 200–300% (S.L. Ross, 2005).This is particularly important in the early stages of a response when the 100% utilisation of recovery and skimming equipment should be given 100% priortity until the appopreaite storage can be delivered in to the field of operation. Priortising the utilisation of recovery and skimming equipment has a very clear and defined NEBA / SIMA benefit.

When contained within the relatively low-energy environment of the temporary storage device, the recovered mix of oil and water will start to separate into layers by a process of gravity separation. The use of baffles to reduce the free surface effect will help speed up separation and prevent remixing of oil and water. Once this separation has occurred it is possible to decant the bottom layer of free water, using pumps or valves, whilst retaining the recovered hydrocarbon.

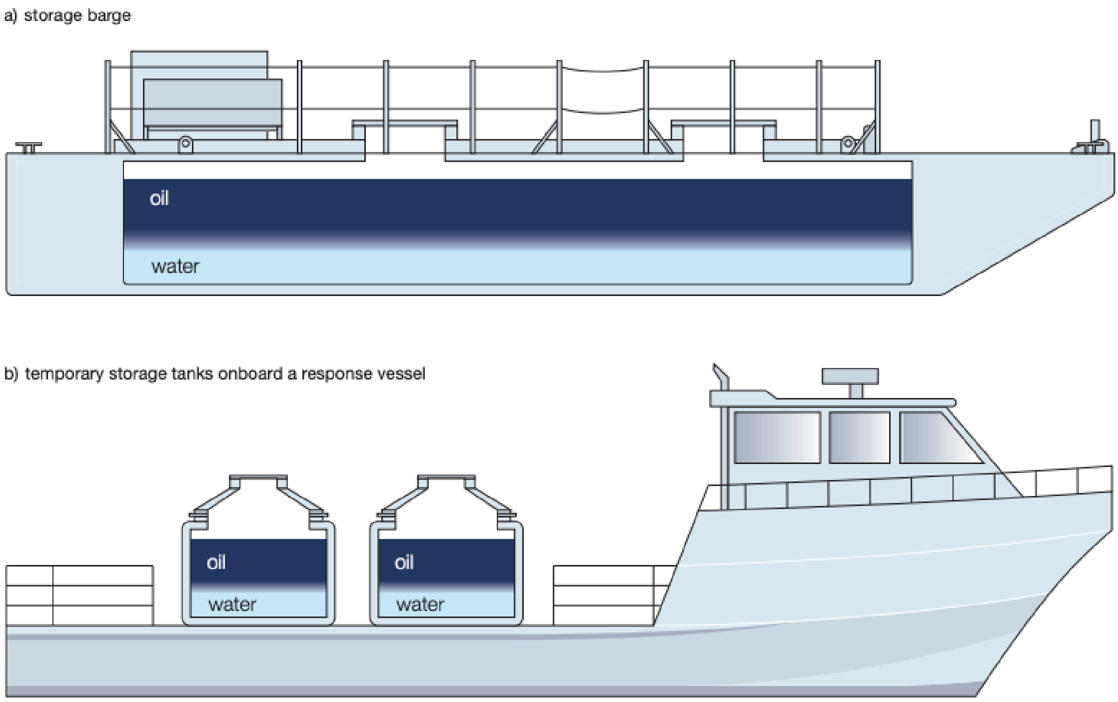

Figure 15 - Examples of gravity separation in temporary storage devices

4.5.2 STRATEGY (WINDOW OF OPPORTUNITY)

There is an optimum period during which the recovered oily water should be retained in the temporary storage vessel to allow adequate separation of the oil and water. When determining this 'optimum retention period', the aim is to maximize the amount of water discharged, whilst minimizing both the amount of oil released with the discharged water and the time that the temporary storage facility is effectively 'out of service'.

If the oil is thick and the encounter rate is good, the amount of water recovered will be minimal because the skimmers will be operating at their most efficient. In this case, the water droplets will be suspended in a continuous oil phase and will take longer to reach the oil/water interface, hence there is potential for much longer separation times. Settling and rates of gravity separation in the case of thicker slicks of higher viscosity oils are therefore a function of the oils' viscosity (S.L. Ross, 1999).

4.5.3 APPROVALS

International regulation regarding the discharge of oil from vessels is contained in Annex I of the MARPOL Convention. Regulation 9 of the Convention prohibits the discharge into the sea of oil or oily mixtures from ships, except where: "*the oil content of the effluent without dilution does not exceed 15 parts per million*".

However, there is provision under the MARPOL Convention for a dispensation in the case of oil spill operations, such that Regulation 9 shall not apply to: *"the discharge into the sea of substances containing oil, approved by the Administration, when being used for the purpose of combating specific pollution incidents in order to minimize the damage from pollution. Any such discharge shall be subject to the approval of any Government in whose jurisdiction it is contemplated the discharge will occur."*

Similarly, Section 678.2 (1) of the Canada Shipping Act formerly offered protection to any certified response organization or its employees "decanting" in the course of oil spill clean-up. This section of the Canada Shipping Act has since been repealed, however the Response Organization Standards and Guidance Documents still reference the section and the possibility of decanting. Protection against liability was removed only when the "conduct was not reasonable in the circumstances" and, in these cases, there would be a liability under the Fisheries Act (pollution of fish habitat) or under the Canadian Environmental Protection Act (ocean dumping). [It is considered reasonable to expect decanted water to be discharged in front of the skimmer operation]

Burrard Clean Operations (predecessor to WCMRC) provided original Canadian protocols for decanting, based on an earlier protocol agreement from the State of Washington. Subsequent to a meeting between industry and the CCG, the following protocol was established May 12th, 1995:

1. All decanting will be done in a designated "Response Area" which includes: a boomed collection area, vessel collection well, recovery belt, weir area or directly in front of a recovery system.
2. Vessels employing sweep booms with recovery pumps in the apex of the boom should decant forward of the recovery pump.
3. All storage systems must allow retention time for oil/water separation held in internal or portable tanks before decanting commences.
4. As a precaution, visual monitoring of the decanting outflow will be maintained to provide early detection of any possible oil.
5. Decanting along the shoreline in areas where vacuum trucks, portable tanks or other collection systems are used will be subject to the same protocol as vessels.

4.5.4 APPLICATION METHOD/EQUIPMENT

Decanting is the process of draining off recovered water from portable tanks, internal tanks, collection wells or other storage containers to increase the available storage capacity for recovered oil. It may be necessary if the available temporary storage capacity is insufficient to hold the total volume of recovered oil and oily wastes.

In order to minimise the potential for recovered product being released at the same time as the free water is decanted, the following practices are recommended:

- The temporary storage device should, prior to use, be checked to ensure that it is not contaminated with residues from any products or substances that may previously have been stored in that device, to ensure that no unauthorised discharges occur
- Appropriate settling time should be allowed to enable gravity separation to occur prior to decanting and discharge of the free water
- Where possible, the use of internal baffles in the temporary storage device should be employed to help speed up separation and prevent remixing of the oil and water
- Free water should be discharged either into a secondary storage container or within the apex of containment booms in the path of the recovery device (so that any accidentally discharged oil can be contained and recovered)

Visible oily discharges require decanting operations to cease.

4.5.5 SAFETY

Decanting produces very little stafey risk in the context of being used within a current oil spill incident and the overall risks of managing such.

4.5.6 MONITORING

Visual monitoring should be undertaken at the discharge site whilst decanting to ensure that only water is released. If possible, the oil/water interface in the storage device should also be monitored to ensure that the discharge hose is only drawing from the layer of free water at the bottom.

It is recommended that a record is kept of where and when decanting has taken place, together with details of the volume of water discharged.

4.5.7 WASTE MANAGEMENT

The decanting activity itself does not produce any waste management issues, in fact very much supports a creditable waste strategy if appropriately used.

4.5.8 CASE STUDIES

Sea Empress, UK, 1996

- 72,000 tons of crude oil
- Sheltered water areas of the spill enabled the barge to carry out an efficient response
- Thin patches of oil meant that the use of decanting was approved, to allow skimming operation to continue

APPENDICES

Table 5. Decanting Criteria and Approval Request

Decanting Request

GENERAL INFORMATION

Incident Details		Environmental Conditions		
Name:			Present	24 hr. Forecast
Location: (Lat/Long)		Wind speed (kts)		
Geographic Location				
Date of Incident (day/mo/yr)		Wind direction (from)		
Time of Incident (24 hour clock)				
Oil		Temp (C°)		
Type:		Sea state (Beaufort scale)		
Volume: bbls		Current speed		

% emulsified:		Current direction (to)		

DECANTING PROCEDURES

Check applicable criteria which will be followed for decanting operations	YES	NO
1. All decanting will be done within the designated "response area".		
2. Decanting will be conducted within a collection area, vessel collection well or directly in front of a recovery system.		
3. Vessels employing sweep booms with recovery pumps in the apex of the boom will decant forward of the recovery pump.		
1. All vessels, barges and other equipment not equipped with an oil/water separator will allow retention time for oil held in internal or portable tanks before decanting commences. Retention time to be no less than _____ hours.		
4. Visual monitoring of the decanting area will be maintained, and documentation of decanting activities will be recorded for each operation. Decanting will be stopped if entrained oil is observed in the discharge.		
5. Tanks used for decanting will be tested prior to use to ensure there are no contaminates from previous activities and that the water is safe to discharge back into the environment.		

SUBMISSION

Prepared by:			
Name		E-mail	
(ICS)Position		Date	
Ph: #		Time	

APPROVAL STATUS

This request is approved____ / not approved____

Representing	Department	Name	Date
Fed Gov't			
Provincial Gov't			
Local Gov't			
1st Nations			
Responsible Party			

Table 6 – In-situ Burning Criteria and Approval Request

In-situ Burning Request

GENERAL INFORMATION

Incident Details		Environmental Conditions		
Name:			Present	24 hr. Forecast
Location: (Lat/Long)		Wind speed (kts)		
Geographic Location:				
Date of Incident (day/mo/yr)		Wind direction (from)		
Time of Incident (24 hour clock)				
Oil		Temp (C°)		
Type:		Sea state (Beaufort scale)		
Volume: bbls		Current speed		
% emulsified:		Current direction (to)		

IN-SITU BURNING EQUIPMENT

Equipment	Available	Description
Fire resistant booms	Y/N	
Tow vessels	Y/N	
Ignition methodology	Y/N	
Aerial Observation platform	Y/N	

ENVIRONMENTAL CONDITIONS

Condition	12 hr. forecast	24 hr. forecast	Acceptable Y/N
Winds < 20 kts			
Waves < 2-3' (short period waves			
Current < .75kts			
Visibility ceiling > 500 ft			
Visibility >.5 miles			

PUBLIC HEALTH RISK

	Yes (No particulate monitoring required)	No Initiate particulate monitoring
Is the distance from human population[1] > 3 miles?		

[1](>100 people/square mile)

RESOURCES AT RISK

	Species	Species Status			Potential Mitigations
		Special Concern (Y/N)	Threatened (Y/N)	Endangered (Y/N)	
Fish					
Marine mammals					
Aquatic birds					

MONITORING PROTOCOLS

Data	Explanation	Y/N
Particulates	PM2.5 if burn is <3 miles from human population	
Burn location(s)	Lat/Long	
Burn duration(s)	Minutes	
Fire boom integrity	After each burn	
Estimate of burn effectiveness	Volume of oil removed (bbls)	
Status of burn residue	Does it sink?	
	Can it efficiently be recovered and is this the best use of scarce resources	

SAFETY

	Y/N	Explanation / Details
Is there a risk of starting unwanted fires?		
Can the burn be controlled?		
Will the burn affect other response operations?		
Can the burn be extinguished in required?		
Has a Safety Plan been developed?		

SUBMISSION

Prepared by:			
Name		E-mail	
(ICS)Position		Date	
Ph: #		Time	

APPROVAL STATUS

This request is approved____ / not approved____

Representing UC	Department	Name	Date
Fed Gov't			
Provincial Gov't			
Local Gov't			
1st Nations			
Responsible Party			

Table 7. Dispersant Criteria and Approval Request

Dispersant Use Request

GENERAL INFORMATION

Incident Details		Environmental Conditions		
Name:			Present	24 hr. Forecast
Location: (Lat/Long)		Wind speed (kts)		
Geographic Location				
Date of Incident (day/mo/yr)		Wind direction (from)		
Time of Incident (24 hour clock)				
Oil		Temp (C°)		
Type:		Sea state (Beaufort scale)		
Volume: bbls		Current speed		
% emulsified:		Current direction (to)		
		Oil Trajectory (speed & direction)		

DISPERSANT EQUIPMENT

Equipment	Available	Description
Approved dispersant	Y/N	
Application method	Y/N	
Aerial Observation platform	Y/N	

PUBLIC HEALTH RISK

RESOURCES AT RISK

	Species	Special Concern (Y/N)	Threatened (Y/N)	Endangered (Y/N)	Potential Mitigations
Fish					
Marine mammals					
Aquatic birds					
Mollusks					
Crustaceans					

ENVIRONMENTAL CONDITIONS

Condition	12 hr. forecast	24 hr. forecast	Acceptable Y/N
Winds: < 35 kts			
Waves: 0.2 – 2.5 m			
Water depth: > 10 m			
Visibility ceiling: > 150 m			

Visibility: > 1.0 nm			
Distance from shore: > 3 nm			

MONITORING PROTOCOLS

Data	Explanation	Y/N
location(s)	Lat/Long/ bearing/ duration of application	
Dosage rate	By vol: (ratio)	
	By area (gal/acre)	
Estimate application effectiveness using SMART protocols	1) visually	
	2) visually and water column sampling at 1 m	
	3) visually and water column sampling at 1 m and 10 m	

SAFETY

	Y/N	Explanation / Details
Will dispersant application affect other response operations?		
Has a Safety Plan been developed?		
If using aerial application, has a NOTAM been issued?		

SUBMISSION

Prepared by:			
Name		E-mail	
(ICS)Position		Date	
Ph: #		Time	

APPROVAL STATUS

This request is approved____ / not approved____

Representing UC	Department	Name	Date
Fed Gov't			
Provincial Gov't			
Local Gov't			
1st Nations			
Responsible Party			

DOCUMENT HISTORY

REVISION NO.	REVISION DATE	DESCRIPTION OF CHANGE	DOCUMENT OWNER
0	November 17, 2021	Initial Version	RRT

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