Environment Canada SCAT Manual 3rd Edition: What's New in SCAT?

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Abstract

The Shoreline Cleanup Assessment Technique (SCAT) is an accepted concept for the description and documentation of oiled shorelines. The field data provide 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 end points. The process is flexible and adaptable for spill responses of different scales and in the full range of Canadian coastal environments. The Third Edition of the Environment and Climate Change Canada (ECCC) SCAT Manual provides a current (2016) best practice guide for Canadian shorelinesthat, with appropriate environmental modifications, can be applied globally.

The purpose of the revised SCAT 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 of:

- 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 Appendices include a Field Job Aid, which presents standard SCAT shoreline and oiling terms and definitions and a set of standard field data forms that may be used to document shoreline oiling, and a Management Job Aid to assist with management, planning, and logistics.

Introduction

The underlying value of a scientifically-based shoreline assessment process can be traced back to lessons learned from the T/V *Arrow* incident in Chedabucto Bay, Nova Scotia, Canadain 1970. An estimated 305 km of shoreline were affected by that oil spill and significant resources were committed to document the shoreline oilingconditions and to develop cleanup strategies for use by response decision-makers (GoC, 1970). Subsequent R&D studies in the affected area were able to build on the initial information base (Owens and Rashid, 1976; Owens et al., 1992). Meso-scale field projects such as the Baffin Island Oil Spill (BIOS) Project contributed to the evolution of SCAT by providing a controlled experimental scenario where oiled shoreline terminology could be established and refined across a broad scientific community (Humphrey et al., 1991).

By 1989, two key elements of shoreline surveys were in place: segmentation concepts for physical and ecological shore-zone mapping had been developed for the British Columbia (BC) coast, starting in 1980, and checklists had become a standard component of EC's shoreline response training courses (Owens 1979). These provided the foundation for the oiled shoreline mapping protocols that were initiated on the 1989 *Exxon Valdez* shoreline assessment surveys which, when combined with the team approach and interagency participation, remain the foundation for a SCAT program.

Today, SCAT is an accepted concept for the description and documentation of oiled shorelines. It is applied to spill preparedness and response activities where the field data provide 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 end points. The process is flexible and adaptable for spill responses of different scales and in the full range of global coastal environments.

Environment Canada (EC), now Environment and Climate Change Canada (ECCC), was one of the leaders in the development of the SCAT approach and documentation protocols during the responses to the T/B *Nestucca* and T/V *Exxon Valdez* oil spills in 1988-1989. The first complete version of a SCAT manual was prepared in 1991 for British Columbia and the first national generic EC SCAT manual was published in 1992; this was revised by a second edition in 2000. To address applications for northern environments (and winter conditions in Canada), EC produced the Arctic SCAT manual in 2004 for the Arctic Council. Over the last 15 years the SCAT program and associated protocols have developed significantly. Consequently, the 2017 ECCC SCAT Manual has been updated to include experiences and lessons learned from responses and SCAT-related projects between 2000 and 2016. This updated manual can be applied world-wide with appropriate coastal environmental adaptations.

SCAT Background

The SCAT approach and documentation protocols were developed initially on the1989 T/B *Nestucca* and T/V *Exxon Valdez* spill responses and since then have formed the basis for the creation of shoreline response programs on many spills, perhaps most notable being the 2010-2014 Deepwater Horizon response in the Gulf of Mexico. The original SCAT concept developed on the *Nestucca* response in Canada involved a multi-agency team that represented the interested parties to evaluate treatment options and inspect those beaches where cleanup had been completed. This concept was adapted for the 1989 *Exxon Valdez* response, although interagency teams were only established in 1990 after the initial, first-phase SCAT program that documented the shoreline oiling. During the 1990s, three agencies (Environment Canada, National Oceanic and Atmospheric Administration (NOAA) in the USA, and the European Commission) produced second-generation versions of SCAT forms based on those developed during the*Exxon Valdez* response. The outcome of this first phase in SCAT development was the creation of an internationally-accepted procedure for the surveying, documentation and description of oiled shorelines based on standard terms and definitions.

The concept of a formal procedure for SCAT field teams to create shoreline treatment recommendations ("STRs") and to have an inspection and sign-off process documented by shoreline inspection reports ("SIRs") was introduced on the M/V *Selendang Ayu* response in 2004-2006 and refined for the Wabamun Lake (2005-2006) and M/V *Cosco Busan* (2007)

incidents. In these responses, the SCAT program evolved into a "cradle to grave" support for Planning and Operations that included field support for shoreline operations, a formal inspection process based on treatment end points, and a phased sign-off protocol.

A key feature of the *Cosco Busan* incident was the issue of re-oiling that required SCAT teams to repeatedly inspect segments until end points were eventually achieved, in part by natural weathering rather than cleanup actions. Similarly, the Deepwater Horizon response required repeated surveys along the coasts of the affected area over many months.

The consequence of this evolution was the development of a strong working relationship between the SCAT teams that generated the shoreline oiling information and the Operations teams conducting the cleanup. Key SCAT milestones are listed in Table 1.

Table 1 Key SCAT Milestones

1970	T/V *Arrow*: science-based shoreline oiling mapping to support the cleanup decision process: shorelines resurveyed in 1973 and 1992
1977	Shoreline survey checklists developed for shoreline assessment training for Environment Canada
1980	Shoreline segmentation and mapping protocols developed for BC mapping
1989 January	T/B *Nestucca*: first spill response surveys with forms and interagency concept - aerial Shoreline Evaluation Team (SET) was used in conjunction with ground Shoreline Surveillance Teams (SST).
1989 April	Aerial VTR mapping to provide data for T/V *Exxon Valdez* General Plan submitted in May 1989
1989 May	Ground SCAT survey with forms and geology/biology/archaeology team to support the shoreline treatment program
1990 May	Ground Shoreline Survey Assessment Team (SSAT) survey with interagency teams
1990	British Columbia SCAT Manual
1992	NOAA Shoreline Assessment Manual
1994	Environment Canada SCAT Manual
1996	River SCAT forms developed on the Komineft (Russia) pipeline spills response
1999	Tar Ball forms developed on the M/V *New Caris*sa response
2004	Arctic Council – EPPR Arctic SCAT Manual
2005	STR and SIR forms developed on M/V *Selendang Ayu* response - "cradle to grave" support for Planning and Operations and Clean-As-You-Go (CAYG) missions
2005	STR and SIR forms adapted for freshwater spill, Lake Wabamun, Alberta, Canada; underwater SCAT procedures.
2007	Pre-inspection surveys to confirm whether a segment was ready for an SIR used on M/V *Cosco Busan* response,
2010	Deepwater Horizon SCAT Operations Liaison teams created to bridge gap between SCAT and Ops;Natural Resources Advisor (NRA) program to document Section 7 compliance; "Snorkel SCAT" for nearshore detection
2016	SCUBA SCAT used for a nearshore sunken oil survey (Piraino et al. 2017)
2016	Oil detection canines (K9-SCAT) and UAS ("drones") used to support SCAT missions on the 16TAN pipeline spill on the North Saskatchewan River

SCAT and the Environmental Unit (EU)

An evolutionary step in the full integration of a SCAT program and the use of SCAT data in the development of shoreline response recommendations into the Incident Command System (ICS) planning cycle occurred during the *Cosco Busan* spill response. During this program, the SCAT Coordinator, Environmental Unit (EU) Leader, and Deputy EU Leader developed a process by which the SCAT recommendations from the field would be captured by phone each day at a certain time and integrated onto a draft STR, which the SCAT Coordinator and the deputy EU Leader would then bring into the Tactics Meetings with the Operations and Planning Section Chiefs, and other key attendees from the spill management team.

The *Cosco Busan* SCAT Program required a rapid pace to integrate SCAT recommendations into the Planning Cycle, as the response was run on an accelerated, daily Operational Period/Planning Cycle. The remote nature of the *Selendang Ay* response promoted a relatively less time-dependent operational planning cycle. The STR (previously STRT – Shoreline Treatment Recommendation Transmittal) form and associated process of capturing key SCAT team field recommendations for treating an affected shoreline were completed and inserted into the Planning Cycle on a more accelerated time frame during the *Cosco Busan* spill response. The key to including input from key trustee agencies lay with discussions within the EU, led by the EU Leader and Deputy, during which treatment recommendations on specific highly sensitive segments and areas were discussed in more detail.

Endangered Species Act (Section 7) and Historic Properties (Section 106) consultation issues were addressed within the EU as a whole for SCAT treatment recommendations, but due to the need for accelerated SCAT/STR input into the Planning Cycle, these inputs were handled separately for specific segments and areas.

During the Deepwater Horizon response, the SCAT program was once again a separate unit within the EU, but the EU Leader was vital to ensuring key consultation and discussions for sensitive areas took place, such as Section 7 and Section 106 consultations as well as input from key state agencies and other landowner and trustee issues.

SCAT and ICS

Throughout this evolution, the SCAT concept has been a cornerstone of support for Operations through the decision and planning process from the initial shoreline oiling until the last segment is signed off. Until the *Selendang Ayu* (2004-2007) and more notably the *Cosco Busan* (2007-2008) responses, the SCAT process, although geared to support Operations, had not yet been fully integrated into the Incident Command System (ICS) spill management system. Following the *Selendang Ayu* and *Cosco Busan* incident, the SCAT process evolved to ensure full integration into the ICS Planning Cycle, and ultimately provide guidance to the ICS 204 Work Assignments in the Incident Action Plans for each Operational Period.

During the *Selendang Ayu* response the SCAT Coordinators worked closely with the EU Leaders to create a process that ensured the SCAT treatment recommendations, and appropriate safety, environmental, and cultural constraints, were vetted through other key elements of the EU. STRs were then “hand-carried” to other key members of the ICS management team, such as the Site Safety Officer, the Planning Section Chief and the

Operations Section Chief before receiving final sign off by the Unified Command. This process was captured by the STRT (now known as STR) forms, the first major evolution in the SCAT process since its original inception.

This process ensured, with a paper trail, that the Operations and Planning Section Chiefs were aware of multi-agency SCAT team recommendations, which they would then incorporate into their planning cycles for implementation in subsequent field operations, on a segment by segment basis. However, this still left the SCAT process somewhat "out of the loop" on key tactical discussions during key planning cycle meetings. The input from the SCAT program was still "outside" of the normal ICS planning meeting cycle and had to be "manually" brought in once the OSC and PSC had reviewed the STRs.

The SCAT process has evolved significantly in the past 15 years to ensure integration into the ICS spill management process. The key link to ensuring rapid and effective integration into the ICS planning cycle, which is the only way to ensure that SCAT treatment recommendations guide the development of the ICS 204 Work Assignments for Operations, is the leadership of the Environmental Unit Leaders and their Deputies who must understand the need to rapidly integrate shoreline treatment recommendations and all associated constraints, concerns, and issues into the Planning Cycle.

Literature Review

The first project deliverable for the Third Edition of the ECCC SCAT Manual was the preparation of a literature review of SCAT and SCAT-related publications that were written since the second edition of the SCAT Manual in 2000. The Literature Review was prepared in March 2016 and updated in December 2016 to include 2016 publications or reports. Several resources were used to identify SCAT and SCAT-related documents relevant to this project, including (but not limited to): project team publications, Arctic and Marine Oilspill Program (AMOP Technical Seminar proceedings, International Oil Spill Conference (IOSC) proceedings, Interspill proceedings, Marine Pollution Bulletin, Spill Science and Technology Bulletin, International Tanker Owners Pollution Federation (ITOPF) online library: http://itopf.soutron.net/Library/Catalogues/Search.aspx, and the OCC SCAT Toolkit: www.shorelineSCAT.com

The literature review identified more than 100 individual contributions since 2000. During the Literature Review, the project team identified key information resources which describe improvements and revisions to the SCAT recommended protocols and techniques described in the SecondEdition, including the following significant developments:

- 2004: "The Arctic SCAT Manual" published by EC for the Arctic Council
- 2005: No Further Treatment (NFT) concept, Shoreline Treatment Recommendation (STR) form and Shoreline Inspection Report (SIR) form developed on the M/V *Selendang Ayu* response
- 2005-2008: Canadian National SCAT Working Group developed policy and documentation for standardization and implementation of SCAT in Canada
- 2007: Post-Operations Monitoring (POM) surveys developed on the M/V *Cosco Busan* response; now referred to as Post-Treatment Assessment (PTA) surveys

- 2010: SCAT Operations Liaison program developed on the Deepwater Horizon response
- 2009-2016: Evolution of detection canines for subsurface oil surveys
- 2016: ASTM Standards Guides revised to include inland and terrain terminology and surface oiling categories: F1686 - Shoreline Oiling Observations; F1687 - Shoreline Oiling Terminology
- 2016: API Sunken Oil Detection and Recovery Technical Report and Field Guide
- General advancements in technology, in particular the use of GPS in field surveys

The Evolution of SCAT Since 2000

SCAT protocols and techniques have evolved significantly since the publication of the second edition of the Environment Canada SCAT Manual in 2000. During the Literature Review, the project team identified 16 references that provide significant milestones in SCAT evolution, and whichwere considered during the development of the third edition of the Environment Canada SCAT Manual. These key references provide new informationon:

- Standardization in Canada (Sergy, 2008; Lamarche et al., 2007)
- SCAT Guidance (Owensand Sergy, 2004; Sergy, 2008, IPIECA, 2014, NWACP, 2014)
- Review of SCAT Evolution (Parker et al., 2011)
- SCAT Management, Planning and Logistics (Santner et al., 2011; Owens, et al. 2015)
- SCAT Data Management and Forms (Lamarche et al., 2007; OCC, 2105)
- Subsurface Oil Detection (API, 2013; API, 2014; Owens, et al., 2014)
- Canine Oil Detection (K9-SCAT) (API, 2016a; API, 2016b; Bunker et al. 2017; Owens et al. 2017)
- Sunken Oil Detection (API, 2016c; Piraino et al. 2017)

Other SCAT Manuals

A significant number of SCAT manuals and guides have been published since the second edition of the Environment Canada Manual, many of which are adapted for specific regions and environments. During the Literature Review, the project team identified 12 key SCAT manuals and job aids that were consulted during the development of the third edition of the Environment and Climate Change Canada SCAT Manual. These documents were developed for various countries/regions, including

- Australia(Great Barrier Reef Marine Park Authority, 2000; AMSA, 2003)
- Canada (Owens and Sergy, 2004; Sergy and Owens, 2007)
- Mediterranean Region (IMO/UNEP, 2009; POSOW, 2013)
- UK (MCA, 2007)
- USA (NOAA, 2002; NOAA, 2013; NWACP, 2014)
- Other (CEDRE, 2006; IPIECA, 2014)

Relevant Case Studies

Since the publication of the second edition of the Environment Canada SCAT Manual in 2000, there have been many oil spill responses which have led to developments in SCAT management practices, SCAT techniques, and data management. The Literature Review

identified 17 spill responses that involved SCAT and that were considered during the development of the third edition of the Environment Canada SCAT Manual:M/T *Westchester*, USA (2000); M/V *Selendang Ayu*, USA (2004); Lake Wabamun, AB (2005); Westridge Delivery line, BC (2007); M/V*Westwood Anette*, BC (2006, 2007); M/V *Cosco Busan*, USA (2007); M/T *Hebei Spirit*, South Korea (2007); Deepwater Horizon, USA (2010); Line 6B Kalamazoo River, USA (2010); Silvertip Pipeline, USA (2011); Cheecham pipeline, AB (2013); USAT *Brigadier General M. G. Zalinski*, BC (2013); Lemon Creek, BC (2013); Whiting Refinery, USA (2014); Refugio spill, USA (2015); M/V *Marathassa*, BC (2015), T/V *Arrow*, NS (2015); Quintero Bay, Chile (2016); and 16TAN pipeline spill, SK (2016).

The SCAT Manual, Third Edition

Important features of the revised manual include a logical, well-defined approach with a Quick Start Guide (Figure 1) to enable rapid navigation through the manual. This systematic approach is based on:

- an initial definition of the need for oiled area assessment surveys;
- elements of a Shoreline Response-SCAT Program Plan development to include mission types, program phases, tasking assignments, and roles and responsibilities;
- guidelines for SCAT field team leads and team assignments;
- creation of communications and coordination within and between the Environmental Unit and the Operations Section; and
- development of a database management system with information outputs both for Operations Section support (STRs) and situational awareness/Common Operating Picture ("dashboards").

This core document is supplemented by topic specific support information on:

- segmentation, including pre-SCAT segmentation and mapping for shorelines and rivers;
- First Response Checklists;
- a range of Shoreline Oiling Summary (SOS) and other forms for different environments (temperate and cold climate), most recently revised in 2016;
- standard terms and definitions that have been revised since 2000;
- use and application of GPS technology during field surveys;
- Best Management Practices;
- SCAT team calibration;
- SCAT-Ops liaison support;
- photography;
- beach profiles;
- subsurface oil detection and delineation (K9-SCAT);
- shallow water sunken oil surveys (viewing tubes, snorkel SCAT);
- data management, reporting and the Common Operating Picture (COP);
- logistics support;
- SCAT Plan outline; and
- SCAT Safety Plans and Job Safety Analysis (JSA)

The Table of Contents and Job Aid contents from the manual are provided in Tables 2 and 3.

Table 2 Table of Contents for the Third Edition SCAT Manual

Section		Subsections	
	Executive Summary		
	Quick Start Guide		
	Acronyms		
1	Introduction		
2	The Basics of SCAT	2.1	The Purpose of SCAT
		2.2	What is SCAT
		2.3	SCAT Principles
		2.4	SCAT Surveys and Missions
		2.5	Typical Phases of a SCAT Program
		2.6	SCAT Process Overview
3	SCAT Roles and Responsibilities	3.1	Introduction
		3.2	Organization with the Incident Management System
		3.3	Roles, Responsibilities, and Interactions of Relevant Personnel
		3.4	SCAT Management Team
		3.5	SCAT Field Teams
		3.6	SCAT Team Leads
4	SCAT Management and Implementation	4.1	Shoreline Response-SCAT Program Plan
		4.2	Checklists
		4.3	Mission Planning
		4.4	Logistics Coordination
		4.5	Team Safety
		4.6	Training and Calibration
5	Pre-SCAT Data	5.1	Pre-SCAT Mapping
		5.2	Segmentation
		5.3	Segmentation Naming
6	SCAT Field Activities	6.1	Shoreline Environments, including Snow and Ice
		6.2	Shoreline Segmentation
		6.3	Oil Fate, Behaviour and Persistence
		6.4	SCAT Surveys and Missions
7	SCAT Data Management	7.1	Shoreline Segmentation
		7.2	SOS Forms
		7.3	Digital Data Collection
		7.4	Photographs, Video and GPS Data
		7.5	QA/QC
		7.6	SCAT Database
		7.7	Categorization of the Degree of Oiling
		7.8	Data Outputs
8	SCAT Recommendations and Shoreline Treatment Decisions	8.1	Endpoints
		8.2	Shoreline Treatment Options
		8.3	Field Constraints
		8.4	Shorelines Treatment Recommendations (STRs)
		8.5	Treatment Completion
9	Case Studies		Highlights of SCAT Development 1989-2016
	References		

	Appendix 1:		Job Aids
	Appendix 2:		GPS Guidelines

Table 3 Contents of the Job Aids

A	**SCAT Field Job Aid**
A.1	Shoreline Information
A.2	Surface Oiling Information
A.3	Subsurface Oil
A.4	SOS Form Examples
B	**SCAT Management Job Aid**
B.1	Endpoints, STRs and SIR
B.2	SCAT Management Forms
B.3	SCAT Plan Outline
B.4	First Response and Equipment Checklist
B.5	SCAT Field Forms

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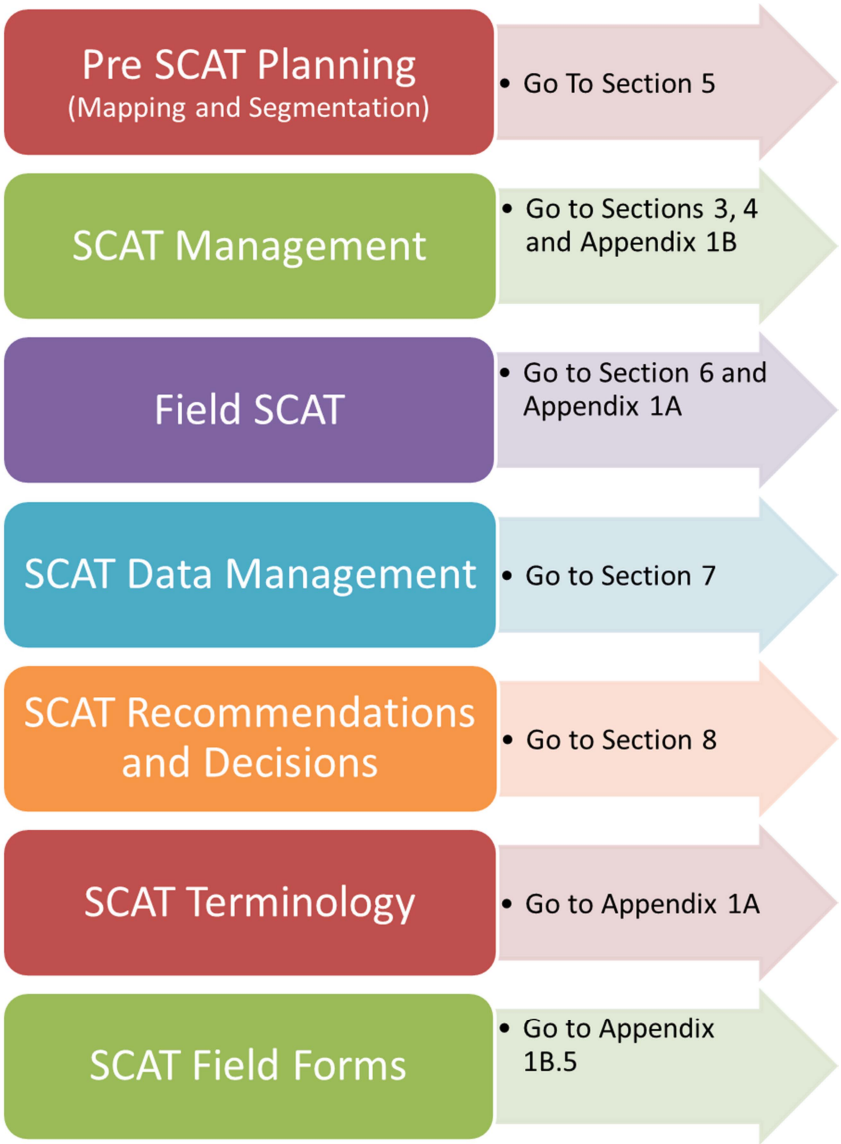

Figure 1 Quick Start Guide

Table 4 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)			■	■	■	
				■	■	■

Selected key messages from the revised SCAT Manual include:

1. **SCAT in the Environmental Unit**: Experience gained over the past decades at spill incidents has demonstrated that management of the SCAT program is most effective when situated in the Environmental Unit (EU) of the Planning Section of an Incident Command System (ICS)-based response. SCAT is a science-based planning tool that incorporates the net environmental benefit principal. Consensus is built for decisions based on SCAT data (priorities, treatment criteria, clean-up endpoints, etc.) in the Environmental Unit. Case studies have noted that if SCAT management were 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 process and could compromise the trust between parties that is a critical component of a successful response.

2. **SCAT Data QA/QC Process**: 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 to the SCAT database. Oiling Categories (Heavy-Moderate-Light-Very Light-Trace) are generated from the SCAT data base; then this 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 the data input are increasingly important. In the case where SCAT data and forms were to go electronically directly to the COP without full field team agreement and QA/QC, there is a risk that inaccurate data are "published", which would have to be revised later. This change could reduce the confidence in the SCAT data, and could negatively impact important response decisions.

3. **Phased Treatment Endpoints**: "Clean-up 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. Clean-up endpoints can be phased to ensure that stakeholder concerns over clean-up 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 on 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 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 down side 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.

Discussion

SCAT has evolved significantly over the last 15 years and will continue to evolve, particularly with improved field tools (e.g., GPS, K9-SCAT) and better data management support. The range of mission types (Table 4) now encompasses full, science-based, support from the initial response and reconnaissance data collection through to the inspection process that enables operational closure. This ECCC Third Edition Manual provides one more step and one more improvement 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.

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