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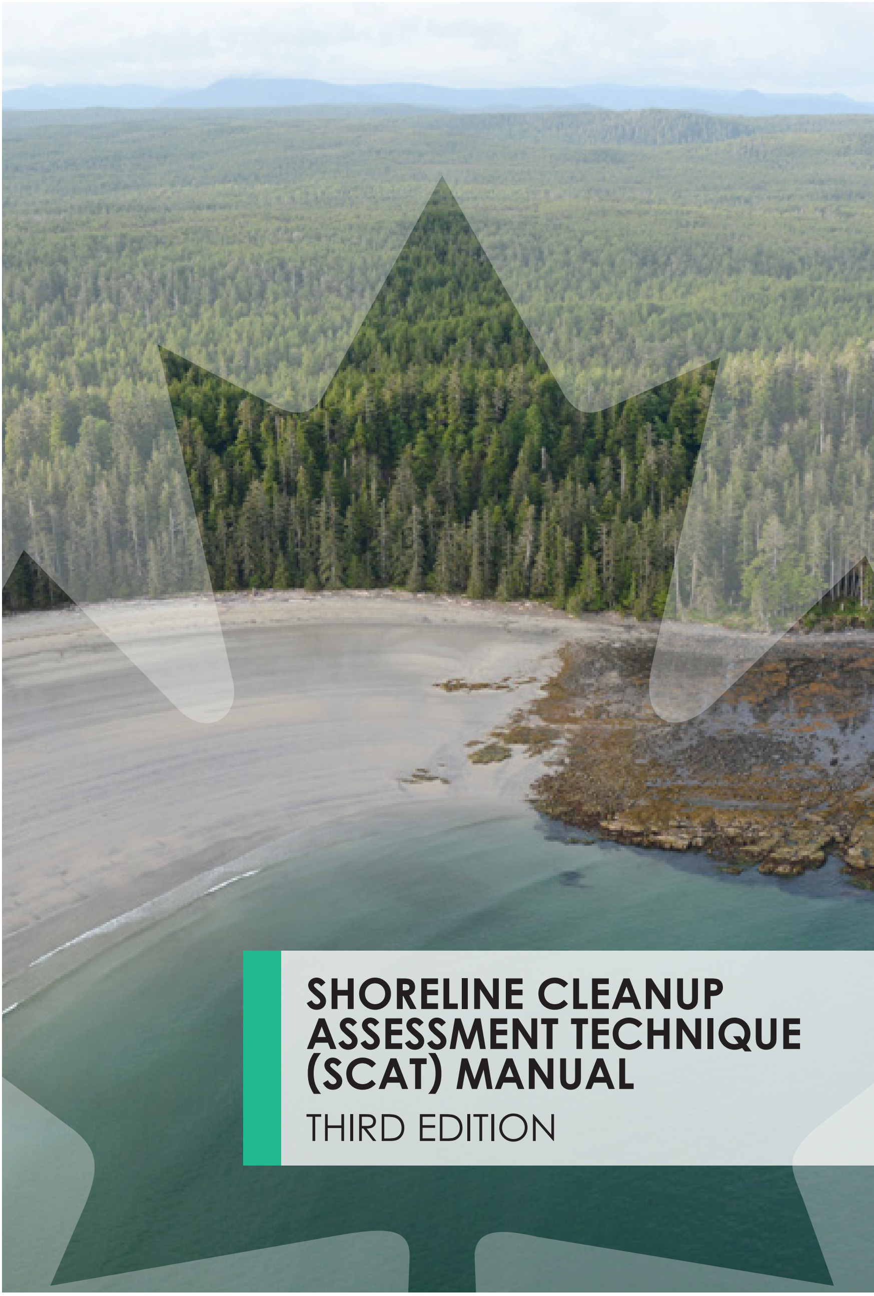

SHORELINE CLEANUP ASSESSMENT TECHNIQUE (SCAT) MANUAL

THIRD EDITION

Canada

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THIRD EDITION

Acknowledgments

The Management of Emergencies Science and Technology Section would like to acknowledge the team of shoreline SCAT experts whose contributions made the third edition of the SCAT Manual possible. The SCAT Manual was written by Edward Owens and Helen Dubach (Owens Coastal Consultants), and by Doug Reimer (Environmental Mapping Ltd), with technical input from Gary Sergy (S3 Environmental); Stephane Grenon, Alain Lamarche and Shannon MacDonald (Triox); and Guillaume Nepveu (CHAAC Technologies). From Environment and Climate Change Canada's Emergencies Science and Technology Section and the National Environmental Emergencies Centre were Sonia Laforest, Project Manager and Technical Authority; Michael Goldthorp; Natalie Jones; Patrick Lambert; Ben Fieldhouse; Carl Brown; Fatemeh Mirnaghi; Graham Thomas; Marie-Pierre Raymond and Melanie Erazola, who provided detailed scientific reviews.

Executive Summary

The Shoreline Cleanup Assessment Technique (SCAT) is an accepted concept for the description and documentation of oiled shorelines. The field data provides systematic, science-based information that is evaluated by a spill management team as they decide on appropriate shoreline response priorities, treatment techniques and treatment completion endpoints. The process is flexible and adaptable for spill responses of different scales and in the full range of Canadian coastal environments. This Third Edition of the Environment and Climate Change Canada (ECCC) SCAT Manual provides a best current (2016) practice guide for Canadian shorelines.

The purpose of this Manual is to provide advice and guidance as a shoreline assessment survey program and a field and data management plan are developed for each unique spill situation. The Manual is organized to describe the key elements as listed:

- The organization and management of SCAT programs;
- Field SCAT data collection strategies and techniques;
- SCAT data management and post-field information processing; and
- The recommendations and decisions that depend on the SCAT field data.

The two Appendices present the following:

1 **Job Aids**

A. SCAT Field Job Aid that includes standard SCAT shoreline and oiling terms and definitions and a set of standard field data forms that may be used to document shoreline oiling observations; and
B. SCAT Management Job Aid to assist with the management, planning and logistics of a SCAT Program.

2 **GPS Guidelines to assist with the appropriate use and data collection of shoreline waypoints.**

Quick Start Guide

Pre-SCAT Planning (Mapping and Segmentation)	Go to Section 5
SCAT Management	Go to Sections 3 & 4 and Appendix 1 B
Field SCAT	Go to Section 6 and Appendix 1 A
SCAT Data Management	Go to Section 7
SCAT Recommendations and Decisions	Go to Section 8
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Acronyms

ALARP	As Low As Reasonably Practicable*
API	American Petroleum Institute
ATV	All-Terrain Vehicle
BMP	Best Management Practice
BTEX	Benzene, Toluene, Ethylbenzene and Xylenes
ECCC	Environment and Climate Change Canada
EU	Environmental Unit
EUL	Environmental Unit Leader
FOSC	Federal On-Scene Coordinator*
GIS	Geographical Information System
GPS	Global Positioning System
GRP	Geographic Response Plan
IAP	Incident Action Plan*
ICP	Incident Command Post
ICS	Incident Command System*
IMS	Incident Management System
IMT	Incident Management Team
JSA	Job Safety Analysis
K9-SCAT	Canine Shoreline Cleanup Assessment Technique
LC50	Lethal Concentration that will kill 50% of the test species
NEB	Net Environmental Benefit
NEBA	Net Environmental Benefit Analysis
NFT	No Further Treatment
NOAA	National Oceanic and Atmospheric Administration
NOO	No Observed Oil
PAH	Polycyclic Aromatic Hydrocarbons
PPE	Personal Protective Equipment
PTA	Post Treatment Assessment
QA/QC	Quality Assurance / Quality Control
RO	Response Organization

Acronyms – Continued

SCA-TS	Shoreline Cleanup Assessment – Technical Specialist
SCAT	Shoreline Cleanup Assessment Technique
SIR	Shoreline (or Segment) Inspection Report
SOS	Shoreline Oiling Summary
SRP	Shoreline Response Plan
SSC	Scientific Support Coordinator
STR	Shoreline Treatment Recommendation
TAG	Technical Advisory Group
TL	Team Lead
TPH	Total Petroleum Hydrocarbons
TWG	Technical Working Group
UAS	Unmanned Aerial System
UAV	Unmanned Aerial Vehicle
UTV	Utility Task Vehicle

* Incident Command System terms: for further information on ICS terminology, see USCG (2014).

1 Introduction

The Shoreline Cleanup Assessment Technique (SCAT) was first formally applied in 1989. Since then, the SCAT concept for the assessment and documentation of oiled shorelines and river banks has been used during many spill response operations worldwide. SCAT has evolved and continues to evolve, incorporating experience from a wide range of specific spill conditions, emerging technologies and best practices. The first edition of the ECCC SCAT manual was published in 1992, and a second revised edition appeared in 2000. The SCAT program and associated protocols have developed significantly since the publication of the second edition and have been updated in this third edition to include the experiences and lessons learned from field surveys during responses and SCAT-related projects between 2000 and 2016.

The primary objective of a shoreline assessment survey is to generate information on the shoreline and the oiling conditions that is evaluated by a spill management team as they decide on appropriate response priorities, treatment techniques and treatment completion endpoints.

The SCAT concept has been adopted widely and is successful for several key reasons. First, the field data provides systematic, science-based information that is appropriate to support the management decision-making process. Secondly, the process is flexible and adaptable for spill response operations at different scales and in many different environments. SCAT surveys that follow the basic concepts and procedures outlined in this Manual have ranged in scale and size from a two-person, one- or two-day assessment that covers only a few kilometres, to multi-year, multi-team programs that survey hundreds of kilometres of shoreline.

Given this wide range of applications, a single manual cannot describe every potential spill situation. A comprehensive SCAT training program is recommended for personnel who may participate in SCAT activities. A SCAT survey program and a SCAT plan are generated for each response to meet the spill-specific conditions. The purpose of this Third Edition of the ECCC Manual is to provide advice and guidance, based on the 25-year history of SCAT survey experience, as a shoreline assessment survey program and a field and data management plan are developed for each unique situation.

A general background to the SCAT process is summarized in an IPIECA/OGP Good Practice Guide (2014) and a brief history of the evolution of SCAT is provided by Owens et al. (2017), and Parker et al. (2011). An Arctic SCAT guide was produced by ECCC for the Emergency Preparedness, Prevention and Response (EPPR) working group of the Arctic Council to address shoreline surveys in ice and snow conditions (Owens and Sergy, 2004) and SCAT surveys in Arctic regions are described in an EPPR Arctic Oil Spill Response Guide (EPPR, 2015). On a historical note, the features of the first large-scale SCAT program are described by Owens and Reimer (2013).

2 The Basics of SCAT

This section describes the key features and components of a Shoreline Cleanup Assessment Technique (SCAT) program.

2.1 The Purpose of SCAT

The primary purpose of a shoreline oiling assessment program is to provide decision-making support for shoreline treatment Planning and Operations throughout a response.

This objective is achieved by the following:

- Collecting accurate, real-time survey data and information on shoreline oiling conditions, as well as shoreline and backshore character;
- Identifying environmental, cultural and operational constraints to shoreline treatment;
- Recommending shoreline treatment priorities;
- Working with the Environmental Unit and Operations to develop appropriate treatment endpoint criteria and treatment options;
- Interpreting the approved work plan for field supervisors;
- Monitoring the treatment progress; and
- Working with stakeholders to ensure agreement that sufficient treatment has been completed.

2.2 What is SCAT

SCAT provides three basic support functions:

- **Field data and information collection:** Field teams conduct surveys on the affected area to provide real-time, accurate documentation on the physical character of the shoreline and on oiling conditions using standardized methods and terminology. This information provides a scientifically credible and sound foundation for the decision-making process.
- **Data processing, assessment and synthesized outputs:** The data management team processes and records the collected information and synthesizes this information into useful outputs for the spill management team. Subsequent decisions and actions taken are recorded, providing a progress report or overview and a history of spill response actions.

- **Advising and supporting decision making:** SCAT outputs and knowledge are applied to guide the decision making and activities of managers within the Incident Command Post (ICP) and to directly support Planning.

A SCAT program supports the spill management team by providing a range of essential scientific and technical services throughout a spill response.

- Importantly, at the beginning of an incident, SCAT field teams ***generate shoreline oil distribution and characteristics data*** that are the foundation for the developed recommendations in the shoreline response program.
- SCAT information and recommendations are used by decision makers, in part, to develop shoreline response ***treatment objectives, treatment endpoint criteria, priorities and best management practices (BMPs)*** from the beginning of an incident.
- SCAT teams coordinate with Operations to generate ***Shoreline Treatment Recommendation (STR)*** forms for segments which do not meet the treatment endpoint criteria. Once approved, these STRs become a ***"work order"*** for shoreline response activities.
- The SCAT program ***supports Operations*** at the Command Post and in the field throughout the response ***to help understand the STRs and particularly the endpoints and the BMPs***. A dedicated "SCAT-Operations Liaison Team" may be appropriate where the SCAT field teams do not have sufficient time to support Operations and Field Shoreline Supervisors.
- SCAT teams conduct ***inspections*** to determine and verify when endpoints are met, so that ***No Further Treatment (NFT)*** is required and Operations can demobilize from a segment. A completed ***Shoreline (or Segment) Inspection Report (SIR)*** form provides operational closure on a segment-by-segment basis.
- Other missions that a SCAT field team may undertake include ***post-treatment assessment (PTA) surveys*** (prior to an SIR inspection), ***photo monitoring*** to create a photographic time series at selected locations and ***beach profiling*** surveys.
- ***Data Management*** is an essential component of the SCAT program (Section 7).

2.2.1 Scope of SCAT

A SCAT program includes different types of field assessment surveys, data processing and data application components used to guide decision making and response. The SCAT approach can be used on spills:

- in different environments, including marine, freshwater and terrestrial;
- on spills of different oil types with different oiling conditions; and
- on spills of different volumes and operational scales.

SCAT may therefore range from very simple to very complex programs depending, primarily, on the size of the affected area. During a spill response, most elements of SCAT are standardized; however, the procedures and process are adaptable and scalable to match the unique spill conditions. These standards and process adjustments are made early in the scoping stage of the spill.

2.3 SCAT Principles

The following are key SCAT Principles:

- A SCAT program involves a **systematic** survey of all oiled and unoiled shorelines in the affected area.
- An objective and trained survey team of **interagency** personnel represents the responsible party, government agencies, land ownership, land use, land management and/or other stakeholder interests.
- The shoreline is divided into geographic **segments** for documentation and operational planning purposes.
- **Standard terms and definitions** are used throughout the program for documentation and data entry.
- The SCAT program provides **management and operational support** for the response until all treatment activities and inspections are completed.

2.4 SCAT Surveys and Missions

Table 2.1 summarizes the types of surveys or missions that might be conducted during a SCAT program. Survey types are selected according to the requirements of the response, so that not every survey type may be required during every response.

Table 2.1 *SCAT Surveys and Missions*

Survey/Mission Type	Description
Reconnaissance survey	An aerial or rapid ground survey of the affected area that documents the general distribution and character of oil on the shoreline, provides a broad overview of the scale and magnitude of the situation for strategic planning, and helps identify priorities for the initial shoreline response.
Systematic shoreline oiling assessment survey	A coordinated, systematic ground survey that generates Shoreline Oiling Summary (SOS) forms, which contain detailed shoreline and backshore information for oiled segments. This information is used to develop recommendations for the overall shoreline response strategy and to generate Shoreline Treatment Recommendations (STRs), or cleanup plans, for each segment that requires treatment.
Operations liaison and support	A continual process of liaison with Operations at the Command Post to ensure that they understand and agree with the shoreline response strategy(ies) and program, and with field supervisors to ensure that they understand the STR and any BMP or site-specific constraints that may apply to a segment.
Treatment monitoring	Periodic or scheduled field visits to monitor the progress of the treatment activities and work with Operations to make any appropriate adjustments.
Post-treatment assessment survey	A survey in a segment where Operations has, or nearly has, completed the assigned work task to provide assurance that the endpoints have been achieved prior to a more formal inspection.
Shoreline inspection survey	A scheduled survey during which agreement is reached that sufficient treatment has been completed and that the endpoints have been achieved in a segment. This mission may involve completion of a Shoreline Inspection Report (SIR), which documents this decision and allows Operations to demobilize from that segment. Additional treatment may be required if a segment does not meet the endpoint criteria.
Photo monitoring	Designed to record visual changes in oiling conditions through time at selected representative locations.
Beach profiling	Periodic or scheduled across-shore profiling surveys to monitor changes in beach elevation through time, which helps understand beach dynamics and sediment erosion or deposition cycles.

2.5 Typical Phases of a SCAT Program

An oil spill response typically involves evolution from the first phase of emergency or reactive response actions into a phase of planned operations, and then to a pre-agreed completion process. The SCAT program supports each of these progressive phases.

2.5.1 Initial Response Phase

When a spill affects a small area (for example, a shoreline that can be walked in one or two days) or if an aerial survey is not practical or feasible, then the initial reconnaissance may be boat- or ground-based. For all other scenarios, aerial observations and/or video imagery:

- provide information and direction for the initial response operations (such as bulk oil removal or priority cleanup locations);
- involve rapid data collection/turnaround;
- provide the "big picture" and scales the problem for management to develop and prioritize strategies; and
- provide information from which a strategy and plan are developed for subsequent systematic ground surveys; for example, segments identified with heavy oil concentrations or with a high remobilization potential may be operational priorities and become segments for which detailed planning data is a priority.

2.5.2 Planned Phase

A ground SCAT or "ground-truth" program primarily involves comprehensive systematic ground surveys, by teams composed of interagency personnel, to provide segment-by-segment detailed information on the oiling conditions (surface and subsurface).

- If no oil is observed (NOO), this condition is documented on an SOS form.
- If oil is present, the team documents oiling conditions, substrate character, treatment constraints, access, logistics, staging, safety and other information that is used to decide whether treatment is necessary and to plan for treatment operations.
- If an oiled segment does not meet the agreed endpoint criteria, the SCAT team generates a Shoreline Treatment Recommendation (STR) form that initiates the treatment activity process.
- When oil is present on dynamic shorelines, SCAT teams should not survey too far in advance from shoreline Operations to ensure that data in the STR is accurate.
- A segment resurvey and modifications to an STR may be appropriate in advance of Operations if significant time has passed or if there has been a storm event and the oiling conditions have changed significantly.
- Typically, a response does not require a large number of field teams: sometimes one or two are sufficient, and even on large spills only four to eight teams are usually required; the more teams deployed, the greater the requirements are for continued calibration and for the exchange of information between the team leads.
- Aerial surveys may continue to provide the "big picture."

This phase may include a range of mission types to support management and Operations, such as:

- monitoring of the treatment activities and liaison with Operations at the Command Post and with field supervisors to ensure that they understand the STR and any BMP or site-specific constraints that may apply to a segment;
- photo monitoring; and/or
- beach profiling.

2.5.3 Completion Phase

- There may be one or more sequential ***phases*** of shoreline cleanup defined in a treatment plan, each with their own actions, endpoints and completion procedures; for example, (1) initial, first response, bulk oil removal phase; (2) treatment activities during the planned phase that are designed to achieve endpoint criteria; (3) post-treatment monitoring, as oil residues may be allowed to weather and degrade naturally; and (4) an inspection phase during which an agreement is reached that sufficient treatment has been completed and the endpoints have been achieved.
- As the treatment specified in an STR near completion, a "post-treatment" assessment survey may validate that a segment is ready for inspection.
- Agreement that sufficient effort has been completed and that endpoints have been met typically occurs through an inspection process that includes representatives of the key parties and stakeholders involved in the response operation.

- Completion is achieved when the inspection team agrees that (a) the treatment endpoint criteria have been met; (b) continued treatment may delay rather than accelerate recovery, or incur additional damage to that resulting from the oil (for example, excessive removal of sediment or vegetation); the Net Environmental Benefit (NEB) principle; (c) further treatment may be feasible (practical) but ***not reasonable*** (practicable): the As Low As Reasonably Practicable (ALARP) principle; or (d) when the Safety Officer identifies that safety issues may not warrant work or continued work activities in a segment (for example steep, unstable shorelines, or areas with strong currents).
- The inspection process may involve completion of a Shoreline Inspection Report (SIR) which recommends to the spill management team that no further treatment (NFT) is required for a segment.
- If consensus is reached that no further treatment or monitoring is required, and this recommendation is approved by the spill management team, then the segment is no longer part of the response.

2.6 SCAT Process Overview

The Figure 2.1 flow diagram illustrates the general sequence of activities for each segment, from the ground assessment survey through to the completion of shoreline treatment.

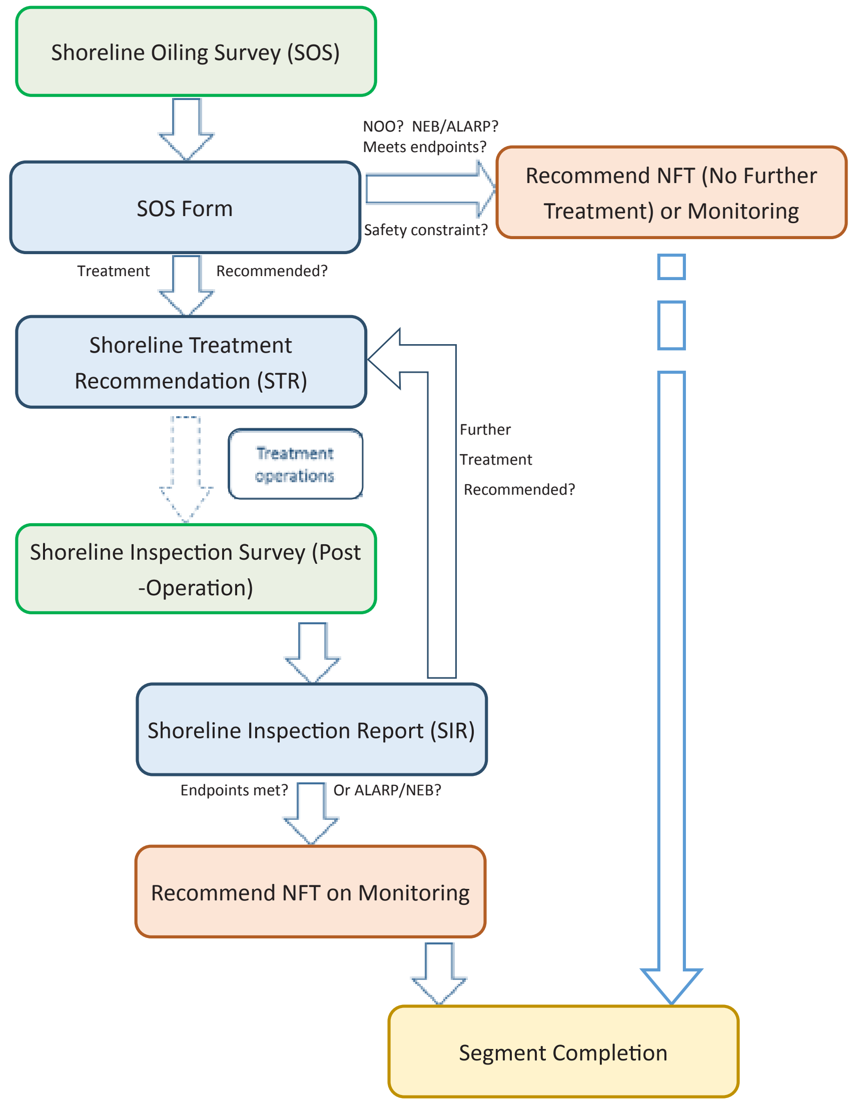

Figure 2.1 *SCAT process flow diagram*

3 SCAT Roles and Responsibilities

3.1 Introduction

- SCAT maintains an important presence at the Command Post and in the Field.
- The SCAT Organization expands or contracts according to the size or complexity of the incident.
- SCAT maintains strong links with key functions in the Incident Management System (IMS), particularly Planning, Shoreline Operations, Safety Officer, Logistics and Air Operations.
- SCAT positions have specific responsibilities and interactions with other personnel.

3.2 Organization within the Incident Management System

Experience gained over the past decades at spill incidents has demonstrated that management of the Shoreline Cleanup Assessment Technique (SCAT) is most effective when situated in the Environmental Unit (EU) of the Planning Section of an Incident Command System (ICS)–based response (Figure 3.1). SCAT is a science-based planning tool that incorporates the net environmental benefit principle. Consensus is built for decisions based on SCAT data (priorities, treatment criteria, cleanup endpoints, etc.) in the Environmental Unit. Case studies have noted that if SCAT management was located within Operations, there exists a real potential that field data could be used directly to create treatment actions which have not been discussed, evaluated or agreed upon by consensus in the EU and without an assessment of the potential or real environmental or cultural resource issues or constraints. This situation can lead to a breakdown in the decision-making process and could compromise the trust between parties that is a critical component of a successful response.

The SCAT Coordinator reports directly to the Environmental Unit Leader (EUL) and maintains strong lateral links and communications with the Operations Section Chief and/or the Shoreside Recovery Group Supervisor at the Command Post. SCAT Field teams parallel that link with the Operations Strike Team or Task Force Leaders in the field. In Figure 3.1, the solid lines represent direct reporting lines, while dotted lines represent strong lateral links.

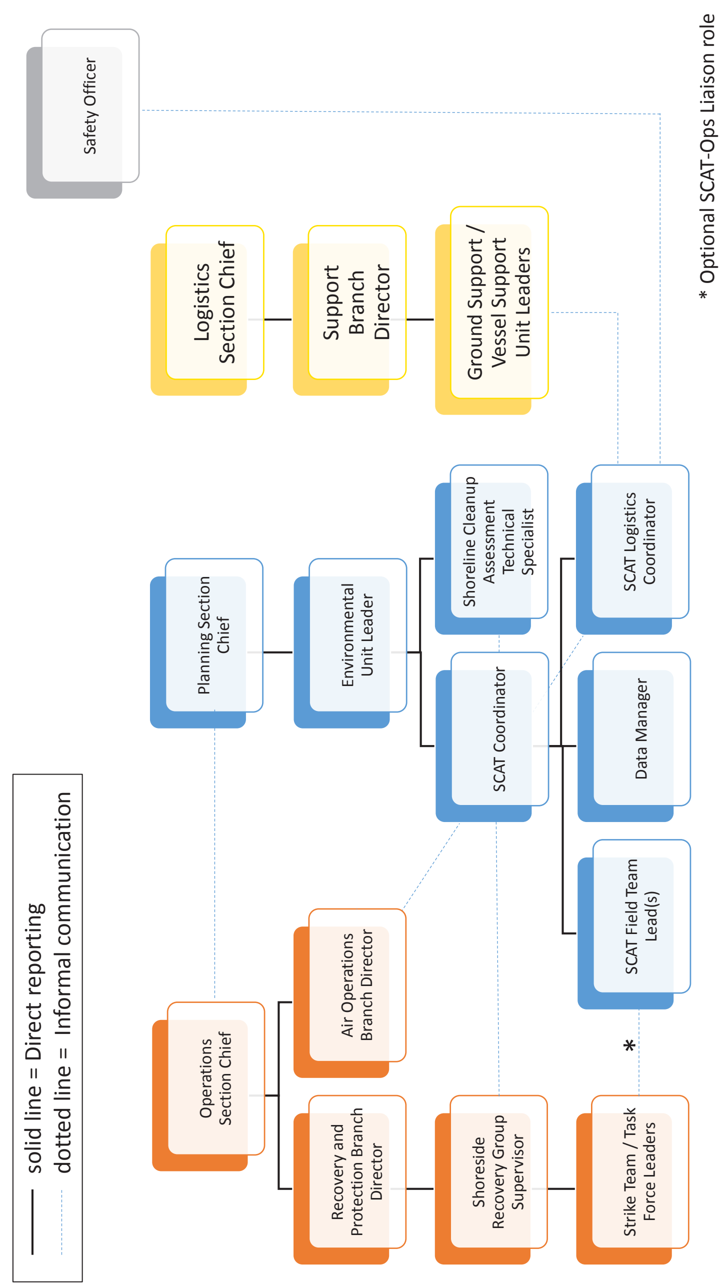

Figure 3.1 *Integration of SCAT personnel within the IMS structure*

3.3 Roles, Responsibilities and Interactions of Relevant Personnel

The key roles and responsibilities of SCAT and related personnel, and important interactions with other personnel are outlined in Table 3.1.

Table 3.1 *SCAT Team Responsibilities and Interactions*

Role	Key Responsibilities	Interactions
Command Post Personnel		
ECCC Scientific Support Coordinator (SSC)	– Member of Command Staff – Staffed by ECCC's National Environmental Emergencies Centre – ECCC's primary representative for the response to coordinate delivery of departmental products and services as well as provision of scientific and technical advice to the Incident Command (IC) – Provides regulatory oversight of the response to protect the environment – Coordinates with Liaison Officers regarding stakeholders issues, concerns and consultations – Some responsibilities may be delegated to an Assistant	– Reports to the Lead Government Agency Incident Commander to ensure that the IC and Unified Command (UC) have the appropriate scientific and technical support and the appropriate information to make decisions – Attends all meetings of the Planning Cycle to ensure a comprehensive understanding of the response operation – Identifies potential concerns or issues in the draft Incident Action Plan (IAP) for the next operational period to ensure that no issues or conflicts exist with ECCC's or other stakeholders' legislation and mandates
Environmental Unit Leader (EUL)	– Determines the need or the potential need for a SCAT Program – Mobilizes the SCAT Coordinator – Establishes and monitors the SCAT program – Chairs any committees or Technical Working Groups (TWGs), such as a Shoreline Treatment TWG	– Reports to the Planning Section Chief (PSC) – Communicates shoreline response objectives/ strategies to the EU – Provides information and data generated by the EU to the Planning and Command decision makers – Ensures the participation of relevant government and other stakeholders through-out the SCAT program
SCAT Coordinator / SCAT Program Manager	– Designs and directs the SCAT program – Coordinates the SCAT field teams and the data manager – Sets SCAT program objectives and SCAT plans – Produces daily (and weekly) summaries of field activities and reports – Coordinates the development of treatment endpoints and treatment recommendations for Command approval – Coordinates the evaluation of the effectiveness of treatment methods and endpoints and modifies them as appropriate – Determines the number of field teams required – Ensures all teams have the appropriate training and calibration, and that they use appropriate terminology – Some responsibilities may be delegated to deputies in the event of a large incident to maintain span of control – Determines the need for any permits (with EUL) – On a larger response, it may be necessary to activate a SCAT Program Manager who would be responsible for long-range strategy, ensuring the missions are completed appropriately, and that there is ongoing calibration. On smaller responses, these functions are performed by the SCAT Coordinator	– Reports to the EUL – Serves as the primary point of contact within the IMS for SCAT activities – Attends IMS meetings as required – Coordinates with the SCAT logistics coordinator to set daily field team missions – Liaises with Shoreline Operations to ensure full understanding of treatment recommendations and endpoints – Coordinates with agencies and other relevant stakeholders for SCAT activities – Ensures all teams are appropriately represented by the relevant parties – Integrates the requirements and concerns of relevant agencies and stakeholders throughout the process from planning to completion

Role	Key Responsibilities	Interactions
ECCC SCAT Technical Specialist	– Provides oversight of the SCAT program to ensure consistency with standards established by ECCC for SCAT programs and procedures in Canada – If concerns, issues or deficiencies are identified in the SCAT program design or delivery, data management, etc., the TS reports these issues to the ECCC SSC with recommendations for mitigation – May be involved in research into the SCAT process during and following an incident – May be a member of a SCAT field team to monitor the process as well as to provide regulatory oversight, or to participate in a post-treatment inspection survey	– Represents ECCC – Reports directly to the ECCC SSC, with links to the EUL, SCAT Coordinator and SCAT Team Lead(s) – Facilitates ongoing discussions with the ECCC and Command regarding the progress of the SCAT program – Identifies concerns or issues that may relate to stakeholder engagement or participation so that any of these concerns can be rectified by the SSC in a timely manner
Shoreline Cleanup Assessment Specialist (SCA-TS)	– Provides technical and scientific input during key decision-making processes, such as the selection of appropriate objectives, priorities, treatment techniques and treatment endpoint criteria – On small-scale spills, the SCAT Coordinator and the Shoreline Cleanup Assessment Technical Specialist roles may be filled by the same person	– Represents the Responsible Party (RP) – Reports to the EUL – Works closely with the SCAT Coordinator – Interacts with the EUL to engage government and other stakeholders

Role	Key Responsibilities	Interactions
SCAT Logistics Coordinator	– Develops daily missions for field teams in consultation with the SCAT coordinator – Ensures that all teams have the appropriate transportation and equipment to safely complete their missions – Produces the SCAT Safety Plan and Job Safety Analysis (JSA) – Maintains SCAT planning tables – Tracks field teams throughout the day until they return – Facilitates daily briefs and debriefs – This role could be fulfilled by the SCAT Coordinator on a small, localized incident	– Reports to the SCAT Coordinator – Works closely with the Safety Officer to ensure the safety of the field teams – Works with the Logistics Section and Air Operations to plan transportation and acquire the equipment for SCAT missions – Maintains communications with teams in the field
SCAT Data Manager	– Collects and collates field data – Conducts QA/QC of incoming data to ensure that all appropriate information, including photographs and GPS data, has been generated and accurately documented – Enters data into GIS database – Produces summary reports, maps and tables – Produces field maps and maps for reports – Maintains an archive for all SCAT data – Supervises data team (on large spills)	– Reports to the SCAT Coordinator

Role	Key Responsibilities	Interactions
Stakeholders	– Participate in the SCAT program and are included in all discussions regarding treatment endpoints, where and how to treat the oiled shorelines and to obtain concurrence that sufficient treatment has been accomplished – Participate on committees or Technical Working Groups, such as the Shoreline Treatment TWG	– Within the EU, represent national, provincial and/or local agencies and other stakeholders
Field Personnel		
SCAT Team Lead	– Acts as the Safety Lead for the SCAT team – Manages and leads field surveys to collect data and report on oiling and shoreline character – Collects other types of data as appropriate, e.g. safety, logistics, ecological, cultural, socio-economic concerns and treatment constraints – Obtains consensus on survey observations between team members in the field – Completes all appropriate documentation of the survey (shoreline forms, reports, etc.). – Conducts QA/QC on all field information that is provided to the SCAT Data Manager – Makes recommendations for treatment via Shoreline Treatment Plans (STRs) – Conducts Shoreline Inspection (SIR) surveys to compare oiling conditions with agreed endpoints and to make recommendations for completion	– Reports to the SCAT Coordinator – Experienced Team Leads (TL) typically represent the RP in the field surveys – Liaises with Operations to ensure a shared understanding of STRs, endpoints and operational limitations (could be conducted by a separate SCAT-Ops Liaison role for a larger incident)

Role	Key Responsibilities	Interactions
SCAT Team Members	– The composition of a SCAT team is mission-dependent (Table 3.2) – The SCAT Team Lead may delegate tasks to Team Members, depending on their expertise and role	– Government and other stakeholders are represented by Field Team Members
SCAT-Ops Liaison	– On large incidents, ensures that all levels of field operations fully understand the recommendations, objectives and constraints of the Shoreline Treatment Recommendations (STRs), so that any questions and concerns can be addressed directly	– Reports to the SCAT Coordinator – Liaises with Operations to ensure a shared understanding of STRs, endpoints and operational constraints

3.4 SCAT Management Team

The size of the SCAT management team at the Command Post can vary depending on the size and complexity of the response. For a simple small-scale incident, one or two people may cover all of the SCAT management roles. For a larger response, the size of the team expands accordingly; ensuring Span of Control is maintained. For example:

- A SCAT-Ops Liaison Coordinator may be responsible for communications between SCAT and shoreline operations in the field.
- An STR coordinator, who reports to the SCAT Coordinator, may be responsible for managing a range of activities associated with obtaining consensus within the EU and then monitoring the approval, implementation and completion of STRs.
- On a small response, a Data Manager may be offsite. For larger operations, a data management team is typically necessary to process the data flow and produce data outputs.

3.5 SCAT Field Teams

One SCAT field team may be sufficient for a small, localized spill, where the affected segments can be covered in a single day. As the size of the spill area to be covered and/or remoteness increases, additional teams are required. Even larger spills may require only four, or as many as eight, teams, which typically would be sufficient to keep the detailed systematic survey program two to three days in advance of shoreline operations. This timing is usually adequate to QA/QC SCAT data, update the SCAT database, create STRs, obtain Command approval, and incorporate the STRs into the Assignment Lists (i.e. ICS204) for the next operational period. In order to ensure that Operations receives the most current data and recommendations, SCAT teams should not attempt to survey too far in advance of Operations, as out-dated observations may not represent changing oiling conditions by the time Operations arrive at a segment. In such cases, or following storm events, a resurvey may be necessary to update the oiling conditions and modify the STR.

The size and composition of a SCAT field team is a function of the mission or survey type (Table 3.2). Shoreline Oiling Summary (SOS) Surveys and Shoreline Inspection Report (SIR) Surveys typically require appropriate representation from the responsible party, federal and provincial agencies, plus local land-owners/managers and/or First Nations representatives. Monitoring surveys, beach profiling, photo monitoring and Post Treatment Assessment surveys may involve a small field team. Due to space limitations in an aircraft, aerial reconnaissance missions may be limited to two people, for example the RP Team Lead and an Agency representative.

Table 3.2 *Appropriate Team Sizes for SCAT Missions*

Mission/Survey Type	Team Size
Recon or Rapid Assessment Survey	Small crew: Team Lead + 1
Shoreline Oiling Assessment Survey	Appropriate SCAT team representation
Post-Treatment Assessment Survey	Small crew: Team Lead + 1
Shoreline Inspection Report Survey	Appropriate SCAT team representation
Operations Liaison Support	Small crew: Team Lead/ SCAT-Ops Liaison + 1
Beach Profiling	Small crew: Team Lead + 2
Photo Monitoring	Small crew: Team Lead + 1
Monitoring	Small crew: Team Lead + 1

A SCAT Team for a systematic Shoreline Oiling Assessment or a Shoreline Inspection Report Survey may include any of the following participants:

- Oil spill / SCAT specialist (Team Lead)
- Responsible party representative
- Federal representative
- Provincial representative
- First Nations representative
- Land owner / manager
- Local shoreline / coastal processes specialist
- Archaeologist / cultural resources specialist
- Ecologist / biologist / wildlife specialist
- Shoreline Operations specialist

One team member may assume two or more of these roles. Ideally, the size of a SCAT Team would be three to five members, with a minimum of two for safety. Additional personnel increase logistical requirements and decrease team efficiency. Ideally, SCAT teams should be consistent, with the same personnel involved from the start of a response to the final inspection survey.

3.6 SCAT Team Leads

The appropriate qualifications of a SCAT Team Leader cover a wide range of skills, including:

- Significant and varied experience with oil spills on shorelines
- Understanding of coastal processes, local geomorphology/geology and ecology
- Understanding of oil behaviour, fate and impacts
- Ability to distinguish between target oil and non-target oil, or "false positives"
- Understanding of oil spill treatment techniques and their effectiveness, impacts and limitations
- Understanding of SCAT terminology, processes and techniques
- Familiarity with technologies relevant to SCAT and data collection (e.g. GPS, range finders, cameras, video cameras, radios, mobile devices, satellite telephones)
- Ability to train, mentor and manage a diverse and constantly changing team (diplomacy, management and leadership skills)
- Awareness of health and safety risks associated with oil and shorelines, and mitigation options
- Physical fitness

4 SCAT Management and Implementation

4.1 Shoreline Response – SCAT Program Plan

A SCAT program is part of the wider shoreline response that integrates shoreline data collection and information processing, strategic long-range (weeks–months) and tactical short-term (days–weeks) planning and field treatment operations. Ideally, a spill-specific Shoreline Response Plan (SRP), which would include the SCAT Plan (Appendix 1B.3), is generated and approved by Incident Command during the initial phase of a response to integrate these different shoreline components (Owens et al., 2015). An SRP includes all of the SCAT activities described in this Manual and identifies:

- standardized SCAT terms and procedures, as described in Appendices A and B;
- the information flow from the SCAT field program and other Environmental Unit sources into the decision-making process for shoreline response ***treatment objectives, treatment endpoints, priorities, best management practices (BMPs)***, ***treatment options***, etc., that define where, when, and how treatment takes place;
- how to ***coordinate*** the shoreline-related activities of the Planning Section and Operations Section; and
- the pre-agreed inspection process that enables treatment ***completion and closure***.

4.2 Checklists

Checklists can help response personnel by:

- establishing **consistency** by standardizing criteria;
- ensuring **important steps are not overlooked**, which is particularly important during the first reactive phase of an incident or during a drill;
- ensuring **steps are taken in the correct order**. For example, notifying stakeholders before certain actions or decisions are made;
- **saving time**: managers should not have to spend time developing a list of action items but rather be able to devote their time to implementing pre-identified tasks; and
- **enabling delegation**: managers can assign action items on a checklist with the delegated task(s) highlighted.

Checklists for each of the three key phases of a SCAT program (Initial, Planned and Completion) are provided in the following pages. In most cases, the SCAT Program Manager is also the SCAT Coordinator (Table 3.1). These checklists are adapted from RRT, 2014.

SCAT Checklist: Initial (Reactive) Phase

Item	Action	Responsibility	Ref.
1	Activate/mobilize SCAT Program Manager / SCAT Coordinator	Environmental Unit Leader	Table 3.1
2	Activate/mobilize and brief SCAT Team Leaders, the SCAT Logistics Coordinator, SCAT Data Manager, data / GIS staff and SCAT Operations Liaison Leads as appropriate	SCAT Program Manager / Coordinator	Table 3.1
3	Obtain EU data and information regarding oil properties, location, transport, fate, effects, behaviour and resources at risk	SCAT Coordinator	6.1, 6.3
4	Deploy aerial reconnaissance and/or rapid ground response teams to gather initial shoreline oiling information to generate a broad picture of the size of the affected shoreline and the degree of oiling	SCAT Coordinator	6.4
5	Establish communications and coordination with relevant stakeholders within the Incident Management Team (IMT), i.e. Shoreline Response Program, EUL, Planning Section, field operations, air operations, logistics and safety personnel	SCAT Coordinator	3.3, 3.4
6	Establish communications and coordination with relevant federal, provincial and local agencies and other external stakeholders through the EUL	EUL / SCAT Coordinator	Table 3.1
7	Establish the shoreline survey objectives, strategies and phases	SCA-TS / SCAT Coordinator	2.5
8	Develop the scope and scale of the initial area to be surveyed by field teams, and survey priorities	SCA-TS / SCAT Coordinator	2.5
9	Determine the number of field survey teams, rotations and appropriate level of support personnel required for the duration of the program	SCAT Coordinator / Logistics Coordinator	3.5

SCAT Checklist: Initial (Reactive) Phase

Item	Action	Responsibility	Ref.
10	Determine the need for specialists in the field teams, depending on the potential shoreline issues and/or concerns, e.g. geomorphologists, archaeologists, ecologists	SCAT Coordinator	3.5
11	Coordinate with the EUL and/or agency coordinators to decide who participates in the field surveys (that is, who is represented in the field teams), and coordinate to mobilize those representatives	SCAT Coordinator	3.5
12	Determine training needs for the field teams; ensure field team members are fully trained and calibrated to the local shoreline and oiling conditions	SCAT Coordinator / Logistics Coordinator	4.6
13	Coordinate with the Logistics Section (Ground/Vessel Support Units) and Air Operations to provide transport requirements for SCAT field team(s)	Logistics Coordinator	4.4
14	Coordinate with the Safety Officer to identify incident-specific health and safety considerations for shoreline assessment operations, and produce a SCAT Safety Plan and Job Safety Analysis (JSA), and provide any appropriate training and equipment	SCAT Coordinator / Logistics Coordinator	4.5
15	Identify and assemble logistics and survey equipment for the field teams	Logistics Coordinator	4.4
16	Segment the survey area and communicate segmentation to the Operations Section Chief, Planning Section Chief, Logistics Section Chief and Documentation Unit Leader. If the area is pre-segmented, check if any revisions are necessary and make appropriate amendments	SCAT Coordinator / Data Manager	5.2, 7.1

SCAT Checklist: Initial (Reactive) Phase			
Item	**Action**	**Responsibility**	**Ref.**
17	Set up computer(s), printer(s) and Internet connections. Brief Team Leads on GPS and photography protocols	Data Manager	7.1
18	Produce field maps to aid logistics (e.g. access, segments) for field teams	Data Manager	7.1
19	Establish communications (radio, cell phone, sat. phone) with the SCAT teams in the field, and implement a check-in protocol until they return to the Command Post or base	Logistics Coordinator	4.4
20	Document initial shoreline oiling conditions and shoreline access, logistics and safety issues from aerial reconnaissance and rapid ground assessment	Team Lead(s)	6.4
21	Arrange and facilitate field team briefs and debriefs at the Command Post or base	Logistics Coordinator	4.4.1
22	Produce maps with segments, waypoints and track lines for the team lead(s) for field reports	Data Manager	7.2
23	Establish a process for QA/QC of the incoming field information, summarize field data and communicate information as appropriate to response managers and planners; ensure that Team Leads have completed QA/QC in the field data	Data Manager	7.5,7.6 7.8
24	Use reconnaissance SCAT data to recommend initial treatment priorities, taking into account heavy oil distribution and the potential for oil remobilization	SCA-TS / SCAT Coordinator	8.2

SCAT Checklist: Initial (Reactive) Phase			
Item	**Action**	**Responsibility**	**Ref.**
25	Create and maintain a contact list of all SCAT personnel and other key players and stakeholders	Logistics Coordinator	3.2, 3.3 3.4, 3.5
26	Develop a training (including safety) and SCAT calibration plan for field personnel	SCAT Coordinator	4.6
27	Determine the requirements for any permits and how to obtain these; coordinate this process with the EU	SCAT Coordinator	Table 3.1
28	Establish a data management system with a GIS function and, if possible, access an appropriate digitized shoreline	Data Manager	7.6
29	Based on initial information from the field teams, select and, if appropriate, modify the shoreline assessment forms and coordinate with the data manager to ensure that the database is modified to accept these changes	SCAT Coordinator / Data Manager	7.2
30	Ensure that there is a survey and reporting schedule (including a daily SCAT report prepared by each Team Lead) to introduce key survey information in time for incorporation into the planning schedule for shoreline operations	SCAT Coordinator / Data Manager	7.8
31	Use initial SCAT data to develop a SCAT / Shoreline Response Plan	SCA-TS / SCAT Coordinator	8.3

SCAT Checklist: Planned Phase – SCAT Surveys / STRs			
Item	**Action**	**Responsibility**	**Ref.**
1	Determine which areas are to be surveyed and prioritize segments. Use the Long-Range SCAT Strategy and Tracking Table and the Short-Term Rolling SCAT Mission Planner	SCA-TS / SCAT Coordinator / Logistics Coordinator	4.3
2	Prepare, deploy and manage field survey teams for shoreline oiling surveys and ensure that mission objectives are accomplished. Use the SCAT Team Daily Tasking and Logistics Plan	SCAT Coordinator / Logistics Coordinator	4.3
3	Arrange for transportation and logistics for field team(s)	Logistics Coordinator	4.4
4	Maintain field and safety equipment (including PPE) for field team(s)	Logistics Coordinator	4.5
5	Produce field maps with segmentation for the field teams	Data Manager	5.1, 7.1
6	Ensure field team(s) understand the needs and requirements for data input, how to properly use field equipment and the mission objectives	Data Manager	4.6, 7.2, 7.3, 7.4
7	Maintain communications (radio, cell phone, satellite phone) with the SCAT teams in the field, and implement a check-in protocol until they return to the Command Post or base	Logistics Coordinator	4.4.1
8	Systematically document oiling conditions using the appropriate Shoreline Oiling Summary (SOS) forms; ensure QA/QC is conducted on final versions of SOS forms before delivery to the data team; prepare daily report	Team Lead(s)	6.4, 7.2
9	Arrange and facilitate field team briefs and debriefs at the Command Post or base	Logistics Coordinator	4.4.1

SCAT Checklist: Planned Phase – SCAT Surveys / STRs			
Item	**Action**	**Responsibility**	**Ref.**
10	Provide the Team Lead(s) with maps with segments, waypoints and track lines for field reports	Data Manager	7.2
11	Collect, collate, QA/QC and summarize field data, including forms, photographs, GPS data, maps and sketches.	Data Manager	7.5, 7.7, 7.8
12	Manage and georeference digital photographs and videos	Data Manager	7.4
13	Produce data summary maps and tables as required by SCAT, Planning, Documentation and key stakeholders	Data Manager	7.7, 7.8
14	Assess available shoreline treatment strategies and tactics; establish a Technical Working Group (TWG), if deemed useful	SCA-TS / SCAT Coordinator	8.2
15	Consider the potential value of field trials or demonstrations for specific treatment options	SCA-TS / SCAT Coordinator	8.2
16	Use SCAT data to enable development of procedures for translating field oiling data and to generate Shoreline Treatment Recommendations	SCA-TS / SCAT Coordinator	8.3, 8.4
17	Determine who will be involved in the development of recommended treatment endpoints and lead the endpoint criteria development process. Establish TWGs, if necessary	EUL	3.3, 8.1
18	Use SCAT data to recommend treatment endpoint criteria for different shore types, oiling conditions, and human use or other criteria. Consider the requirement to establish Technical Working Group(s) to develop endpoint criteria and the selection of appropriate treatment options	SCA-TS / SCAT Coordinator	8.1

SCAT Checklist: Planned Phase – SCAT Surveys / STRs

Item	Action	Responsibility	Ref.
19	Coordinate the inclusion of field survey and treatment constraints into SCAT plans and STRs for Operations, based on ecological, cultural and socio-economic issues noted by the field team and recommendations from specialists/TWGs	SCA-TS / SCAT Coordinator	8.3
20	Use SCAT data to recommend initial cleanup guidelines, priorities and endpoints to the response management for approval. Consult with TWGs, the Wildlife Specialist and the Historical/Cultural Resources Specialist to develop Best Management Practices (BMPs)	SCA-TS / SCAT Coordinator	8.1, 8.2, 8.3
21	Use STR procedures to translate field oiling data and recommendations into Shoreline Treatment Recommendations (STRs) for segments that are above the endpoint criteria	Team Lead(s) and Data Manager	8.4
22	Review STRs	SCA-TS / EUL	8.4
23	Seek approval of EU-reviewed STRs from Command, and provide approved STRs (or "Work Orders") to the Operations Section Chief	SCAT Coordinator	8.4
24	Coordinate with Operations to ensure they receive information in good time to efficiently plan and conduct shoreline treatment operations	SCAT Coordinator	8.4
25	Provide final SCAT / Shoreline Response Plan, SCAT data and input to the Shoreline Response Program	SCA-TS / SCAT Coordinator	4.1

SCAT Checklist: Planned Phase – Monitoring and Liaison

Item	Action	Responsibility	Ref.
1	Ensure that all elements of the SCAT / Shoreline Response Plan are addressed and documented and that mission objectives are accomplished	SCAT Coordinator	4.1
2	Ensure Operations in both the IMT and the field understand the requirements and constraints of the STRs and the BMPs	SCAT Coordinator / Team Lead(s) / SCAT-Ops Liaison	8.4
3	Determine which areas are to be surveyed/monitored and prioritize segments; use the Long-Range SCAT Strategy and Tracking Table and Short-Term Rolling SCAT Mission Planner	SCAT/Logistics Coordinator	4.3
4	Deploy shoreline assessment teams to track and monitor the effectiveness of treatment and liaise with Operations; use the SCAT Team Daily Tasking and Logistics Plan	SCAT/Logistics Coordinator	4.3
5	Deploy shoreline assessment teams to monitor and document changes in oiling locations, character and extent; use the SCAT Team Daily Tasking and Logistics Plan	SCAT/Logistics Coordinator	4.3
6	Arrange for transportation and logistics of field team(s)	Logistics Coordinator	4.4
7	Maintain field and safety equipment for the field team(s)	Logistics Coordinator	4.5
8	Provide Team Lead(s) with field maps with segmentation, oiling maps, approved STRs and any other appropriate information on the segment(s) to be surveyed	Data Manager	5.1, 7.1, 7.7, 7.8, 8.4

SCAT Checklist: Planned Phase – Monitoring and Liaison			
Item	**Action**	**Responsibility**	**Ref.**
9	Maintain communications (radio, cell phone, satellite phone) with the SCAT teams in the field, and implement a system for field teams to check in regularly until they return to the Command Post / Base	Logistics Coordinator	4.4.1
10	Maintain calibration of field teams as oiling conditions change. Conduct regular calibration sessions to ensure observations and documentation remains consistent	SCAT/Logistics Coordinator	4.6
11	Document the changes in oiling conditions due to natural processes, movement and treatment; ensure QA/QC is conducted on final versions of the SOS and other forms before delivery to data team; prepare daily report; monitor and document the effectiveness of treatment and natural recovery, and compare with treatment objectives and endpoints	Team Lead(s)	6.4, 8.1, 8.2, 8.4
12	Arrange and facilitate field team briefs and debriefs at the Command Post or Base	Logistics Coordinator	4.4.1
13	Provide the Team Lead(s) with maps with segments, waypoints and track lines for field reports	Data Manager	7.2
14	Collect, collate, QA/QC and summarize field data, including forms, photographs, GPS data, maps and sketches	Data Manager	7.5, 7.7, 7.8
15	Manage and georeference digital photographs and videos	Data Manager	7.4

SCAT Checklist: Planned Phase – Monitoring and Liaison			
Item	**Action**	**Responsibility**	**Ref.**
16	Produce data summary maps and tables of oiling, SCAT surveys and the treatment process as required by SCAT, Planning and other key stakeholders, and ensure that these are delivered to the Documentation Unit	Data Manager	7.7, 7.8
17	Develop periodic summary and progress reports (initially, these may be daily data reports, but they would transition into weekly summaries)	Data Manager	7.8
18	Establish a treatment review process, allowing modification of guidelines and STRs as oiling conditions change, or if treatment becomes ineffective (ALARP) or the conditions no longer present an NEB risk	SCA-TS / SCAT Coordinator	8.4
19	Review STRs and modify as appropriate	SCAT Coordinator	8.4

SCAT Checklist: Completion Phase

Item	Action	Responsibility	Ref.
1	Ensure that all elements of the SCAT / Shoreline Response Plan are addressed and documented	SCAT Coordinator	4.1
2	Develop and recommend the formal inspection and treatment completion approval process/procedures	SCA-TS / SCAT Coordinator	6.4.9, 6.4.10, 8.5
3	Establish a communication protocol by which Operations notifies the SCAT Coordinator when treatment has been completed on a shoreline segment	SCAT Coordinator	4.4.1
4	Evaluate the need for establishing a Post-Treatment Assessment (PTA) as a precursor to formal inspections with the landowners/managers	SCAT Coordinator	6.4.9, B.1d
5	Determine which areas are to be surveyed or inspected and prioritize segments; use the Long-Range SCAT Strategy and Tracking Table and Short-Term Rolling SCAT Mission Planner	SCAT Coordinator / Logistics Coordinator	4.3
6	Determine the membership of the SIR teams, which team members have recommendation authority and which can provide comments, and ensure that the mission objectives are understood	EUL / SCA-TS / SCAT Coordinator	3.5, 6.4.10
7	Identify or design an appropriate Shoreline Inspection Report (SIR) form and, if required, a PTA form for the completion process	Data Manager	B.1c, B.1d
8	Arrange for transportation and logistics of field team(s)	Logistics Coordinator	4.4
9	Maintain field and safety equipment for the field team(s)	Logistics Coordinator	4.5

SCAT Checklist: Completion Phase

Item	Action	Responsibility	Ref.
10	Provide field teams with oiling and segmentation maps, STRs and other appropriate information on the segment(s) to be surveyed	Data Manager	5.1, 7.1, 7.7, 7.8, 8.4
11	Maintain communications (radio, cellphone, satellite phone) with the SCAT teams in the field, and implement a check-in protocol until they return to the Command Post or base	Logistics Coordinator	4.4.1
12	Maintain calibration of field teams as oiling conditions change. Conduct regular calibration sessions to ensure observations and documentation remain consistent and that mission objectives are accomplished	SCAT Coordinator / Logistics Coordinator	4.6
13	Deploy shoreline assessment teams to conduct post-treatment assessments to confirm endpoints have been achieved	SCAT Coordinator / Logistics Coordinator	6.4.9, 6.4.10,
14	Compare endpoints with oiling conditions during an SIR inspection so that all parties can agree that sufficient treatment has been completed and that No Further Treatment (NFT) is required on a segment-by-segment basis; document using SOS and SIR forms; ensure QA/QC is conducted on final versions of SOS/SIR and other forms before delivery to the data team; prepare a daily report	Team Lead(s)	6.4.9, 6.4.10,
15	Identify possible locations for long-term monitoring to ensure that natural weathering or self-cleaning takes place as anticipated	Team Lead(s)	6.4.8, 6.4.11
16	Arrange and facilitate field team briefs and debriefs at the Command Post or base	Logistics Coordinator	4.4.1

SCAT Checklist: Completion Phase			
Item	**Action**	**Responsibility**	**Ref.**
17	Provide the Team Lead(s) with maps with segments, waypoints and track lines for field reports	Data Manager	7.2
18	Collect, collate, QA/QC and summarize field data, including forms, photographs, GPS data, maps and sketches	Data Manager	7.5, 7.7, 7.8
19	Manage and georeference digital photographs and videos	Data Manager	7.4
20	Produce data summary maps and tables of oiling conditions, SCAT surveys and operational status, as required by SCAT, Planning and other key stakeholders	Data Manager	7.7, 7.8
21	Produce periodic summary and progress reports	Data Manager	7.8
22	Establish a system for providing recommendations for sign-off to the EUL for Command approval	SCAT Coordinator	3.3
23	Establish a system for notifying Operations of segments requiring further treatment	SCAT Coordinator	3.3
24	Track inspection surveys and provide the EUL with summary reports on progress towards completion of all STR segments	Data Manager	7.8
25	Ensure that all SCAT data and documentation are collected, undergo QA/QC and are archived	Data Manager	7.6
26	Ensure equipment is returned as teams demobilize	Logistics Coordinator	4.4.1
27	Assist SCAT personnel with the demobilization process	Logistics Coordinator	4.4.1

4.3 Mission Planning

During an initial, emergency response phase, SCAT missions are scheduled daily, with an emphasis on the rapid identification of locations with mobile oil or bulk oil on shorelines and on recommending shoreline protection and bulk oil treatment priorities. Subsequently, the emergency response phase transitions to the more strategically oriented planned phase.

4.3.1 Mission Plans

In the planned response phase, SCAT missions/surveys are scheduled according to response objectives and survey priorities. SCAT mission planning falls into three categories based on functionality and purpose:

- **Long-range** (1 month or longer) strategy and survey planning, to:
  - set priorities;
  - enable planning for staffing rotations and continued logistics support;
  - track each mission and activity;
  - provide a program history.
- **Short-term** (1–2 weeks) mission planning, to:
  - plan missions according to immediate survey priorities and changing conditions;
  - ensure appropriate data, logistics and safety support.
- **Daily** field team tasking and logistics planning, to:
  - link SCAT activities to the ICS process and the planning cycle (using Assignment Lists or ICS 204 forms);
  - describe the planned activities for the following day / Next Operational Period;
  - provide detailed logistical arrangements; and
  - support urgent or unforeseen issues or events as they arise.

Forms are generated for each planning category, examples of which are presented in Appendix 1B.2.

4.3.2 Survey Windows

Survey timing and field schedules are planned based on site-specific factors, such as tidal predictions, daylight hours and transit time to the survey site. Each of these factors is considered by the SCAT Coordinator as part of the long-range, short-term and daily mission planning process. In some cases, there may be days when field work is not possible or practical due to a short survey tidal window or the absence of a daylight window. For example, the tide graph in Figure 4.1 indicates that the coincidence, and therefore the survey windows, with water levels less than +2.0 m during daylight hours are limited during this eight-day period.

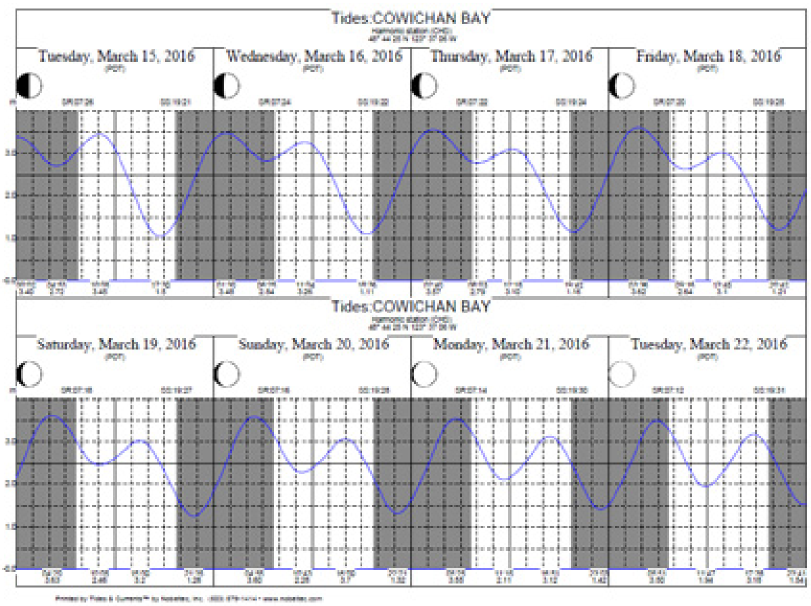

Figure 4.1 *Example of tidal water levels and daylight hours*

Table 4.1 presents the typical number of days each month for southern Vancouver Island with the coincidence of (a) a 3-hour or longer day-light survey window, and (b) water levels less than +1.5 m during those hours. This survey limitation during the T/V *Arco Anchorage* response operation in the Straits of Juan da Fuca, in December 1985, resulted in "Night SCAT" surveys during the low tide windows (Levine, 1987).

Table 4.1 *Example of a Daylight Survey Window Table Showing Days with <3 Hours of Daylight and Low Tide Levels Less than +1.5 m*

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
10	10	5	0	0	0	0	0	8	15	25	25

4.4 Logistics Coordination

4.4.1 Responsibilities

The SCAT Coordinator (or SCAT Logistics Coordinator on a larger response) uses the SCAT mission planning forms to implement daily logistics support for the field teams. Typically, the larger and more remote the incident, the more complex are the logistical requirements. The SCAT/Logistics Coordinator is responsible for:

- scheduling and briefing field team personnel;
- arranging accommodation for non-local SCAT personnel;
- arranging transportation for SCAT surveys (see 6.4.2);
- notifying field team personnel of their missions (via the daily tasking and logistics plan, Appendix 1B.2);
- acquiring the appropriate equipment for field teams (see Equipment Checklist, Appendix 1B.4b);
- ensuring field team members have appropriate water, food, ice, etc.;
- managing communications with the field teams:
  - ensuring teams in the field can contact the base, and vice versa
  - providing cellphones, radios and satellite phones where necessary
  - arranging regular check-ins
  - notifying teams of plan changes
  - allowing teams to pass on time-sensitive information to the SCAT Coordinator;
- planning (time and location) and conducting the morning and/or evening brief; and
- assisting SCAT personnel with the demobilization process.

Field team members typically should expect long working days, often with early morning starts and/or late evening finishes, particularly in remote locations and/or with inconvenient tides.

4.4.2 Transportation

The type of transportation used for SCAT surveys, including transit to the survey site, depends on the size of the affected area and the remoteness of the incident, as well as the survey type and survey environment, and might include one, or a combination of, the following:

- Helicopter
- Fixed-wing aircraft
- Vessels (e.g. workboats, air boats, dinghies)
- Cars/vans/minibuses
- UTVs/ATVs

The SCAT/Logistics Coordinator is responsible for coordinating with Air Operations to arrange for helicopters / fixed wing aircraft, and with the Logistics Section to arrange for vessels, vehicles, UTVs, etc.

There often exists competition for transportation resources, particularly aircraft and vessels, with other response field activities; e.g. on-water operations, (on-water) aerial reconnaissance and wildlife reconnaissance and recovery. This demand on logistics can be acute during the initial phase of a response. The SCAT/Logistics Coordinator must therefore understand and relay to the EUL and Command the often critical importance of SCAT surveys, even if the oil has not yet been stranded on the shoreline.

4.4.3 Site Access

Planning for systematic ground surveys requires information about site access. Relevant information may exist in a pre-SCAT database for the area and/or Geographic Response Plans (GRPs), if these are available. If pre-SCAT information is not available, site accessibility information is gained by consulting local maps/charts, over-flight data or satellite imagery, or by using local knowledge, and by consulting with other units in Operations and Planning.

External approval or monitoring may be required for access to private lands, First Nations lands or locations where there may be restrictions due to environmental or cultural concerns.

Detailed site-specific access information is documented by the SCAT field teams during the ground survey phase for segments where treatment is required. Site access conditions may be temporal, varying with tides, currents, weather or snow/ice cover, factors which may also impact site safety. This information regarding site access and safety is shared with Operations and Safety, and is input to logistics planning for staging and waste management.

4.5 Team Safety

Safety of the field teams is the first priority of a SCAT Program. Risks in the field vary depending on the environment, wildlife, weather, season, mission type and transportation type, and therefore must be assessed for each new response, and must be continuously assessed to identify any changes over time.

SCAT field team safety is coordinated through the SCAT/Logistics Coordinator. She/he is responsible for:

- consulting with the Safety Officer to fully understand site risks;
- preparing the SCAT Safety Plan (see Table 4.2 for Safety Plan contents);
- preparing the Job Safety Analysis (JSA);
- ensuring that all team members have the appropriate safety training;
- ensuring that all team members have the appropriate Personal Protective Equipment (PPE) to conduct their work safely;
- establishing a maintenance/inspection schedule for PPE;
- updating the Safety Plan and JSA as new risks are identified;
- Observing the current and forecast weather; and
- communicating changing risks (e.g. weather) to the field teams.

In the field, the Team Lead is the Safety Officer for the team. She/he is responsible for:

- conducting daily "tailgate" team briefings;
- ensuring everyone on the team fully understands:
  - The mission
  - The survey location
  - Current and forecast weather
  - Potential hazards
  - Hazard mitigation
  - PPE requirements
  - Communications;
- completing the JSA;

- ensuring the field teams read, understand and certify the JSA prior to the survey;
- answering any questions about the mission, and mitigating any safety concerns; and
- conveying any safety issues/concerns from the field to the SCAT Coordinator (or SCAT Logistics Coordinator), so that person can inform the Safety Officer / Operations.

All team members have Stop Work Authority if they have serious concerns about the safety of the mission. This action requires the team to consider alternatives to remove, reduce or mitigate the risk. If mitigation is not possible, then the mission is aborted by the Team Lead.

Table 4.2 *Contents of a Safety Plan*

Safety Plan Contents
Roles and Responsibilities
Communication
Job-specific risks, including – Weather, sea state, tides, currents – Transportation – Working on/near water – Wildlife
Incident-specific safety rules and protocols
Training requirements
PPE requirements
Emergency notification
Incident reporting and forms
JSA Template

4.6 Training and Calibration

Basic knowledge is required for each team member in order to sustain a successful SCAT field program. Consideration should be given to the knowledge and experience of each member, and whether training is required prior to field deployment or in the field. Specific training topics might include:

- Shoreline processes
- Oil weathering processes
- Oil behaviour on the shorelines
- Natural recovery
- Shoreline treatment techniques
- Net Environmental Benefit Analysis
- SCAT techniques and processes
- Recognizing oil on the shoreline
- False positives
- SCAT terms and definitions
- SCAT reporting and forms
- Field safety
- Equipment use (e.g. GPS, PPE)
- Ecological awareness
- Historical/Cultural Awareness
- Local information

Training standards help maintain consistency and facilitate team consensus in the field; however, this is not always practicable. Each new member must therefore be trained or mentored to reach the minimum requirements, with refresher training and/or calibration for those rotating back to a program after a significant time away.

Regular calibration exercises between individual team members and between different teams help to ensure consistency, particularly as the degree and character of the oil changes over time.

5 Pre-SCAT Data

Much of the critical information used by the SCAT Program during a response can be compiled in advance. It is more practical to collect/assess certain data before an incident ("pre-spill"), when there is more time available to address important issues, rather than under the time constraints of an initial emergency response. The key components of Pre-SCAT data are Pre-SCAT Mapping and Pre-SCAT Segmentation. For dynamic shorelines, Pre-SCAT data should be reviewed and updated on a regular basis.

5.1 Pre-SCAT Mapping

Pre-SCAT shoreline mapping provides operational response datasets in association with geographical response plans for timely and effective coordination of resources during a response. Pre-SCAT data ensures that unbiased scientific data are immediately available to the Incident Command at the time of a spill, facilitating early implementation of effective best practices and consistency. The same data can be equally used by governments, stakeholders, industry and Response Organizations (ROs).

At the time of a spill event, pre-SCAT datasets are used to populate a SCAT data management system with foundation information which is then supplemented with real-time observations obtained during SCAT surveys on oiling conditions, as well as other information related to operational support. The pre-SCAT mapping dataset, along with other available data, also provides an information source used by the SCAT Program and Environmental Unit to plan SCAT logistics; determine resources at risk; develop recommendations on priorities, endpoints and treatment tactics; and identify access points, staging areas and any safety concerns in advance of deployment of Operations. Pre-SCAT data also provides baseline information on the shoreline.

The types of data typically included in pre-SCAT shoreline mapping are provided in Table 5.1.

Pre-SCAT information can be collected using a pre-SCAT segmentation form (Appendix 1B.5b).

One of the basic principles of pre-SCAT mapping is the understanding that the same levels of information may not necessarily be required or available at all locations, particularly in remote areas. A fit-for-purpose approach enables mapping and information to be compiled at different levels of datasets and detail, allowing for flexibility and adaptation with respect to risks and priorities.

5.2 Segmentation

Segmentation is the backbone of a SCAT mapping and data framework. All information collected for Pre-SCAT, or during SCAT surveys, monitoring or inspection surveys is managed and processed within this framework. Each segment has a set of criteria and conditions (endpoints, priorities, tactics and constraints) that are used by Planning and Operations throughout a response. Mapping and segmentation should be conducted at low tide, so that information on the lower tidal zone is included. RRT (2015) provides additional information on segmentation.

Table 5.1 *Pre-SCAT Mapping Datasets*

Pre-SCAT Mapping Datasets	
Backshore Character	– E.g. cliff, lowland, beach, etc.
Shoreline Character	– Along-shore and across-shore form and substrate evaluations – Penetration, remobilization, retention and burial potential – Treatment and protection tactics – Operational logistics and safety
Oil Behaviour Parameters	– Exposure to wave action – Tidal range – Natural collection sites – debris, logs, traps, barriers – Overwash potential – Intertidal/nearshore vegetation
Access and Staging	– Land, water and air access equipment – Types and capacity of staging areas – Boat ramps – Storage facilities – Proximity to resources and operational support

Pre-SCAT Mapping Datasets	
Response Constraints	– Ecological – Archaeological/historical – Cultural and subsistence – Human use – Socio-economic – Resources at risk
Jurisdiction and Ownership	– Federal – Provincial – Municipal – Commercial – Private – First Nations – Agency, government and private contact information
Support Data	– Segment boundary coordinates – Photos/videos – Maps
Response Priorities	– Sensitivity ranking (ecological, cultural and human use) – Seasonal assessments – Remoteness and availability / deployment of resources

Shoreline segmentation, wherever possible and appropriate, should consider the following parameters:

5.2.1 Shore Zone Character

The primary rationale for shoreline segmentation is based on the division of along-shore sections within which the shoreline character is relatively homogeneous in terms of physical features, sediment type, vegetation cover and wave exposure, as they relate directly to oil behaviour and treatment options (Figure 5.1). Shoreline types are discussed in the Table 6.2 and Appendix 1A.1e.

5.2.2 Backshore Character

The backshore character (or coastal character) and use are often important for response decisions as well as logistics. Changes in the backshore can be an important consideration in segmentation as they may affect access, staging and treatment options; i.e., is the backshore character a cliff, forested lowland, over-wash lagoon, agricultural field, public park or parking lot? Coastal Character is discussed in Appendix 1A.1f.

5.2.3 Jurisdiction

Segments that span jurisdictional boundaries can often necessitate the inclusion of multiple stakeholders with different objectives and concerns that could be avoided if segments or sub-segments are delineated according to these boundaries. These boundaries can be administrative, political or related to land ownership or management.

5.2.4 Rivers and Streams

A guiding principle for segmentation is to avoid the use of a river and stream for segment breaks. Rivers and streams often have fisheries or other wildlife concerns and a segment break in the channel places all related restrictions into two separate segments when those may apply equally to both banks of the channel. It is preferable to make the stream or river channel and the adjacent shoreline a single unit so that the segment has its own physical and ecological identity (Figure 5.2).

5.2.5 Operational Logistics

If segments are too long, it may be difficult for operations to develop treatment plans that coordinate the deployment of resources and manpower, along with practical waste disposal options. Shoreline access points often can be a convenient middle point for long segments. As a guideline, operations segments should be between 100 m and 1000 m (1 km), although shorter segments may be required in unique situations. On long uniform shorelines with no specific features to use for segment identification, such as long sand barrier beaches, boundaries can be created during a response at regular intervals, i.e. 500 m, with GPS coordinates and marked with backshore stakes / flagging.

5.2.6 Nearshore Protection/Containment Options

An aspect of segmentation often not considered is that of "water segments." As the name would suggest, water segments are not shoreline segments but rather water features that break shorelines, such as tidal inlets or a wide river channel. Their importance to oil spill response is related to an on-water protection or containment strategy. Their inclusion in mapping allows the provision not only of shoreline treatment datasets but also of protection and containment datasets as they relate to sections of coastline.

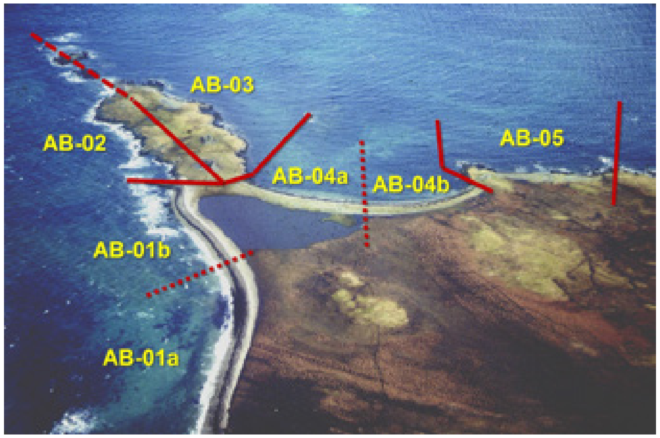

Figure 5.1 *Example of Primary Segmentation*

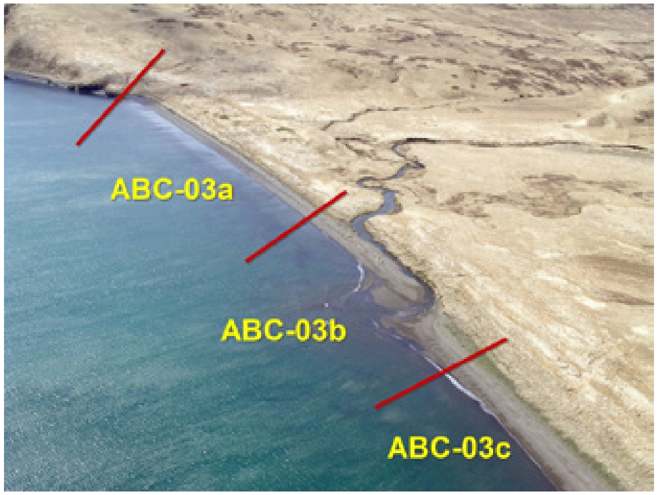

Figure 5.2 *Segmentation at Rivers and Streams*

5.3 Segmentation Naming Convention

In order to provide shoreline segmentation that can be used by all response personnel, a segment naming convention must be systematic, easy to adapt and intuitive to use. On small local spills with only a few segments, this can be a simple sequence of numbers, i.e. 1–10. On larger spills with more extended coverage, segments are broken into operational groups, i.e. ABC-01 to ABC-10. Segmentation may have to include regional as well as local geographic naming to provide a unique reference name to all shorelines within response plans.

A hierarchical structure, starting at the highest level and subsequently broken into smaller sections down to the individual shoreline segments or sub-segments, provides a method to collect and manage data at different levels of detail (geographic scale) within the same segmentation framework. Each segment or sub-segment would have a unique reference name within the hierarchy, no matter how large the response area (Table 5.2).

The higher levels in the hierarchy (1–3) provide a **Geopolitical Reference** (BC/SAL/BRD), and the lower levels (4–5) define the individual sections of shoreline or **Mapping Units** (STN-01). The resulting hierarchical naming, for example BC/SAL/BRD/STN-01, would define a section of shoreline around Stanley Park in Burrard Inlet, B.C. A **Sub-segment** identifier (6) can be added if it is important to further define and describe unique features or conditions within a segment.

Minimizing the segment numbering to a small count within local geographic groups is more intuitive for operational segments. Depending on the size and location of a spill, only the last section(s) of the naming reference would be used in a response, i.e. STN-01.

Table 5.2 *Segment Naming Hierarchy*

	HIERARCHY or LEVEL	Example CODE
Geopolitical Reference Codes	(1) Global: Province or State, e.g. British Columbia	BC
	(2) Regional: Smaller Scale, e.g. Salish Sea	SAL
	(3) Area: Larger Scale, e.g. Burrard Inlet	BRD
Mapping Unit Codes	(4) Group: Local Geographic Reference, e.g. Stanley Park	STN
	(5) Segment: Individual section of shoreline	01
	(6) Sub-Segment: Secondary response features or condition	A

6 SCAT Field Activities

6.1 Shoreline Environments, Including Snow and Ice

The SCAT program follows Environment and Climate Change Canada's (ECCC's) shoreline classification system, which is based on substrate character (material) and secondarily on shoreline morphology (form). Historically, for national oil spill response in Canada, this classification has been the common standard for the physical description of shoreline types, backshore types, coastal character and substrate types.

- Descriptions of substrate materials and shoreline form are provided in Appendix 1A.1d.
- Descriptions and example photographs of shoreline types are provided in Appendix 1A.1e.
- Further details on the ECCC shoreline standards are documented and defined in Sergy (2008) and updated in ECCC (2016).
- The link between the ECCC shoreline types and 20 shoreline treatment techniques is described in ECCC (2016).

6.1.1 Marine Shoreline Classification Systems

Several different shoreline classification systems, designed for different purposes, are in common use. The ECCC marine shorelines oil spill response Field Guide defines 16 shore types (Table 6.1) to describe a segment in terms of one primary and multiple secondary shoreline types. API/NOAA use 27 marine classes for the Environmental Sensitivity Index (ESI) habitat mapping (NOAA, 2016), and the British Columbia coastal mapping program has 40 shore type classes (Howes et al., 1995), both summarizing the entire segment in one shoreline type. A general crossover comparison of these three systems is provided in Table 6.1. Whereas the ECCC marine Field Guide defines 16 Shore Types, a seventeenth is added in this Manual so a distinction can be made between ice-rich and ice-poor tundra cliffs.

6.1.2 Dynamic Shorelines

Shorelines can change dramatically over time in terms of sediment types and beach morphology. Many shores have long-term seasonal (summer-winter) cycles of sediment accretion and erosion related to seasonal wave-energy levels which can significantly alter the sediment type and/or the beach morphology. Other changes can be rapid (hours) and result from significant weather events (storm waves, storm surges / wind tides) or cyclical tide events. For this reason, a SCAT program cannot rely completely on maps and images to segment shorelines and identify shoreline types; this data must be verified in the field and corrected where differences are observed. Changes may occur during the course of a SCAT Program requiring periodic re-surveys, particularly following large storm events.

Ice formation and decay can change the substrate type from permeable to impermeable, or vice versa, in a matter of hours. Swash or spray ice and frozen rain typically form as air temperatures drop below freezing. Freeze-thaw cycles, in which daytime and nighttime temperatures change around the freezing point, can result in short-term dynamic, repetitive changes in substrate character during the freeze-up or thaw seasons.

Table 6.1 *Comparison of Shoreline Classifications*

ECCC Marine Shoreline Types	API/NOAA Marine Shoreline Habitats	BC Coastal Class (Shore-Zone)
Impermeable Shorelines		
Bedrock	– 1A Exposed Rocky Shores – 1C Exposed Rocky Cliffs – 2A Exposed Wave-Cut Platforms – 8A/B Sheltered Rocky Shores	– 1/4 Rock Ramp – 2/5 Rock Platform – 3 Rock Cliff, Narrow
Ice	-	-
Manmade Impermeable	– 1B Exposed, Solid Manmade Structures – 8B Sheltered, Solid Manmade Structures	– 33 Manmade, Impermeable

ECCC Marine Shoreline Types	API/NOAA Marine Shoreline Habitats	BC Coastal Class (Shore-Zone)
Permeable Shorelines		
Manmade Permeable	– 6B/C Riprap – 8C Sheltered Riprap	– 32 Manmade, Permeable
Sand Beach	– 3A Fine to Medium-Grained Sand Beaches – 4 Coarse-Grained Sand Beaches	– 16/19 Rock Ramp with Sand Beach – 17/20 Rock Platform with Sand Beach – 18 Rock Cliff with Sand Beach – 27/30 Sand Beach
Mixed Sediment Beach	– 5 Mixed Sand and Gravel Beaches	– 11/14 Rock Ramp with Sand and Gravel Beach – 12/15 Rock Platform, with Sand and Gravel Beach – 13 Rock Cliff with Sand and Gravel Beach – 25 Sand and Gravel Beach
Pebble-Cobble Beach	– 6A Gravel Beaches – 6B Gravel Beaches (cobbles and boulders)	– 6/9 Rock Ramp with Gravel Beach – 7/10 Rock Platform, with Gravel Beach – 8 Rock Cliff with Gravel Beach – 22 Gravel Beach
Boulder Beach	– 6B Gravel Beaches (cobbles and boulders) – 8D Sheltered Rocky Rubble Shores	– 22 Gravel Beach
Mud Flat	– 7 Exposed Tidal Flats – 9A Sheltered Tidal Flats	– 29 Mud Flat
Sand Flat	– 7 Exposed Tidal Flats – 9A Sheltered Tidal Flats	– 28 Sand Flat
Mixed Sediment Flat	– 7 Exposed Tidal Flats – 9A Sheltered Tidal Flats	– 21/23 Gravel Flat or Fan – 24/26 Sand and Gravel Flat or Fan
Snow-Covered Shoreline	-	

ECCC Marine Shoreline Types	API/NOAA Marine Shoreline Habitats	BC Coastal Class (Shore-Zone)
Vegetated Shorelines		
Wetlands/Marsh	– 10A Salt- and Brackish-Water Marshes – 10B Freshwater Marshes – 10C Swamps – 10D Shrub-Scrub Wetlands	– 31 Estuarine/Organics/ Fine
Peat Shoreline	– 8E Peat shorelines	
Tundra Cliff (ice rich)	– 3C Tundra Cliffs	
Tundra Cliff (Ice poor)	– 3C Tundra Cliffs	
Inundated Low-lying Tundra	– 10E Inundated Low-Lying Tundra	

6.2 Shoreline Segmentation

Shoreline Segmentation is an essential component of the SCAT process, ideally undertaken prior to an incident ("pre-SCAT"). Where pre-SCAT segmentation data is available, the SCAT field teams verify this information during their initial surveys, and make recommendations for revisions to the Data Manager. Where pre-SCAT data is not available, segmentation must be completed as soon as possible during the initial phase of a response. Further information on segmentation is provided in Section 5.2 and on Shoreline Types in Appendix 1A.1e.

6.3 Oil Fate, Behaviour and Persistence

6.3.1 Oil Weathering

Weathering is the set of biological, physical and chemical processes that change the compounds of spilled oil. Important processes while oil is still on water include spreading, dispersion, evaporation, dissolution and emulsification. Processes that are more important in later stages of weathering and that usually determine the ultimate fate of spilled oil are biodegradation and photo-oxidation.

Weathering rates depend on:

- oil type;
- physical oil properties (viscosity and pour point);
- chemical oil properties;
- volume of oil spilled;
- weather and shoreline conditions;
- location (on water or stranded); and
- physical energy levels (marine and coastal processes).

6.3.2 Oil on the Shoreline

Oil typically strands in the intertidal zone, although the water level controls whether oil is stranded in the upper intertidal zone or above the normal limit of wave action. The lower half of the tidal zone is usually water saturated; therefore, oil does not tend to readily adhere to substrates in the middle-lower intertidal zone and oil on mudflats is easily remobilized by rising tides.

Depending on the shoreline and oiling conditions, stranded oil may be subject to remobilization, burial and penetration:

- Remobilization may occur when oil does not adhere to the shoreline substrate or vegetation, and when water movement (tides, currents) moves the oil to another area.
- Burial occurs mainly on sandy shorelines, and sometimes high-energy pebble and cobble beaches, where the sediment is easily moved by the waves, and can occur seasonally and during the daily tidal cycle.
- Penetration occurs where oil moves under gravity through interstitial spaces between sediments. Penetration rate and depth are a function of oil viscosity and sediment size.

6.4 SCAT Program Surveys and Missions

A summary of the applications, benefits and limitations of different SCAT survey methods and types of missions is provided in Table 6.2. A summary of the survey techniques that are applicable to the different SCAT missions is indicated by the shaded areas in Table 6.3.

Table 6.2 *SCAT Program Surveys and Missions*

Type	Application	Benefits	Limitations
Aerial Reconnaissance (RAS)	– Important for all but very small areas (i.e., a few km) – First phase survey to obtain high-level / regional oiling information – Continued as appropriate for changing oiling conditions	– Scales the incident – Rapid – Helps determine locations and priorities for first shoreline operations and ground SCAT surveys	– Weather/ visibility – Low level of detail – Cannot detect Light, Very Light, Trace or subsurface oiling – Unlikely to see detail of substrate, particularly on mixed sediment, or vegetated shorelines
Ground Reconnaissance (Vessel or Foot) (RAS)	– For small areas which can be covered in one or two low tide windows	– Scales the incident – Rapid – Helps determine locations and priorities for first shoreline operations and ground SCAT surveys	– Low detail – No digging, so cannot detect subsurface oiling (except during K9-SCAT surveys)

Type	Application	Benefits	Limitations
Systematic Shoreline Oiling Summary (SOS) Survey (Vessel or Foot)	– For all segments, both oiled and not oiled, located within the affected area (as defined by a reconnaissance survey)	– Provides detailed data for endpoint recommendations, STRs and SIRs – Systematic documentation of the location, character and amount of surface and subsurface oil, or of No Observed Oil (NOO)	– Slow – Rapid data turnaround necessary for the first surveys to provide information for Planning and Operations
Operations Liaison and Support (OLS)	– For segments undergoing treatment	– Ensures Operations in the field have full understanding of the STR, endpoints, BMPs and constraints – Allows assessment and documentation of segment progress – Aids SCAT mission planning	– May require separate SCAT-Ops Liaison position(s), particularly for large and/or remote incidents
Treatment Monitoring (MON)	– For segments undergoing treatment	– Allows assessment and documentation of segment treatment progress – Highlights any need for adjustment of the STR – Aids SCAT mission planning	– May require separate SCAT-Ops Liaison position(s), particularly on large and/or remote incidents
Monitoring (of natural recovery) (MON)	– For segments where treatment was not recommended or is no longer operational	– Allows assessment and documentation of natural recovery – Allows comparison with expectations of recovery rates	

Type	Application	Benefits	Limitations
Post-Treatment Assessment (PTA) Surveys	– For segments where Operations has, or has nearly, completed treatment	– Confirms that the endpoints have been achieved prior to a formal inspection – Prevents wasting effort and the time of an SIR team if the segment is not ready for inspection	– May not be practical for remote incidents
Shoreline Inspection Report (SIR) Surveys	– For segments where Operations has completed treatment	– Provides recommended closure for segments that have reached agreed endpoints, allowing demobilization	– Additional treatment may be required if a segment does not meet the endpoint criteria
Photo-Monitoring (PM)	– For selected representative locations	– Designed to visually record changes in oiling through time at selected sites – Helps to show the history of oiling, including treatment and natural recovery	
Beach Profiling (BP)	– Periodic or scheduled across-shore profiling surveys for segments with dynamic processes	– Enables the monitoring of changes in beach elevation through time – Helps understand beach dynamics and sediment erosion or deposition cycles	

Table 6.3 *Survey Methodologies for SCAT Missions*

SCAT Missions	Method					
	Aerial – Visual	Aerial – Video	Aerial – UAS	Ground – Foot	Ground – Boat	Ground – K9-SCAT
Reconnaissance Survey	■	■	■	■	■	
Shoreline Oiling Survey (SOS)				■	■	■
Limited Access SOS			■			
SCAT Operations Liaison			■	■		
Monitoring (photo/profile)			■	■	■	
Post-Treatment Assessment				■	■	■
Shoreline Inspection Report				■	■	■

6.4.1 Pre-Oiling Survey

In some situations, it may be possible to survey the shoreline prior to oiling, for example, if the release is a significant distance offshore. The purpose of this type of mission could be to:

- establish a baseline of shoreline character;
- identify pre-existing oiling, particularly on shorelines with historical or operational spills;
- identify trash/debris that may be relocated to protect habitat and reduce oiled waste;
- update shoreline maps / pre-SCAT maps;
- segment the shoreline or update segmentation maps and data;
- identify access, safety and operational issues;
- identify or verify ecological, socio-economic, cultural and historical issues; and/or
- identify priority shorelines for protection.

6.4.2 Reconnaissance Survey

The reconnaissance (recon) survey provides a rapid overview of the situation and provides "big picture" information without the detail and time required for a full shoreline oiling survey (Section 6.4.3). Reconnaissance data includes:

- photographs;
- videos (ideally with verbal commentary);
- GPS tracks and waypoints;
- simple written reports, indicating:
  - › Shoreline type
  - › Location (fate) of observed oiling
  - › Oil character, where this is possible from the air
  - › Approximate length and width of observed oiling
  - › Access and safety information
  - › General sensitive resources information; and
- sketches.

The reconnaissance survey typically would not require full representation from each of the parties identified for the field teams, but would benefit from at least one RP and one agency representative.

6.4.2.1 Aerial Reconnaissance

Aerial reconnaissance is conducted for all but very small areas and enables rapid "big picture" data collection and reporting. Aerial reconnaissance data identifies the location(s) of the heaviest oiling to provide an initial direction and prioritization for operations and for ground SCAT teams. Aerial videography, preferably with verbal commentary, can be used to collect shoreline and oiling data, although this may involve post-processing time, which could delay the transfer of information. For best observations and videography, aerial surveys typically require

- Altitude: 50–150 m.
- Ground speed: approx. 50–70 knots.
- Flight line: approx. 200 m seaward of the water line.
- Viewing targets: directed ahead at approximately 45 degrees from the flight line, with the sun behind the video camera operator for best lighting.

The most important parameter is maintaining an "in view" video frame of four to five seconds, which is determined by a combination of altitude and ground speed.

6.4.2.2 Ground/Vessel Reconnaissance

Ground or vessel reconnaissance is conducted for smaller spills, where the affected area can be covered in less than one to two hours, and for ground verification or support of aerial observations, e.g. oil character, false positives. Ground or vessel reconnaissance is rapid and does not generate detailed information, such as that provided in a Shoreline Oiling Summary (SOS) form. Reconnaissance data identifies the general location of the heaviest oiling and can provide the initial direction and prioritization for operations and for ground SCAT teams.

6.4.3 Ground Shoreline Oiling Summary (SOS) Survey

Where practicable, the SCAT teams survey the shorelines of the affected area (as defined by the reconnaissance survey(s)) on foot, supported by boats or road vehicles/ATV/UTVs as appropriate. For areas inaccessible by foot, surveys can generally be conducted by (a) boat along the fringes to avoid further disturbing these habitats and/or to avoid driving any oil deeper into the sediments by trampling, (b) a K9-SCAT team or (c) deploying an UAV/UAS with video capability.

The SOS survey collects detailed data documented on incident-specific SOS forms (Appendix 1B.5a). SCAT teams agree in the field on the oiling character and on potential recommendations for treatment for segments that do not meet endpoint criteria, then complete SOS forms and sketches (see examples, Appendix 1A.5) for oil zones within each segment. Data from the field includes:

- completion of the SOS form (Appendix 1B.5a);
- completion of the STR form or SIR form (Appendix 1B.2);
- preparation of sketch(es) (Figures 6.1) and/or annotated photographs/images (Figure 6.2) of the segment if oil is observed. No sketch is required if no oil is observed in the segment;
- recording of the track line of the team;
- recording of GPS waypoints of the segment and zone boundaries, oil locations and other specific features;
- digital photographs and logging date, time and location. No photos are required if no oil is observed in the segment, but a few alongshore general photographs typically would be taken from the high-tide mark to document the shore zone and backshore character; and
- digging of pits/trenches if subsurface oil is suspected based on beach characteristics.

SCAT teams typically should attempt to survey two to three days ahead of shoreline operations to allow sufficient time for processing and QA/QC of data and for the preparation and approval of STRs, but not so much time that oiling conditions change before Operations arrives at the site.

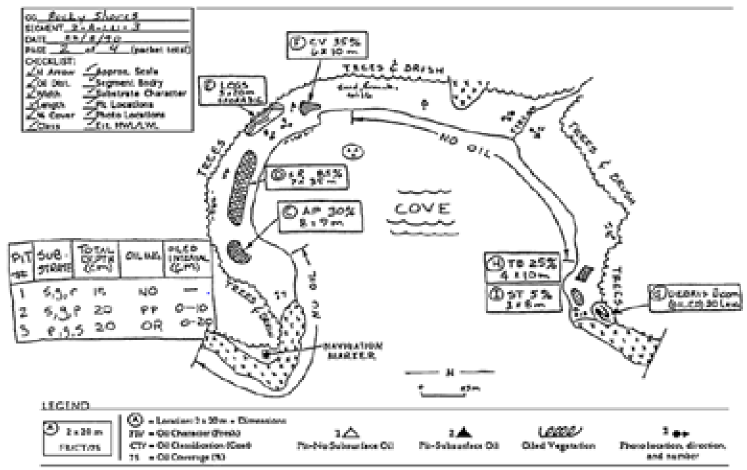

Figure 6.1 *Example of segment sketch*

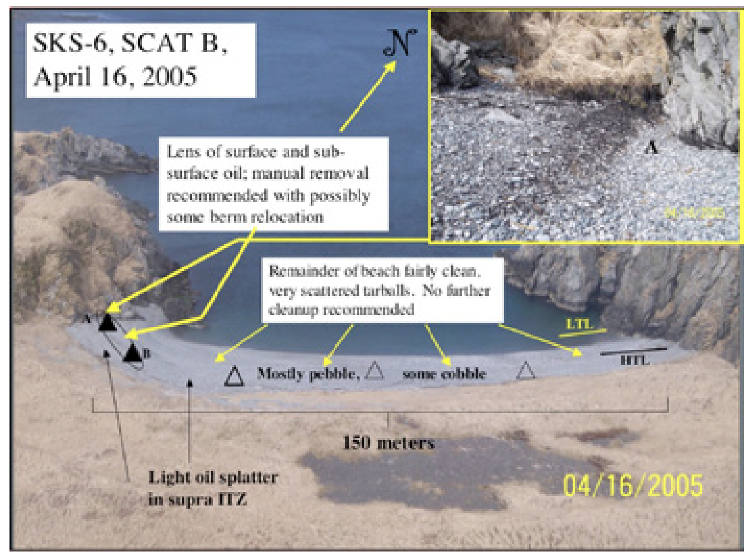

Figure 6.2 *Example of annotated photographs*

6.4.4 Surface Oiling

The optimum platform for observation and documentation of surface oiling is on foot; however, other platforms may be appropriate, depending on the shoreline type, access, and degree and character of oiling (Table 6.4).

Table 6.4 *Platforms for Shoreline Surveys*

Platform	Application
Foot	– Accessible shorelines – Can detect down to surface trace oiling
UTV/ATV	– Moderate to heavy oiling – Requires shoreline with sufficient bearing capacity, trafficability and suitable access
Vessel	– For shorelines where pedestrian access is difficult or presents health and safety issues, and/or may cause physical damage to the shoreline (e.g. for fringe oiling on vegetated/soft shorelines) – Requires shallow draft vessel – May be impractical in very shallow or high wave-energy waters
UAV/UAS	– For shorelines which are difficult to access by foot or vessel – May be difficult to detect Trace or Very Light oiling, or oil on/within vegetation
Jet skis	– For shorelines which are difficult to access by foot, and with shallow water – For access to shorelines with limited access, allowing survey by foot
Kayaks	– For shorelines which are difficult to access by foot, and with shallow water – For access to shorelines with limited access, allowing survey by foot
Canines	– For rapid detection of trace and hidden or subsurface oiling – For shorelines which are difficult to access by foot or vessel – Canine may be directed from a vessel or UTV

6.4.5 Subsurface Oiling Surveys

Sub-surface investigation to define the location, extent and character of the oiling is required where oil may have become buried by sediments or penetrated into underlying sediment. Traditionally, these surveys have been based on visual observations in pits and trenches, and by documenting any observed subsurface oil in Section 7 of the SOS forms. Experience has found digging pits and trenches, even with the aid of mechanical equipment, is very labour-intensive and time-consuming. Auguring provides a mechanical tool, but this is also slow. Both manual and mechanical methods rely on small horizontal spot samples, and therefore are not effective for the detection or delineation of discontinuous subsurface oil.

Recently, K9-SCAT, using oil detection canines, has been shown to be an effective method of detecting and delineating surface and subsurface oil (see API 2016a; API 2016b). K9-SCAT has several advantages over pitting/trenching, including increased speed and efficiency and the ability to cover 100% of the search area (as opposed to spot sampling).

6.4.6 Submerged and Sunken Oil Surveys

A SCAT program assesses the actual and potential behaviour of stranded oil on shorelines and of submerged or sunken oil in the shallow-water nearshore zone. Detection and delineation of submerged oil (that is suspended in the water column) or sunken oil (that is on the seabed) present a range of challenges and involve techniques different from those developed for on-shore SCAT surveys; these are addressed in API (2016d) and API (2016c) for submerged and sunken oil respectively.

Three case studies briefly describe successful underwater SCAT surveys:

- Lake Wabamun (Alberta, 2005): walking surveys along the lakeshore (out to a depth of 0.5 m), and boat-based surveys (for reed beds in deeper water) involved visual observation techniques with the naked eye, view-boxes (bathyscopes) and dip nets or scoops for verification (Sergy et al., 2011).
- Deepwater Horizon (Gulf of Mexico, 2010): shore-based surveys with snorkel observations and shovels to detect and delineate oil mat sand and other accumulations in the lower intertidal and adjacent shallow subtidal zone during periods when this zone was underwater, in water depths up to 1.0 m (API, 2013).

- Quintero Bay (Chile, 2016): experienced SCAT observers who were trained SCUBA divers accurately documented and delineated a sunken slurry oil spill in water depths that ranged between 10 and 20 m; the four-day seabed survey covered over 57,000 m^2, of which 32,000 m^2 had no observed oil (Piraino et al., 2017).

6.4.7 Operations Liaison Support

Once a Shoreline Treatment Recommendation (STR) has been issued, SCAT works closely with shoreline Operations to:

- ensure Operations fully understands the requirements of the STR;
- ensure Operations understands and adheres to the BMPs and other issues or constraints detailed in the STR, which might include:
  - Ecological/Biological/Wildlife constraints
  - Historical/Cultural/Socio-economic constraints
  - Safety issues;
- provide Operations with documentation to help locate the oil;
- provide Operations with technical input on treatment tactics;
- obtain operational feedback on the STR; and
- monitor and document the progress of the treatment on each segment, which helps to:
  - Track shoreline treatment progress
  - Plan PTA and SIR surveys.

On a large and/or remote response, where the SCAT Team Leads may not be able to devote sufficient time to liaise with shoreline operations in the field, this responsibility may be assigned to a separate SCAT-Operations Liaison role.

6.4.8 Monitoring Survey

Monitoring surveys may be conducted during operational or monitoring phases to:

- track changes in oiling conditions due to treatment or natural recovery;
- monitor shoreline changes, particularly following storm events;
- document and assess weathering processes;
- compare actual oil behaviour, weathering and fate with expectations; and/or
- assess the effectiveness of recommended treatment and adjust tactics if appropriate.

6.4.9 Post-Treatment Assessment Survey

Post-Treatment Assessment (PTA) Surveys are conducted once shoreline Operations consider they have reached the treatment endpoint criteria. SCAT PTA teams can include trustee and/or other resource agencies, as appropriate. During their inspection, the PTA teams determine the requirement(s) for further treatment. If the PTA determines that no further treatment is required, based on the endpoint criteria, NEB, ALARP or Safety concerns (see 6.4.10, below), the team documents that decision and the character of any remaining oil on SOS and PTA forms (Appendix 1B.5a, Appendix 1B.1d). If the team determines that further treatment is required, either Operations is notified that they should continue treatment according to the current STR, or the team completes a new or revised STR Form to describe changes or additional treatment as appropriate.

6.4.10 Shoreline Inspection Report Survey

The final part of the SCAT process is a Shoreline Inspection Report (SIR) survey that includes representatives of the key parties involved in the response operation, including relevant land managers/owners. During this type of mission, the team assesses whether sufficient treatment has been completed in a segment, and that No Further Treatment (NFT) is required, due to either:

- Achievement of treatment endpoint criteria;
- Net Environmental Benefit (NEB);
- As Low As Reasonably Practicable (ALARP); or
- Safety issues.

Section 8.5 provides further descriptions of NFT.

After the inspection, each team completes an SIR Form (Appendix 1B.1c). If the shoreline condition is determined by consensus to have reached NFT status, a recommendation is made to Incident Command that no further activities are required in that segment. The SIR Form is signed by each of the Incident Command representatives. Any landowner / land manager comments on the SIR are reviewed by Incident Command prior to approval.

SIR approval does not preclude a lead or trustee agency to require the responsible party to conduct additional treatment activities pursuant to any applicable laws, or in the event that additional oil is discovered. SIR approval also does not preclude additional actions required by other agencies with jurisdiction (e.g., long-term maintenance and monitoring).

If the shoreline response involves a phased approach for the operations (Section 8.1.1), then SIR surveys may be conducted for more than one SCAT phase.

6.4.11 **Photo-monitoring**

Photo-monitoring surveys record changes in oiling conditions through time at selected representative locations. Sites may be visited regularly (weekly, monthly) and documented with photographs, videography and/or SOS forms. Stakes or other natural markers provide visual links that enable the photographer to relocate at the exact same location and to frame the image for comparison with earlier imagery. Time-series photographs may illustrate changes in oil character and distribution, and show natural recovery and treatment progress. These images can be particularly useful to explain the history of recovery/cleanup to response personnel who rarely leave the Command Post, and to new SCAT team members (Figure 6.3).

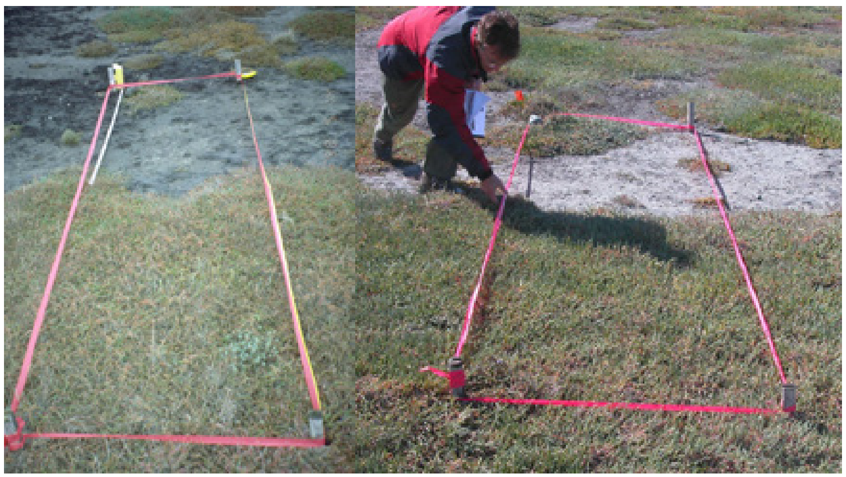

Figure 6.3 *Photo-monitoring plots showing recovery and plant growth following an oil spill*

6.4.12 **Beach Profiling**

Beach Profiling involves periodic or scheduled across-shore profiling surveys to monitor changes in beach elevation through time. Beach profile data is particularly useful on dynamic shorelines and helps understanding beach dynamics and sediment erosion or deposition cycles. Where oil has, or has the potential to, become buried under sediment, beach profile data help the SCAT teams understand the depth at which the oil may be buried. The Emery method is a simple technique that is easy to use, easy to train people to use and involves very simple profiling equipment (Figures 6.4 and 6.5) (Emery, 1961).

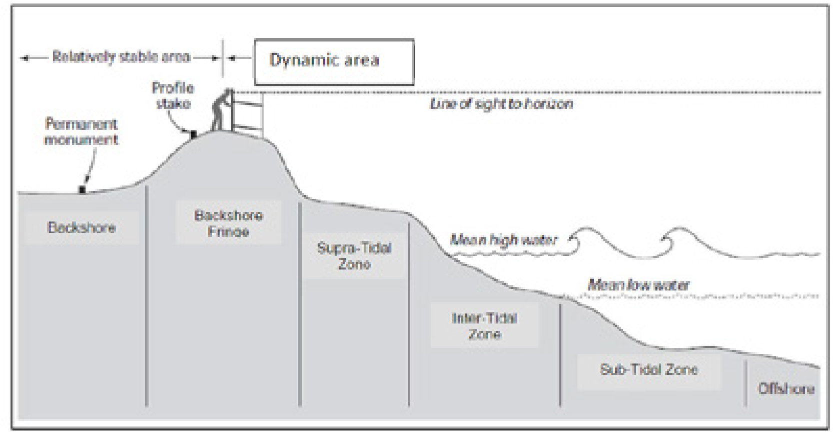

Figure 6.4 *The pole and horizon beach profile survey method (adapted from WHOI, 2000)*

Figure 6.5 *Beach profiling using the pole and horizon method*

7 SCAT Data Management

SCAT data collected during a response supports multiple purposes and requires a well-organized data management program to compile, process and disseminate information. Regardless of the size of the incident, the same general procedures are required to fulfill the anticipated requirements and requests for information and data.

- The purpose of SCAT data is to provide key information to decision makers to enable efficient and guided application of operational resources, including the selection of the most appropriate technique / response approach, recommended direction to areas of highest priority, and the minimization of the effects of the treatment activities.
- SCAT data from repeated surveys throughout the response provide detailed systematic documentation on shoreline oiling conditions at the time of the response, as well as the recovery of shorelines due to treatment and/or natural recovery.
- Processed SCAT data (database and GIS) provide maps and tabular information related to segment-specific or regional summaries that indicate the extent and distribution of oiling, as well as changes in conditions over time. These time-series maps and tables provide progress reports for the response organization as well as off-site regulatory agencies and media.
- Presenting accurate and informative information to the general public and media is important throughout the response. Consistent SCAT data provided by representative co-operative stakeholder teams provide a single and credible science-based information source.
- The systematic collection and recording of SCAT data throughout the response provides a chronological documentation of events and changes that are important for post-response evaluations.
- A summary of SCAT data products and outputs is indicated in Table 7.1; the shaded cells indicate which products/outputs are associated with the types of SCAT missions.

Table 7.1 *SCAT Data Products and Outputs*

SCAT Missions	Resolution	Data Products/Outputs				
		Maps	GIS Data	UAS Mosaics	Images/ Photos	Forms
Reconnaissance Survey	Low	■	■		■	
Shoreline Oiling Survey (SOS)	High	■	■		■	■
Limited Access SOS	High	■	■	■	■	■
SCAT Operations Liaison	High	■		■	■	
Monitoring (photo/profile)	High	■	■	■	■	■
Post-Treatment Assessment	High		■		■	■
Shoreline Inspection Report	High	■	■		■	■

SCAT data must be agreed upon by all members of the field team, and the SCAT Team Lead must ensure that a QA/QC process is completed on the field data before entry into the SCAT database. Oiling Categories (Heavy-Moderate-Light-Very Light-Trace) are generated from the SCAT database; the derived information and data are made available to the Situation Unit for inclusion in the Common Operating Picture (COP). With the ever-increasing use of electronic data management systems, control and distribution of data input is increasingly important. In a case where SCAT data and forms are to go electronically directly to the COP without full field team agreement and QA/wQC, there is a risk that inaccurate data could be "published" and would have to be revised later. This change could reduce the confidence in the SCAT data, and might negatively impact important response decisions.

Data management activities can be carried out by SCAT field teams for small single team incidents where there is time to organize, process and present observations. On larger incidents, or where multiple SCAT teams are collecting data, a SCAT data management team is required to process and record the extensive amount of information generated and ensure data are collated and made available to decision makers in a timely manner. For any incident size, the fundamental responsibility for SCAT data management is the same:

- Data integrity
- Data preservation and documentation
- Data processing
- Data availability and distribution
- Data security
- Data confidentiality

The Environment Canada "Shoreline Cleanup Assessment Technique (SCAT) Data Management Manual" (Lamarche et al., 2007) provides an in-depth discussion on SCAT data management.

7.1 Shoreline Segmentation

Shoreline Segmentation (Section 5.2) is an essential component of the SCAT process, ideally undertaken prior to an incident ("pre-SCAT"). Where pre-SCAT segmentation data are available, the SCAT field teams verify this information during their initial surveys and make recommendations for revisions to the Data Manager. Where pre-SCAT data are not available, segmentation must be completed during the initial phase of a response.

7.2 SOS Forms

Shoreline Oiling Summary (SOS) forms are the standard recording method for field SCAT surveys to document shoreline character, oiling conditions and operational logistic information relevant to individual shoreline segments.

The standard marine SOS forms have been modified for lake and wetland shoreline types, and for environmental conditions (temperate, arctic/winter) (Appendix 1B.5a) as well as for SCAT survey requirements (for example, K9-SCAT). SCAT SOS forms are designed to provide a summary evaluation of field observations and traditionally contain similar data sections (Table 7.2).

Table 7.2 *Typical Information on a SCAT SOS Form*

SCAT SOS form Documentation	
General Information	Date, time, tides, segment identification, survey types, weather, exposure
Survey Team	Names, organizations
Segment Information	Total length, surveyed length, intertidal width, lat/long coordinates, GPS waypoints
Shoreline Character	Form and material
Backshore Character	Form, slope, height, material
Operational Features	Debris, access, staging, restrictions
Surface Oiling	GPS data, substrate, tidal zone, oiled area, oil distribution, oil thickness, oil character
Sub-surface Oiling	GPS data, substrate, tidal zone, depth, oiling interval, oil character, water table, sheen
Comments	Cleanup recommendations, ecological/cultural/human use issues, wildlife observations, other descriptions and concerns
Survey Data Collected	Maps, sketches, photos/videos, GPS tracks and waypoints

Survey forms designed for specific environments or specific SCAT surveys contain additional data components. For example, arctic or winter SOS forms include sections to record ice and snow conditions; wetland forms include vegetation descriptions; K9-SCAT forms include sections to record canine alerts. SOS forms provide information relevant to the needs of the response and should be modified accordingly at the beginning of a response to include new terms or definitions that describe oiling conditions or features specific to an incident.

In addition to the quantitative documentation on a SCAT SOS form, it is common practice to record comments, sketches and notes on either supplemental data sheets or in field note books. It is important that all observations recorded are clearly identified (coordinates, GPS data, segment identification, dates and times) and are provided to the SCAT data management team along with SOS forms, photos and GPS datasets.

7.3 Digital Data Collection

The use of mobile devices to collect SCAT data allows the direct transfer of field observations into a SCAT data system. When appropriately designed, a remote data collection system can directly store information on a secured database server, and can include a log (time and date) of each entry and modification of any piece of information acquired in the field as it is entered. Advantages of such systems include the following:

- They save time for data entry and processing;
- They remove the possibility of data transcription errors from paper to a digital/database system;
- They allow access to maps, locations and previous survey data in the field;
- They allow real-time data transmission from the field to the incident command centre;
- They allow most mobile devices to be locked and encrypted to improve data protection; and
- They provide automatic integration of multimedia files such as photos, videos, sketches and maps, all of which may be automatically georeferenced.

Although digital data collection can provide several benefits, some important guidelines must be followed:

- When used properly, most mobile device batteries last for a full day of field surveys. The major sources of battery drain are the screen luminosity, Wi-Fi and the GPS. A portable USB battery can be used to extend the device's autonomy.
- Protective covers should be used to protect electronic equipment against hazards such as water, sand, dust and being dropped on the ground.
- Since all data collection systems use different models, data transmission and normalization protocols must be set in place. These include data communication with the SCAT database and exportation of files such as PDFs, images and videos.
- When using remote data collection, care must be taken to ensure that the collected data are provided in forms that can be easily reviewed, and that any modification of the data be monitored. Monitoring can be applied through a number of methods, such as electronic logs showing the history of data modifications or by providing electronic formatted outputs (such as protected PDF files) which may be printed and signed to provide a paper trail.
- If there is direct telemetry of field observations, it is important to establish guidelines on the types of data sent, how they are used within the response, how the consensus decisions are captured, how the QA/QC process is managed, and how the data itself is stored and managed.

7.4 Photographs, Videos and GPS Data

SCAT data management systems (databases) and related GIS mapping systems are standard for all but small spills, and the timely creation of spill data for the Environmental Unit, Unified Command, Operations and stakeholders requires field data to be in a format that can be quickly incorporated into these systems, e.g. digital tracklines, waypoints, photos and spatial data related to the location of shoreline features, oiling and survey coverage.

It is important to maintain consistency across field datasets, including the use of technology and data collection techniques and procedures. This involves ensuring that field personnel understand the different settings and features of the equipment for which they are responsible and that data transfer procedures are established.

7.4.1 Photographs

SCAT surveys can result in thousands of photos taken during field surveys and operations support. Photos are organized and processed to provide effective reference and location information (Figures 7.1 and 7.2), typically including:

- Watermarked images
- GIS reference maps
- Photo logs
- Photo database
- Inclusion in the SCAT database
- Survey reference
- Segment reference

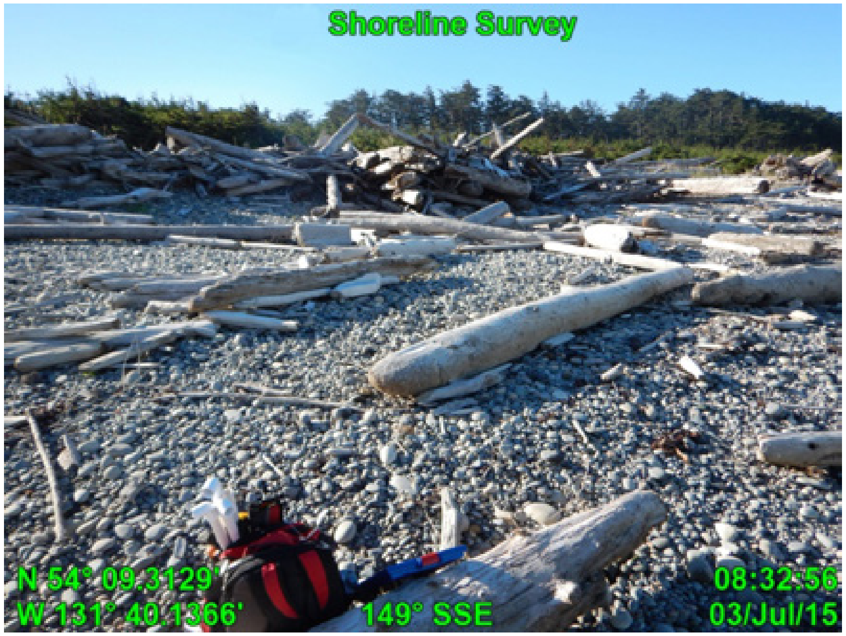

Figure 7.1 *Example of labelled photograph*

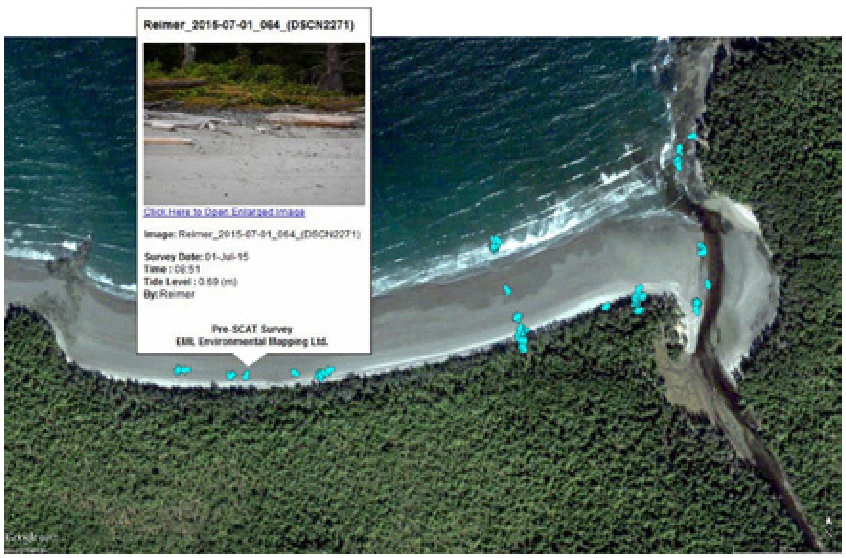

Figure 7.2 *Example of a georeferenced photograph*

7.4.2 Videography

Most digital cameras, phones and tablets can record videos in addition to photos. These can be useful for recording operational activities related to shoreline treatment. As with photos, it is important to document the location of the imagery. If a device does not internally record positional data, waypoints should be taken at video locations.

The use of videography is a common practice during aerial surveys, with GPS tracklines recorded in conjunction with all aerial overflights. As with photos, post-survey processing of videos can provide additional reference datasets including:

- Watermarked imagery (Figure7.3)
- Track line maps (Figure 7.4)

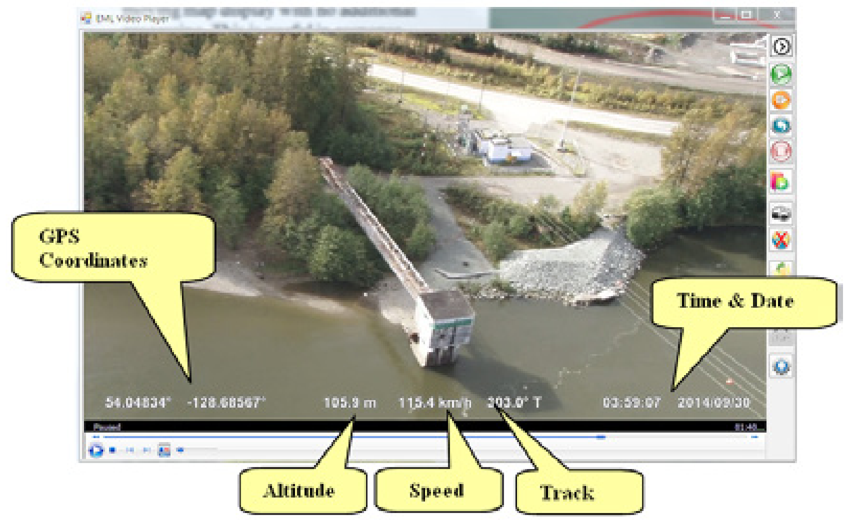

Figure 7.3 *Aerial video survey frame showing flight data*

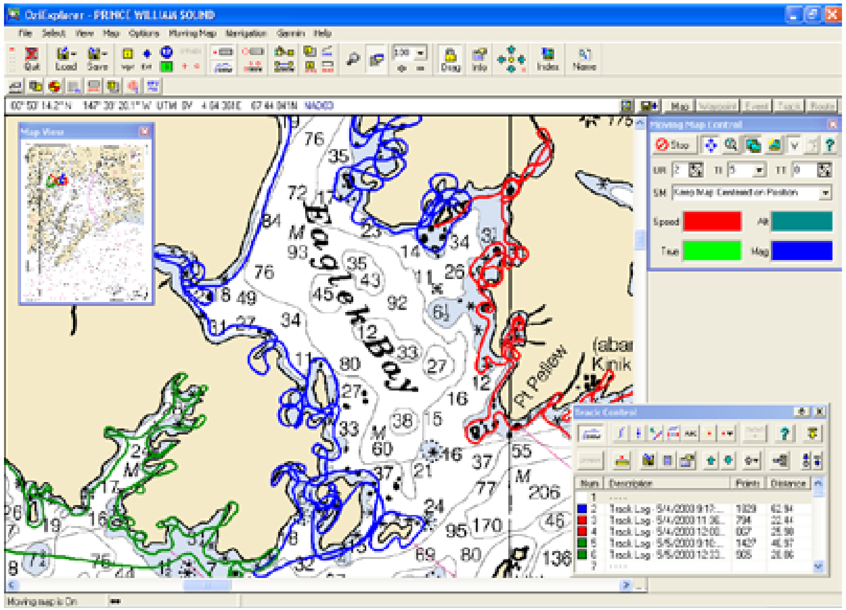

Figure 7.4 *Inflight real-time GPS navigation for video surveys*

7.4.3 GPS

The collection of GPS data, track lines and waypoints has become a standard SCAT survey practice and is a SCAT team data deliverable along with (paper or digital) forms and photographs. Current SCAT survey forms include space to record latitude and longitude coordinates and/or waypoints of segment boundaries and observed oiling conditions. All photographs taken during SCAT surveys are georeferenced, otherwise appropriate GPS data are collected to allow post-survey geospatial processing. Guidance for GPS use is provided in Appendix 2.

7.5 QA/QC

Quality assessment and quality control (QA/QC) is a fundamental aspect of SCAT data management. All SCAT data collected during field surveys, entered into databases and GIS systems, processed and prepared for distribution are systematically reviewed for consistency, errors, omissions and clarity. SCAT data provide the scientific basis for response planning and operational activities as well as information for distribution to the media. It is important that every effort is made throughout the data management process to ensure information is as accurate as possible, by:

- Reviewing SCAT forms and notes prior to data entry
- Reviewing SCAT data entry and telemetry data for errors
- Reviewing processed data and outputs for inconsistencies

7.6 SCAT Database

The data and information generated by SCAT surveys are crucial to timely and informed decision making and are the basis of spill planning and effective operational shoreline response. On small spills, data requirements may be efficiently handled with a dedicated SCAT application, team lead reports and simple spreadsheets. On larger incidents, a dedicated SCAT database is required. Pre-SCAT datasets, where available, can be used to populate a SCAT data management system with foundation information which is then supplemented by real time observations obtained by SCAT surveys on oiling conditions and other aspects related to treatment.

The use of databases and other automated systems increases performance, particularly in terms of the quality of data processing and the speed with which timely decision-making products can be produced.

At the base level, a SCAT database is designed to record and store all of the information obtained during SCAT surveys, either by entering data from field data sheets such as SOS forms, or by direct transfer of data collected electronically. Typical SCAT database entry screens are designed to match the same data recorded on the SCAT survey forms (Figure 7.5).

Database systems are typically designed to simplify data storage and retrieval, making the processing of information for response requirements efficient and timely. In addition to producing tables representing various aspects of SCAT data, database systems can include or link to Geographical Information Systems (GIS) to provide an integration of spatial data. For SCAT data management, the integration of GIS is ideally suited to displaying and analyzing summary and overview decision-making maps for the response (more information on this topic is provided in Section 7.8).

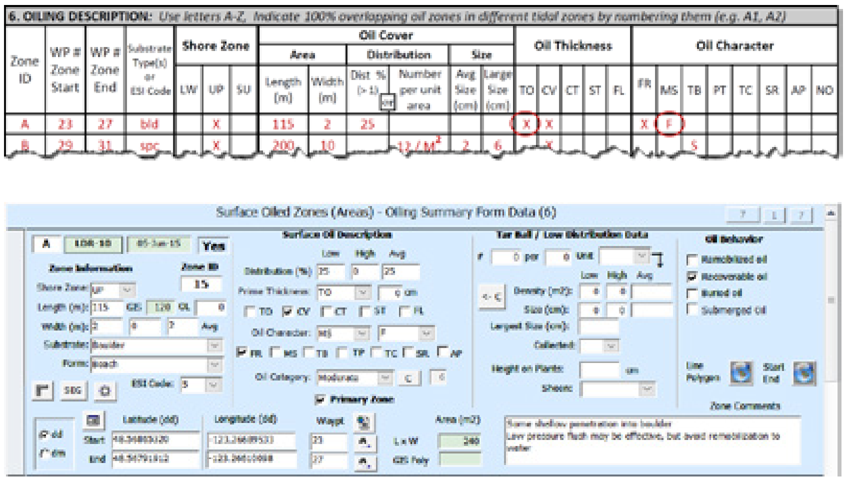

Figure 7.5 *SCAT data transfer from form to database*

One of the most important aspects of a SCAT database is the ability to track all of the events associated with a particular section of shoreline (segment) through time along with changes in oiling and status as related to the response, including:

- Surveys (Reconnaissance, SOS, Monitoring, SCAT-Ops Liaison, PTA, SIR)
- Survey Results (oiling, status)
- STR (generation, activation, completion)
- Unified Command decisions (Safety/Environmental holds, NEB, ALARP, NFT)
- Operations activity

Response records should be able to report on the timing of all events that relate to a segment providing a chronological history of what and when events happened. This is a common application of a SCAT database; however, on small incidents, similar information could be maintained by the SCAT team in reports or spreadsheets.

7.7 Categorization of the Degree of Oiling

SCAT survey documentation can include large amounts of segment data, including shoreline character, logistics and specific surface and sub-surface oiling conditions. In order to process this data and provide information that can be systematically presented and compared through time, it is necessary to create summary evaluations.

Oil categorization matrices are designed to provide this summarization by categorizing shoreline oiling into a standard ranking system. This information provides an overview of the degree or severity of oiling that can then be presented in tables, charts, maps and reports, and often affects the prioritization of operations and end-point evaluations. Typical categories are:

- High
- Moderate
- Light
- Very light
- Trace

General oil categorization matrices have been developed for different conditions and are presented in detail in Appendix 1A.2f and 1A.3d.

Although oil categorization matrices are a standard method in the analysis and processing of SCAT oiling data, it is important to understand that the categories within the matrices are not fixed, and may need to be evaluated and adjusted based on the environmental conditions and oiling character for each specific incident. For example, variations in tidal range or open water exposure may require adjusting the Oil Band Width categories; properties of the oil may require adjusting the thickness categories; diminishing oil concentrations (<1%) may require adjusting or expanding the distribution categories.

From a SCAT data management and response perspective, it is critical that any representation of oiling or oiling categories in tables, maps, charts and graphs be presented based on the length and position of the oiled shoreline and not by segment.

7.8 Data Outputs

Depending on the type and size of a response, there may be a multitude of different data requirements and requests. Data outputs may be simple tables, charts and maps (Figures 7.6, 7.7 and 7.8) or complex data analysis and comparison presentations.

Oiling and Status are the two fundamental datasets most commonly generated for a response:

- **Oiling** represents the degree (oiling category) and extent (length of shoreline) of oiling. This may be represented as Current Oiling, which changes through time with treatment and natural recovery, or as Maximum Oiling, which represents the highest oiling category at any time during the survey program.
- **Status** represents the shoreline activity with respect to the operational stages and requirements of Incident Command to complete the required actions and to move segments out of the response. Typical shoreline status categories might include:
  - Active (recommended or undergoing treatment)
  - Monitor (SCAT shoreline monitoring and inspections as per the response plan)
  - In-Active (NOO, NFT assessments)
  - Hold (activities on segment on hold due to access restrictions, safety, wildlife)
  - Pending (SCAT assessment of treatment and monitoring completed as per the response plan, SIR recommendation pending Command approval)
  - Complete (No Further Treatment required)

Any number of new categories or sub-categories can be represented to provide ongoing support for the response as required, and these may change depending on the different phases of the response.

7.8.1 Oiling

Oiling is always represented on tables, charts, diagrams and maps as lengths of actual shoreline oiling, never by lengths of segments that have some degree of oiling within that length of shoreline (Figures 7.6, 7.7 and 7.8).

7.8.2 Status

Status is typically represented by segments and segment lengths. The segment status values can be combined and summarized to provide

tables and charts (Figure 7.9), as well as links to GIS applications to create maps showing the current segment status for the response area (Figure 7.10). Each response has different conditions and often has unique data requirements that necessitate the adaptation of existing, or the creation of new, data outputs to support information requests.

BREAKDOWN OF SURFACE OILING CONDITIONS

Area	Total Shoreline Surveyed (km)	Heavy (km)	Moderate (km)	Light (km)	Very Light (km)	Trace (km)	No Oil Observed (km)	Oiled as of Last Survey (km)
Area 1	25.7	0.0	0.0	0.0	0.0	0.5	25.2	0.5
Area 2	25.6	1.7	1.6	1.6	0.8	0.0	19.9	5.7
Area 3	558.4	13.1	22.9	52.1	35.4	15.5	419.5	139.0
Area 4	1072.9	78.3	60.8	54.4	62.4	13.6	803.3	269.6
Area 5	335.9	18.0	14.7	17.2	13.7	0.2	272.2	63.8
Area 6	282.4	17.1	12.0	30.1	10.2	5.0	208.0	74.4
Area 7	536.8	13.2	15.0	25.2	41.2	5.9	436.4	100.4
Area 8	123.0	0.0	0.0	0.0	0.0	0.0	123.0	0.0
Area 9	145.6	0.3	1.2	3.4	1.1	0.0	139.5	6.0
Area 10	112.6	0.0	0.0	0.0	2.8	0.1	109.6	3.0
TOTALS	**3218.9**	**141.7**	**128.2**	**183.9**	**167.7**	**40.9**	**2556.5**	**662.4**

BREAKDOWN OF SURFACE OILING CONDITIONS

Area	Total Surveyed (km)	Heavy (km)	Moderate (km)	Light (km)	Very Light (km)	Trace (km)	No Oil Observed (km)	Oiled as of Last Survey (km)
Beach	1764.0	98.6	77.2	123.6	98.4	31.5	1333.8	429.4
Marsh	834.2	25.7	29.7	35.7	39.7	5.4	698.1	136.3
Bedrock	556.1	17.1	19.8	23.8	26.5	3.6	465.4	90.9
Manmade	64.7	0.2	1.4	0.7	3.1	0.4	59.3	5.8
TOTALS	**3218.9**	**77.2**	**128.2**	**183.9**	**167.7**	**40.9**	**2556.5**	**662.4**

Figure 7.6 *Examples of oiling tables*

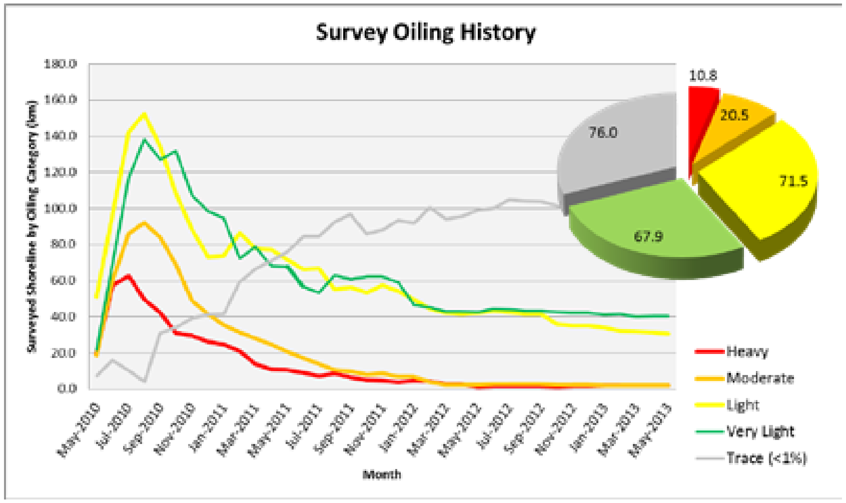

Figure 7.7 *Examples of oiling charts*

Figure 7.8 *Example of an oiling map*

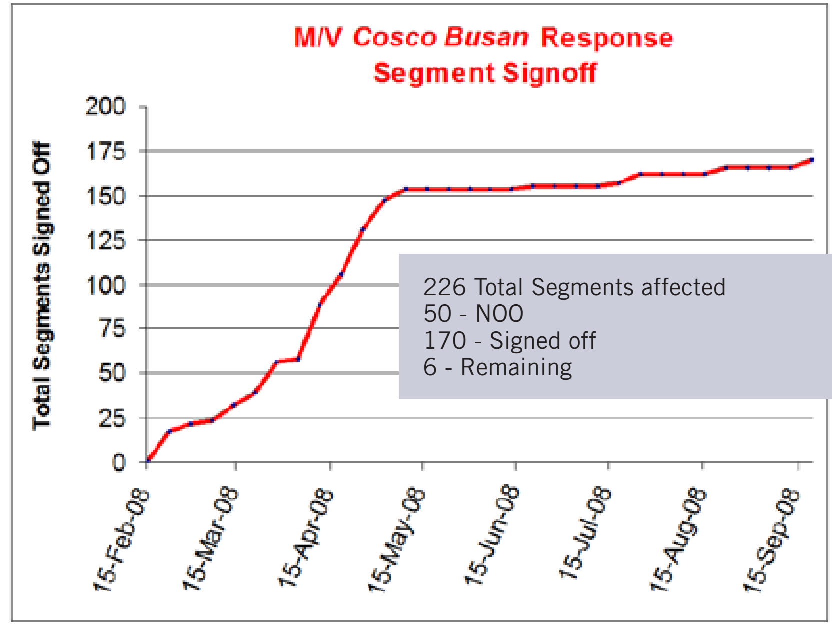

Figure 7.9 *Example of status summary graph*

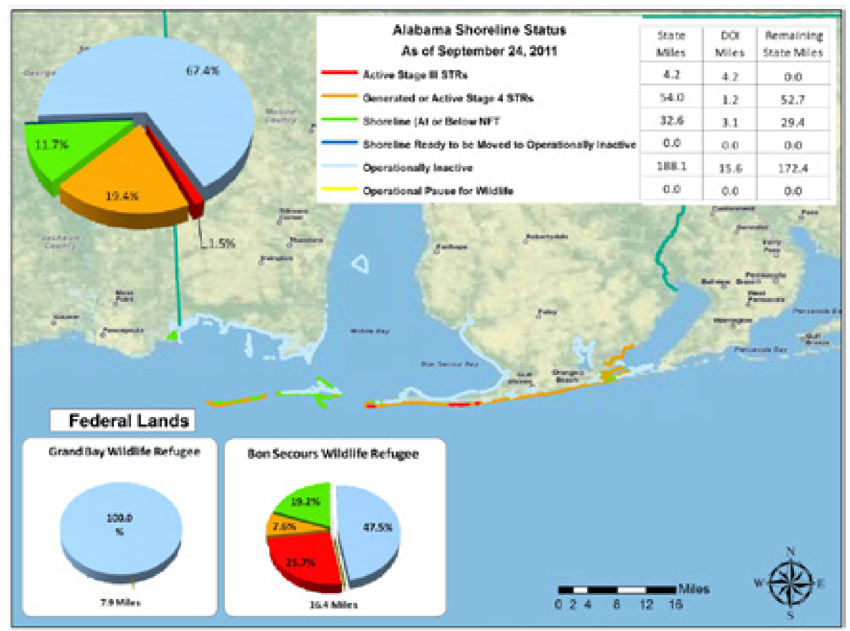

Figure 7.10 *Example of status summary map with charts*

8 SCAT Recommendations and Shoreline Treatment Decisions

The systematic ground surveys generate SOS forms that contain detailed shoreline and backshore information for oiled segments that are used to develop recommendations for the overall shoreline response program and to generate treatment or cleanup plans for each segment that requires treatment.

– Initially, SCAT data and recommendations are part of the information base used by decision makers to develop shoreline response ***treatment objectives, treatment endpoints, priorities and best management practices (BMPs)***.
– Once the treatment endpoint criteria have been agreed upon and approved, these provide the direction for the SCAT program to define which segments would require treatment by comparing the oiling data against the endpoint criteria.
– If the oiling conditions exceed the endpoints, such that the segment requires treatment, the SCAT program generates ***Shoreline Treatment Recommendations (STRs)*** on appropriate treatment options.
– If oiling conditions meet the target endpoints, the segment is designated either in the "no treatment" or "no treatment/ monitor" category.
– After treatment, a SCAT ***inspection*** survey documents the oiling conditions and compares this against the endpoint criteria to determine whether further actions are required.

Figure 2.1 illustrates the typical sequence of activities and decisions from the initial shoreline survey data and information through to completion of shoreline treatment.

8.1 Endpoints

The data collected by the SCAT program are the foundation for the decision-making process to determine those shorelines which are to be cleaned or treated (the Shoreline Treatment Recommendations forms, STRs) and subsequently provide a procedure to evaluate the completion of the desired treatment (the treatment endpoints). Shoreline treatment endpoints or criteria are assigned to each segment or group of segments to provide a practical and agreed working definition of treatment standards against which treatment activities can be assessed. Endpoints may apply to all segments, groups of segments or single segments.

In the first phase of a spill response, endpoints typically are developed using SCAT reconnaissance data and existing environmental knowledge (Section 2.5.1). These first phase endpoints may be superseded in the planned response phase (Section 2.5.2).

There are three key times in the decision-making process that are critical regarding endpoints:

– at the very beginning, in the emergency response phase of the spill, to guide field operations with immediate treatment targets, for example, areas with mobile oil, and to assist the long-range planning process (Section 2.5.1);
– in the planned response phase of a shoreline response program for ***the development of treatment standards***, the selection of treatment techniques and the development of treatment plans (Section 2.5.2); and
– towards the end of the operation to ensure that those ***standards have been achieved*** in order to provide closure for each treated segment and for the shoreline response operation as a whole.

Endpoint standards and criteria:

– are developed, typically, based on SCAT terminology (Appendix 1A);
– may be based on environmental, cultural, operational or safety criteria; and
– are established for (a) different shore types, (b) different ecosystem types or land uses and (c) different oiling conditions.

8.1.1 Phased Endpoints

There may be one or more sequential ***phases*** of shoreline cleanup defined in a treatment plan, each of which may have endpoints:

– a first phase set of standards to focus on the removal of bulk oil or of oil that could be easily remobilized, or on high-priority oiled segments;
– while this first phase operation is in progress, the decision team can develop the completion endpoints or criteria which determine and identify those shoreline segments or areas that require treatment;
– a monitoring period after completion of treatment if residual oil is left to weather naturally; and
– an inspection phase after the pre-determined monitoring period.

"Cleanup endpoints" has long been the term used to describe the criteria required for the conclusion of shoreline response operations on affected shorelines and the environment.

Cleanup endpoints can be phased to ensure that stakeholder concerns over cleanup are addressed based on different shoreline types, levels of usage and specific environmental sensitivities. Managers and participants responsible for the development of endpoints may be reluctant to define these criteria at the beginning of a response. In addition, there may be a desire to review, and possibly revise, endpoints part-way through a response, resulting in the problem of "moving goalposts" for the Responsible Party. This issue can be resolved by establishing a process of phased endpoints rather than requiring the development of "final" endpoints at the outset. This flexible approach was used in the Deepwater Horizon Shoreline Response Program, during which No Further Treatment (NFT) endpoints were established for four different phases of the response ("2010 NFTs", "2011 NFTs", etc.). More recently, 2016 NFT criteria were established during the 16TAN pipeline spill in Saskatchewan, with the intention of developing 2017 NFTs for the next phase of the response. With a phased approach, there is no immediate time constraint for the decision-making process and an opportunity exists for further discussion and agreement of the "final" endpoints, by which time all those involved should have a better understanding of the situation than was available during the initial response.

Typically, at least two "endpoint criteria" phases should be established: the initial removal of bulk oil that could potentially remobilize, followed by one or more NFT phases. In the interim, the STRs provide Operations with phased targets so that effort is not delayed or wasted. The downside of this approach may be that some segments would have to be treated again at a later time if the subsequent endpoints are more stringent than the original criteria.

8.1.2 Development of Endpoints

The development of standards or endpoints is usually conducted by an interagency team that includes federal, provincial and local entities; shoreline/land owners or managers; and the responsible party, if one is involved in the response. The generation of endpoints is influenced by various criteria, including the type of shoreline, the value of the habitat, operational feasibility, natural cleaning and Net Environmental Benefit. Endpoints have a direct effect on the selection of appropriate response strategies and cleanup techniques, which in turn determine the volume and type(s) of waste which are generated. As a consequence of this interrelationship, treatment or cleanup standards may vary geographically, for example, if logistics constraints favour in situ treatment for remote oiled areas to minimize the operations effort and waste generation.

8.1.3 Treatment Endpoint Criteria

Endpoints can be qualitative, quantitative or analytical. Typically, a mixture of qualitative and quantitative endpoints is used to enable a field determination and consensus by the inspection team on whether a segment reaches the specified endpoint criteria, without the need for laboratory analysis and confirmation.

Qualitative endpoints are commonly used to describe the presence or absence of oil on the shoreline and the character of that oil. Qualitative endpoints are rapid and straightforward, and are relatively easy to observe and assess in the field. Examples include:

- "No Oil Observed (NOO)"
- "No mobile oil"
- "No oiled debris"
- "No rainbow sheen"

Quantitative endpoints are based on visual measurements and observations of the quantity and character of the oil using standard SCAT terminology. Quantitative endpoints have been used during many response operations and are rapid and straightforward, requiring only a familiarity with SCAT terminology. Examples include:

- "No oil greater than stain and greater than 10% coverage"
- "No subsurface oil greater than 5 cm thick"
- "No tar balls greater than 1 cm in diameter and greater than 5% surface distribution"

Analytical endpoints are rarely used for oil spill endpoint criteria in coastal environments, but could be applied where there are specific concerns of toxic effects to humans, wildlife or fish from residual oil, or for odour concerns. Analytical endpoints often require laboratory analysis of samples, and therefore data are not "real-time" or practical. Examples include:

- "No unacceptable odour remaining within the beach sediment"
- "No greater than the 96-hour LC50 value for local fish species"
- "Not to exceed national maximum contaminant levels for x (e.g. BTEX, PAH or TPH)"

Other examples of endpoints and a detailed discussion are provided in the Environment and Climate Change Canada "Guidelines for Selecting Shoreline Treatment Endpoints for Oil Spill Response" (Sergy and Owens, 2007).

8.2 Shoreline Treatment Options

Shoreline treatment techniques can be categorized broadly as:

- Natural recovery or weathering
- Washing
- Removal
- In situ treatment
- Chemical or biological treatment

The techniques are described in detail in the ECCC's *"A Field Guide to Oil Spill Response on Marine Shorelines"* (Environment and Climate Change Canada, 2016) and summarized in Table 8.1.

All options, except for natural recovery, involve some form of intrusion on the ecological character of the shoreline type that is treated. The decision-making process must involve a review of the net environmental benefit and consideration of and compliance with government regulations. Table 8.2 presents a summary of the assessment of the anticipated effect or impact on the substrate and flora of the site.

Treatment techniques are recommended to be compatible with the character of the shore zone and with the oiling conditions (type and volume of oil) as documented by the SCAT process and considering a range of operational parameters (Table 8.3). The optimal treatment technique would:

- Have a minimal impact;
- Involve minimal labour and logistical requirements;
- Provide rapid treatment rates; and
- Generate no/minimal oiled waste.

Oil spill countermeasures decisions must align with current legislative and regulatory regimes, and be made following a net environmental benefit assessment that confirms the benefits outweigh the effects of the response technique.

Table 8.1 *Shoreline Treatment Techniques*

Strategy	Technique	Objective	Primary Shore Type Applications
Natural recovery	Natural recovery	To allow the oiled shoreline to recover without intervention by leaving the stranded oil to natural weathering and oil removal processes. Typically involves monitoring of recovery.	– All
Wash and Recover	Flooding	To flood a site with a large amount of ambient-temperature sea water so that mobile or remobilized oil is lifted and carried downslope to a collection area.	– All
	Low pressure, ambient wash	To wash and flush oils at low pressure, using sea water at ambient temperatures, towards a collection area	– Bedrock/ice – Manmade – Coarse sediments – Wetlands
	Low pressure, warm/hot wash	To wash and flush oils towards a collection area using heated sea water at low pressure	– Bedrock/ice – Solid manmade
	High pressure, ambient wash	To wash and flush oils towards a collection area using sea water at ambient temperatures and high pressure	– Bedrock – Solid manmade
	High pressure, warm/hot wash	To wash and flush oils towards a collection area using heated sea water at high pressure	– Solid manmade
Removal	Manual removal	To remove oil or oiled materials, including oiled sediments, using manual labour and hand tools	– All
	Vacuums	To remove oil using vacuums by suction from areas where it has pooled or collected in sumps or depressions	– All
	Mechanical removal	To remove oil and oiled materials using mechanical equipment	– Beaches
	Vegetation cutting	To remove parts of oiled plants in order to prevent the oil from remobilizing or to protect animals and birds from contact with oil	– Wetlands
	Passive sorbents	To place and leave sorbent materials in fixed locations to collect oil that comes in contact with the sorbent	– All

Strategy	Technique	Objective	Primary Shore Type Applications
In Situ	Dry mixing / tilling / aeration	To break up or increase the exposure of the surface and/ or subsurface oil to both air and subsequent tides in order to accelerate natural weathering and removal processes without removing sediment	– Beaches – Flats
	Wet mixing / tilling	To release and recover surface or subsurface oil by physically agitating intertidal sediments in shallow water (less than 1 m deep) on site	– Beaches – Flats
	Sediment relocation / surfwashing	To move oiled materials from one location to another location where there is a higher level of water movement, typically wave energy, that is available to accelerate natural oil removal processes	– Beaches
	Burning	To burn oil, oiled debris or oiled vegetation at the site to remove or reduce the amount of oil on the shoreline	– Beaches – Wetlands

Strategy	Technique	Objective	Primary Shore Type Applications
Chemical	Shoreline treatment agents (dispersant)	To remove the oil from the shore zone by adding a chemical agent that enhances the formation of fine oil droplets, which are subsequently dispersed into the adjacent waters to biodegrade	– Bedrock/ice – Solid manmade
	Shoreline cleaners	To remove or lift oil from shoreline substrates by adding a chemical agent so that the oil can be contained and recovered on the adjacent waters	– Bedrock/ice – Manmade – Beaches
	Solidifiers	To alter the viscosity of oil by adding a chemical agent to facilitate its collection and recovery	– All, except sediments with large pore spaces (e.g. cobbles, boulders)
Biological	Bioremediation	To enhance or increase the rate of biodegradation of oil in the intertidal zone by adding oil spill bioremediation agents. Bioremediation techniques include bioenhancement, bioaugmentation and phytoremediation.	– All

Table 8.2 *Relative Potential Impacts of Treatment Tactics*

Tactic	Bedrock	Manmade Solid/Ice	Sand Beaches	Mixed Sediment Beaches	Pebble/Cobble Beaches	Boulder Beaches	Sand Tidal Flats	Mud Tidal Flats	Snow-covered Shoreline	Salt Marshes	Peat Shorelines	Inundated Low-lying Tundra	Tundra Cliffs
Natural recovery	–	–	–	–	–	–	–	–	–	–	–	–	–
Flooding	◆	◆	◆	◆	◆	◆	◆	◆	■	◆	◆	◆	◆
Low pressure, ambient wash	◆	◆	■	■	■	◆	●	●	■	◆	◆	◆	◆
Low pressure, warm/hot wash	■	◆	●	■	■	■	●	●	●	●	●	●	◆
High pressure, ambient wash	◆	◆	●	●	●	■	●	●	●	●	●	●	●
High pressure, warm/hot wash	■	◆	●	●	●	■	●	●	●	●	●	●	●
Manual removal	◆	◆	◆	◆	◆	◆	■	●	◆	●	●	●	◆
Vacuums	◆	◆	◆	◆	◆	◆	■	■	◆	■	◆	◆	◆
Mechanical removal	–	–	■	■	■	■	■	●	◆	●	■	●	■
Vegetation cutting	■	◆	–	–	–	■	–	●	–	●	–	●	–
Passive sorbents	◆	◆	◆	◆	◆	◆	◆	■	◆	■	◆	◆	◆
Tilling/mixing/ aeration	–	–	■	■	■	–	■	●	■	●	●	●	◆
Sediment relocation/surfwash	–	–	■	■	■	–	●	●	■	●	●	●	◆
Burning	◆	◆	■	■	■	■	●	●	■	■	●	●	–
Shoreline Dispersants	◆	◆	◆	◆	◆	◆	–	–	–	●	●	●	◆
Shoreline cleaners	◆	◆	◆	◆	◆	◆	–	–	–	■	–	–	◆
Solidifiers	–	–	◆	◆	◆	◆	■	■	–	■	◆	◆	◆
Bioremediation	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	●	◆	◆

◆ low potential effect ■ medium potential effect ● high potential effect – n/a

Table 8.3 *Operational Issues*

Technique	Logistics Support and Labour	Relative Operational Rate	Waste Volumes (Types)
Natural Recovery	**VERY LOW** – monitoring teams	**n/a**	**NONE**
Wash and Recover	**VERY HIGH** – pumps, hoses, sorbents, boom, skimmers, storage – labour-intensive	**SLOW**	**HIGH** (liquids)
Removal (Manual)	**VERY HIGH** – shovels, rakes, sorbents and vacuums – labour-intensive	**SLOW**	**MODERATE** (solids or liquids)
Removal (Vacuum)	**LOW** – vacuum trucks	**RAPID**	**HIGH** (liquids)
Removal (Mechanical)	**LOW** – earth-moving or agricultural equipment	**RAPID**	**HIGH** (solids)
In Situ Treatment	**VERY LOW** – mechanical support, earth-moving or agricultural equipment	**RAPID**	**VERY LOW** (some solid logistics waste, possible burn residues)
Shoreline Dispersants	**LOW** – usually used for small area "spot" cleaning	**RAPID**	**VERY LOW** (some solid logistics waste)
Shoreline Cleaners	**HIGH** – pumps, hoses, sorbents, boom, skimmers, storage – labour-intensive	**SLOW**	**HIGH** (liquids)
Bioremediation	**LOW** – possible mechanical support for mixing	**RAPID** (very slow treatment rate)	**VERY LOW** (some solid logistics waste)

8.3 Field Constraints

Best Management Practices (BMPs) are applied to SCAT field surveys and shoreline treatment operations to ensure the safety of all personnel and to protect wildlife and cultural, historical and archaeological resources. The BMPs may affect the field activities by limiting access to certain areas in both time and/or space.

Special concerns, such as nesting or feeding areas, may restrict entry to specific locations only at certain times of the year. Other BMPs are more generic and relate to concerns or constraints for a habitat, such as a salt marsh or seagrass bed.

The SCAT Coordinator works with the other members of the EU to develop BMPs for (a) SCAT survey team activities, and (b) Operations activities as input to STRs, either for individual shoreline segments/ habitats or for recommended shoreline treatment techniques.

The SCAT program involves a continual process of liaison with Operations at the Command Post to ensure that they understand and agree with the shoreline response strategy and program, and with field supervisors to ensure that they understand the STR and any BMP or site-specific constraints that may apply to a segment.

8.4 Shoreline Treatment Recommendations

The mechanism by which SCAT field observations and recommendations are used to develop a shoreline treatment plan is through a ***Shoreline Treatment Recommendation (STR)*** form. SCAT Field Teams prepare an ***STR*** for each oiled segment that does not meet the endpoint criteria. Treatment recommendations are developed based on oiling conditions, shore type, coastal processes, endpoints, treatment constraints and Best Management Practices. Any BMPs or safety issues that may apply are appended to the form and individual STRs are submitted by the SCAT Coordinator for review by the EU, approval by Command and implementation by Operations.

There are typically two types of STRs:

- A generic STR based on shoreline type and oiling character. This type of STR can be generated by the SCAT Coordinator at the beginning of a response in order to provide immediate guidance for Operations, or where the treatment recommendations and endpoints likely would not change significantly throughout the response.
- A segment-specific STR that is prepared by a SCAT Field Team for each oiled segment that does not meet the endpoints. Any BMPs or safety issues that may apply are appended to the form and individual STRs are submitted by the SCAT Coordinator for review by the EU.

Both generic and segment-specific approved STRs become part of the Incident Action Plan (IAP) through the **ICS 204** process and provide Operations with a "permit to work" from which they can implement the treatment decision and work to meet the endpoint target.

An example STR form is provided in Appendix 1B.1b.

8.5 Treatment Completion

The completion of treatment, that is, when there is agreement that the endpoints defined in an STR are achieved, requires an interagency consensus that ***appropriate and practical treatment endpoints*** have been met.

A preliminary step in this process, when nearing treatment completion within a segment, may be for Operations to contact the SCAT Coordinator, who can schedule a Post-Treatment Assessment (PTA) survey (Section 2.4) to ensure that the segment is ready for an interagency inspection.

The completion inspection process typically involves a SCAT oiling survey with representatives of the responsible party, government agencies and landowners / land managers for that segment. The inspection process may involve a ***Shoreline (Segment) Inspection Report (SIR)*** that is signed to document that ***No Further Treatment (NFT)*** is recommended if the inspection team agrees that:

- the endpoint(s) have been achieved, and/or
- sufficient appropriate treatment has been completed such that further activities may cause a negative Net Environmental Benefit (NEB).

If the segment does not meet the endpoint(s), and if the Operations team cannot immediately remedy the situation while the inspection team is on site, the original or a modified STR would be continued. The PTA survey is intended to avoid this extra step.

Two other factors may result in an NFT recommendation:

- The ALARP (As Low As Reasonably Practicable) principle: a consensus decision that further treatment may be operationally feasible but is unreasonable, impractical, or of little environmental or economic value.
- Safety: a decision made by the Safety Officer, during either the STR review process or the field operation, which identifies real or potential risks to response personnel that cannot be mitigated.

The recommendation(s) in the signed SIR is (are) submitted to the Incident Command for approval, after which time the segment(s) is (are) removed from active Operational status and the field team can demobilize from the segment.

An example SIR form is provided in Appendix 1B.1c.

9 Case Studies – Highlights of SCAT Development 1989–2016

T/B Nestucca, western Vancouver Island, BC, 1989

- An interagency shoreline evaluation team (SET) process was developed to include representation from the federal government and the local Nuu-Chah-Nulth Tribal Council.
- A standard reporting checklist and shoreline oiling classification, based on oil character and oil cover (distribution), were introduced to provide a consistent information base.
- The SET teams conducted post-treatment inspections to provide a consensus that sufficient treatment had been completed.
- Reference: Owens, 1990.

T/V Exxon Valdez, 1989–1993

- Original segmentation was conducted by mapping from an aerial videotape survey and was based primarily on the observed oiling conditions, so that many sections of coast had long segments (many kilometres in length) if they had No Oil Observed (NOO).
- Subsequent re-mapping and re-segmentation of Prince William Sound, beginning in the late 1990s, was based on aerial videotape surveys with shore type (upper intertidal zone) and coastal (backshore) substrate and geomorphology as the basis for segmentation.
- In 1989, each SCAT field team (referred to as a Shoreline Cleanup Advisory Team at the time) comprised a geomorphologist, an ecologist and a cultural resources expert (archaeologist); in 1989, the State of Alaska and Exxon had their own separate survey programs.
- Over 8,000 km of shoreline were surveyed by aerial mapping and subsequently 5,500 km were surveyed systematically on the ground by four Exxon teams deployed in Prince William Sound out of Valdez, and by four Exxon teams deployed out of Seward and Kodiak to survey the Gulf of Alaska shorelines; it was only in the spring of 1990 that an integrated team approach with federal, state and Exxon representatives was introduced.
- Standard forms, standard terms and definitions were developed, and the data were entered into a computer database. Some of the terms and definitions were revised for the 1990 and following surveys.

- In 1989, the Interagency Shoreline Cleanup Committee (ISCC) planned the survey priorities for the Exxon SCAT teams, and the shoreline cleanup recommendations developed by the SCAT program and Operations were presented to the Federal On-Scene Coordinator (FOSC) for approval; in 1990, recommendations based on the SCAT data were initiated by an interagency Technical Advisory Group (TAG) and the recommendation category of No Treatment Required (NTR) was introduced for use by the TAG.
- Reference: Owens and Reimer, 2013; Teal, 1990.

T/B Bouchard 155, St. Petersburg, Florida, 1993

- Segments were defined by distance along shore (0.1 miles on a vehicle odometer) and positioned by GPS units on long, straight sand beaches.
- Both surface and subsurface oiling were mapped and documented.
- A four-person interagency Shoreline Cleanup Technical Committee was set up with representation from the potential responsible parties and the federal and state governments to review the SCAT data and work with Operations to develop a recommended cleanup strategy for the FOSC.
- Reference: Owens et al., 1995.

M/V Selendang Ayu, Aleutian Islands, Alaska, 2004–2005

- No pre-segmentation was available so the shoreline was segmented from scratch at the beginning of the response using nautical charts prior to the deployment of interagency SCAT teams.
- The initial segments had to be modified by field teams as either the segment boundaries were found to be inaccurate or they needed to be subdivided due to insufficient detail on shore types from the charts.
- Two SCAT teams worked from helicopters in the area near to the Command Post (the logistics base at Dutch Harbor) and two vessel-based SCAT teams surveyed the areas that were beyond the range of the helicopters.
- This was the first response during which a formal STR and SIR protocol was developed.

- The concept of a No Further Treatment (NFT) shoreline category was developed for segments in which No Oil Observed (NOO) was documented or if the segment met pre-defined and pre-agreed oiling criteria.
- Of the 806 segments (763 km) surveyed in the affected area, 391 (345 km) had NOO, 290 (304 km) were designated as NFT (114 km), and 125 (114 km) had an STR recommendation.
- Reference: Owens et al., 2008.

Train derailment, Lake Wabamun, Alberta, 2005–2008

- A submerged oil survey program was developed to record the density of submerged tar balls along the shoreline and within reed beds.
- Submerged oil surveys involved visual observation techniques with the naked eye and bathyscopes, and dip nets or scoops for verification.
- Field teams used a “submerged oil survey form” on which tar balls density was recorded and associated with waypoints provided by a GPS.
- Submerged tar balls density data was mapped and used by cleanup personnel to locate and remove tar balls.
- Reference: Sergy et al., 2011

M/V Cosco Busan, San Francisco Bay, California, 2007

- Shoreline subdivisions were in place at the state mapping level based on divisions within each county: e.g. AL-A = Division A in Alameda County. Within this framework, the SCAT teams generated segments based on oiling conditions and shore types.
- Four interagency SCAT teams were each assigned to a separate geographic area and the Team Leads for each region provided direct liaison with the Operations Field Supervisors.
- Initial aerial reconnaissance surveys were limited by fog and rain.
- The STR and SIR protocols were refined further with the addition of a pre-inspection survey to ensure that the segment would meet endpoints prior to inspection by the full interagency and land manager/owner SCAT team.

Deepwater Horizon, Gulf of Mexico, 2010–2013

- The affected area was divided, for logistical and administrative reasons, into two geographical regions at the beginning of the response, each with an Area Command Post; duplicate SCAT organizations were established, with parallel protocols for the SOS, STR and SIR processes, and a single database.
- At times, up to 20 SCAT teams were deployed simultaneously in 2010.
- The field data collection program involved the same Team Leads from April 2010 through 2013 to provide continuity and consistency, even as the workload was reduced.
- Regular calibration days ensured consistency of reporting between the Team Leads as the degree of oil and oil character evolved over time.
- The "standard" definitions for the Surface Oil Character Matrix for Wide, Moderate and Narrow oiled band width were adapted to more accurately characterize the oiling conditions in the micro-tidal range environment of the Gulf of Mexico.
- The large geographic scale of the shoreline response program created communication span-of-control issues between the SCAT field teams and the Operations field supervisors in late summer 2010; this issue was remedied by the creation of a layer of SCAT-Operations Liaisons who were embedded with the field operations, and who maintained close communication with the SCAT program managers at the Command Posts and the SCAT Field Team Leads.
- The SCAT field program and the generation of treatment recommendations were closely coordinated with input from Cultural Resource Advisors and Endangered Species Act consultants.
- A large-scale subsurface oil detection program became necessary due to the burial of oil by seasonal sediment deposition during the spring and summer of 2010.
- The concept of establishing different No Further Treatment (NFT) criteria by different operational phases was applied in this multi-year response.
- References: Santner et al., 2011; Michel et al., 2013.

K9-SCAT experience

- The Joint Industry Program (JIP) initiated a project to explore the use of trained canines to detect oil under ice (Brandvik and Buvik, 2009).
- Following the Deepwater Horizon subsurface oil SCAT program, an API study identified and evaluated current and potential techniques for the detection and delineation of subsurface oil (API, 2013). This API study presented recommendations for the development and testing of potential subsurface oil detection techniques and recommended field trials to evaluate the applicability of canine oil detection.
- Field trials conducted in 2015 provided proof of concept and demonstrated that oil detection canines can be an efficient and effective technique for locating and delineating subsurface oil (API, 2016a).
- A product of the field trials was the development of API's Canine Oil Detection (K9-SCAT) Guidelines (API, 2016b).
- A field survey was conducted in 2016 following several releases from the T/V *Arrow* in 2015 in Chedabucto Bay, Nova Scotia; this shoreline survey demonstrated that K9-SCAT is effective and efficient in detecting small volumes of surface and subsurface oiling in different environments.
- Two K9-SCAT teams were deployed to support the Husky 16TAN river spill response in Saskatchewan in summer/fall 2016. The canines cleared many sections of river bank where oil was not present and were able to detect subsurface and submerged oil, as well as very small amounts of oil that often would have not been observed by traditional SCAT teams.
- Oil detection canines provide a low risk, high confidence tool that is neutral and unbiased.

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The purpose of this Manual is to provide advice and guidance to the operational oil spill response community. Environment and Climate Change Canada notes that additional SCAT resources are available from other expert sources.

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