Shoreline Cleanup Assessment Technique (SCAT) Data Management Manual

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Oiled Shoreline Cleanup Assessment and Response Guides

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Preface

The Shoreline Cleanup Assessment Technique (SCAT) process is now a familiar part of an oil spill response in many countries. The SCAT unit plays a key role in assessing the scale and scope of a shoreline response program. Although SCAT field procedures and data collection are well developed and standardized, far less guidance is available on the management, analysis, and usage of SCAT data. The SCAT Data Management Manual addresses this issue. The need for SCAT data management is explained and procedures are provided to ensure proper data management and effective use of SCAT data to support decision-making. The manual provides direction and the tools required for both the SCAT data manager and the SCAT coordinator.

This manual is one of a series of initiatives taken by Environment Canada to provide the best available knowledge, guidance, and standards for responders and decision-makers faced with issues of protection and cleanup of oil spills in coastal marine and freshwater environments. The science and technology knowledge base is combined with experience from recent responses, experts, and practitioners to craft manuals, job aids, and other tools to educate spill responders and enhance the spill response process.

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Overview of Manual

The SCAT Data Management Manual consists of seven chapters that can be grouped into three parts.

Part 1 GENERAL PRINCIPLES
This part provides background information on SCAT and describes the various aspects and components of SCAT field data collection.

Chapter 1 – Background
Provides a short overview of SCAT as an introduction for those not familiar with the process and a refresher for those who are.

Intended reader -: Anyone not familiar with the SCAT process

Chapter 2 – Collecting SCAT Data
Describes SCAT survey methods, addresses aspects of field data collection, and lays the groundwork for information inputs to the data manager.

Intended reader - Anyone not familiar with SCAT data management

Part 2 MANAGING SCAT DATA
This part describes the processes and methods used to manage SCAT data. These three chapters contain the core material of the manual, including details on how to manage the data and ways in which to use the information in different formats to support planning, decision-making, and operational functions.

Chapter 3 – The SCAT Data Management Team
Summarizes SCAT data management work and describes the responsibilities of the SCAT data management team and their required abilities.

Intended reader - Spill response managers, SCAT coordinators, and SCAT data management personnel

Chapter 4 – How to Manage SCAT Data
Describes the processes for managing SCAT data, including:

- how to set up a SCAT data management system;
- how to manage initial response survey data; and
- how to manage full-scale SCAT ground survey data.

Intended reader - Technical support personnel involved in SCAT data management

Chapter 5 – How to Apply SCAT Data
Explains how to process SCAT data so that it can be used to support planning, decision-making, and operational functions.

Presents examples of maps and reports used for decision-making and describes the data processing necessary for their production.

Intended reader - SCAT coordinators and technical support personnel involved in SCAT data management

Part 3 DEVELOPING SCAT DATABASES
This part covers the technical aspects of developing and maintaining a SCAT database.

Chapter 6 – How to Develop SCAT Databases
Provides technical details on SCAT data structure and describes each data element of a SCAT database.

Intended reader - Technical support personnel involved in SCAT data management

Chapter 7 – SCAT Data Management Support Tools
Describes the basic tools used to support SCAT data management, provides guidelines for developing SCAT data management systems, and makes recommendations for SCAT data management training.

Intended reader - SCAT coordinators and technical support personnel involved in SCAT data management

Quick Start

If this is an emergency and you need an immediate quick start, go to the Emergency Guide on page vii.

Otherwise, if you want to:

- **understand the SCAT process,** read Chapter 1.
- **know more about SCAT field survey and data collection methods,** read Chapter 2.
- **obtain a general understanding of what is involved in SCAT data management,** read Chapter 3.
- **know exactly what to do to manage SCAT data,** read the step-by-step procedures in Chapter 4.
- **understand how to process SCAT data,** read Sections 5.1 and 5.2 in Chapter 5.
- **review examples of decision support maps and reports developed from SCAT data,** read Section 5.3 in Chapter 5.
- **develop your own SCAT database,** read Chapter 6.
- **select SCAT data management tools,** read Sections 7.1 and 7 2 in Chapter 7.
- **develop a SCAT data management training program,** read Section 7.3 in Chapter 7.

SCAT Data Management Emergency Guide

This section is intended for those who need to manage SCAT data but:

- o have not read and do not have time to read the entire manual; and
- o have not taken SCAT data management training.

Following these steps will get you started and enable you to provide minimal but adequate SCAT data management services.

Step 1: Preparation (also see Section 4.1)

Initiate the following to set up the data management system.

Before Arrival at the Command Centre

- o Obtain the following general information about the spill: location, potentially impacted area, location of the Command Centre, and directions on how to get there.
- o Obtain any available maps and charts of the impacted area (topographical maps of 1/50,000 scale or less are preferred).
- o If a pre-spill segmentation database is available for the impacted area, obtain a paper or electronic copy of the data.
- o Prepare the data management equipment, which should include:
    - a portable computer, with office management tools (word processor and spreadsheet);
    - a portable printer, including spare paper and ink;
    - copies of maps and charts of the area;
    - a Geographic Information System (GIS) if you have one on your computer and know how to operate it; and
    - if a GIS is not an option, colour markers (red, orange, yellow, green, blue, and black).
- o Arrange travel to the Command Centre and arrive there as soon as possible.

After Arrival at the Command Centre

- o Report to your SCAT contact.
- o Set up and verify equipment.
- o Obtain the latest information about the incident, particularly the incident name, location, and the type and amount of oil that has been released.
- o Obtain a map or diagram showing the location of operations divisions.
- o If not already available, create a map showing the location of operations divisions using an electronic base map and a GIS. If these are not available, use your paper maps.
- o Copy and distribute either the newly created map or the paper map.

Step 2: Manage Initial Response Survey Data (also see Section 4.2)
Aerial reconnaissance surveys are performed immediately after the incident in order to evaluate the entire affected area as quickly as possible.

Take the following actions to manage the information obtained from these surveys.

- o Obtain a copy of the SCAT data that has been collected.
- o Examine the data and make sure you understand it well.
- o Clarify any items that seem unclear. Make sure that any modification is documented, i.e., marked on paper document or entered in a log file for electronic documents.
- o If the data includes oil zones with evaluations of oil width, distribution, and lengths, use Table 17 to assess the oil cover for each oil zone.
- o If using paper maps, make a copy and note the oiling assessment on the map. Use coloured markers to draw oil zones with different categories of oil levels, i.e., red for heavy, yellow for moderate, green for light, and blue for no oil.
- o If using a GIS, create a file and digitize the oil cover information for each oil zone.
- o If there is time, create a spreadsheet to enter the basic information gathered during the surveys (see Table 16).
- o Enter the information within the spreadsheet.
- o Process the information and create summary tables (see How to Process Data on page ix).
- o Copy and organize the survey data. Specifically, copy all paper material and transfer any electronic files to permanent media, such as CDs.

Step 3: Manage Full-scale SCAT Ground Survey Data (also see Section 4.3)
Full-scale SCAT ground surveys begin shortly after the initial response effort. To support this effort, take the following actions.

- o Prepare data-capture support documents for the field teams, i.e., prepare and distribute Shoreline Oiling Summary forms, blank sketch sheets, and any available base maps that can be used to report oiling observations.
- o On the day before the survey, distribute these documents to the field teams and note the name and affiliation of each team member.
- o Obtain data gathered by the ground survey teams at the end of their work day. Make a list of all data transferred in a logbook (Table 19). If there is time, enter this information in a spreadsheet or word processor.
- o Examine survey material. Make sure you understand the survey method and any marks or handwriting. Verify that there is no missing data and that data on forms and sketches are the same.
- o Make sure that the following data (also referred to as “Basic Information”) has been entered:
    - shoreline segment code;
    - date of survey;
    - oil zone width;
    - oil zone distribution;
    - oil zone thickness;
    - nature of oiled substrate;
    - depth of penetration or burial (for pits or trenches);
    - wave exposure; and
    - slope.

- Clarify any items that require modification by interviewing the SCAT team leader.
- Prepare data for processing.
    - If you have access to a spreadsheet, enter the basic information (listed as the fifth item in Step 3).
    - If you have access to a GIS, create the following three layers:
        - shoreline segments, to enter the limits of shoreline segments as polylines;
        - oil zones, to enter oil zone oiling data and oiling levels as polylines;
        - pits or trenches, to enter subsurface oiling data and assessment as points.
- Process data (see How to Process Data below).
- Produce and distribute summary maps and reports.
- Copy and organize survey data, i.e., copy all paper material and transfer any electronic files to permanent media, such as CDs.

How to Process Data (see also Chapter 5)
To process the data, take the following actions.

- Evaluate surface oil cover and oiling category within each oil zone. Use Table 16 for aerial survey data and Tables 25 and 26 for full-scale SCAT ground survey data.
- For other types of assessment, refer to Section 5.1.1.
- Evaluate oiling conditions for each segment surveyed, pooling data from each oil zone using the methods described in Section 5.1.2.
- Create summary tables and maps, using the methods and guidelines described in Section 5.1.3.

Use any available computerized tools.

- Summary tables can be developed with spreadsheets.
- Summary maps can be created with a GIS.
- If a GIS is not available, create the summary maps by drawing over a paper map with a colour marker. Assessment results can also be drawn on a plastic transparency over a map of the area.

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Tables

Chapter 1 Background

This chapter summarizes the Shoreline Cleanup Assessment Technique (SCAT), describes its purpose, and outlines how it is used within a response organization. It gives a general overview of SCAT data management and describes the nature and purpose of pre-spill SCAT databases. An outline of the chapter is provided in Figure 1.

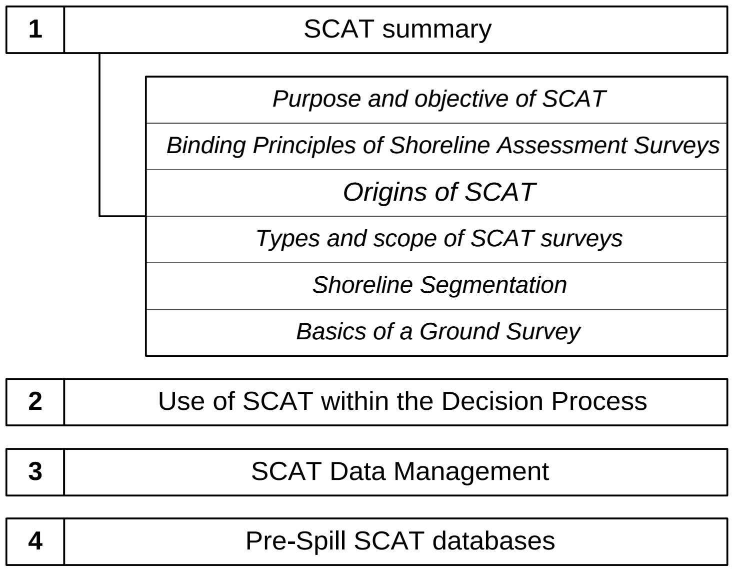


Figure 1 Topics in Chapter 1

1.1 SCAT Summary

1.1.1 Purpose and Objectives of SCAT

The Shoreline Cleanup Assessment Technique (SCAT) is a standardized methodology for collecting field data to document shoreline conditions after oil spills[1].

During an oil spill response, SCAT teams systematically survey the affected area to provide a rapid and accurate geographic picture of shoreline oiling conditions. The information is used to make real-time decisions regarding shoreline treatment and cleanup operations.

Specifically, the data collected during SCAT surveys support the following critical tasks:

- the accurate description of the location, amount, and character of oil on the shoreline, and if unknown, the shoreline type and coastal characteristics;
- the development and recommendation of treatment priorities, methods, plans and standards appropriate for the observed oiling conditions and environmental and socio-economic constraints; and
- the effective implementation of operational plans and determination of when cleanup activities are complete.

1.1.2 Binding Principles of Shoreline Assessment Surveys

Shoreline assessment surveys are based on several fundamental principles, including:

- a systematic assessment of all shorelines in the affected area;
- division of the coastline or riverbank into homogeneous geographic units or “segments”;
- the use of a standard set of terms and definitions for documentation;
- a trained and objective survey team; and
- the timely provision of data and information for decision-making and planning.

[1] Throughout this manual, the terms “shoreline” or “shore” apply to marine, freshwater lake, pond, river, and stream environments.

1.1.3 Origins of SCAT and Reference Documents

Over the years, many techniques have been used to describe oiled shorelines (Owens and Sergy, 2003). The SCAT approach and documentation protocols were initially developed in 1989 during spill response operations for the *Nestucca* and *Exxon Valdez*. Subsequently, generic second-generation SCAT protocols were developed (Owens and Sergy, 1994). Other agencies adopted the approach and produced similar field forms and manuals, e.g., European Commission – Jacques et al., 1996; NOAA, 2000. Several years later, the second edition of the SCAT Manual was produced to reflect updates and modifications derived from user experience and interagency adaptations (Owens and Sergy, 2000). Most recently, the Arctic SCAT Manual (Owens and Sergy, 2004) was developed to address arctic shoreline types and activities under conditions of snow and ice. Refer to Owens and Sergy (2000) and Owens and Sergy (2004) for more detailed descriptions of the SCAT process and procedures.

The SCAT process was developed for the following practical reasons.

1. Even when small amounts of oil are spilled, the affected area can be extensive. A systematic survey technique is therefore an efficient method for obtaining accurate information quickly.
2. The distribution of oil along a shoreline is rarely uniform. Even within small areas, oil can be heavily concentrated in one section, but thinly distributed on adjacent sections.
3. The operational phase of a response can extend over long periods of time, from weeks to months, particularly for large spills. A systematic survey program is necessary to provide an appropriate level of support to decision-makers as oiling conditions change with time.
4. Often ecological and cultural resource issues can only be identified by field surveys.

1.1.4 Types and Scope of SCAT Surveys

SCAT surveys are flexible and adaptable to the spill conditions and to the appropriate level and type of information required for each spill. Surveys are conducted using different methods and at different scales and times. All surveys are performed in a systematic manner over the course of the spill, although the precise nature of the data collected changes with the type of survey. The various types of SCAT survey methods and their objectives are summarized in Table 1 and Figure 2. A response can include all or a few of the different survey methods.

Table 1 Summary of SCAT Survey Methods (from Owens and Sergy, 2004)

Survey Methods	**Key Objectives**
Aerial Reconnaissance	Define overall scale of the problem to develop regional objectives. Mapping or documentation are not required. May result in hand-drawn information on a map/chart and a few photographs.
Aerial Video Survey, First Responder Ground Survey	Systematically document or map to create segments; develop regional strategies and plans; and define locations and lengths of oiled shorelines, including surface oil band width and estimated distribution.
Systematic Ground Survey	Systematically document surface and subsurface shoreline oiling conditions in all segments within the affected area. This category includes full-scale, post-treatment, and long-term monitoring surveys.
Spot Ground Survey	Systematically document surface and subsurface shoreline oiling conditions for selected segments or portions of segments in the affected area.

Initial Treatment Phase

Aerial Reconnaissance *

Purpose:
- Identify location of Video Surveys
- Establish Protection Priorities and locations

Data:
- Presence or absence of oil
- Location of oil accumulations along the shoreline

Aerial Video Surveys and Mapping

Purpose:
- Describe physical shoreline character and
- Oiling conditions

Data:
- Location of Shoreline Segments
- Shoreline Segment Characteristics
- Oiling Conditions

Treatment Phase

Detailed Ground Surveys

Purpose:
- Objectively describe oil distribution and character
- Provide information to be used by: the Environmental Unit, the Waste Program, the Supply Offices, the Planning and Operations Sections

Data:
- Location of oiled zones and subsurface oil
- Oiling characteristics
- Operational considerations (access, safety, etc.)
- Recommended treatment methods

Aerial Reconnaissance Surveys *

Purpose:
- Monitor treatment progress
- Identify additional potential issues

Data:
- Presence or absence of oil
- Location of treatment personnel

Inspection Phase

Ground Surveys

Purpose:
- Evaluate if additional treatment is needed
- Determine if treatment method should be modified
- Objectively evaluate level of oiling

Data:
- Location of oiled zones and subsurface oil
- Oiling characteristics
- Treatment endpoint reached

* Aerial reconnaissance surveys include visual observations only, are not necessarily systematic, and may result in a hand-drawn notations on a map/chart and a few photographs.

Figure 2 SCAT Surveys Performed during an Oil Spill Response

The following are the three primary survey methods used.

- **Aerial reconnaissance surveys** quickly evaluate the extent of the impacted area. The objective is simply to define the geographic distribution of oiled shorelines, to help define the overall scale of the problem, and to develop regional objectives.
- **Aerial videotape/mapping surveys** provide detailed information that is used to divide the affected shorelines into segments and to map the oil distribution and shoreline character within each segment.
- **Full-scale ground surveys** methodically and systematically document all details of the surface and subsurface oiling conditions within each of the segments determined by the aerial mapping.

Additional supplementary surveys include the following.

- **First responder ground surveys** are typically conducted by local people to provide an initial ground-view assessment of the nature of the oiling conditions before formal responders arrive on the scene. These surveys provide data similar to that provided by aerial videotape/mapping surveys.
- **Spot ground surveys** are similar to full-scale ground surveys, but are applied on a few shoreline segments or even on portions of selected shoreline segments.
- **Post-treatment ground surveys** are used to monitor the progress of treatment and to determine if the treatment endpoint criteria have been reached.
- **Long-term monitoring surveys** or programs repeat observations and measurements from ground surveys in order to provide a sequential record of change over time.

1.1.5 Shoreline Segmentation

The essential first step in the SCAT process is to divide the coastline into shoreline segments. This process is central to the SCAT concept since all observations are reported at the shoreline segment level. Shoreline segments are alongshore units within which the shoreline character is relatively uniform. Examples of “typical” shoreline segments include: sandy beaches between rocky outcrops and a stretch of rip-rap in a harbour or marina.

1.1.6 Standard Terms and Definitions

Oiling conditions are described using standard terms and definitions so that: 1) decisions can be made using relatively accurate information; 2) the potential for misunderstanding is minimized; and 3) comparisons can be made between segments and over time. Standard terms and definitions are provided in Owens and Sergy (2004) and Owens and Sergy (2000). These terms can be adapted and modified to suit conditions of the spill, but this must be done before any surveys start.

1.2 Basics of a Ground Survey

As ground SCAT surveys generate the largest and most complete set of data, an overview of the method is provided here. Ground surveys are designed to be carried out by a team of observers who “walk the shoreline” and document oiling conditions by following the essential steps outlined in this section and listed in Table 2.

Table 2 Essential Steps in Performing a Ground Survey

1. Divide the survey area into shoreline segments.
2. Describe the physical characteristics of each shoreline segment.
3. Describe surface oiling characteristics of each across-shore zone within a segment.
4. Describe subsurface oiling characteristics within each segment.

Divide the survey area into shoreline segments
Dividing the coastline into working units called “Shoreline Segments” constitutes the essential first step of a SCAT survey. Shoreline segments are defined as longitudinal sections of the coastline within which the shoreline character is relatively homogeneous in terms of physical features and type of sediment. Each segment is assigned a unique location identifier. Segment boundaries are established on the basis of prominent geological features (such as headland), changes in shoreline and substrate type, or establishment of the boundary of an operations area.

Describe the physical characteristics of each shoreline segment
The two key characteristics of a shoreline segment are the shoreline type and the coastal character. The shoreline type refers to the predominant nature of the zone in which the oil has been deposited, whereas the coastal character describes the backshore or inland zone from which operations would access the oiled area and/or stage personnel and equipment.

Describe surface oiling characteristics
Surface oiling is described by using a set of precisely defined standard terms and definitions. Some examples include the length and width of each of the oiled zones observed, the oil thickness category level, and the oil “distribution”, defined as the percentage coverage of the oil.

Describe subsurface oiling characteristics
Subsurface oiling is also described by using a set of precisely defined standard terms for a number of pits or trenches that are dug in various parts of the contaminated segments.

SCAT observations are recorded on forms, as sketches, or in a field notebook. SCAT data consist of the following elements:

- **spatial observations** which include the start and end of shoreline segments and surface oil zones, as well as the location of pits or trenches;
- **standardized data elements or “attributes”** associated with each of the spatial elements, e.g., the dominant nature of the shoreline material in the shoreline segment; the length, width, thickness and distribution of each of the observed surface oil zones; and the thickness of the oil band for each of the pits or trenches; and
- **“free-form” observations** in the form of text descriptions, such as safety issues, or specific access difficulties.

1.3 Use of SCAT during the Decision-making Process

Documentation of oiling conditions using SCAT surveys is now a generally accepted concept that is part of most spill response operations in North America. SCAT data is used directly or indirectly by almost all personnel involved in the response.

Responders in Canada and the United States have adopted an organizational structure called the “Incident Command System” or “Response Management System”. This structure and how the SCAT data management program fits into it is shown in Figure 3. Boxes represent sections and lines show hierarchical relationships. The SCAT program is typically part of the Environmental Unit in the Planning Section. The processing of data gathered during SCAT surveys and how it is used during the response decision cycle are shown in Figure 4.

SCAT surveys generate data in the form of paper or electronic forms and sketches. These are compiled, analyzed, and evaluated to produce treatment recommendations and a number of summary tables and maps. Personnel involved in planning use this processed information, along with additional data about environmental sensitivity or other constraints, to produce a regional segment-specific action plan.

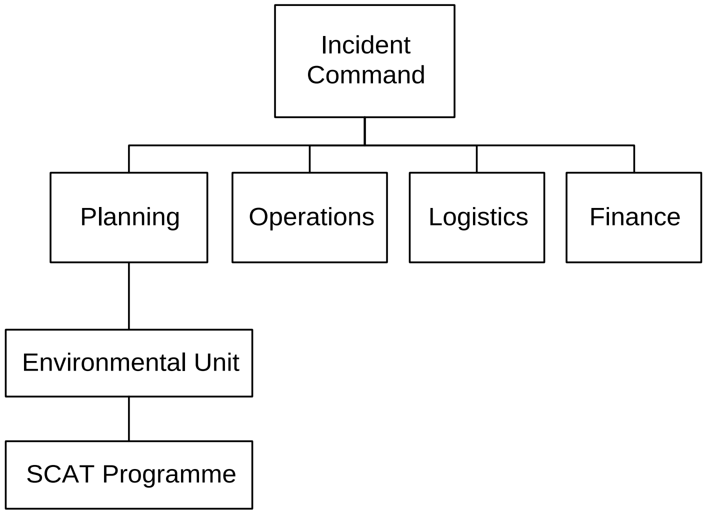


Figure 3 Location of SCAT Program within an Incident Command or Response Management System

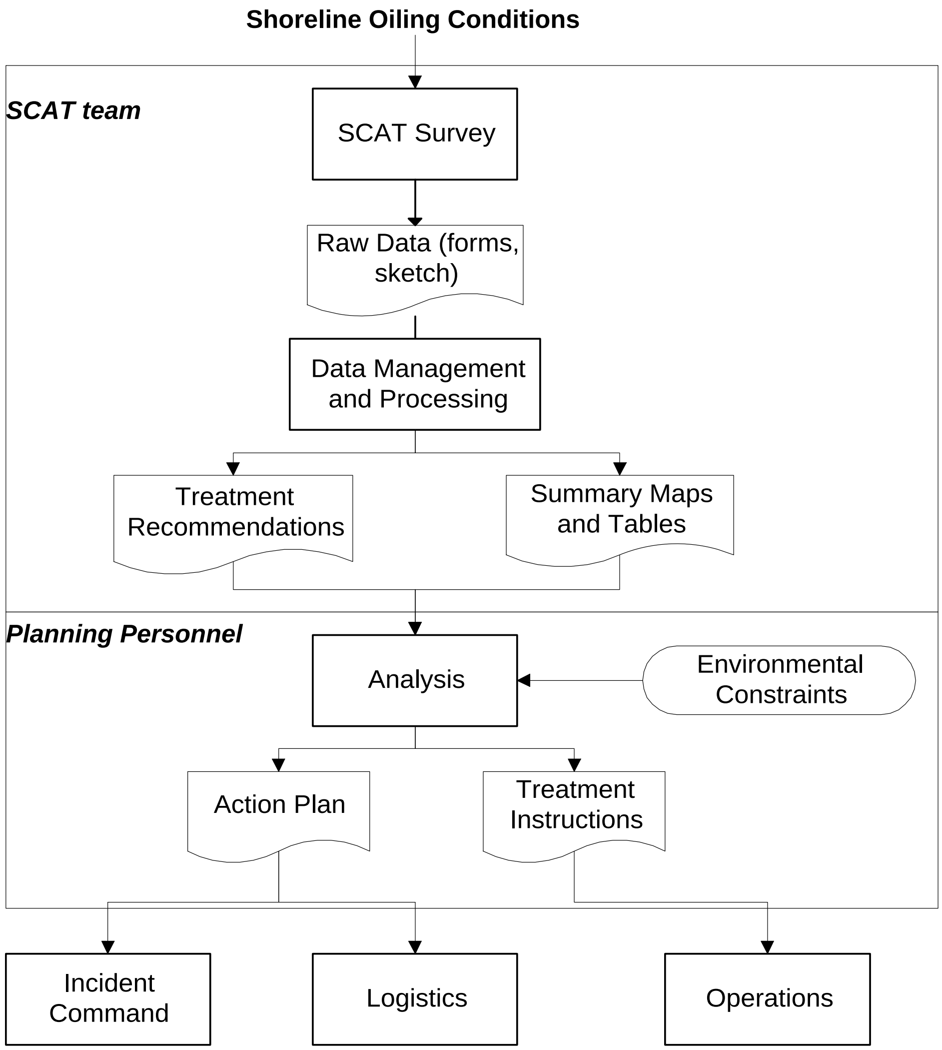


Figure 4 Processing and Use of SCAT Data during an Oil Spill Response

The segment-specific plan includes detailed treatment instructions provided on a segment-by-segment basis. Treatment instructions are used directly by operations personnel. The regional action plan is used by Incident Command to obtain an overall picture of the situation.

Data generated by SCAT surveys are used in the following ways.

- Planners analyze the data and use it to select the appropriate treatment methods, evaluate the treatment effort and necessary resources, and develop treatment and cleanup priorities.
- The Unified Command uses summaries of oiling information in the form of overview maps and tables to obtain a general picture of the situation, i.e., the scale of the problem and the scope of the response.
- Operations personnel use detailed information about each shoreline segment to evaluate access to the site, locate the oil, and apply the selected and approved treatment method.
- Logistics use the resources and treatment methods identified by planners to provide the appropriate personnel and equipment to support the treatment effort.
- Finance personnel use information included in the plan to estimate costs.

The principal uses of SCAT data in the context of the management sections of an incident response organization are listed in Table 3.

Table 3 Uses of SCAT Data within Each Section of Incident Command or Response Management System

Planning
Define response priorities.
Select cleanup or treatment method.
Identify the required level of effort for shoreline operations.
Define and apply cleanup or treatment end-point criteria.
Update the situation status boards.
Identify the amounts and types of waste that could be generated at each site.
Monitor the progress of the response.
Operations
Locate the sites to be treated.
Use the most appropriate access method.
Apply the selected treatment method(s) for each oiled area.
Apply the selected waste transfer and disposal method(s).
Logistics
Estimate the required equipment and personnel and their support requirements.
Finance
Estimate the cost of the response.
Unified or Incident Command
Evaluate the scale of the problem and the scope of the response.

The following other groups and organizations also use SCAT-derived information.

- **Agencies and trustees** use both summary and detailed information to evaluate the proposed activities and monitor the progress of the response.
- **Public information** teams use summary information to inform senior off-site managers and the public about the scale of oiling and progress of the operations.
- **Environmental teams and Natural Resources Damage Assessment (NRDA)** teams use detailed oiling information to assess effect and recovery and identify potential liabilities.

1.4 SCAT Data Management

Field activities are of little value to decision-makers or planners if the information obtained is not available when it is needed. Documentation of shoreline oiling conditions using the SCAT method typically produces a large amount of data. Data management activities can be carried out by SCAT field teams for small-scale or single-team surveys or at incidents where there is time to organize and present a summary of the observations. If the field activities involve several SCAT teams, however, a bottleneck of data will most likely be created. In these cases, a SCAT data management team ensures that SCAT data and the derived information are made available to the many levels of decision-makers in a timely manner. The field survey teams rarely have the time or opportunity to perform data management activities.

More precisely, SCAT data needs to be processed in order to obtain the following information:

- evaluation of oiling characteristics;
- production of treatment recommendations for each segment surveyed;
- update and production of oiling summaries, including length of oiled segments and nature of the oiled shorelines; and
- update of the work status.

Treatment recommendations usually need to be discussed further with Operations personnel before they are finalized and included in an action plan, which is generally produced daily. Studies have shown that as little as one to two hours may be available to process the SCAT data once it is collected (Lamarche and Tarpley, 1997). During larger incidents, SCAT activities can easily cover more than 20 segments daily. In these cases, a SCAT data management team is essential to ensure that SCAT data is effectively used in the decision-making process.

To summarize, the main role of SCAT data management personnel is to analyze the SCAT data in a timely fashion and generate the various types of outputs to be used for decision-making. SCAT data management thus includes all tasks that are required to handle and process SCAT data. Routine data management activities include:

- quality control of all documents and raw data as they are received from the SCAT survey teams, including examining all documents to verify that no data are missing and to ensure that all the information and sketches can be clearly understood;
- data entry to a computerized system as analyzing SCAT information normally involves electronic processing;
- analysis of the SCAT information to produce and print specific data or information, summary tables and summary maps, and to validate the results;
- communication of results and summary documents to the SCAT manager and/or leader of the Environmental Unit for distribution; and
- general maintenance of the SCAT data, including producing hard copies of both the original documents and the information stored in computerized systems, creating backup copies of all the material, and maintaining the computerized files.

The exact nature of the tasks performed by SCAT data management personnel varies according to the phase of the spill. For example, early management work includes setting up computerized systems and tools, finding proper base maps of the affected area, capturing the locations of shoreline segments within a Geographic Information System (GIS), and entering segment characteristics in the corresponding attributes table. This information might need to be updated as more precise data on shoreline segment characteristics and location are provided by ground SCAT surveys. Later work includes capturing and analyzing detailed shoreline oiling data and regularly updating shoreline oiling summary tables and maps that are used by the Environmental, Planning, and other teams.

When the response operation is complete and demobilized, SCAT data management personnel may perform an overall review and audit of all the data entered. They may also be involved in keeping track of long-term monitoring of survey information.

1.5 Pre-spill SCAT Databases

Many organizations have developed pre-spill SCAT data-collection programs. These programs collect as much information as possible before a spill to support response activities if an incident occurs.

The nature of the information gathered during pre-spill surveys includes, at a minimum:

- definition of shoreline segments;
- description of the shoreline type and coastal character;
- operational data related to access areas and potential staging areas; and
- the potential presence of debris that could be oiled.

Pre-spill surveys generally include low-altitude aerial video surveys to identify shoreline segment locations and characteristics. Data gathered during these surveys is typically analyzed and stored within a Geographic Information System (GIS) (Percy et al., 1997; Laflamme and Percy, 2003; Hillman and O'Brien, 1996; Owens et al., 2003).

Pre-spill databases can significantly reduce the level of effort for aerial mapping and ground SCAT surveys during the first phase of a spill response (Lamarche et al., 2003).

Chapter 2 Collecting SCAT Data

This chapter provides information about the data-collection process. It discusses the following topics, which are listed in Figure 5.

Overview of SCAT surveys summarizes the nature and purpose of the types of surveys used to collect SCAT data. The five SCAT survey methods are described under the following headings:

- aerial reconnaissance;
- aerial video/mapping surveys;
- first responder ground surveys;
- full-scale SCAT ground surveys; and
- post-treatment ground surveys.

Pre-spill SCAT surveys and mapping describes the purpose and nature of the activities leading to the data acquisition for pre-spill segmentation databases.

Data capture tools describes the data-capture equipment that can be used to support field surveys, including GPS receivers, digital cameras, and field computers.

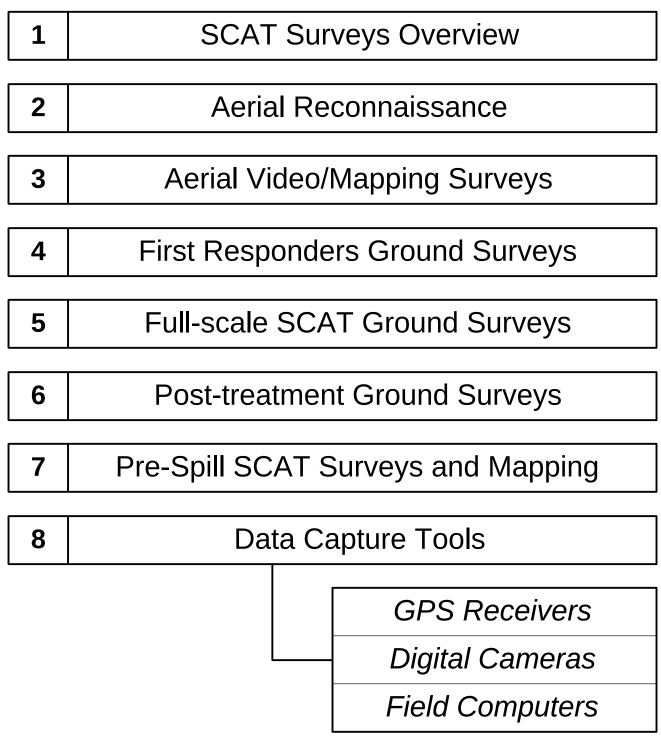


Figure 5 Topics in Chapter 2

2.1 Overview of SCAT Surveys

Field survey personnel collect data in a number of different types of surveys. The nature of the survey varies with the needs of the response. The following is a brief description and objective statement for each type of SCAT survey.

First Phase – Initial Response

(1) **Aerial reconnaissance** provides a quick overview of the extent of shoreline oiling.
(2) **Aerial video/mapping surveys** provide systematic data on the physical characteristics of the shoreline and the amount of oiling.
(3) **First responder (ground) surveys** provide an initial assessment of oiling characteristics shortly after a spill and before a formal SCAT survey is carried out.

Second Phase - Treatment

(4**) Full-scale SCAT team ground surveys** provide detailed, systematic information on segment characteristics and oiling conditions.

Third Phase - Inspection

(5) **Post-treatment ground surveys** support the inspection and "sign-off" process.
In addition, **aerial video/mapping surveys** can be used as the basis for developing pre-spill SCAT databases.

The following section provides detailed information about each survey method, including the method by which data is collected, the format in which the data is recorded, the exact nature or character of the data that is collected, and the frequency of data collection.

2.2 Aerial Reconnaissance

2.2.1 Objectives

Aerial reconnaissance surveys provide a quick overview of the extent of oil distribution. These surveys typically cover long sections of coastline and provide general information on the extent of oiling.

In most cases, aerial reconnaissance observations, which are visual only, simply indicate where oil has reached the shoreline. In some cases, the observer might be able to provide some information on the amount of oil observed, but in a very qualitative way, such as "heavy", "moderate", or "light" oiling distribution.

Aerial reconnaissance surveys are usually performed in the very first stage of a spill response. Information collected by these surveys is essential for determining the location and extent of the areas impacted by the oil and to plan subsequent aerial videotape/mapping or ground SCAT surveys.

2.2.2 Data Collection Method

Aerial reconnaissance observations are reported from a low-flying helicopter or fixed-wing aircraft by a trained observer scanning the shoreline at low tide. The observations are generally recorded as annotations on a paper map or chart, but may be reported verbally, particularly in the early phases of a spill response, and may include photographs. An aerial reconnaissance survey is usually conducted daily until there is no longer any free oil on the water that could become stranded.
Recently, pen-based field computerized systems have become available to support this type of data collection effort (Blouin and Boulé, 2005).

2.2.3 Type of Data Collected

The primary data reported is the location of observed oil. The format of the data reported varies and can take the following forms:

- a verbal report explaining where oil was observed;
- the presence or absence of oil drawn on a paper map;
- the GPS position of the start and end of an oiled shoreline;
- possibly a general evaluation of the amount of oil; and
- photographs (usually digital).

As this is a rapid survey intended to gain an overall picture of the scale of the oiling, the data recorded by this method are not intended to be used for site-specific planning. If the aircraft is flying at speeds greater than 100 knots or at altitudes higher than 100 m, it is sometimes difficult to distinguish between oil and “false positives”, where natural features, such as lichens, mussel beds, stranded seaweed or heavy mineral deposits, are mistaken for oil. The accuracy of the observations depends on the experience of the observer.

2.3 Aerial Video/Mapping Surveys

2.3.1 Objectives

Aerial video surveys are used primarily to describe the physical characteristics of the shoreline and provide an initial systematic assessment of oiling conditions. An important function of aerial video surveys is to divide the impacted shoreline into shoreline segments, if these do not already exist, and to present the physical and oiling characteristics of each segment.

2.3.2 Data Collection Method

Video survey mapping has been used for more than 25 years to develop a pre-spill segmentation database (Owens, 1983). Mapping efforts to date have covered most of the coastlines of Canada and parts of the United States.

While mapping techniques have not changed much, data collection methodology has been modified over time to take advantage of improved video-recording equipment, such as digital video cameras and new technologies, such as the Geographic Positioning System (GPS) and portable laptop computers.

Aerial video surveys may be conducted several times during the course of a response. An initial survey may be conducted within the first few days to support the segmentation process. Additional video surveys may be conducted to record oiling conditions at various time intervals in the course of a response.

The video survey method includes three distinct steps (Owens and Reimer, 1991):

1. field acquisition of the video image and an audio commentary;
2. analysis of the recorded information to extract data on the shoreline and oiling characteristics; and
3. processing of the data to transfer the information into a computerized database, generally a Geographic Information System (GIS).

The entire process is summarized in Figure 6.

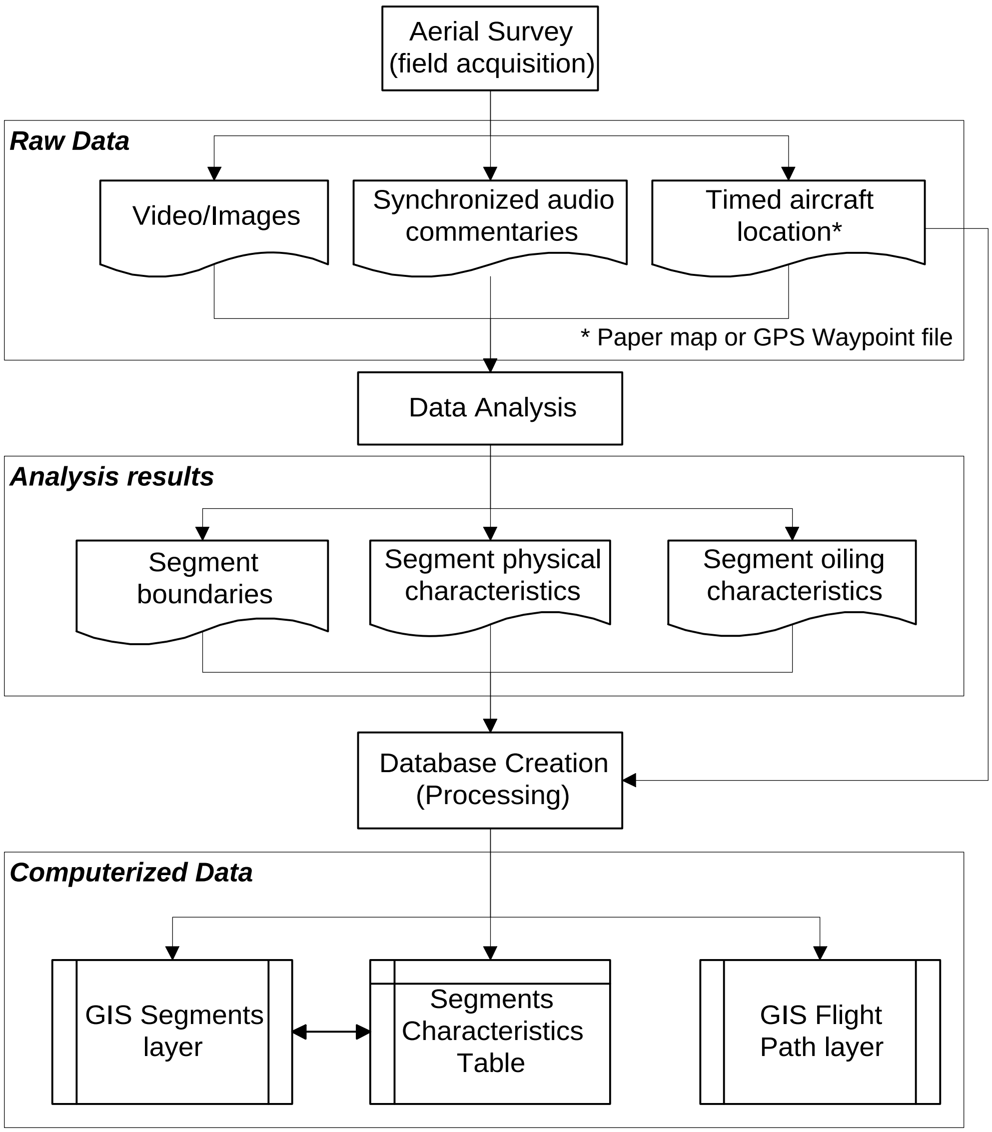


Figure 6 Data Acquisition Process for Aerial Video Surveys

Field Data Acquisition

The survey is conducted from a helicopter or small fixed-wing aircraft with a door removed to allow an unobstructed view for both camera and observer. The area to be surveyed is normally determined from previous aerial reconnaissance observations.

The flight plan is fine-tuned using the expertise of the observers since it has to take into account sun angles to minimize glare, water levels as the survey should be conducted at low tide, and flying altitude to ensure that the entire intertidal zone can be observed.

The precision of the observations increases with decreasing speed and altitude. The selected survey speed and altitude is a compromise between the desired precision and the amount of shoreline that needs to be covered in a given time. Surveys are generally performed at an altitude of 50 to 100 m and a speed of 60 to 80 knots (110 to 150 km/hour).

The pilot should understand the purpose of the survey. Good communication with the pilot improves data quality by minimizing camera work. Providing the pilot with a monitor that shows the video image as it is recorded significantly improves the efficiency and effectiveness of the survey.

An experienced observer verbally describes the characteristics of the shoreline and oiling while flying at low altitude along selected portions of the coastline. At the same time, the camera records an image of the coastline.

The technique relies heavily on the ability of the observer to identify shoreline material and oil characteristics continuously and to verbally record this information on the audio channel of the camera. In fact, the quality of the acquired data depends very much on the level of knowledge and experience of the observer. The technique is similar in concept to that of a radio commentator who is providing a verbal description of the observed scene, in this case the characteristics of the physical shore-zone and the oil distribution and character. The video image provides a visual frame for that description.

The video technician provides support in monitoring the flight path, logging in GPS locations, managing the automatic processing of GPS waypoints from a portable computer or GPS unit, and assists in changing and logging the tapes or DVDs.

Data Generation

The data acquired in the field, which includes the video image, a continuous commentary, and flight position data, is later analyzed to define the shoreline segments and to extract shoreline and oiling characteristics.

The first step in mapping is to define the shoreline segments. Segmentation is based on the geographic information provided by the video image and the GPS position data. Segments are identified by viewing the video image while listening to the verbal description of the physical shoreline character. The commentary typically identifies when there is a change in material or character in the shore zone and this location is fixed from the video image.

Specifically, the analyst or mapper notes the time and location of the beginning of each shoreline segment as indicated by both the image and the video commentary. If GPS waypoints were logged during data capture, the “video time” automatically provides the location of the start of the segment. Otherwise, the start of the segment is deduced from a paper map on which the position of the aircraft was recorded at various flight times.

The segment characteristics are extracted from the audio commentary and verified by the video image. At a minimum, segment characteristics include the nature of the shoreline material and the coastal form. Additional information of operational value is also noted, such as staging potential, backshore access, and visible presence of debris. The analyst extracts the overall oiling characteristics of the segment as described by the commentary. This typically includes the width of the oiled band and an estimate of the surface oil distribution.

Creation of Database

The results of the data analysis may simply be noted on paper maps and standard forms or entered into a computer-based data form. The start and end of each shoreline segment are used to delineate the location of each segment unit within a specific data layer of a Geographic Information System (GIS). The characteristics of the segment are entered either in the data table of a database or within the attributes portion of the GIS layer.

The technology of aerial video data acquisition continues to evolve with the availability of more precise digital video equipment and better automation and coordination with GPS signals. Video cameras are now available that can record the GPS position along with the recording time and audio commentary. Computerized automation now enables the almost real-time creation of GIS layers linking image with position. This information can be made available to the response teams shortly after raw data is captured. It will always take some time, however, to complete the data analysis process, including mapping and data storage.

2.3.3 Type of Data Collected

Video surveys provide an array of data and any of the acquired information can be used at some point in the response. The raw video coverage and the computerized information, however, are usually the only information used to support the planning and response effort.
The following data is generated by an aerial video mapping survey:

- raw video, i.e., the unaltered images and commentary, stored on tape or DVD;
- shoreline segment boundaries that are defined by the analysis or mapping process; (This information is in the form of points or polylines within the GIS layer if the data is computerized.)
- characteristics of each shoreline segment in the form of the data elements that may be recorded in data tables; and
- overall oiling characteristics of each segment.

Data obtained from aerial videotapes are listed in Table 4 and an example of a GIS layer is shown in Figure 7.

Table 4 Shoreline Characteristics Obtained by Analysis of Aerial Videotapes

Data Element	Example of a Data Value
Shoreline segment identification	AGN-02
Dominant shoreline type	Bedrock
Dominant coastal character	Cliff
Total segment length	120 m
Wave exposure	Exposed
Oiling characteristics	1-m wide band of 100% surface oil cover

2.4 First Responder Ground Surveys

2.4.1 Objective

First responder surveys provide an initial assessment of oiling characteristics shortly after a spill and before full-scale SCAT surveys are implemented.

2.4.2 Data Collection Method

The first responder ground survey is similar in format to a standard SCAT survey with the following important differences.

- The observer uses a simplified SCAT form, as shown in Figure 8.
- Surveyors are not necessarily trained in the SCAT method or have not received a basic level of training.

Data generated by first responder ground surveys provide information on oiling characteristics that follow the SCAT standard but in a simplified format. See Part 4 of “The Arctic SCAT Manual” (Owens and Sergy, 2004).

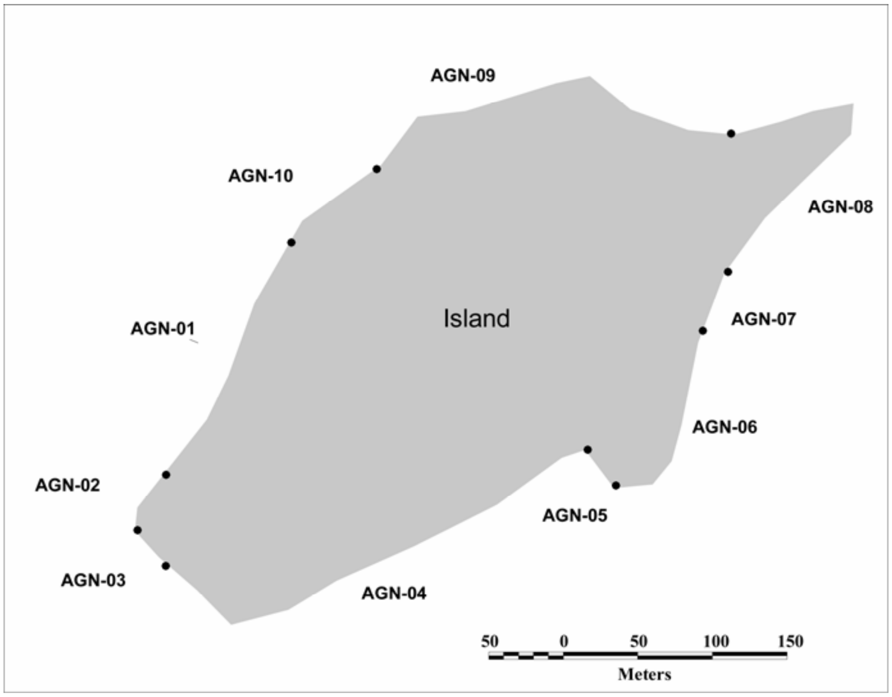


Figure 7 Example of a GIS Layer Showing Coordinates of Shoreline Segments Defined from Aerial Video Survey Mapping

2.4.3 Type of Data Collected

The data generated are essentially the same as in a full-scale SCAT survey and consist of Shoreline Oiling Summary forms (generally the simplified “short” form), sketch maps, and photos and videos.

2.5 Full-scale SCAT Ground Surveys

2.5.1 Objectives

Full-scale SCAT ground surveys provide detailed information on (1) shoreline segment characteristics, (2) surface and subsurface oiling conditions, and (3) operational considerations. The information collected is used to develop response strategies for each oiled shoreline segment.

Full-scale SCAT ground surveys form the backbone of the SCAT method. Since SCAT data is used as soon as it is collected and analyzed to support the development of response strategies, the data is generally made readily available in the most appropriate form to any group involved in the decision-making process.

2.5.2 Data Collection Method

Ground SCAT surveys are conducted by teams of two or more trained surveyors under the direction of a SCAT coordinator. A ground survey includes three steps:

1. pre-survey planning;
2. on-site observations and measurements; and
3. post-survey data reduction and storage.

"SHORT" SHORELINE OILING SUMMARY (SOS) FORM - for ________________ Spill Page _____ of _____

1 GENERAL INFORMATION	Date (dd/mm/yy)	Time (24h): standard/daylight	Tide Height
Segment ID:			
Operations Division:		hrs to hrs	rising / falling

Survey by: Foot / ATV / Boat / Helicopter / Overlook / ________ | Sun / Clouds / Fog / Rain / Snow / Windy / Calm | Air Temp + / - ____ deg C

2 SURVEY TEAM # _______ name	organization	contact phone number

3 SEGMENT Total Segment Length ______ m Segment Length Surveyed _______ m Maximum Intertidal Width_______m

Start GPS: LATITUDE ____________deg. ____________min. LONGITUDE ____________deg. ____________min. Datum:__________

End GPS: LATITUDE ____________deg. ____________min. LONGITUDE ____________deg. ____________min.

4A SHORELINE TYPE (UITZ) select only one primary (P) shoreline type and any number of secondary (S) types - circle those oiled

BEDROCK: Cliff____ Ramp____ Platform____	Sediment BEACH: Sand____ Mixed____ Pebble/Cobble____ Boulder____
MAN-MADE: Solid____Permeable____ (Type)__________	Sediment FLAT : Mud____ Sand ____ Mixed____ Pebble/Cobble/Boulder____
MARSH:_____	OTHER: *If snow and ice use Winter SOS*

4B COASTAL/BACKSHORE CHARACTER - select only one primary(P) and any number of secondary(S) — complete for (P) primary only

Cliff/Hill:____est height ____m	Flat / Lowland: ___ Beach ____ Dune ____ River Inlet/Channel ___	Substrate Type: ___________
Sloped:___ (>5°)(15°)(30° Man-Made ____ (type) ________	Delta ____ Lagoon ___ Marsh/Wetland_____	Forested / Vegetated / Bare

5 OPERATIONAL FEATURES Suitable backshore staging Y/N Access : Direct from backshore Y / N Alongshore from next segment Y / N

Debris : Y / N oiled Y / N amount _____bags or _____trucks access restrictions ______________________________

Current dominated channel _____ Other Features:

6A ZONE ID ________ Description of Oil Conditions in Supra / Upper / Mid / Lower Intertidal Zone (circle one)

Oil Band	Surface Oil Distribution	Surface Oil Thickness	Surface Oil Type	Subsurface Oil Penetration	Subsurface Oil Burial	
Width Length	< 1%	Film	Fresh Liquid	< 1 cm	Clean Layer :	
	1 - 10%	Stain	Mousse	1 - 5 cm		
m x m	11 - 50%	Coat	Tarballs	5 - 10 cm	________ cm	
SEDIMENT TYPE(S) :	51 - 90%	Cover	Tar Patties	> 10 cm	Oiled Layer :	
	91 - 100%	Thick Oil	Asphalt Pavement			
	________ %	______ cm	____________ other	__________ cm	________ cm	

6 B ZONE ID ________ Description of Oil Conditions in Supra / Upper / Mid / Lower Intertidal Zone (circle one)

Oil Band	Surface Oil Distribution	Surface Oil Thickness	Surface Oil Type	Subsurface Oil Penetration	Subsurface Oil Burial	
Width Length	< 1%	Film	Fresh Liquid	< 1 cm	Clean Layer :	
	1 - 10%	Stain	Mousse	1 - 5 cm		
m x m	11 - 50%	Coat	Tarballs	5 - 10 cm	________ cm	
SEDIMENT TYPE(S) :	51 - 90%	Cover	Tar Patties	> 10 cm	Oiled Layer :	
	91 - 100%	Thick Oil	Asphalt Pavement			
	________ %	______ cm	____________ other	__________ cm	________ cm	

8 COMMENTS cleanup recommendations — ecological/recreational/cultural/economic issues & constraints — wildlife obs.

(for ALL sub-segments record: sub-segment ID, length, length surveyed,and GPS start/end fixes)

Sketch Yes/No Photos Yes/No (Roll # _____ Frames______) Video Tape Yes/No (tape #______) Version : Sergy Dec 30, 2006

Figure 8 Example of a Short Shoreline Oiling Summary (SOS) Form (often used in first responder ground surveys)

1. Pre-survey Planning

Pre-survey planning activities are typically the responsibility of a SCAT coordinator in collaboration with support personnel. Pre-survey planning includes the following tasks.

- The affected coastline is divided into shoreline segments. This can be part of an aerial video-survey/mapping effort. The segmentation can be part of the activities of the field survey team if there is no segmentation and video surveys are not part of the SCAT program.
- A segment-numbering scheme is created that takes into account the work areas or divisions created by Planning or Operations personnel.
- The shoreline segments to be surveyed are selected. This is done in collaboration with Planning and Operations personnel to ensure that the areas covered represent regional priorities and to provide information for planned upcoming activities.
- Alternate survey areas are selected in case weather conditions prevent access to the primary choice(s).
- Field equipment and supplied are assembled.
- Appropriate access methods are selected to each of the survey areas.
- The field survey crews are organized. These crews are typically an interagency team representing organizations or groups that have a responsibility and interest in shoreline treatment actions. Ideally, the skills of the crew should combine a good knowledge of the SCAT method, coastal geology, coastal ecology, and operations in order to identify feasibility issues, logistical constraints and solutions, and archaeology in areas where there are archaeological or cultural resources. Survey crews are made up of at least two members and are led by an experienced SCAT surveyor who may be accompanied by a representative of a local government agency or someone with a good knowledge of the area, and a representative of the Responsible Party.
- Available information and data are collected. This includes detailed topographical or ecological maps of the area(s) to be surveyed and the necessary data acquisition forms.
- All team members are briefed on the survey objectives, methods, forms, and safety concerns.

2. On-site Observations and Measurements

On-site field activities include:

- a segment overview to verify that the pre-determined segment boundaries are correct, to gain a perspective of the extent of stranded oil, and to estimate the level of effort necessary to complete the assessment;
- definition or confirmation of the segment boundaries and sub-segment boundaries, if necessary;
- description of the character of the shoreline materials and form within the segment or sub-segments;
- description of the surface oiling conditions for each of the oiled zones observed, using standard terms and definitions;
- description of the subsurface oiling conditions; (If the shoreline material is permeable, pits and/or trenches are dug at one or more locations and observations recorded.)
- a sketched drawing of the entire segment, an example of which is shown in Figure 9, indicating the location of oiled zones, pits, and other features, as well as the oiling characteristics of each oiled zone; and

photographs or a short video of specific features of interest, with the location of each feature noted on the sketch or in a notebook.

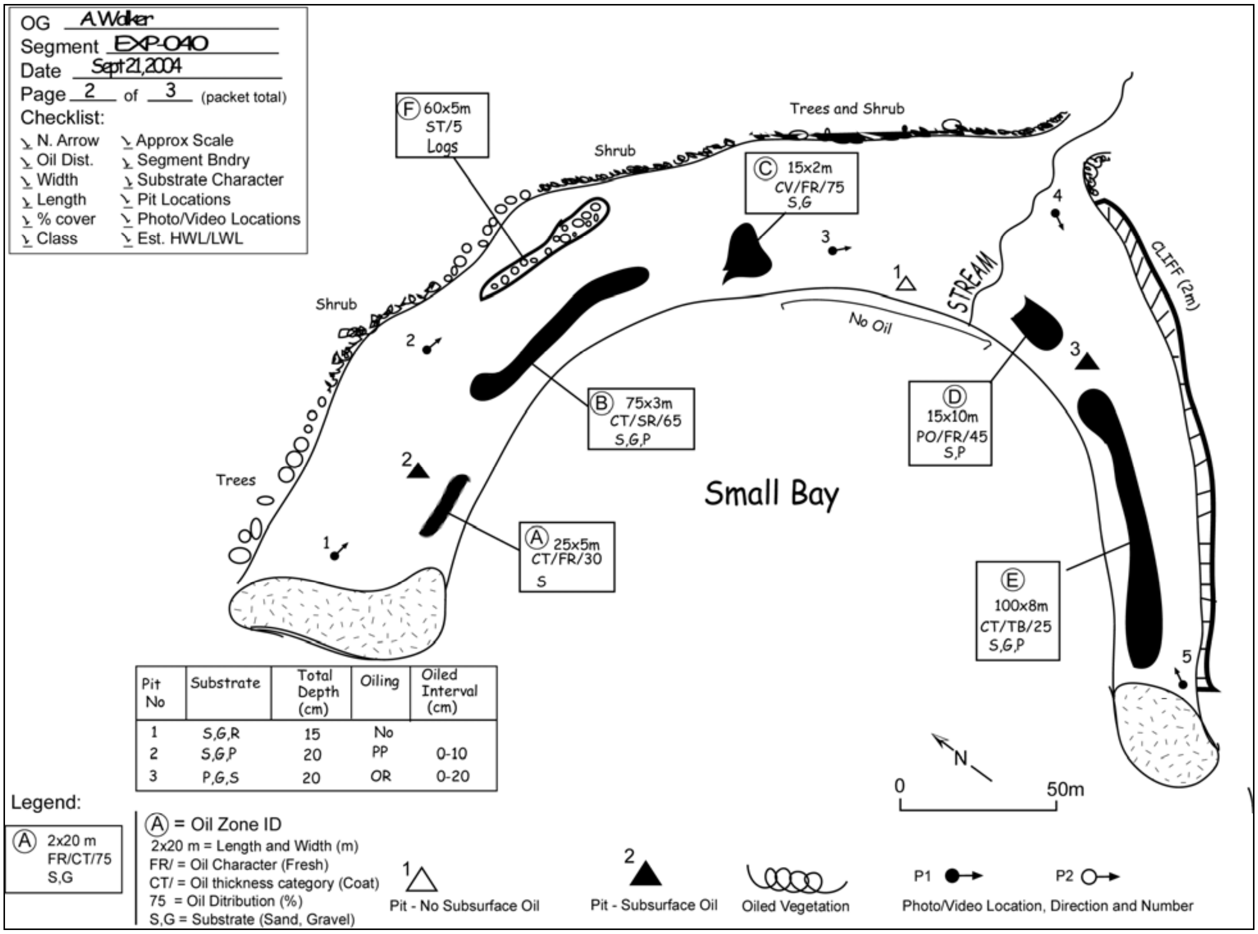


Figure 9 **Example of a Sketch** - The information noted on the sketch corresponds to that on the SOS form shown in Figure 8.

Documentation of the shoreline characteristics and oiling conditions normally involves walking along the segment and recording observations, i.e., surface oiled zone characteristics, presence of debris, etc., in a field notebook. Measurements include the latitude and longitude of the start and end of the shoreline segment and the alongshore boundaries of any observed oil zones.

Data forms are usually completed after the entire segment has been surveyed. The information written on the form is reviewed, discussed, and agreed upon by the team members.

The exact nature of the form may vary with the nature of the shoreline. The Shoreline Oiling Summary (SOS) form shown in Figure 10 is the generic benchmark or template from which modifications are made to suit the spill, shoreline, or condition. Generally, only a small portion of the original SOS form is modified to allow capture of additional information specific to the unique nature of the shoreline. SCAT forms most frequently used in Canada are listed in Table 5.

3. Post-Survey Data Reduction and Storage

After the field survey, the team:

- o finalizes and copies all forms, sketches, field notes, and photograph/video logs;
- o submits copies of all the material (forms and sketches) to the SCAT coordinator and data manager;
- o files a daily report to the SCAT coordinator; and
- o reviews the day’s activities, discusses modifications or improvements to the field methods, and prepares for the next day.

Table 5 SCAT Oiling Summary Forms Most Often Used in Canada

Name of Form	Criteria for Use
Shoreline Oiling Summary (SOS)	When surface and subsurface oiling characteristics vary within a segment. This is generally considered to be the "standard" form.
"Short" Shoreline Oiling Summary	When surface oiling is uniform within a segment.
Tar Ball Oiling Summary	When only tar balls or tar patties have washed up on the shore.
Lake Shoreline Oiling Summary	When oil affects the shoreline of a freshwater lake.
River Bank Oiling Summary	When oil affects the banks of a large river.
Stream Bank Oiling Summary	When oil affects the banks of a small stream.
Winter and Arctic Oiling Summary	When a spill occurs along shorelines covered by snow and ice, in winter or in the Arctic.
Winter and Arctic Short Oiling Summary	When surface oiling is uniform within a segment covered with snow or ice.
Winter Lake Oiling Summary	When oil affects the shoreline of freshwater lakes covered with snow or ice.
Winter River Bank Oiling Summary	When oil affects the banks of a large river covered with snow or ice.
Winter Stream Bank Oiling Summary	When oil affects the banks of a small stream covered with snow or ice.
Winter Tar Ball Oiling Summary	When only tar balls have washed up on shorelines covered with snow or ice.

2.5.3 Type of Data Collected

Full-scale SCAT surveys produce the largest and most detailed data set of the five survey methods. The following information is collected for each shoreline segment surveyed:

- a Shoreline Oiling Summary Form that is handwritten and may have been copied onto weather-resistant paper;
- a hand-drawn sketch map;
- still photographs or videos; and
- free-form notes (in a notebook).

The data recorded on these media include the following categories.

1. Position data that represent the location of items on a computerized map, including the following:

- latitude and longitude of the start and end of shoreline segments;
- location of surface oiled zones and pits and trenches, usually indicated on a sketch map;
- location of photographs or video also indicated on a sketch map.

GPS receivers often provide the exact start and end coordinates of surface oiled zones, the location of pits and trenches, and the position of photographs and videos.

2. Segment and oiling data observations that are used to define the amount of oil, evaluate treatment methods, and plan the response.

SOS forms and sketch maps include many elements that describe the characteristics of the shoreline segment, conditions during the survey, oiling, and complementary information. Each of the data elements that can be recorded during a ground survey is listed and described in Chapter 6 of this manual. The elements that are considered essential and are thus always recorded are listed in Table 6.

SHORELINE OILING SUMMARY (SOS) FORM - for ______________________ Spill Page _____ of _____

1 GENERAL INFORMATION

Segment ID: EXP-040	Date (dd/mm/yy) Sept 21, 2004	Time (24h): standard/daylight 09:00 hrs to 10:30 hrs	Tide Height 1m rising / falling
Operations Division: B			

Survey by: Foot / ATV / Boat / Helicopter / Overlook / ________ Sun / Clouds / Fog / Rain / Snow / Windy / Calm Air Temp + / - 15 deg C

2 SURVEY TEAM # ________

name	organization	contact phone number
A. Walker	International Field Surveyors Inc.	(000) 111-2222
B. Hiker	EC	(333) 444-5555
C. Climber	Coast Guard	(333) 666-7777

3 SEGMENT Total Segment Length 250 m Segment Length Surveyed 250 m Maximum Intertidal Width 50 m

Start GPS: LATITUDE -45 deg. 1.7064 min. LONGITUDE -74 deg. 51.4710 min. Datum: WGS84

End GPS: LATITUDE -45 deg. 1.7946 min. LONGITUDE -74 deg. 51.6666 min.

4A SHORELINE TYPE (UITZ) select only one primary (P) shoreline type and any number of secondary (S) types - circle those oiled

BEDROCK: Cliff S Ramp____ Platform____ Sediment BEACH: Sand____ Mixed P Pebble/Cobble____ Boulder____

MAN-MADE: Solid____ Permeable____ (Type)________ Sediment FLAT : Mud____ Sand____ Mixed____ Pebble/Cobble/Boulder S

MARSH:____ OTHER: *If snow and ice use Winter SOS*

4B COASTAL/BACKSHORE CHARACTER - select only one primary(P) and any number of secondary(S) complete for (P) primary only

Cliff/Hill: ✓ est height 2 m Flat / Lowland: ___ Beach P Dune ___ River Inlet/Channel ___ Substrate Type: S,G,P

Sloped: ___ (>5º)(15º)(30º) Man-Made ___ (type) ______ Delta ___ Lagoon ___ Marsh/Wetland ___ Forested / Vegetated / Bare

5 OPERATIONAL FEATURES Suitable backshore staging Y/N Access : Direct from backshore Y N Alongshore from next segment Y N

Debris Y N oiled Y N amount 3 bags or ____ trucks access restrictions ____________

Current dominated channel ____ Other Features:

6 SURFACE OILING CONDITIONS begin with "A" in the lowest tidal zone - circle the zone/s that correspond to primary shoreline type

OIL ZONE ID	OIL TIDAL ZONE LI	MI	UI	SU	COVER Length m	Width m	Distrib. %	OIL THICKNESS TO	CV	CT	ST	FL	OIL CHARACTER FR	MS	TB	PT	TC	SR	AP	NO	SUBST. TYPE(S)
A		✓			25	5	30						✓						✓		S
B		✓			75	3	65			✓								✓			S,G,P
C		✓			15	20	75		✓												S,G
D		✓			15	10	45	✓					✓								S,P
E		✓			100	8	25			✓					✓						S,G,P
F			✓		60	5	5				✓										Logs

7 SUBSURFACE OILING CONDITIONS use letter for ZONE location plus Number of pit or trench — e.g., "A1"

TRENCH or PIT NO.	TIDAL ZONE LI	MI	UI	SU	MAX. PIT DEPTH cm	OILED ZONE cm-cm	SUBSURFACE OIL CHARACTER SAP	OP	PP	OR	OF	TR	NO	WATER TABLE cm	SHEEN COLOUR B, R, S, N	CLEAN BELOW Yes / No	SUBST. TYPE(S)
1			✓		24								✓				S,G,R
2			✓		24	0-10			✓						R	Yes	S,G,P
3			✓		24	0-20				✓					B	Yes	P,G,S

8 COMMENTS cleanup recommendations — ecological/recreational/cultural/economic issues & constraints — wildlife obs.

(for ALL sub-segments record: sub-segment ID, length, length surveyed, and GPS start/end fixes)

Sketch Yes/No Photos Yes/No (Roll # 3 Frames 1-5) Video Tape Yes/No (tape # ______) Version Sergy Dec 30, 2006

Figure 10 Example of a Completed Shoreline Oiling Summary (SOS) Form

Table 6 Essential Data Recorded during SCAT Full-scale Ground Surveys

Essential Data on Segment and Oiling Characteristics
General Segment and Survey Information
● Segment code or number
● Survey date and time
● List of survey team members and contact information
● Weather and tide (water level) conditions
● Access, staging, and safety or operational concerns
Surface Oiling Conditions
For each observed oiled zone:
● Tidal zones
● Length and width of each of the oiled zones
● Oil distribution (% surface cover)
● Oil thickness
● Oil character
● Nature of the oiled substrate
Subsurface Oiling Conditions
For each observed pit or trench:
● Depth
● Oil penetration (start and end depth of observed oil)
● Thickness of clean sediment on top of buried oil
● Thickness of sediment at base of penetrated or buried oil
Photographs or Videos
● List of photos and videos

2.6 Post-treatment Ground Surveys

2.6.1 Objectives

Post-treatment ground surveys are used to evaluate whether the shoreline treatment criteria have been reached or to monitor changes in the oiling conditions observed along each shoreline segment.

2.6.2 Data Collection Method

The data collection method is similar to that used when conducting full-scale SCAT ground surveys.

2.6.3 Type of Data Collected

The data collected during a post-treatment ground survey is similar to that collected during full-scale SCAT ground surveys. Post-treatment ground surveys, however, usually include sketches only if oil was observed or if the oiling characteristics were not uniform along the segment. Spill-specific Shoreline Oiling Summary forms may be developed to take into account the unique nature and goals of the monitoring program.

2.7 Pre-spill SCAT Surveys and Mapping

2.7.1 Objectives

The primary purpose of a pre-spill SCAT survey is to complete as many phases of the SCAT process as possible before a spill occurs in order to reduce the level of effort in the field and to support the response planning effort if an incident occurs.

Pre-spill SCAT activities are used to develop GIS databases that include shoreline segment characteristics and locations. These databases are often integrated with more general environmental resource databases that include information on ecological resources, land use, and infrastructure information.

2.7.2 Data Collection Method

As described in Section 2.3, aerial video surveys are generally used in developing pre-spill SCAT databases. Examples of other methods include the use of one-metre resolution georeferenced aerial photographs, also called "digital orthophotos".

The data collection method follows the three phases identified for video surveys, that is, field acquisition of video images and commentary, analysis of the recorded information, and processing and entering the data into a computerized database. Examples of computerized pre-spill data entry forms are given in Figures 11 and 12.

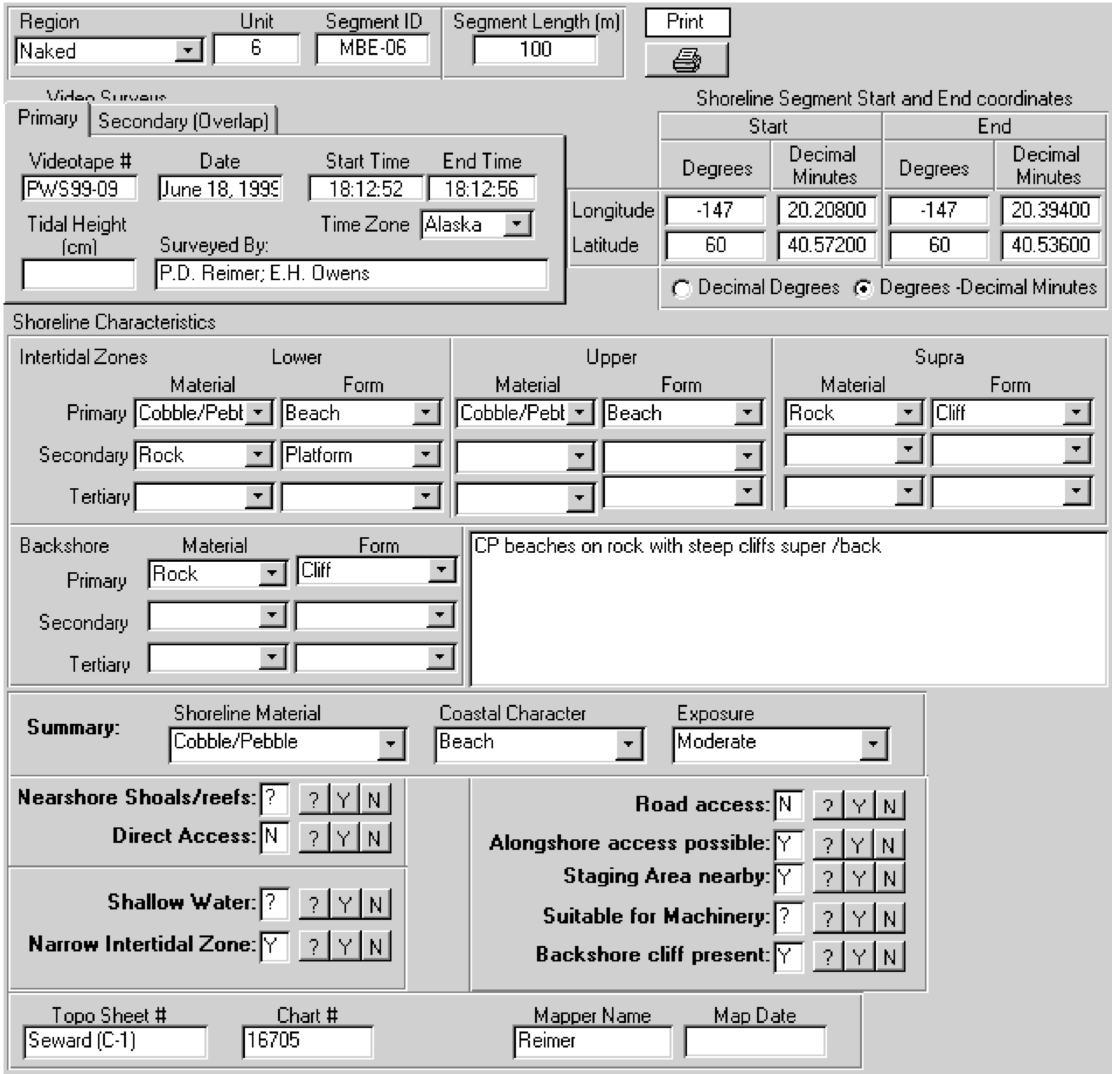
Since pre-spill databases are developed away from the demanding environment of a spill response, more time can be devoted to data analysis. As a result, likely response strategies can de developed or detailed information can be provided on secondary characteristics within each shoreline segment.

2.7.3 Type of Data Collected

Generally, special data forms are developed to record pre-spill SCAT data. The content of the form may vary according to the specific needs of the organization developing the database.

- start and end coordinates of each shoreline segment;
- the segment code and length of alongshore segment;
- the nature of the primary shoreline material in the upper intertidal zone; (Pre-spill SCAT databases generally include the nature of shoreline materials observed in other tidal zones.)
- the segment wave exposure;
- the nature of the primary coastal (backshore) character; (Pre-spill SCAT databases generally include the description of secondary coastal characteristics that might affect a response.)
- practical information about access, staging areas, and operational safety; and
- information about the video survey used to develop the segment characteristics, e.g., video tape or DVD number, name of surveyor, date of the survey, and start and end time of segment on the videotape or DVD.

Many pre-spill SCAT databases include information on land use and ecological resources within the segment. This type of information can be used to determine treatment priorities or to refine proposed treatment strategies.



Region: Naked
Unit: 6
Segment ID: MBE-06
Segment Length (m): 100
Print

Video Surveys
Primary | Secondary (Overlap)
Videotape #: PWS99-09
Date: June 18, 1999
Start Time: 18:12:52
End Time: 18:12:56
Tidal Height (cm):
Time Zone: Alaska
Surveyed By: P.D. Reimer; E.H. Owens

Shoreline Segment Start and End coordinates

	Start Degrees	Start Decimal Minutes	End Degrees	End Decimal Minutes
Longitude	-147	20.20800	-147	20.39400
Latitude	60	40.57200	60	40.53600

Decimal Degrees / Degrees -Decimal Minutes

Shoreline Characteristics

Intertidal Zones	Lower Material	Lower Form	Upper Material	Upper Form	Supra Material	Supra Form
Primary	Cobble/Pebt	Beach	Cobble/Pebt	Beach	Rock	Cliff
Secondary	Rock	Platform				
Tertiary						

Backshore	Material	Form
Primary	Rock	Cliff
Secondary		
Tertiary		

CP beaches on rock with steep cliffs super /back

Summary: Shoreline Material: Cobble/Pebble; Coastal Character: Beach; Exposure: Moderate

Nearshore Shoals/reefs: ?
Direct Access: N
Shallow Water: ?
Narrow Intertidal Zone: Y
Road access: N
Alongshore access possible: Y
Staging Area nearby: Y
Suitable for Machinery: ?
Backshore cliff present: Y

Topo Sheet #: Seward (C-1)
Chart #: 16705
Mapper Name: Reimer
Map Date:

Figure 11 Example 1 of a Computerized Pre-spill Data Entry Form - developed for aerial video surveys along shorelines of Prince William Sound, Alaska

2.8 Data Capture Tools

While paper forms and sketches are the primary method of collecting field data, recent technological developments have made a number of techniques reliable and inexpensive enough for use to support data acquisition.

Three tools that are now frequently used to support SCAT data collection are GPS receivers, digital cameras, and field computers. The function, characteristics, advantages, and limitations of each tool are presented in Table 7 and described in this section. These tools can be used in all types of SCAT surveys.

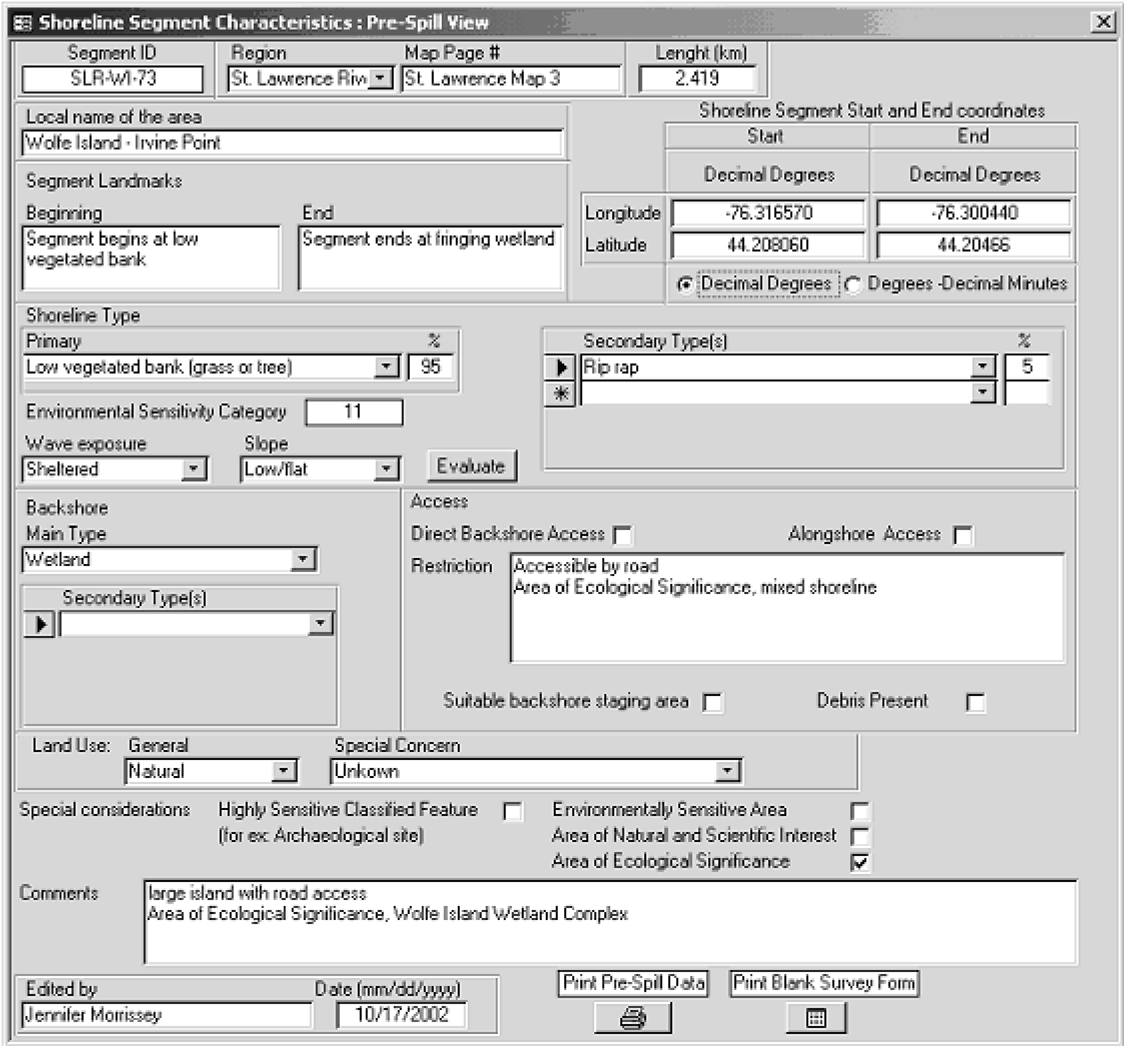


Figure 12 Example 2 of a Computerized Pre-spill Data Entry Form - developed to enter SCAT and resource data for the Great Lakes shorelines.

2.8.1 Global Positioning System (GPS) Receivers

Purpose and Characteristics

The Global Positioning System technology is an array of 24 satellites generating signals to hand-held GPS units to automatically compute geographic coordinates. Essentially, GPS provides data on the location of the GPS receiver and the time of the observation.

GPS technology[2] works in the following way.

- o Each of the 24 satellites broadcasts its exact location along with the time, which is computed by an atomic clock and is precise within a billionth of a second.

[2] A good general explanation of the workings of GPS technology is available on the internet exhibition "How GPS Works", developed by the Smithsonian National Air and Space Museum available at www.nasm.si.edu/exhibitions/gps/work.html.

Table 7 Field Data Capture Equipment

GPS Receivers
Characteristics
• Uses signals from satellites to calculate geographical coordinates • Horizontal measurement accuracy of between 1 to 20 m
Limitations
• Will not work in certain areas (clear view of the sky needed) • Accuracy of the coordinate measurement varies
Uses to support SCAT
• Navigation to the start or end of a shoreline segment • Record location of surface oil zones, pits, pictures, or other affected resources
Digital Cameras
Characteristics
• Records high-resolution still images or short video clips
Limitations
• Digital documents can be easily modified • Data is easily lost or destroyed • Data transfer and image or video format vary with different brands of camera • Ease of operation makes it possible to record too many images
Uses to support SCAT
• Valuable complement to SCAT observations • A strict data transfer procedure should be developed • Each image file should be accurately documented
Field Computers
Characteristics
• Small weatherized, hand-held or portable computers used to capture data during field surveys
Limitations
• Lack of keyboard or small size of keyboard makes it difficult to enter text during ground surveys • Small display area for PDAs • For optimal use, field computers need to be incorporated into an overall system that includes a central processing computer • Requires training
Uses to support SCAT
• Navigational support • Better quality data • Faster data availability • Eliminate data transcription error • Shorten time necessary for data processing and provision of decision support documents

- A GPS receiver unit on the ground captures the signal continuously transmitted by the satellites. The receiver uses the time stamp of the signal to compute its distance from each satellite.
- Using this information, the GPS receiver calculates the relative distance to each satellite and computes the geographic position (latitude and longitude) of the unit at the precise time when the signal was received.

GPS receivers continuously compute time and position. Most units use consecutive measurements to perform various additional calculations, such as:

- geographic coordinates of the receiver at a specific time; (This data can usually be stored by the operator as a waypoint, each of which has a unique identification.)
- velocity (speed) of the receiver and the direction of movement (by comparing two successive coordinates);
- altitude of the receiver;
- distance between the calculated position of the unit and any waypoint; and precision of the measurement.

Limitations

GPS receivers have the following limitations.

- A clear view of the sky is necessary for the receiver to detect and capture the signals from satellites. A GPS unit may not be able to provide geographic coordinates in certain portions of a survey area, for example near a steep cliff.
- The accuracy of the location provided by the GPS unit may vary considerably from one measurement to the next even when the receiver is moved only a few metres. Accuracy depends on the number of satellites used for the computation (3 is a minimum) and typically varies by 10 to 40 m for a hand-held GPS unit.

It is possible to obtain accuracies of 1 m or less by using a technique called “differential GPS”. This method makes use of the information provided by an additional receiver fixed at a known location nearby to correct the measurement made by the “roving” unit in the hands of the surveyor.

Use to Support SCAT

GPS receivers can support field surveyors in many ways, including assisting in:

- navigating to the start or end of a shoreline segment;
- recording the start and end of oiled zones; (The GPS can be used to calculate the size of the oiled zone depending on the size of the oiled zone and the accuracy of the signal.)
- obtaining the position of photographs or videos, affected resources, such as oiled birds or archaeological artifacts, and pits and trenches.

Aerial surveys greatly benefit from GPS technology which not only provides the real time position of the aircraft but also records the flight path into a computer file. The file can later be used in conjunction with GIS technology to better estimate the actual start and end of shoreline segments.

Practical Comments

The coordinate value reported by a GPS has a very high number of digits after the decimal point. This will usually exceed the accuracy of the computation. When recording geographic coordinates provided by a GPS receiver, the surveyor should take care either to provide the precision of the measurement or to record only the number of digits corresponding to that precision. The number of significant digits that should be provided when writing down latitudes and longitudes provided by GPS receivers is shown in Table 8.

Table 8 Accuracy of Geographic Location Provided by GPS Receiver

Accuracy	Number of significant digits		Example	
	GPS position reported in:		Latitude	Longitude
1 m	Decimal degrees	**5**	45.02841	-74.85781
	Degrees – decimal minutes	**3**	45° 30.121”	-74° 45.121”
10 to 20 m	Decimal degrees	**4**	45.0284	-74.8578
	Degrees – decimal minutes	**2**	45° 30.12”	74° 45.12”

2.8.2 Digital Cameras

Purpose and Characteristics

Digital cameras record high quality still images and short video clips and can replace traditional cameras in most situations.

Digital cameras offer the following advantages:

- high-resolution still images;
- ability to record a short voice message attached to the digital document;
- ability to record a short video, including image and sound;
- weather-resistant casing; and
- some models are equipped with GPS receivers and automatically provide a position with the image.

Digital cameras are also easy to operate, reliable, and inexpensive. They are an excellent complement to field survey forms and can be used to illustrate the oiling condition of a segment as soon as the surveyors return from the field as no laboratory processing is needed to extract and print the images.

Limitations

The following are some issues that may be associated with the use of digital cameras, most of which are “procedural” in nature (Lamarche and Roberts, 2004).

- Digital photographs can be very easily “doctored” or modified, in which case they become useless for legal purposes.
- Digital documents are easily destroyed or lost, i.e., deleted, either by equipment failure or “operator error”.
- Each brand of digital camera has its own particular method of data transfer and often its own format of image encryption.
- As digital photographs are very easy to record and a memory card can store 400 or more images, a surveyor could be tempted to needlessly record too many photographs.

Use to Support SCAT

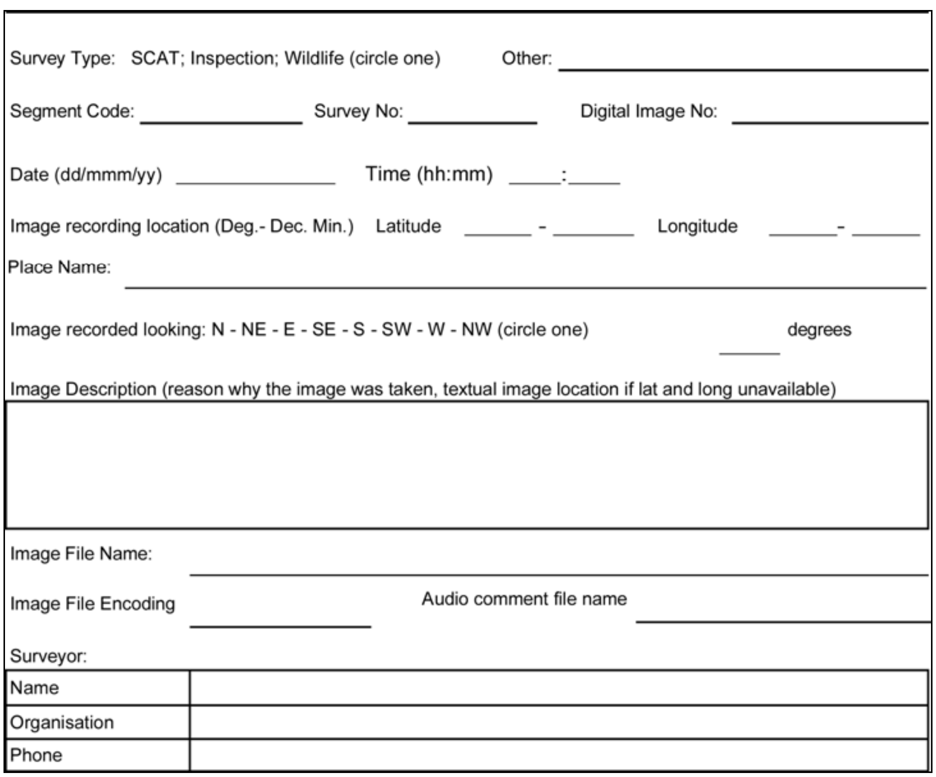
Digital pictures or short video clips can be a valuable complement to SCAT observations. The following are recommended ways to deal with issues associated with the use of digital images.

- Implement a procedure for the transfer of data and documentation of digital images to ensure that they will be incorporated within a chain of custody. An example of a written procedure to transfer and document digital images is given in Table 9.
- Assign responsibility to the digital camera operator to extract images from the camera and provide them in data files on an appropriate recording media, such as a CD.
- Use key words to document each of the images generated by a survey.

An example of a form that could be provided to field surveyors to document each of the images collected during a survey is shown in Figure 13.

Table 9 Example of Written Procedure to Transfer and Document Digital Images

1. A field surveyor records a digital image.
2. The following information is recorded in the field, right after image recording:
- segment ID and survey code
- digital image sequence number
- date and time
- digital image direction
- latitude and longitude or description of location of surveyor when image was recorded
- description of image.
3. After returning from the field, the surveyor transfers the recorded image to a desktop computer.
At this point, the following additional information should be added to the form:
- file name of image
- file name of audio recording (if applicable)
- surveyor's name, organization, and phone number.
4. The surveyor transfers the image files and writes a description for the designated spill data manager.
5 The designated spill data manager records the time and date the images are received.



Survey Type: SCAT; Inspection; Wildlife (circle one) Other: ____________

Segment Code: ________ Survey No: ________ Digital Image No: ________

Date (dd/mmm/yy) ________ Time (hh:mm) _____:_____

Image recording location (Deg.- Dec. Min.) Latitude ______ - ______ Longitude ______- ______

Place Name: ____________

Image recorded looking: N - NE - E - SE - S - SW - W - NW (circle one) ______ degrees

Image Description (reason why the image was taken, textual image location if lat and long unavailable)

Image File Name: ____________

Image File Encoding ________ Audio comment file name ________

Surveyor:

Name	
Organisation	
Phone	

Figure 13 Example of Form for Digital Images

2.8.3 Field Computers

Purpose and Characteristics

Small, weatherized hand-held computers, also referred to as Personal Digital Assistants or PDAs, are used to capture SCAT data in the field. These units are linked to a GPS receiver to enable the real-time capture of positional data. Portable desktop computers are used to support aerial surveys.

Ground SCAT data collected on field computers can be transmitted to personnel responsible for SCAT data management and directly incorporated into SCAT databases. On-board desktop computers can be used to support navigation and record the flight path during aerial surveys. The steps for doing this are shown in Figure 14.

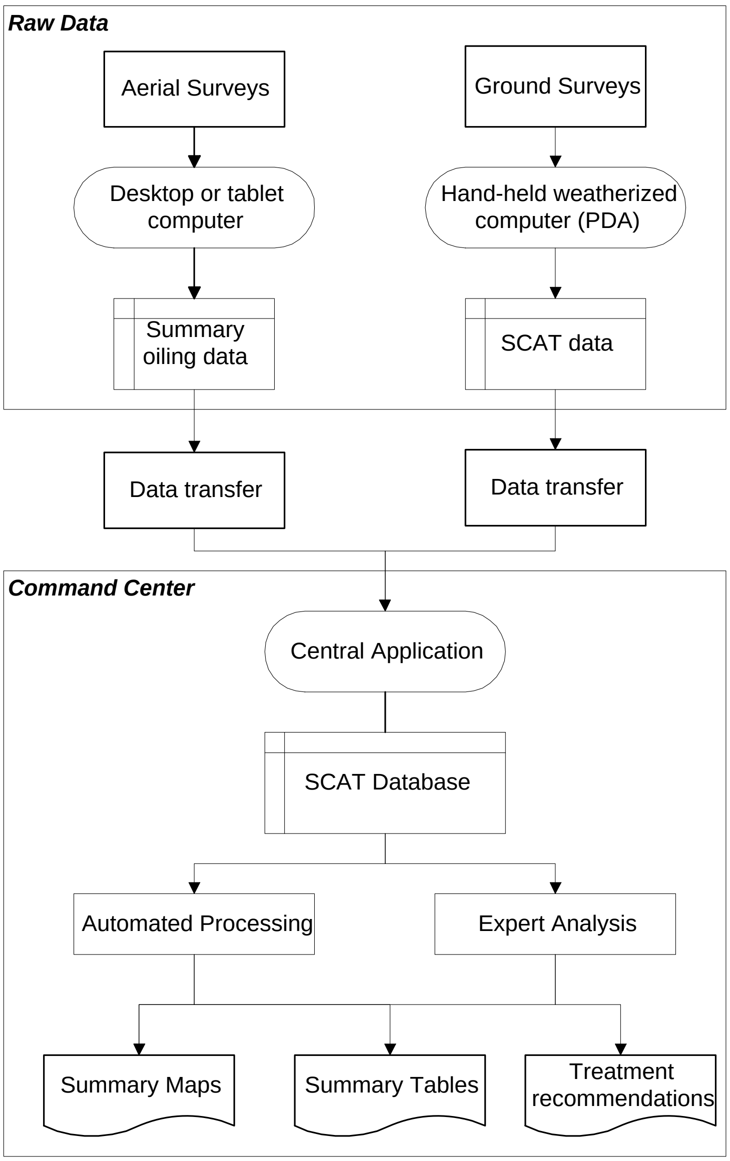
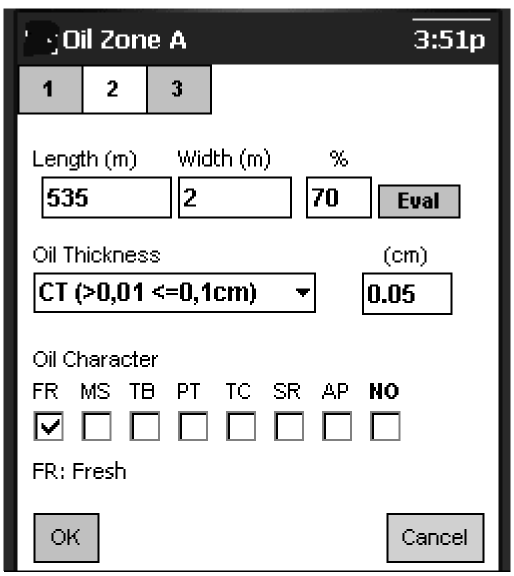


Figure 14 Steps for Using Field Computers to Capture SCAT Data

Limitations

- o Personal digital assistants (PDAs) have very small display areas. Therefore, dedicated data capture software should break down SOS forms into a number of sections.
- o Text entry is difficult as most PDAs either have very small keyboards or none at all. Dedicated data capture software should therefore use various techniques, such as pull-down menus, to limit the user interaction. An example of an SOS form interface is shown in Figure 15. The ability to enter free-form comments on such forms, however, will always be limited.
- o Field computers need to be part of a chain of processes and systems leading to the production of decision support documents such as maps, tables, and forms in order to contribute optimally to the decision-making process.
- o The use of field computers must be planned and the tool made part of the equipment toolbox before a spill occurs to avoid the need to develop interfaces and procedures on an ad hoc basis.
- o Survey personnel must be trained to operate the field computer.
- o The limitations of a GPS system apply when using field computers. Field computers cannot entirely replace paper. It is difficult, if not almost impossible, to reproduce the flexibility of pen and paper for producing sketches, especially with the drawing area on a PDA being so small.



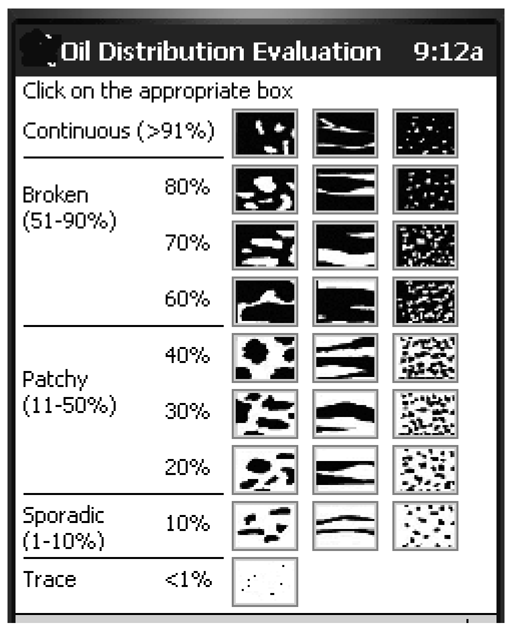


Figure 15 Example of an SOS Form Interface - showing Section 2 (left) of the oiling characteristics data entry screen and an oil evaluation aid (right).

Use to Support SCAT

Theoretically, any data that can be recorded on a paper form can be recorded on a small portable computer. When field computers are well integrated within response processes, they provide the following advantages:

- additional navigational support to survey teams by the ability to overlay the GPS-calculated position over electronic maps of the survey area;
- data capture support to limit the possibility of field data entry error: (This can be done by using validation rules incorporated on the field entry screen, drop-down lists, or selection support screens. The recorded value of GPS coordinates can also be automatically adjusted to the accuracy of the measurement.)
- fast availability of the data, which can also be sent to the command centre by wireless communication;
- elimination of data transcription error, i.e. coping data from paper SOS form to the SCAT data management software system.
- almost instantaneous integration of field data into a centralized treatment system that can then be used to produce summary maps, tables, and other outputs to support the decision-making process.

Field computer applications have been developed to support aerial reconnaissance (Blouin and Boulé, 2005) and ground SCAT surveys (Lamarche et al, 2004).

Chapter 3 SCAT Data Management Team

SCAT data processing and data management are essential to ensuring that SCAT data and derived analysis are available to support the work of all groups involved in the response to a spill. To achieve this, a number of distinct tasks are carried out to acquire, validate, document, store, secure, process, and maintain a database of SCAT information.

Depending on the size of a spill, data management functions can be performed by the SCAT coordinator, a single SCAT data manager, or a SCAT data management team. In this manual, the ‘team’ is referred to as meaning any of these. This section provides a brief overview of the SCAT data management tasks and the formation and responsibilities of the SCAT data management team. An outline of the chapter is provided in Figure 16.

1	Overview of the SCAT Data Management Process
2	Position of the SCAT data management team in the spill response organization
3	Responsibilities of the SCAT data management team
4	Why and when to establish a SCAT data management team
5	Composition of a SCAT data management team
6	Data Management Tools

Figure 16 Topics in Chapter 3

3.1 Overview of SCAT Data Management Process

The SCAT data management team is responsible for gathering the material collected by SCAT teams, ensuring that the data and information are of suitable quality, analyzing the data, and providing summary tables, maps, and outputs to support tactical and strategic planning decisions and assist the operations teams in the field.

These general goals are achieved through a series of procedures and methods that are detailed in Chapter 4 (How to Manage SCAT Data) and Chapter 5 (How to Apply SCAT Data). An overview of these processes is provided in Figure 17.

Overview of SCAT Data Management Tasks

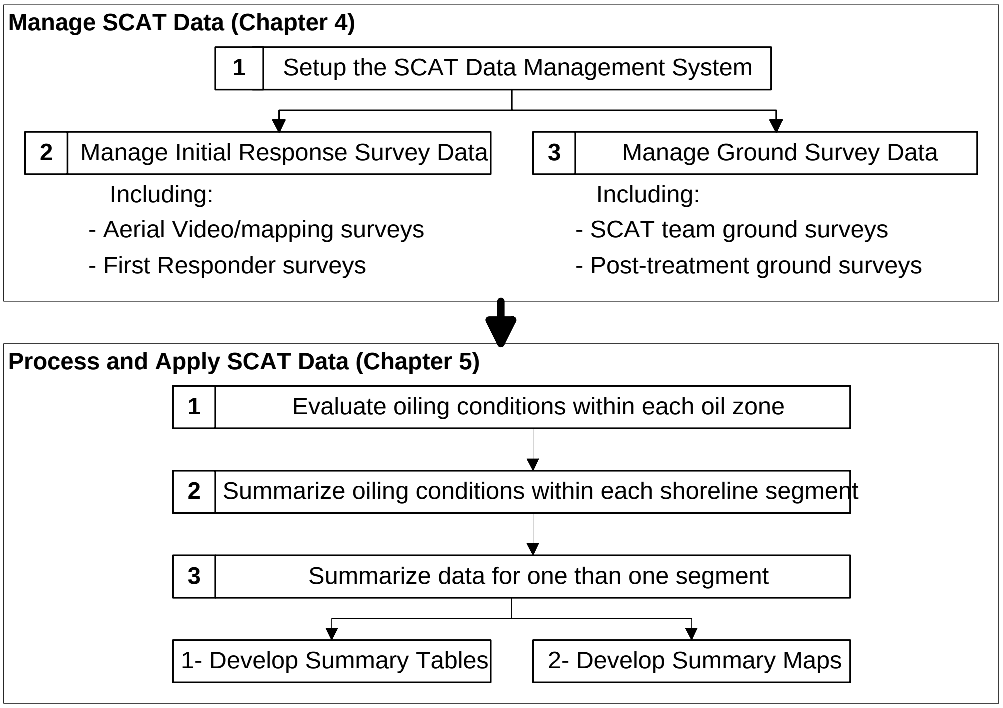


Figure 17 SCAT Data Management Tasks

3.1.1 Managing SCAT Data

Managing SCAT data can be broken down into three series of tasks.

1. Set up the SCAT Data Management System

This series of tasks involves preparing a data management system, including personnel and equipment, for implementation at the Incident Operations Centre (also referred to as the Command Centre).

The following are prerequisites to ensure efficient SCAT data management.

- o Data management tools should be selected well before any spill occurs as part of the response preparedness and contingency planning.
- o Providers of SCAT data management services should be identified and well trained in operating the selected data management tools.

When a spill occurs and the SCAT data management team is contacted, they will take the following steps.

1. Obtain general information about the spill.
2. Obtain available cartographic material.
3. Obtain shoreline characteristics data.
4. Prepare the data management tools for transport to the Command Centre.
5. Once on site, report to the designated personnel.
6. Set up and verify the equipment.
7. Obtain data describing the incident.
8. Obtain the location of operations divisions.
9. Enter the locations of the operations divisions in the database.
10. Print and distribute general overview maps.

These tasks are detailed in Section 4.1.

2. Manage the initial response survey data

Initial response surveys are performed immediately after the incident in order to evaluate the entire affected area as quickly as possible. The data provide a coarse overview of the oiling characteristics along large portions of the coastline. Data management tasks performed to prepare for data processing thus need to focus on a rapid turnover in order to provide data summaries that can be used for planning as quickly as possible.

The following are the steps in managing initial response survey data. These steps are detailed in Section 4.2.

1. Obtain aerial survey data.
2. Examine material.
3. Clarify items that may need to be modified.
4. Adjust the database.
5. Enter data in the database.
6. Produce and distribute summary maps and reports.
7. Back up and organize survey data.

3. Manage the ground survey data

Data and material generated by SCAT ground surveys are detailed and relate to a range of different elements, e.g., shore type, surface and subsurface oiling conditions, access, staging potential, and ecological constraints. Managing this information constitutes a major portion of the SCAT data management team's efforts. Decisions based on the results of SCAT surveys have a direct impact on the quality of the response and the level of effort of the shoreline treatment activities. The turnaround time for processing SCAT data is often very short, particularly during the early stages of a response. SCAT data management tasks performed to prepare for data processing therefore need to provide optimal data quality as quickly as possible.

The following are the steps in managing SCAT ground survey data. These steps are detailed in Section 4.3.

1. Prepare data capture support documents.
2. Distribute documents to the ground survey crews.
3. Obtain data from the ground survey crews.
4. Examine ground survey material.
5. Clarify any item that requires modifications/changes and correct omissions.
6. Enter data in the SCAT ground survey database.
7. Validate the data.
8. Produce and distribute summary maps and reports.
9. Back up and organize survey data.

3.1.2 Processing and Applying SCAT Data

When data is entered in a database, it must be processed before it can be presented in reports, maps, or tables. Three levels of processing can be defined.

1. Evaluating oiling conditions for each oil zone

At the lowest level, processing is done for each of the oil zones and observed and recorded on the SOS form. Oil cover and oiling category are assessed directly from the width, thickness, and distribution of each oil zone. The substrate type is evaluated from the recorded substrate types of each oil zone. Basic processing can also include an estimation of remobilization potential and oil persistence.

2. Summarizing oiling conditions for a single shoreline segment

In order to be presented as overviews, oiling assessments must be provided on a shoreline segment basis. Methods developed to summarize oiling characteristics for each segment must take into account the fact that SCAT surveys may report oiling as multiple parallel oil zones with varied oiling characteristics.

The following information can be summarized from the SCAT survey observations in a single shoreline segment:

- overall substrate type, oil cover, and oiling category;
- length of shoreline by oiling category; and
- volume of oil.

3. Summarizing data for more than one segment

The third level of processing involves the data manipulations necessary for developing maps and tables used to summarize the information in many segments for entire surveys and/or the entire area affected by a spill. The method selected may vary according to the nature, characteristics, number of segments covered, and complexity of the SCAT data recorded during field surveys.

Section 5.1 provides detailed explanations of how to develop summary maps and reports. Examples of summary maps and tables are provided in Section 5.3.

3.2 Position of SCAT Data Management Team in Spill Response Organization

The SCAT data management team works under the supervision of the SCAT coordinator. The SCAT program is usually part of the Environmental Unit in the Planning Section, as shown in Figure 3. The management team's first priority is to provide technical support to members of the SCAT unit, including the coordinator and members of the field survey teams.

The SCAT coordinator prioritizes information and data requests submitted to the data management team. Establishing priorities is important as SCAT data and SCAT-derived information are usually in very high demand during a response. The SCAT coordinator manages the SCAT data team to ensure that requests are filled punctually and that the data team has enough resources in terms of personnel, computers, printers, etc., to meet these requests.

The roles of the SCAT program manager, data manager, and field coordinator are described in Table 10.

Table 10 Roles of SCAT Program Manager, Data Manager, and Field Coordinator

The **SCAT Program Manager** provides overall direction of the SCAT program and acts as the technical link between Planning, Operations, and Unified Command personnel.
The **SCAT Data Manager** is responsible for the "mechanical" data-related activities.
The **SCAT Field Coordinator** looks after the scheduling and support requirements of the field teams.

3.3 Responsibilities of SCAT Data Management Team

The SCAT data management team has very distinct responsibilities, some of which involve legal issues. These responsibilities are listed in Table 11 and discussed in this section.

Table 11 Responsibilities of SCAT Data Management Team

1	Data integrity
2	Data preservation and documentation
3	Data processing
4	Data distribution

1. Data Integrity

SCAT data may be used in court and must therefore be handled scrupulously. The concept of "Chain of Custody" is applied to SCAT materials. This procedure requires that an identifiable individual has physical custody of a piece of evidence at all times (in this case, documents produced by SCAT survey teams). In practice, this means that a member of the SCAT data management team takes charge of the forms and sketches produced by SCAT team members, documents this collection procedure, and stores the material in a secure location. This transaction and every succeeding transaction between the collection of the evidence and the appearance of the material in a court should be completely documented.

In the spirit of the "Chain of Custody" concept, the SCAT data management team is responsible for data integrity. Original SCAT documents received by the management team should not be altered in any way. Any necessary changes, e.g., for clarification or to include information that has been inadvertently omitted, should be clearly noted on the document itself and initialed and dated by the person who makes the change(s).

2. Data Preservation and Documentation

The SCAT Data Management Team is responsible for ensuring that all original SCAT data and materials produced to support the response effort are preserved and documented.

Maintenance of the SCAT database initially involves making copies of all data forms and sketches and storing this material in folders. The organization principle is simple: original documents should be easy to locate if someone needs to consult the material.

Computerized files should be backed up daily. It should be possible to recover data quickly in the event of computer failure to prevent a break in the workflow. The backup procedure should also make it possible to reproduce the results of any past data processing during the response.

There is no error-free database. Therefore, data used for processing should also be verified at some point during the response, when time permits, in order to detect errors that might have crept into the data files. Data validation techniques include simply comparing the information on the original paper material to the outputs of the digital data and developing techniques for detecting "unreasonable data". Calculating oil volumes can be used for this purpose. A general review of the data is typically performed when all SCAT field survey operations are finished.

3. Data Processing

To ensure that data is accurately represented in summary reports, tables, and maps, the precision and limitations of the data must be understood. This is important in order to prevent the generation of misleading or inaccurate information. For example, a map that simply shows the affected area should be clearly labelled so that the user does not confuse this piece of information with an oil distribution map. This is discussed in more detail in Chapter 5.

4. Data Distribution

The SCAT data management team is responsible for distributing the processing results in a timely manner. Within the time constraints of spill response, decisions and actions must follow well defined cycles and strict deadlines. Preparing Incident Action Plans is a critical element of the Incident Command System (ICS) management process. Response planners rely on the timely provision of information to meet the daily scheduled deadlines.

Members of the SCAT data management team must understand the decision-making process and the management cycle, which varies with each incident. SCAT data management teams must also understand that response personnel cannot wait for the available documents in order to carry on with their work. The data management team must organize their workflow so that documents are generated and communicated to those who need them when they need them.

Not providing needed information on time results either in parallel processing systems, such as manually skimming through paper SOS forms or failure to use the data at all.

3.4 Why and When to Establish a SCAT Data Management Team

SCAT data management teams are used primarily to prevent potential bottlenecks in the decision-making cycle caused by the need to process the SCAT data. This bottleneck may arise because SCAT teams do not have time to process the data themselves or because the SCAT coordinator does not have the time to produce SCAT summaries.

SCAT data management teams should be used whenever the SCAT data produced by survey activities exceeds the processing power of the SCAT coordinator and when SCAT data must be analyzed and summarized for planning purposes. Factors that should be taken into consideration when defining the need for a SCAT data management team are summarized in Table 12.

An obvious example of the need for a SCAT data management team is when a spill covers tens of kilometres of shoreline and the area is surveyed by three or four teams producing data and information for multiple segments over several days. On the other hand, a spill that affects only one or two shoreline segments would not require a data management team. As a rule of thumb, a data management team is probably not needed if the field work involves a single SCAT team and covers 7 shoreline segments or less.

Even for a smaller spill, however, one individual must be assigned responsibility for the tasks that would be performed by a SCAT data management team to ensure that the information gathered in the field is available for the decision-making process.

Table 12 Defining the Need for a SCAT Data Management Team

Factor	Criteria
Number of shoreline segments	More than 7
Number of SCAT teams	More than 1
Survey frequency	More than twice
Processing time needed to summarize the data	More than 1 hour

3.5 Composition of SCAT Data Management Team

The SCAT data management team could consist of a single individual or a group of people. The number of people in the team depends on the amount of SCAT data that needs to be processed each day and the tools selected to support these tasks. Normally, there should be enough resources in a SCAT data management team to perform all needed tasks every day. The leader of the SCAT data management team should thoroughly understand SCAT data, the decision-making cycle, and the needs of the decision-makers during a response. Additional personnel can be less knowledgeable and perform more mechanical tasks, such as bookkeeping and data entry.

The SCAT team leader must be able to:

- evaluate the time required to perform each of the tasks necessary to deliver decision support documents and materials;
- develop techniques for organizing the work to ensure that support is provided in time to be useful;
- understand the mechanics of the decision-making cycle, which may vary with conditions specific to each spill, in order to know when to provide decision support tools and who needs them;
- understand the limitations of the data; and
- understand the data capture process in order to identify the sources of data limitations and the needs of survey personnel.

3.6 Data Management Tools

While all data management tasks can be performed manually with pencil and paper, computerized tools are more efficient and speed up the process. Computerized tools range from simple office applications, such as word processors and spreadsheet programs, to more sophisticated Geographic Information Systems and specialized SCAT data management and processing systems.

An experienced SCAT data manager would probably be able to provide a ready-to-use set of tools for the data management process. Some government and private agencies have developed GIS-based computerized pre-spill databases. When such systems are available, it is important to be prepared for a spill response by developing links between SCAT data management tools and the pre-spill database and to test the efficiency of these links during drills and exercises.

In order to ensure efficiency during a response, data management tools should be selected before a spill as part of the spill preparedness effort. The data management team selected to operate this system should be thoroughly trained and included in drills and exercises.

Details about the structure and content of a SCAT database are provided in Chapter 6 and guidelines for selecting data management tools are provided in Chapter 7.

Chapter 4 How to Manage SCAT Data

This chapter provides details and suggestions about carrying out the tasks involved in managing SCAT data. The material in this section is aimed primarily at technical personnel who are directly involved in the data management process. The main tasks in managing SCAT data are outlined in Figure 18.

Managing SCAT Data Overview

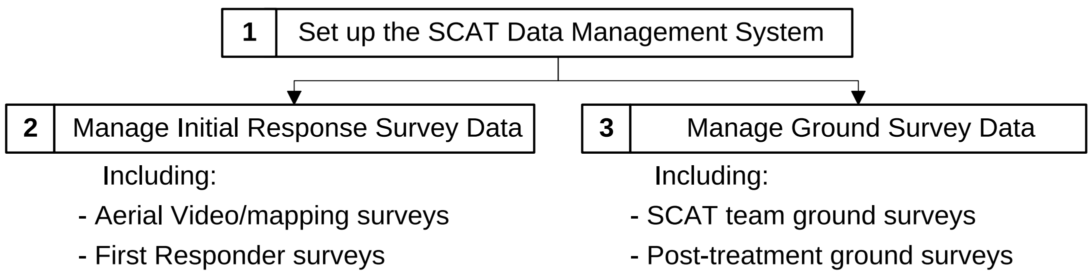


Figure 18 Main Tasks in Managing SCAT Data

1. **Set up the SCAT data management system** – This includes all tasks necessary to prepare a data management system, including personnel and equipment, to be implemented at the Incident Operations Centre (also referred to as the Command Centre).

2. **Manage the initial response survey data** - This includes all tasks necessary to obtain, organize, and process data gathered during aerial video/mapping and first responder surveys.

3. **Manage the ground survey data** - This includes all tasks necessary to obtain, organize, and process data gathered by SCAT teams during ground surveys, including pre- and post-treatment surveys.

Establishing a SCAT data management system is a necessary prerequisite for any subsequent data management tasks. The type of work conducted during a spill response evolves over time, which is reflected in the nature of the data collected and the types of surveys that are performed.

As explained in Chapter 2, shoreline oiling is assessed by carrying out a number of different types of surveys. The data generated in these surveys can be managed in a number of ways, according to the volume and accuracy of the data that they produce, as is shown in Table 13 and explained below.

Aerial Reconnaissance surveys, which are used to report the probable extent of oiling, generally do not provide information in a form that can be included in a SCAT database. The observation and reporting methods used in aerial video/mapping and first responder surveys, however, provide a systematic coverage of the surveyed area using standard observation techniques and terminology. Both survey methods are designed to rapidly cover large sections of shoreline and provide data that are similar in form and quality. As a result, the data produced by these "initial response surveys" can be managed in similar ways.

Full-scale SCAT ground surveys are usually conducted after the initial oiling documentation effort. These surveys typically produce a large amount of data and material that require a more complex management effort. Post-treatment ground surveys, which include inspections and long-term monitoring, provide information of a quality and complexity similar to that of full-scale SCAT ground surveys and are therefore managed in a similar way.

Table 13 Data Characteristics and Management Methods Used for SCAT Surveys

Type of Survey	Data Characteristics	Data Management Method
Aerial Reconnaissance	Free-form observations Survey not always systematic Generally non-standardized observation method	Generally not included in the SCAT database
Aerial Video/Mapping	Systematic survey Standard observation technique Oiling recorded as single bands of oil along the coastline Generally takes shoreline segmentation into account	Initial Response Survey
First Responder Ground Survey	Systematic survey Standard observation technique (uses the “short” SOS form) Oiling recorded as single bands of oil along the coastline Generally takes shoreline segmentation into account	
SCAT Ground Survey	Systematic survey Standard observation technique (uses SOS form and sketches) Oiling recorded as surface and subsurface oiled zones Based on shoreline segments	Ground Survey
Post-treatment Ground Survey	Systematic survey Standard observation technique (uses forms and sketches) Oiling recorded as surface and subsurface oiled zones Based on shoreline segments	

The map shown in Figure 19 is used in this and the following chapter to illustrate the various points and topics covered in the discussion. This map simulates the data produced by response activities after a hypothetical spill along the coast of Nova Scotia near Halifax. The base layers discussed in Section 4.1.1 are shown on the map.

The database for the simulated incident was developed using a dedicated software system linked to a GIS. The nature of most data management tasks does not depend on the use of a specific software tool. Most tasks are similar in principle and practice even if the data management team uses a manual system or a less specialized computerized system.

4.1 Setting Up a SCAT Data Management System

A number of specific tasks need to be performed before the SCAT data management team can start to create a database. First, a source of SCAT data management services should have been identified as part of contingency plans. The response organization should also select or at least be aware of the SCAT data management tools that can be used if an incident occurs. The provider of SCAT data management services should be well trained in operating the data management tools. Guidelines for selecting data management tools are provided in Chapter 7.

The sample map in Figure 19 assumes that computerized tools have been used for data processing, including a Geographic Information System (GIS), dedicated SCAT database, and office software, i.e., word processor and spreadsheet. In addition, the selected map depicts an area for which a pre-spill segmentation database has been generated as part of a regional response preparedness program.

A management system is established as soon as the supplier of SCAT data management services is notified that their services are required. SCAT data management tasks are best performed at the Command Centre since close contact with the SCAT coordinator and members of the SCAT teams is required. Before the SCAT data management team arrives at the Command Centre or wherever the SCAT team is located, however, the team leader can implement a number of preliminary tasks to ensure optimal efficiency. These tasks are outlined in Figure 20.

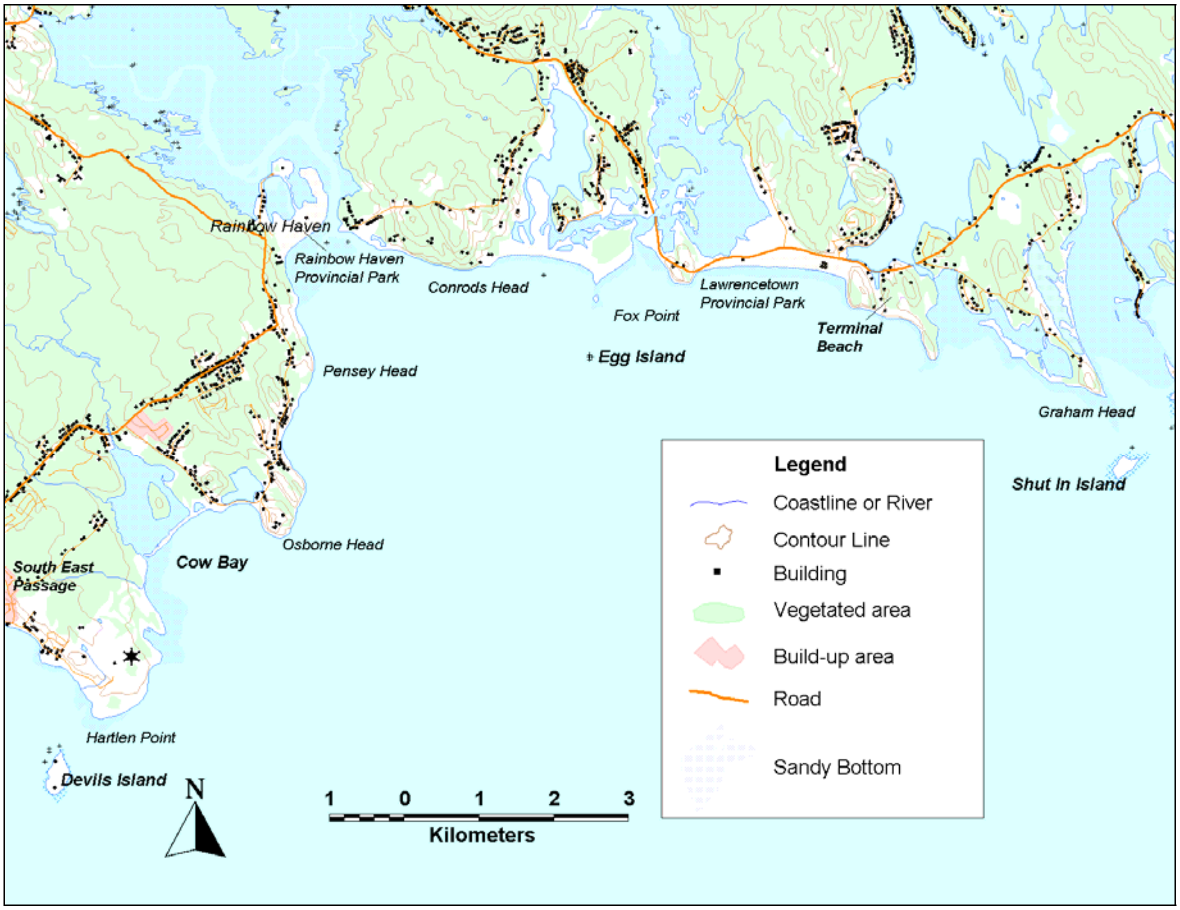


Figure 19 Map with Base Layers for Simulated Spill Area

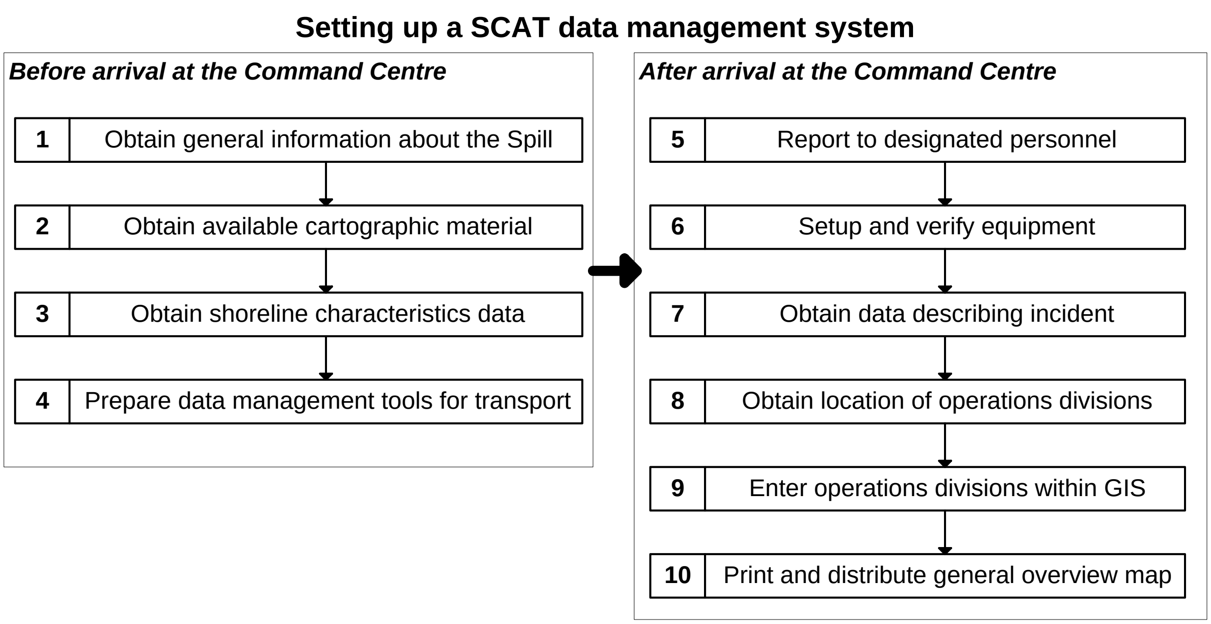


Figure 20 Tasks for Setting Up SCAT Data Management

4.1.1 Before Arrival at the Command Centre

The SCAT data management team is activated by a contact, usually a phone call, to the SCAT data management leader. If time permits, it is advisable to obtain the following key information that may not be readily available on site, particularly if the response team is at a remote location.

1. Obtain general information about the spill
   - Ideally, **the general location** can be identified by a set of geographic coordinates providing the latitude and longitude for the source of the incident.
   - **Information on the potentially impacted area** could be provided by a set of geographic coordinates, but a verbal description of the potentially impacted area is adequate for general planning purposes. The name of the closest major city and the direction in which the spilled oil is expected to move are also useful.
   - **The location of the Command Centre** and directions for getting there ensures that the SCAT data manager understands how to reach the Command Centre.
   - **Local contact coordinates** can include the name and phone number of the SCAT coordinator or, if this is not yet known, a member of the response team to whom the SCAT data management personnel should report on arrival at the Command Centre.

2. Obtain any available cartographic material or electronic files to support the mapping of data for the potentially affected area
   - **Vector base map layers** provide the delineation of the coastline. Useful base layers include hydrographic features such as coastline, as well as rivers and roads.
   - **Topographical maps** indicate access roads, man-made structures such as buildings and landmarks, geophysical structures such as cliffs and marshes, and place names. If available, topographical maps should be provided at more than one scale, e.g., 1/20,000 or more can be used for sketching in the field and 1/100,000 or less are useful for general orientation and regional summaries. Topographical maps are typically available as georeferenced raster images or as vector layers.
   - **Aerial photographs or images** of the area can be used as base maps for field sketching. In many areas, georeferenced, corrected aerial images (also called orthophotos) are available. These images are useful for supporting field work. One metre-resolution orthophotos (also called DOQQ) are available for most of the U.S. coastline.

It is very important that SCAT data management personnel have a minimum set of base maps before they leave for the Command Centre unless that material is already available on site. These maps, which are listed in Table 14, should cover the area potentially impacted by the spill. A number of websites provide downloadable georeferenced data not only for North America but also for the rest of the world. The map in Figure 19 shows the base layers in the area covered by the simulated spill example.

Table 14 Minimal Base Maps Required for SCAT Data Management

Vector hydrographic layer
• Delineation of coastline
• Delineation of major rivers
Map with place names

3. Obtain any available data on shoreline character

If a pre-spill database exists for the region, contact the pre-spill data manager to make sure that this data is available at the Command Centre. If possible, download or copy the pertinent data to ensure availability. Ideally, organizations that produce and manage pre-spill SCAT databases will have developed a mechanism, i.e., a procedure or file transfer protocol, for providing access to the pre-spill data or authorized users.

The map in Figure 21 shows the boundaries of shoreline segments as points along the coastline and the shoreline types extracted from a pre-spill SCAT database. Base layers are shown in subdued colours, typically black and greys, to provide more emphasis on the shoreline types.

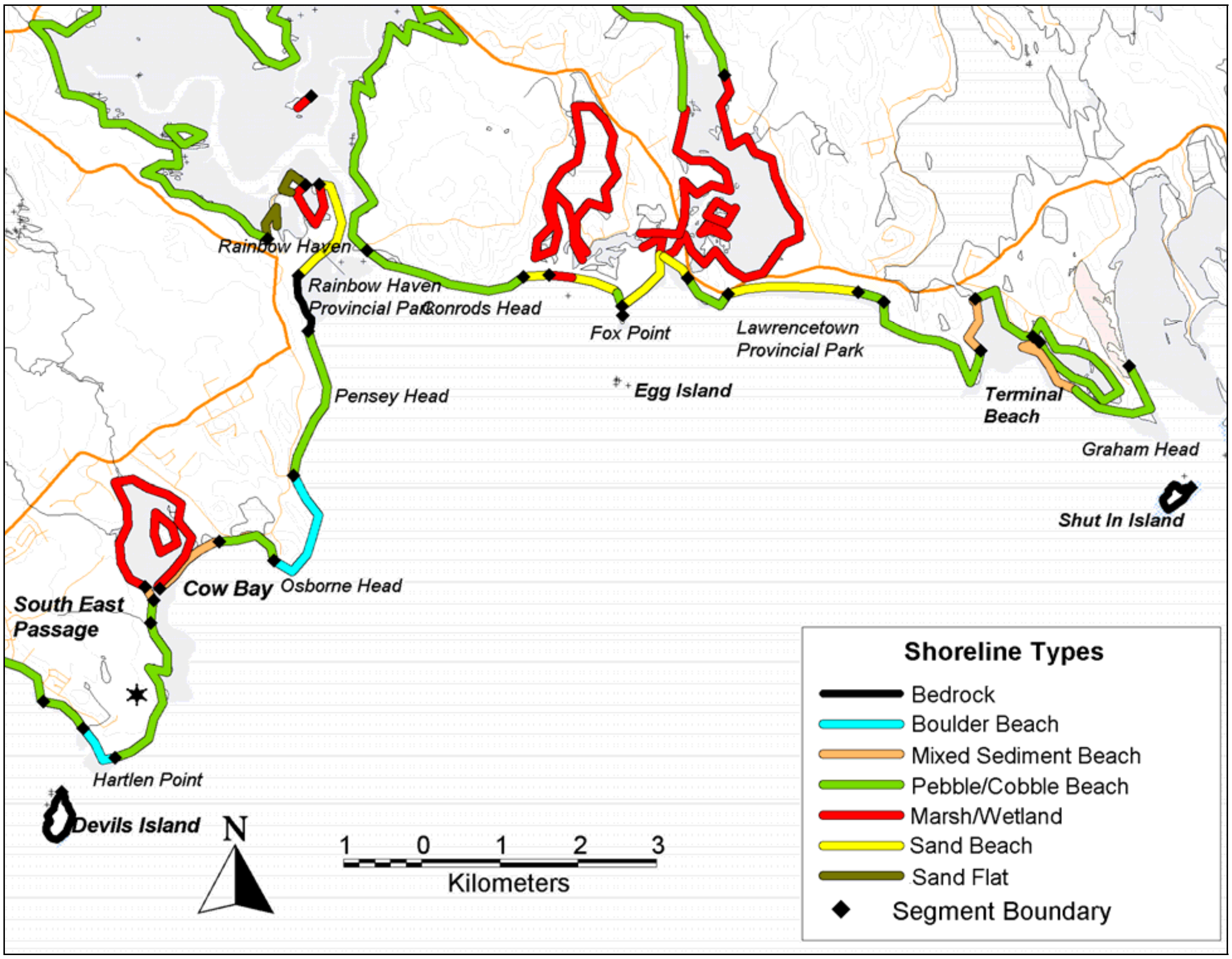


Figure 21 Map Showing Shoreline Segments and Types

4. Prepare data management equipment (software and hardware) for being transported to the Command Centre

- o Integrate all available computerized mapping data within a Geographic Information System (GIS). Any available computerized mapping data should be integrated within the GIS environment selected by the Data Manager as soon as this is downloaded to ensure that the data files are not corrupted and that they cover the selected area.
- o When the integrity of the data has been verified, back up all base data on secure media such as compact disks.

- o Verify that all software to be used for data management functions correctly. This includes GIS systems, spreadsheets, word processors, database management systems, and dedicated spill management software. Ensure that all files for managing and storing data are available and ready to use. If a dedicated SCAT data management system is to be used, make sure that it is fully operational.
- o Locate backup copies of all software used for data management so that all tools can be reinstalled in the event of equipment failure.

Command Centres can be located anywhere and often do not offer all amenities, such as printers or network connections, particularly during the initial phase of a response. The SCAT data management team must be self-reliant in order to provide services regardless of the situation “on site”. The equipment and software that make this possible are listed in Table 15. The following should be noted.

- o Sensitive equipment such as printers must be properly packaged for transport.
- o Large printers have many advantages on site since maps are often produced on larger paper. A supply of large (11 by 17 in.) blank printer paper must also be available.
- o Similarly, a basic supply of extra print cartridges, printer paper, and blank rewritable compact disks should be part of a “ready-to-use” equipment package.

Table 15 Data Management Tools Required at Command Centre

Tool	Purpose
Main portable computer, including:	Main data processing tool
A CD burner	Backup of data
Local Area Network (LAN) connection	Communication and sharing of resources
CD and DVD reader	Software installation
All available base data	Support production of documents
All necessary software (GIS, spreadsheet, word processor, database, and dedicated SCAT data management)	Data management and processing
Large printer (for 11 x 17 in. paper)	Production of maps and reports
Hub for Local Area Network	Communication and sharing of resources
Secondary portable computer, including:	Secondary data processing tool in case primary computer fails.
CD burner	Backup of data
Local Area Network (LAN) connection	Communication and sharing of resources
CD and DVD reader	Software installation
All available base data	Support production of documents
All necessary software (GIS, spreadsheet, word processor, database, and dedicated SCAT data management)	Data management and processing
Backups of all software tools	Reinstall needed software in the event of failure
Stacks of rewritable CDs	Backup data
Printer paper (regular and large size)	

4.1.2 After Arrival at the Command Centre

Report to designated personnel, i.e., SCAT coordinator or chief of Planning Section.

5. Set up and check all equipment

Ideally, the SCAT data management workplace should be physically located near the SCAT coordinator and members of the SCAT survey team should know where it is.

6. Obtain any available general data about the incident

General incident information is usually displayed on a wall close to the Planning Section. Basic incident information includes:

- incident name, which is used to label all reports and maps;
- location of incident; and
- type and quantity of oil released.

This information is entered in a data table when setting up the ground SCAT database.

7. Obtain a diagram showing the location of Operations Divisions, if available

Areas of operation, or Operations Divisions, are usually determined early during the spill response. These are used to organize on-site activities geographically and are regularly referred to in planning documents. The location of Operations Divisions is usually displayed on a wall map close to the Planning Section. Although Operations Divisions refer to "areas", their boundaries are generally best displayed as thick "lines" on maps. Operations Divisions should be entered on their own specific GIS map layer.

8. Enter Operations Division data within a GIS layer

Although Operations Divisions correspond to "areas" and should thus normally be shown as polygons, the boundaries are typically shown with a simple line. This presentation format is for aesthetic reasons only. In some situations, however, Operations Divisions are entered as polygons, for example, when there are specific areas corresponding to off-shore operations or islands.

9. Print and distribute an overview map of spill response area

The general overview map should include segment boundaries if available, location of Operations Divisions, and some landmarks, as shown in Figure 22. The appropriate scale for an overview map that covers the entire spill response area can be determined when the area of operation has been defined. This type of overview map has many uses and applications and is typically reproduced in large numbers and widely distributed. In certain spill response organizations, some information is already digitized and ready to integrate within computerized tools, such as GIS or databases.

4.2 Managing Initial Response Survey Data

Initial response surveys are performed immediately after the incident so that the entire affected area can be evaluated as quickly as possible. These systematic surveys can be performed either from the air, using a low-flying aircraft, or from the ground, often from a boat. The data provide a superficial overview of the oiling characteristics along large portions of the coastline. Data management tasks performed to prepare for data processing therefore need to focus on a rapid turnover so that data summaries that can be used for planning can be provided in the least amount of time. This can be achieved by performing the tasks shown in Figure 23 and discussed in this section.

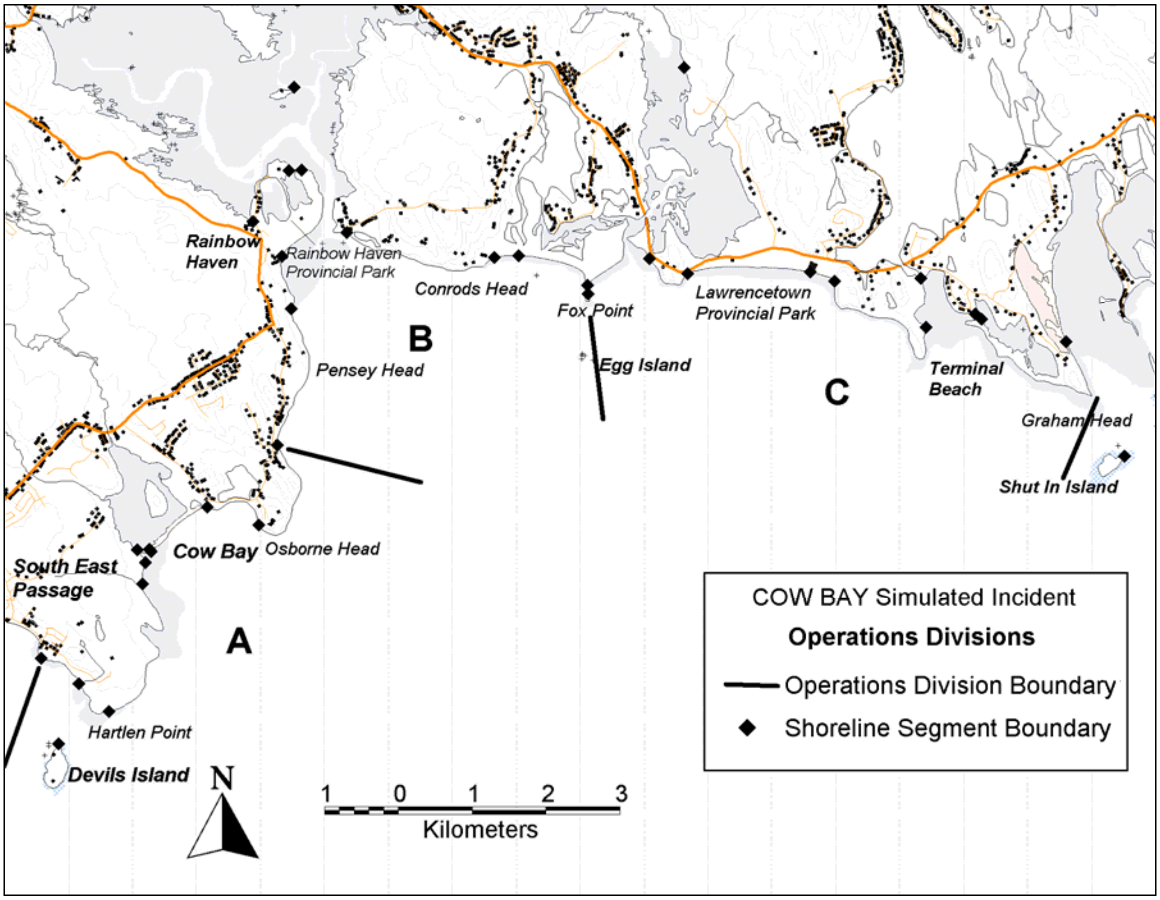


Figure 22 Overview Map Showing Operations Divisions and Boundaries of Shoreline Segments

1. Obtain survey data

The SCAT data management coordinator should seek out any data that can be used to begin the process of mapping the oiled shorelines. Due to time constraints, aerial survey observations usually consist of hand-drawn notations on a map indicating where beached oil was observed and the level of oiling. The method used to estimate and record oiling level varies according to the organization responsible for the aerial survey. Some organizations, such as the Quebec region of the Canadian Coast Guard, have developed a computerized tool to capture shoreline oiling observations during aerial surveys. Aerial observations should be recorded on paper maps and indicate at least the presence or absence of beached oil. Experienced aerial surveyors provide the width and distribution (Surface Oil Cover) of the oiled band, which enables the assessment of the oiling category (Table 17) for “heavy”, “moderate”, and “light” oiling conditions. Even experienced observers cannot identify “very light” oiling conditions due to the speed and altitude typically used for an aerial reconnaissance. At this reconnaissance scale, the surface oil zones are usually represented on a map by a single band of oil along the coastline.

2. Examine material

The SCAT data management coordinator reviews the material submitted from the initial response surveys to ensure that it is clear and understandable.

3. Clarify any item that might require modification

Items accompanying the survey data include the survey method, i.e., helicopter or fixed-wing aircraft, airspeed, altitude, tide level, visibility, and type of data recorded. Any written markings that are difficult to read should be clarified, which may require a short interview with the survey personnel.

The amount of information provided by an aerial survey varies from one spill to another depending primarily on the experience of the surveyor. For example, experienced surveyors can record the approximate width of oil bands as well as the type of shoreline or shoreline material. Less experienced surveyors are more likely to indicate oil levels in broad general categories, e.g., heavy, moderate, or light. In this case, the method used to select the oiling level must be explained and clarified.

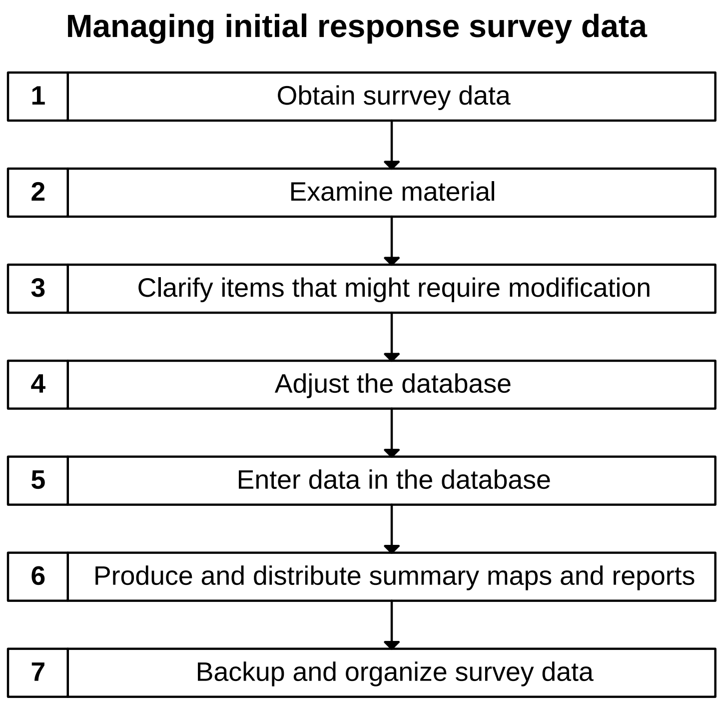


Figure 23 Tasks for Managing Initial Response Survey Data

When reviewing material obtained by a first responder ground survey, the reviewer must ensure that the information necessary for assessing oil cover and oiling category is complete and easy to understand. Any changes or clarifications made on the paper documents must be clearly indicated to distinguish them from the original field observations.

4. Adjust the database

The material generated by the aerial survey might show that some recorded data elements do not have a corresponding field in the database since aerial surveys are not entirely standardized. This material could also include data that reflects the unique conditions of the spill. If so, the table used to record the aerial survey data is modified accordingly.

This step will generally not be necessary for first responder surveys as the database is created from the various information elements of the standardized “short” SOS form. First responder data can be entered in the same data tables as the more detailed SCAT ground surveys. The nature of the survey must be clearly indicated, however, as there is a difference in the level of detail in first responder surveys and full-scale SCAT ground surveys. The boundaries of shoreline segments defined during first responder and SCAT ground surveys may also differ significantly. It is therefore recommended that data from first responder surveys should be stored in different computerized tables than the more detailed data from SCAT ground surveys.

5. Enter data in the database

Data generated by an aerial reconnaissance survey are listed in Table 16. The data should be entered as a band following the shoreline. If the boundaries of shoreline segments are available, this information should be used to break the oil bands based on the underlying shoreline segment. If the shoreline type is known from a pre-spill database, this information should be associated with the corresponding aerial observation.

Finally, if the observer enters the width and distribution of each oil band, this information is used to categorize the oil cover. A simple script, developed within the GIS used for data management, can be created beforehand to automate the assessment process. An example of a section of the pseudocode that can be used within the GIS script to assess the oil cover is shown in Figure 24. The pseudocode was developed from the “surface oil cover” information provided in Table 17. This is adapted from Owens and Sergy (2004) and applies to a shore zone with an intertidal component.

Table 16 Data Generated by Aerial Surveys

Data Element	Purpose/Description
Date/Time*	Date and start/end times of the aerial survey.
Survey No.*	The aerial survey number is used to select or group data when producing maps and reports.
Surveyor	The name and affiliation of the observer.
Oiling Level*	This can be either an appreciation of the observed Surface Oil Cover category (i.e., “high”, “moderate”, etc.) or computed from the width and distribution of the oil band.
Width of Oil Band	This can be provided in “categories” following the SCAT standard.
Distribution	This can be provided in standard categories.
Length	The length of the band should be computed by using the built-in GIS functions.
Shoreline Segment	If available, this data element provides the ID of the shoreline segment(s) where the oil band was observed.
Shoreline Type	This can either be provided by the observer or extracted from a pre-spill segmentation database.
Operations Division	This is often used to organize tabular reports.

* *Essential data. Notice that the oiling level can be assessed from the observed width and distribution of oil. If this is the case, then width and distribution become essential.*

Table 17 Estimating Surface Oil Cover Category for Marine Environments (width x distribution data)

	Width of Oiled Area		
Distribution	**Wide (>6 m)**	**Medium (>3 to 6 m)**	**Narrow (<3 m)**
Continuous (91 to 100%)	Heavy	Heavy	Moderate
Broken (51 to 90%)	Heavy	Heavy	Moderate
Patchy (11 to 50%)	Moderate	Moderate	Light
Sporadic (1 to 10%)	Light	Light	Light

```
Repeat for each record in the Aerial Survey Data table
    If Width of Oil Band is >0 m and Oil Distribution is >0 then
      If Width of Oil Band is >6 m then
        If Oil Distribution is >90% then Oil Cover is Heavy
          Else if Oil Distribution is >50% then Oil Cover is Heavy
          Else if Oil Distribution is >10% then Oil Cover is Moderate
          Else if Oil Distribution is 10% or less then Oil Cover is Light
      Else if Width of Oil Band is >3 m then
       If Oil Distribution is >90% then Oil Cover is Heavy
          Else if Oil Distribution is >50% then Oil Cover is Moderate
          Else if Oil Distribution is 50% or less then Oil Cover is Light
      Else if Width of Oil Band is <3 m then
       If Oil Distribution is >90% then Oil Cover is Moderate
          Else if Oil Distribution is >50% then Oil Cover is Moderate
          Else Oil Distribution is 50% or less then Oil Cover is Light
      Else Oil Cover is Light
      End If
    Else
      Oil Cover is No Oil
    End If
  End Repeat
```

Figure 24 Pseudocode for Evaluating Oil Cover from Width and Distribution of Oil Bands

6. Produce and distribute aerial survey summary maps and reports

A number of useful maps and reports can be produced from the initial response survey data. The ones most often used are listed in Table 18. These are described in detail in Section 5.3. An example of a “general purpose” map that summarizes aerial survey data is shown in Figure 25. A map summarizing first responder survey data would be similar in appearance. (See the example in Figure 44 in Section 5.3.1). A summary table of shoreline lengths indicating the following would be generated from the same data set:

- length of coast surveyed;
- length of heavy surface oiling;
- length of moderate surface oiling; and
- length with no observed oil.

Table 18 Maps and Reports Most Often Used from Aerial Surveys

Output (Map or Report)	Users
Map showing surface oil cover Length of oiled shoreline report, broken down by surface oil cover	SCAT coordinator Planning section Incident command Public groups

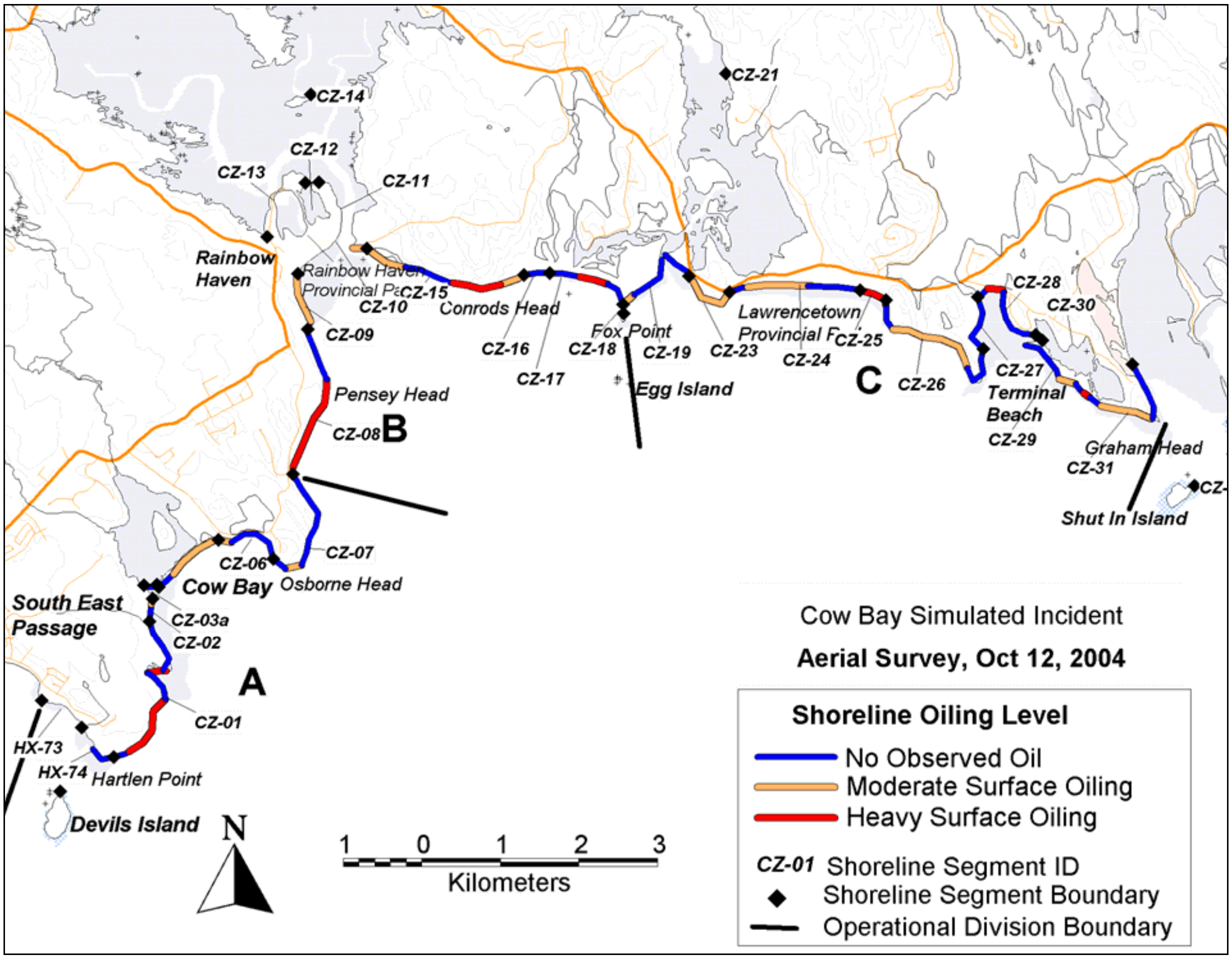


Figure 25 Map Showing Shoreline Oiling Levels from Aerial Observations

7. Back up and organize survey data

The following backups should be done as soon as the data has been entered and the outputs are produced.

- Make copies of all paper material.
- Make copies of any computer files on a permanent medium such as a CD. Digitized information to be copied on a CD includes not only data tables but also the GIS workspace used to produce the outputs, as considerable effort goes into formatting the information, i.e., creating labels, selecting the extent of maps, and creating legends. Workspace files can usually be clearly identified by their extension, i.e., .WOR for MapInfo, .APR for ArcView 3.x, and .MXD for ArcView 8.x.
- Organize the data sets. The paper material should be organized in folders and include copies of any paper output produced from the data. Digital information should be correctly labelled in a way that makes it easy to understand the content. Ideally, a log file should be created of all backups. This should list information copied on permanent media as well as the code of the CD. The printed listing of the log files should be stored in an appropriate and secured location for future reference.

4.3 Managing Full-scale SCAT Ground Survey Data

Data and material generated by full-scale SCAT ground surveys include a large amount of data relating to a range of different elements, e.g., shoreline types, surface and subsurface oiling conditions, access, staging potential, and ecological constraints. Managing this information constitutes a major part of the SCAT data management team's efforts. Decisions based on the results of SCAT surveys directly affect the quality of the response and the level of effort of shoreline treatment activities.

In addition, the turnaround time for processing SCAT data is often very short, particularly during the early stages of a response. SCAT data management tasks to prepare for data processing must therefore ensure optimal data quality in a minimum time. This can be achieved by a number of steps described in this section and listed in Figure 26.

Managing Ground Survey Data

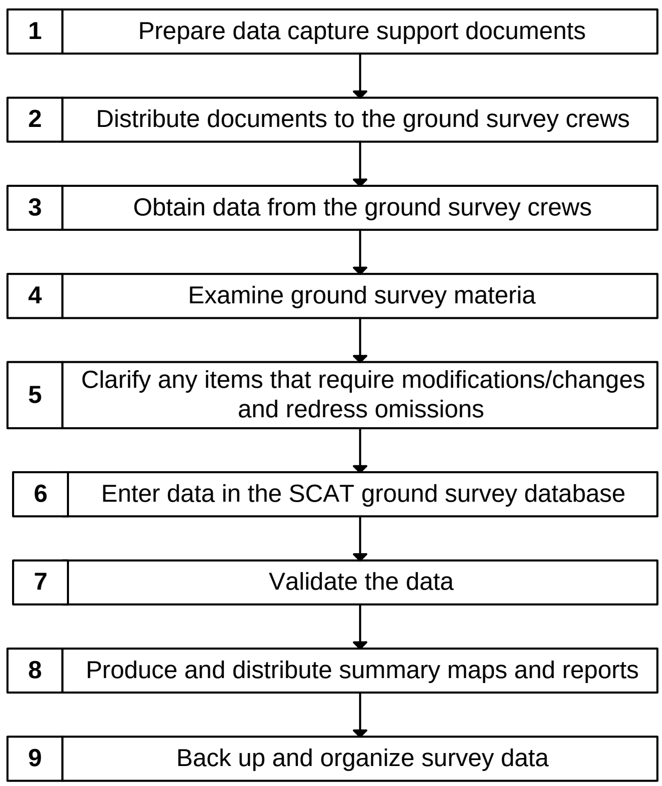


Figure 26 Tasks for Managing Data from SCAT Ground Survey

1. Prepare data capture support documents for field teams

The following documents should be generated to support the field data capture effort of ground survey crews.

- o Prepare a list of the areas to be surveyed. Identify primary and secondary areas in case the primary areas are inaccessible due to weather, logistics, or for other reasons.
- o Print or copy Shoreline Oiling Summary Forms and sketch map bases for each area to be surveyed. These outputs should ideally be printed on water-resistant paper.

Topographical maps of the areas to be surveyed should be provided if they are available. An example of a portion of a 1/50,000-scale topographical map used for general orientation is provided in Figure 27. Topographical maps are preferred for areas where access to the coast is by land and because marine charts typically provide little information on terrestrial features. If access to the shore is by sea, then hydrographic or marine charts should also be provided if they are available and at a suitable scale.

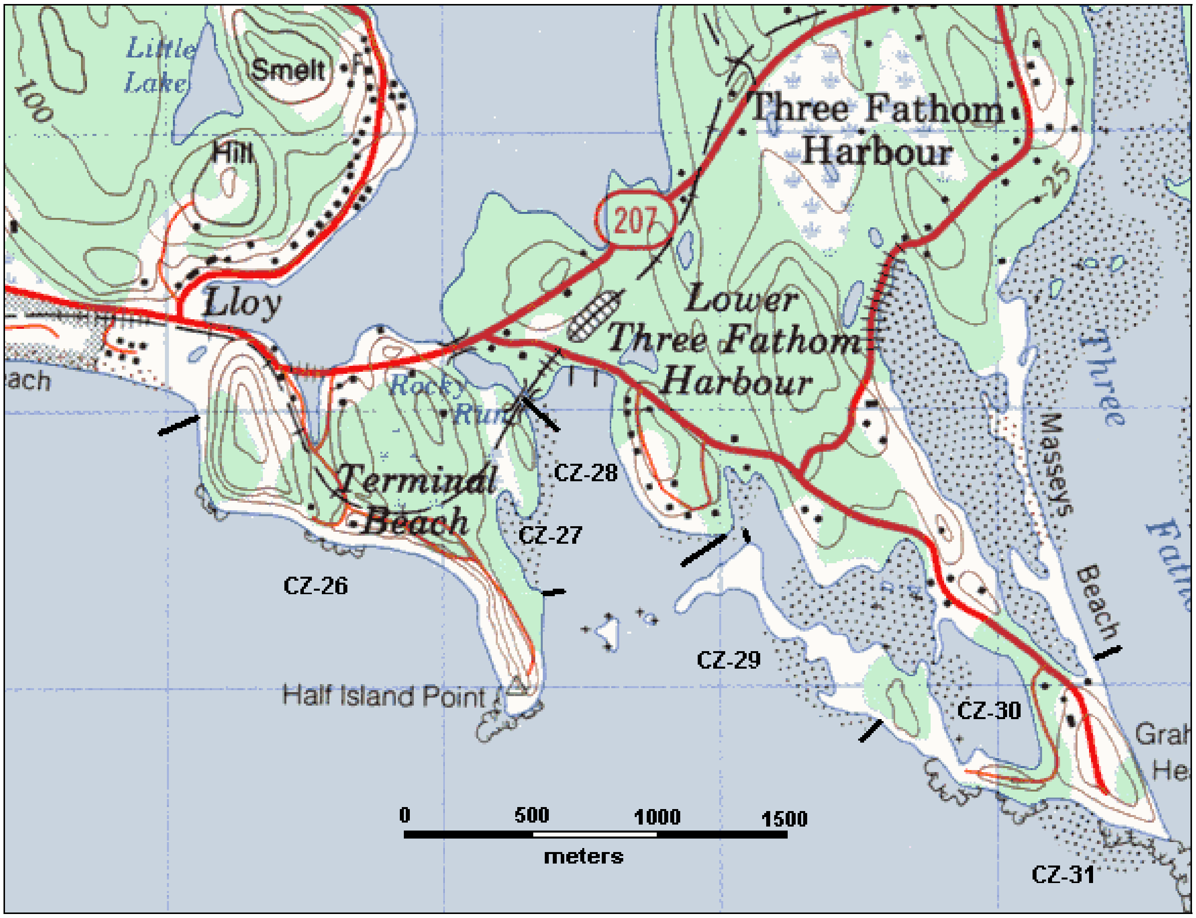


Figure 27 **Topographical Map (1/50,000 scale)** – This map shows the general location of areas to be surveyed by the ground SCAT surveys. Black lines indicate the boundaries of pre-existing shoreline segments.

An example of a base map that can be used for sketching is shown in Figure 28. This map includes all the information that is also on the topographical map. It was produced directly from the GIS workspace used for data entry and processing. Using such maps for sketching makes data entry much easier. Note that if the shoreline segment boundaries are known, this information should appear on the topographical map representation prepared for sketching.

Similarly, any available data or information that relates to the shoreline segments to be surveyed should be provided to the field teams. This could include data from previous ground and aerial surveys as shown in Figure 29 and data generated for a pre-spill database.

2. Distribute documents to the ground survey crews
   - o Obtain the list and composition of each of the survey crews usually from planning personnel or the SCAT coordinator. Enter this information into the database.
   - o Distribute the data capture documents to the leaders of each survey crew.

It is preferable to complete this step at the end of the day and before the survey so that the team has enough time to inspect the materials and ensure that the document package is complete for the area(s) to be surveyed.

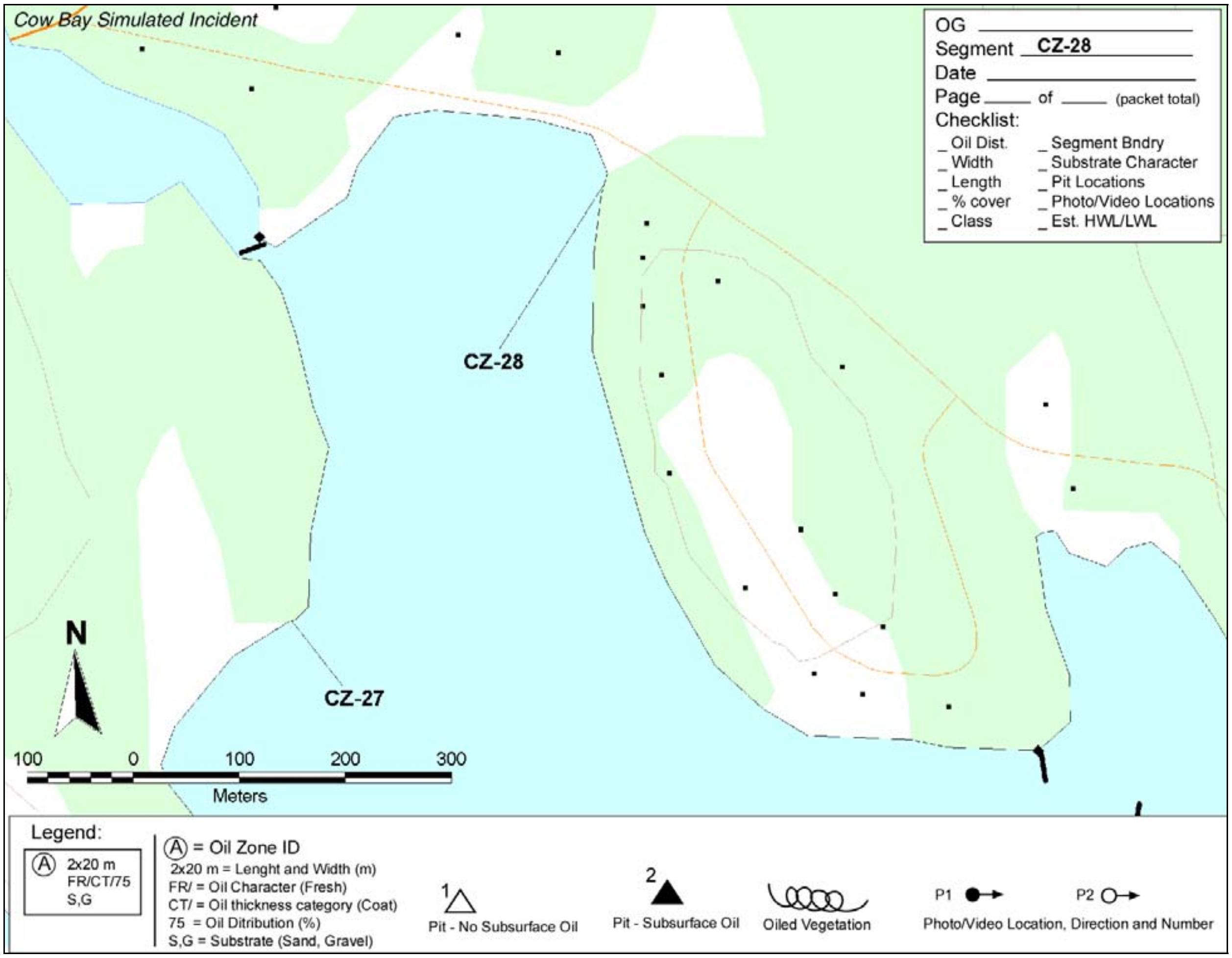


Figure 28 Typical Base Map for Sketching Oiling Characteristics and Other Features Within a Segment to be Surveyed (in this case, CZ-28). Black lines indicate the boundaries of shoreline segments.

3. Obtain data from the ground survey crews
   - Each day, on completion of a survey, team leaders should provide the SCAT data management coordinator with all documents produced during the field survey. Documents can be transferred manually when the crews return from the field or sent electronically by fax or e-mail to the SCAT data management centre. Obviously, this requires specialized hardware and software tools. While sending the data electronically speeds up the data entry, all paper material must be given to the SCAT data management personnel at some point in time.
   - The field team and the SCAT data management centre should maintain a log of the data that is transferred. This log is compiled as soon as the SCAT team leader hands in the field data and should include the date, time, name of person that handed in the data, name of the recipient, and a brief description of the documents transferred, i.e., SOS forms, sketch maps, digital photos, videos, and copies of field books. An example of the information to be included in the "SCAT data transfer" logbook is given in Table 19. A similar log should be generated for information that is transferred electronically.

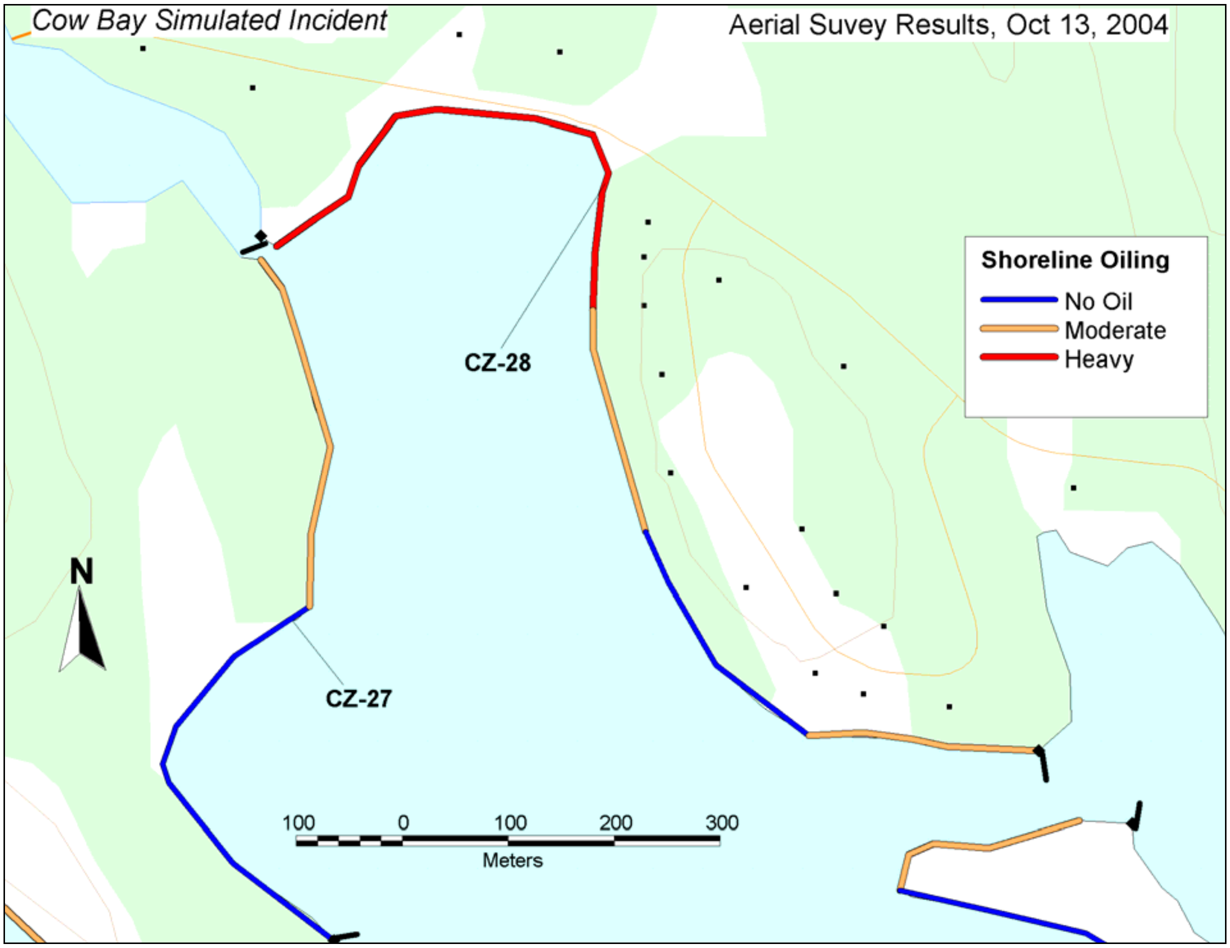


Figure 29 Shoreline Oiling Observations Generated by an Aerial Survey – performed for a portion of the coast to be surveyed by a full-scale ground SCAT team

Table 19 Example of a SCAT Data Transfer Logbook

Data Element	Description
Date	Date of data transfer
Time	Time of transfer
Provided by	Name of personnel who handed in the data
Recipient	Name of the SCAT data management personnel who received the data
Support material	Electronic, paper, CD, etc.
For each document provided indicate:	
Type of document	Nature of the document provided, for example: o SOS form o sketch map o digital photo o video
Support material	Electronic, paper, CD, etc.
Modifications made	Indicate whether the document was modified and why (see item 5 below)

4. Examine ground survey material
    - o Verify survey method.
    - o Clarify any marks or obscure handwriting.
    - o Verify that there is no missing data, e.g., location of digital photos or videos and data essential for assessing oiling category.
    - o Verify that the data recorded on SOS forms coincides with observations recorded on sketches. Make sure that all oiled zones recorded on the sketch are also included on the SOS form. Closely examine the characteristics of surface and subsurface oiled zones, i.e., length, width, thickness, distribution, tidal zone, and substrate, for differences or discrepancies between the sketch and the form.

Special care should be taken to ensure that all relevant data required for assessing and producing summaries are complete. This “core” data is listed in Table 20.

5. Clarify any items that need modifications/changes and correct omissions
    - o Interview SCAT team leader if any information is missing or seems unclear or contradictory.
    - o All modifications or clarifications should be recorded on the document itself and ideally also be indicated in a log file or logbook.

Table 20 Core SCAT Data used for Processing and Assessment

Data Element	Use for which the Data is Required
Oil zone width	Surface oil cover and oiling category
Oil zone distribution	Surface oil cover and oiling category
Oil zone thickness	Surface oil cover and oiling category
Depth of penetration/burial	Subsurface oiling
Nature of oiled substrate	Treatment method, oil persistence, and remobilization potential
Shoreline segment code	Data management
Wave exposure	Remobilization potential and persistence
Slope	Remobilization potential and persistence

6. Enter data in the SCAT ground survey database

a) Enter data on spatial characteristics

Spatial characteristics include the boundaries of shoreline segments and the location of oiled zones, both surface and subsurface. Based on the ground survey, existing segment boundaries derived from a pre-spill database can be changed. If so, the reason for the change should be documented. The location of spatial data is generally indicated on the sketch map of the surveyed shoreline segment.

The following tips and recommendations are based on past data entry experiences.

- o When available, use locations provided by GPS receivers.
- o To enter locations from GPS data into a GIS layer, either develop a specialized GIS script or display the locations as points on a separate layer. Use the points as guides to indicate the location of a subsurface oiled zone or draw a line to represent a surface oil zone.
- o If no GPS latitude and longitude coordinates are provided, try to infer the location of the oiled zones from the sketch.
- o Use the length of a spatial data element, i.e., segment or oil zone, as reported on SOS forms, unless the SCAT surveyor instructs otherwise.

- Select a fixed scale for all entry of spatial data as this makes it easier to draw elements of the proper size.
- Do not try to be “more precise” than the sketch.

b) Enter data on non-spatial characteristics

There is a lot of information on the SOS forms and sketches. The following recommendations can increase the speed of data entry and reduce the possibility of error.

- Develop data entry forms that use drop-down lists and sub-forms to make it easier to key in data.
- Many information items are repeated from one SOS form to the next and sometimes from one oiled zone to the next. Accelerate data entry by either cutting and pasting information or carrying over certain types of information when using data entry forms.
- If time is limited, determine which items of data are critical to produce data summaries and assessments and enter these data elements first. The remaining information can be entered after summaries have been produced.

7. Validate the data

Data entered in computerized systems can be validated in a number of ways.

- Visual validation involves reviewing all data that is entered by comparing it with the SCAT form. This is best done from paper outputs of the data that has been entered.
- Mistakes in data entry can often be detected from summary maps and tables. An efficient method for validating oiling characteristics data is to calculate oil volumes and either map or print the results. Unrealistic volumes, either too large or too small, usually stand out and can be checked for data entry errors.

Several examples of maps and tables used for validation purposes are provided. The oiling categories for segment CZ-28 evaluated for each surface oil zone from the width, oil thickness, and distribution data are shown in Figure 30. The data used for the evaluation are drawn on the map, along with the ID letter of the oil zone. The location of the zones is plotted in relation to the across-shore tidal zone in which the oiled band is located, so that some zones overlap alongshore.

Subsurface oiling results are also represented using symbols to indicate where a pit or trench was dug. The results of the oil volume calculations for the minimum, average, and maximum values of each of the oil thickness categories noted in each of the oil zones shown in Figure 30 are given in Table 21. The table confirms the observation that most of the oil is concentrated in oil zones A, B, C, and D. The same data with respect to the observed oiled substrates are shown in Figure 31.

8. Produce and distribute summary maps and reports

A number of useful maps and reports that can be produced from full-scale ground SCAT survey data are examined in Section 5.3. The most commonly used types of output created from SCAT ground survey data are listed in Table 22.

9. Back up and organize survey data
   - Make copies of all paper material.
   - Make copies of any computer files on a permanent medium such as a CD.
   - Digitized information that is copied on a CD includes not only data tables but also the GIS workspace used to produce the outputs as considerable effort goes into developing these workspaces, i.e., creating labels, selecting the map extent, creating legends, etc.. Workspace files can be recognized by their file extensions, for example, .WOR for MapInfo, .APR for ArcView 3.x, and .MXD for ArcView 9.x.
   - Organize the data sets. The paper material should be organized in folders and include copies of any paper output produced from the data.

Digital information should be clearly labelled. Ideally a log of all backups should be produced. The log should include a list and description of all information copied on permanent media, as well as CD labels. The backup actions should be taken as soon as the data have been entered and the outputs produced.

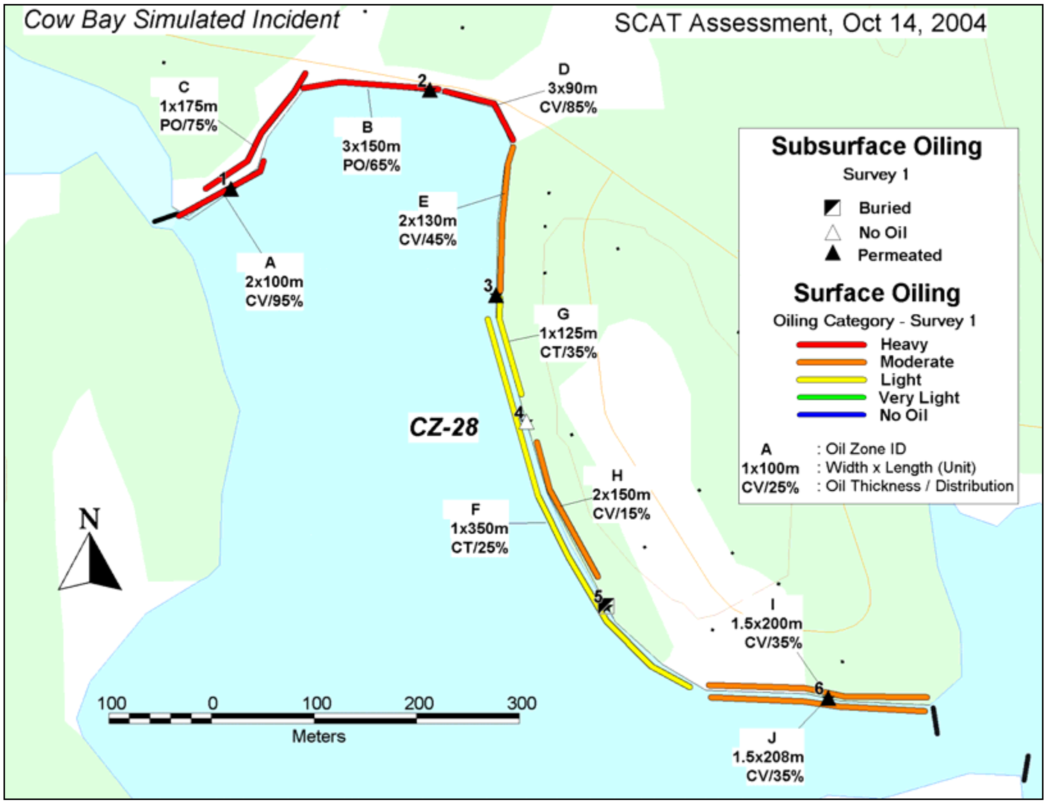


Figure 30 **Data Entry for Segment CZ-28** - The data entered were used to assess the oiling category for each of 10 surface oil zones.

Table 21 **Oil Volume Calculations from Simulated SCAT Data for Segment CZ-28**

					Oil Thickness (cm)			Oil Volumes (m^3)		
Oiled Zone ID	**Width (m)**	**Length (m)**	**Distribution (%)**	**Oil Thickness Category**	**Minimum**	**Average**	**Maximum**	**Minimum**	**Average**	**Maximum**
A	2	100	95	CV	0.1	0.5	1.0	0.2	1.0	1.9
B	3	150	65	PO	1.0	1.5	2.0	2.9	4.4	5.9
C	1	175	75	PO	1.0	1.5	2.0	1.3	2.0	2.6
D	3	90	85	CV	0.1	0.5	1.0	0.2	1.1	2.3
E	2	130	45	CV	0.1	0.5	1.0	0.1	0.6	1.2
F	1	350	25	CT	0.0	0.1	0.1	0.0	0.0	0.1
G	1	125	35	CT	0.0	0.1	0.1	0.0	0.0	0.0
H	2	150	15	CV	0.1	0.5	1.0	0.0	0.2	0.5
I	1.5	200	35	CV	0.1	0.5	1.0	0.1	0.5	1.1
J	1.5	208	35	CV	0.1	0.5	1.0	0.1	0.5	1.1
TOTAL								**5**	**10**	**16**

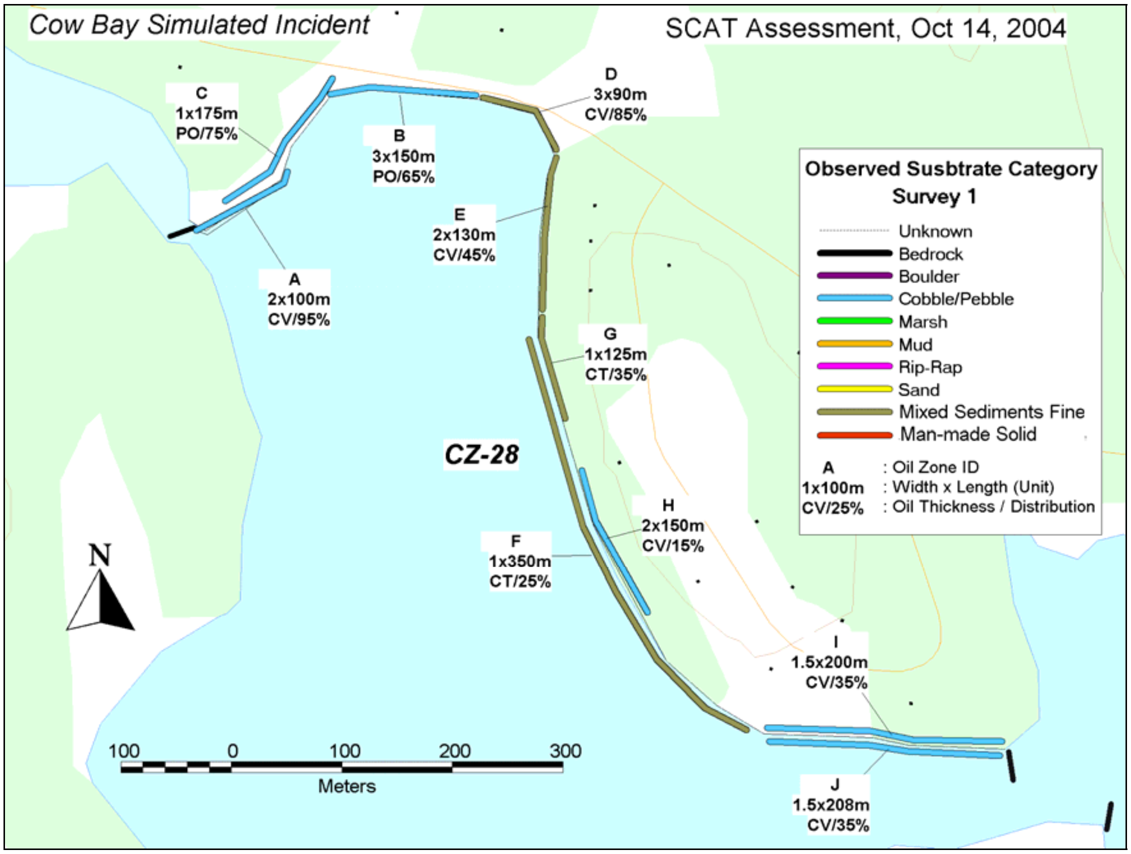


Figure 31 Substrate Category for Each of the 10 Oiled Zones Observed in Segment CZ-28

Table 22 Maps and Reports Most Often Used for SCAT Ground Surveys

Output	Users
SOS forms (original and computerized) Sketch maps	SCAT coordinator Operations section SCAT survey team members
Treatment recommendations transmittal form	SCAT coordinator Planning section Operations section Stakeholders
Surface oil category map (detailed or summary) Oil zone substrate types maps Work status maps Length of oiled shoreline report*****	SCAT coordinator Planning section Incident command Public groups
Survey summary table	SCAT coordinator Planning section

*****Broken down by oil substrate type and surface oil category

Chapter 5 How to Apply SCAT Data

This chapter describes the methods used to process SCAT data and lists the main types of outputs (reports, maps, and tables) produced to support various response activities. The SCAT data that is documented, entered within a data management system, and validated can be presented in many ways to support the planning and decision-making process. The chapter is divided into the following three sections.

Section 5.1 SCAT Data Processing provides detailed technical information on how to analyze and process SCAT data before it can be used to create summary maps and reports. This section is intended primarily for technical personnel directly involved in the data management process.

Section 5.2 Classification of SCAT Data Output assists SCAT coordinators and planners to select the most appropriate maps and reports for a particular incident and lists those maps and reports that are most commonly used.

Section 5.3 SCAT Data Outputs describes many of the maps and reports that can be created from SCAT data during a response. It includes examples of the outputs and guidelines for their selection. This section is intended for technical personnel and provides tips and instructions on creating the maps and outputs. SCAT coordinators and planners will also benefit from the many examples of maps and reports.

5.1 SCAT Data Processing

SCAT data must be processed before being presented in most types of outputs such as maps and tables. The three levels of data processing are described in this section and outlined in Figure 32. The processing algorithms are described extensively so they can be reproduced and used by technical personnel responsible for SCAT data management.

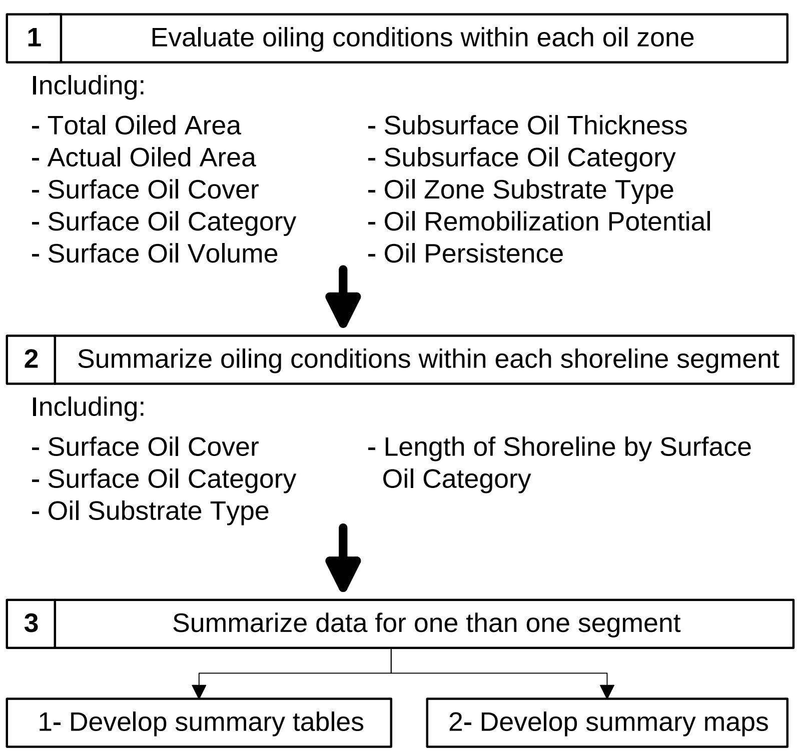


Figure 32 Overview of SCAT Data Processing Tasks

5.1.1 Evaluating Oiling Conditions for Oil Zones

The first step in processing SCAT data is to evaluate the oiling characteristics for each surface or subsurface oil zone. All overview or summary reports and outputs are based on the data produced from this basic assessment. The characteristics of each oil zone are evaluated in terms of oil cover, surface oil category, and the type of substrate in a specific oil zone within a segment. This basic processing can also include an estimate of the remobilization potential and oil persistence.

The characteristics typically used to describe oiling conditions are listed in Table 23 and discussed in this section. Most of these are defined in the Arctic SCAT Manual (Owens and Sergy, 2004). These characteristics can be created from the basic field data. Assessment methods for each of the oiling characteristics are discussed in this section.

Table 23 Characteristics of Oiling Condition in Oil Zones

Characteristic	Description
1. Total Oiled Area	A value calculated from the length and width of the oil zone. It indicates the extent of the overall affected area.
2. Actual Oiled Area	A value calculated from the length, width, and surface oil distribution of the oil zone. It is a measure of the actual surface area covered by oil. This is also known as the "equivalent area" oiled.
3. Surface Oil Cover	A matrix term derived from the width and surface oil distribution of each oil zone. It provides a general index of the degree of surface oiling.
4. Surface Oil Category	A matrix term derived from the surface oil cover and oil thickness in each oil zone. It provides a more specific index of the degree of surface oiling.
5. Surface Oil Volume	A value calculated from the length, width, surface distribution, and thickness data for the oil zone.
6. Subsurface Oil Thickness	A value derived from the observed depth of penetration or the observed thickness of the subsurface oil lens data.
7. Subsurface Oil Category	A matrix term derived from the subsurface oil character and the depth of penetration or the thickness of a buried oil layer. It provides a general index of the degree of subsurface oiling. This is also known as "relative oil concentration".
8. Oil Zone Substrate Type	A term derived from the types of substrate in the oil zone. It describes the nature of the oiled material.
9. Oil Remobilization Potential	An estimate derived from the oiled substrate type, oil character, surface oil cover or surface oil category, and the intertidal location of the oil zone. This provides an assessment of the likelihood that the oil could be refloated by rising water levels.
10. Oil Persistence	An estimate derived from the oil type, surface oil category, the intertidal location of the oil zone and the wave energy level. This provides an assessment of the length of time that the oil could remain if allowed to weather naturally.
11. Maximum Volume of Sediment Removed	A value calculated from the total oiled area and depth of sediment removal by mechanical methods, such as front-end loaders or graders. This value provides an estimate of the amount of waste that might be generated.

1. Total Oiled Area

The total oiled area is calculated by multiplying the length and width of the surface oil zone and is used to define the overall extent of the area affected by the stranded oil. Special attention should be paid to the measurement units when performing the calculation. For a single oil zone, the results will normally be provided in square metres.

2. Actual Oiled Area

The actual oiled area (also known as the "equivalent area oiled") is calculated by multiplying length, width, and surface oil distribution (as a percent value) of the oil zone. It is a measure of the actual surface area within the zone that is covered by oil. The results of the calculation can be provided as a single value or a range, depending on how the surface oil distribution is reported on the SCAT form. An example of a calculation for simulated oiling data is given in Table 24. The example illustrates the possible range of variation of the actual oiled area with different distribution categories.

Table 24 Results of Calculations for Total and Actual Oiled Area for Simulated Oiling Data

Oil Zone ID	Width (m)	Length (m)	Total Oiled Area (m^2)	Distribution (%)				Actual Oiled Area (m^2)		
				Category	Min.	Mid.*	Max.	Min.	Mid.*	Max.
A	2	100	**200**	Continuous	91	95	100	**182**	**190**	**200**
B	2	100	**200**	Patchy	11	30	50	**22**	**60**	**100**
C	2	100	**200**	Broken	51	65	90	**102**	**130**	**180**
D	2	100	**200**	Sporadic	1	5	10	**2**	**10**	**20**

**Mid. refers to the centre of the interval for each category of distribution.*

3. Surface Oil Cover

A general index of the degree or relative severity of oiling is often created from the detailed SCAT data and this index is used in mapping and operational planning. Two such indices for intertidal environments are shown in Tables 25 and 26 (from Owens and Sergy, 2004). Others could be created to fit the conditions of the incident. In this example, the surface oil cover is an index derived from a matrix based on the width of the oiled zone and the distribution of the oil within that zone.

The derivation of the oil cover term can be automated. An example of the pseudocode is given in Figure 33. This can easily be integrated within a spreadsheet or GIS program.

Table 25 Estimation of Surface Oil Cover Category (width x distribution data)

	Width of Oiled Area			
Distribution	**Wide (>6 m)**	**Medium (>3 to 6 m)**	**Narrow (>0.5 to 3 m)**	**Very Narrow (<0.5 m)**
Continuous 91 to 100%	Heavy	Heavy	Moderate	Light
Broken 51 to 90%	Heavy	Heavy	Moderate	Light
Patchy 11 to 50%	Moderate	Moderate	Light	Very light
Sporadic 1 to 10%	Light	Light	Very light	Very light
Trace <1%	Very light	Very light	Very light	Very light

Table 26 Estimation of Surface Oil Category (surface oil cover category x thickness data)

	Surface Oil Cover Category			
Thickness	**Heavy**	**Moderate**	**Light**	**Very Light**
Thick Oil (>1 cm)	Heavy	Heavy	Moderate	Light
Cover (>0.1 to 1.0 cm)	Heavy	Heavy	Moderate	Light
Coat (>0.01 to 0.1 cm)	Moderate	Moderate	Light	Very light
Stain/Film (<0.01 cm)	Light	Light	Very light	Very light

```
Repeat for each record in the Surface Oil Zones Data table
  If Width of Oil Band is >0 m and Oil Distribution is >0 then
    If Width of Oil Band is >3 m then
      If Oil Distribution is >90% then Surface Oil Cover is Heavy
        Else if Oil Distribution is >50% then Surface Oil Cover is Heavy
        Else if Oil Distribution is >10% then Surface Oil Cover is Moderate
        Else if Oil Distribution is >1% then Surface Oil Cover is Light
        Else Surface Oil Cover is Very Light
    Else if Width of Oil Band is >0.5 m then
     If Oil Distribution is >90% then Surface Oil Cover is Moderate
        Else if Oil Distribution is >50% then Surface Oil Cover is Moderate
        Else if Oil Distribution is >10% then Surface Oil Cover is Light
        Else if Oil Distribution is >% then Surface Oil Cover is Very Light
        Else Oil Cover is Very Light
    Else
      If Oil Distribution is >90% then Surface Oil Cover is Light
        Else if Oil Distribution is >50% then Surface Oil Cover is Light
        Else if Oil Distribution is >10% then Surface Oil Cover is Very Light
        Else if Oil Distribution is >% then Surface Oil Cover is Very Light
        Else Surface Oil Cover is Very Light
    End If
  Else
    Surface Oil Cover is No Oil
  End If
End Repeat
```

Figure 33 Example of a Pseudocode for Evaluating Surface Oil Cover

4. Surface Oil Category

A general index of the degree or relative severity of oiling is often created from the detailed SCAT data and this index is used in mapping and operational planning. Two such indices for intertidal environments are shown in Tables 25 and 26 (from Owens and Sergy, 2004). Others could be created to fit the conditions of the incident. As shown in Table 26, the surface oil category is derived from a matrix based on the estimated surface oil cover and the observed thickness of the oil in the zone.

The derivation of the surface oil category term can be entirely automated. An example of a pseudocode that can easily be integrated within a spreadsheet or GIS program for that purpose is shown in Figure 34.

```
Repeat for each record in the Surface Oil Zones Data table
  If Thickness of Oil Zone is >0 cm and Oil Cover <> No Oil then
    If Thickness of Oil Zone is >1 cm then
      If Surface Oil Cover is Heavy then Surface Oil Category is Heavy
        Else if Surface Oil Cover is Moderate then Surface Oil Category is Heavy
        Else if Surface Oil Cover is Light then Surface Oil Category is Moderate
        Else if Surface Oil Cover is Very Light then Surface Oil Category is Light
    Else if Thickness of Oil Zone is >0.1 cm then
     If Surface Oil Cover is Heavy then Surface Oil Category is Heavy
        Else if Surface Oil Cover is Moderate then Surface Oil Category is Heavy
        Else if Surface Oil Cover is Light then Surface Oil Category is Moderate
        Else if Surface Oil Cover is Very Light then Surface Oil Category is Light
    Else if Thickness of Oil Zone is >0.01 cm then
     If Surface Oil Cover is Heavy then Surface Oil Category is Moderate
        Else if Surface Oil Cover is Moderate then Surface Oil Category is Moderate
        Else if Surface Oil Cover is Light then Surface Oil Category is Light
        Else if Surface Oil Cover is Very Light then Surface Oil Category is Very Light
    Else
      If Surface Oil Cover is Heavy then Surface Oil Category is Light
        Else if Surface Oil Cover is Moderate then Surface Oil Category is Light
        Else if Surface Oil Cover is Light then Surface Oil Category is Very Light
        Else if Surface Oil Cover is Very Light then Surface Oil Category is Very Light
    End If
  Else
    Surface Oil Category is No Oil
  End If
End Repeat
```

Figure 34 Example of a Pseudocode for Evaluating Surface Oil Category

5. Surface Oil Volume

The surface oil volume for a single oil zone is calculated by multiplying the width, length, thickness, and percent distribution of the oil. The precision of the oil volume measurement is affected by many uncertainties, including the following.

a. The width and length of the oil zone are recorded as single values used to characterize a non-geometric feature. In most cases, the width represents the "most common or middle value" of a range.
b. As it is not possible to measure oil thickness accurately and this measurement typically varies within an oiled zone, this value generally corresponds to a range category.

As a result, the calculation of surface oil volume generates a very approximate value and should be reported in maps and tables in a manner that reflects this lack of precision. This point is illustrated in Table 27 which shows the degree of variation of a surface oil volume measurement for a series of oil zones with similar length and width, but with varying oil distribution and thickness.

Table 27 Results of Oil Volume Calculation for Simulated Oiling Data

			Distribution (%)				**Oil Thickness (cm)**				**Oil Volumes (m^3)**		
Oil Zone ID	**Width (m)**	**Length (m)**	**Category**	**Min.**	**Mid.***	**Max.**	**Category**	**Min.**	**Mid.**	**Max.**	**Min.**	**Mid.***	**Max.**
A	2	100	Continuous	91	95	100	PO	1	1.5	2	**1.82**	**2.85**	**4.00**
B	2	100	Patchy	11	30	50	CV	0.1	0.5	1	**0.02**	**0.30**	**1.00**
C	2	100	Broken	51	65	90	CV	0.1	0.5	1	**0.10**	**0.65**	**1.80**
D	2	100	Sporadic	1	5	10	CV	0.1	0.5	1	**0.00**	**0.05**	**0.20**

**Mid. refers to the centre of the interval for each category of distribution.*

6. Subsurface Oil Thickness

Subsurface oil is either buried under a layer of sediment or has penetrated the shoreline material by infiltration from the surface, thus oiling the subsurface material up to an observed depth. The subsurface oil thickness is a value derived from the observed depth of penetration or the observed thickness of a buried oil layer. This value is obtained from pit or trench observations and is used to estimate the depth of oil removal or treatment that might be required or the thickness of the unoiled overburden.

The subsurface oil thickness is not easy to represent in a clear and simple way on a map. The subsurface oil state, however, can be easily represented. This is a value that indicates whether oil is buried or has penetrated the shoreline material. This value, plotted for each pit or trench dug along a shoreline, provides additional indications about the nature of the oiling conditions that will affect the treatment methods. The assessment of the subsurface oil state for each of the pits or trenches dug during the SCAT survey is easy to infer and automate from the depth measurements of the oil zone, as shown in Figure 35.

```
Repeat for each record in the Sub-Surface Oil Data table
  If Oiled Zone Lower Limit is >0 cm
    If Oiled Zone Upper Limit is >0 cm then Subsurface Oil State is Buried
    Subsurface Oil State is Permeated
  Else
    Subsurface Oil State is No Oil
  End If
End Repeat
```

Figure 35 Example of a Pseudocode for Evaluating Subsurface Oil State - from the observed oiled zone in the upper and lower limits of a pit or trench

7. Subsurface Oil Category

The subsurface oil category is a matrix term derived from the subsurface oil character (also known as "relative oil concentration") and the depth of penetration or the thickness of a buried oil layer. This provides a general index of the degree of subsurface oiling as shown in Table 28.

Table 28 Estimation of Subsurface Oil Category (width x distribution data)

	Depth of Penetration or Thickness of Oil Lens			
Relative Oil Concentration	**>30 cm**	**21 to 30 cm**	**11 to 20 cm**	**0 to 10 cm**
OP (Oil-filled pores)	Heavy	Heavy	Heavy	Moderate
PP (Partially filled pores)	Heavy	Moderate	Moderate	Light
OR (Oil residue as a cover)	Moderate	Moderate	Light	Light
OF/TR (Film or stain – trace)	Light	Very light	Very light	Very light

The derivation of the subsurface oil category can be automated. An example of a pseudocode that can easily be integrated with a spreadsheet or GIS program for that purpose is shown in Figure 36.

```
Repeat for each record in the Subsurface Oil Zones Data table
  If Thickness of Oil is >0 and Relative Oil Concentration is >0 then
    If Relative Oil Concentration is OP then
      If Thickness of Oil is >10 cm then Subsurface Oil Category is Heavy
        Else Subsurface Oil Category is Moderate
    Else If Relative Oil Concentration is PP then
      If Thickness of Oil is >30 cm then Subsurface Oil Category is Heavy
        Else if Thickness is >10 cm then Subsurface Oil Category is Moderate
        Else Subsurface Oil Category is Light
    Else if Relative Oil Concentration is OR then
      If Thickness of Oil is >20 cm then Subsurface Oil Category is Moderate
        Else Subsurface Oil Category is Light
    Else
      If Thickness of Oil is >0 cm then Subsurface Oil Category is Light
        Else Subsurface Oil Category is Very Light
    End If
  Else
    Subsurface Oil Cover is No Oil
  End If
End Repeat
```

Figure 36 Example of a Pseudocode for Evaluating Subsurface Oil Category

8. Oil Zone Substrate Type

Substrate types observed within each oil zone are recorded as a single letter representing the category of grain size or substrate material. This is shown in Table 29. If coarse sediments are present, more than one type of substrate is often recorded for each surface oil zone. In this case, each observed type of substrate should be noted in order of predominance. For example, entering "B, C, S, P" in the substrate type box of an oiling form indicates that the predominant type of substrate observed is boulder, followed by cobble, sand, and pebbles.

Table 29 Types of Substrate (Sergy, 2007, personal communication)

Code	Description	Grain Size
R	Bedrock	NA
B	Boulder	>256 mm diameter
C	Cobble	64 to 256 mm diameter
P	Pebble	4 to 64 mm diameter
G	Granule	2 to 4 mm diameter
S	Sand	0.06 to 2 mm diameter
M	Mud/silt/clay	<0.06 mm diameter
O	Organic/peat/soil	NA
MMS	Man-made solid	NA
MMP	Man-made permeable	NA
U	Unconsolidated	NA
VEG	Live Vegetation	NA

NA – not applicable

Only one substrate type can be shown on maps. As this can sometimes be an issue when more than one type of substrate has been observed, the predominant or primary oiled substrate category for each oiled zone must be determined in order to produce summary tables and maps using the surface oiled substrate types. This can be resolved by developing a 'substrate type' to 'substrate category' translation matrix such as the one shown in Table 30.

Table 30 Example of Summary Evaluation of Substrate Types - from combinations of basic substrate types

Codes	Summary Substrate Type
C, P, G	Cobble-pebble-granule
C, P, G, S	Mixed sediment - coarse
P, G, S	Mixed sediment - fine
V*	Marsh, wetland, or vegetation
MMS	Man-made solid or sea wall
MMP	Man-made permeable or rip-rap

Grain size or substrate categories are usually noted in order of predominance in the appropriate box on a SCAT form. If there are seemingly incompatible combinations of substrate types, such as bedrock and sand, the predominant type of oiled substrate should be verified with the SCAT team leader.

9. Oil Remobilization Potential

The oil remobilization potential is an estimate of the likelihood that untreated stranded oil could be re-floated by rising water levels and redistributed by wave action to oil or re-oil an adjacent or nearby section of shoreline. The remobilization potential provides useful information for determining priorities for shoreline treatment. Evaluating remobilization potential usually involves input from a person with oil spill experience, such as the SCAT team leader or the SCAT coordinator. A map derived form this data set is a valuable starting point for the decision-making and planning process.

Remobilization potential is derived from oiled substrate type, oil character, surface oil cover or surface oil category, and the intertidal location of the oil zone. The ShoreAssess® system includes a set of instructions for automating the evaluation of remobilization potential.

10. Oil Persistence

Oil persistence is an estimate of the length of time that stranded oil is likely to remain in an oiled zone if no attempt is made to treat or remove it. The expected persistence can be very short, i.e., "hours to days" for certain types of oil such as gasoline or can range up to "months to years" for heavy, weathered oil that is stranded above the limit of normal wave action.

Persistence is derived from the oil type, surface oil category, the intertidal location of the oil zone, and the wave energy level. Evaluation of the oil persistence will normally be the result of expert assessment by the SCAT team leader or the SCAT coordinator. The ShoreAssess® system includes a set of instructions for automating the evaluation of oil persistence

11. Maximum Volume of Sediment Removed

Using mechanical treatment methods, such as graders or front-end loaders, speeds up the treatment of oiled sediment beaches, but also generates a lot of waste. The maximum amount of waste likely to be produced is estimated by multiplying the total oiled area by the depth of penetration of the equipment used.

If subsurface oil has been observed underneath an oil zone, then the depth of penetration of the oil can be used to estimate the maximum amount of sediment that will need to be removed to get rid of the oil, as well as the equivalent amount of waste generated.

5.1.2 Summarizing Oiling Conditions Within Each Shoreline Segment

If the oiling conditions are not uniform within a segment and there is more than one surface oil zone in the segment, the second processing step is to organize the oiling assessments so they can be presented as overviews or data summaries on a segment-by-segment basis. The methods used to summarize oiling characteristics for each segment must take into account that SCAT surveys may report oiling as multiple parallel across-shore zones with varied oiling characteristics within each zone.

Creating summaries of oiling conditions for single shoreline segments includes:

- o developing an oil surface cover term, a surface oil category term, and/or a term for oiled substrate type that represents the conditions within the entire segment; and
- o calculating the length of the surface oil cover in the shoreline segment or surface oil category terms.

Creating shoreline segment oiling summaries is not entirely straightforward as SCAT ground survey observations frequently involve:

- o several oil zones, located in different tidal zones within a single segment, the combined total length of which exceeds the actual length of that segment;
- o more than one type of oil zone substrate, e.g., oiled sand in the lower intertidal zone and oiled cobble-pebble in the upper intertidal zone; and
- o more than one surface oil category, perhaps ranging from light to heavy oiling.

The simulated oiling conditions of segment CZ-28 represent a typical situation that might arise. The result of the assessment of each of the oiling characteristics within the oil zone, following the method presented in Section 5.1.1, is shown in Table 31. The mapped parameters are presented and discussed in more detail in Section 5.3.

Table 31 Results of Oiling Assessments for Each Oil Zone from Simulated SCAT Data for Segment CZ-28

							Assessments		
Oil Zone ID	Tidal Zone	Width (m)	Length (m)	Distribution (%)	Oil Thickness Category	Substrate Types	Surface Oil Cover	Oiling Category	Substrate Category
A	LI	2	100	95	CV	C,P	Moderate	Heavy	Cobble-Pebble
B	UI	3	150	65	TO	C,P,G	Moderate	Heavy	Cobble-Pebble
C	UI	1	175	75	TO	C,P,G	Moderate	Heavy	Cobble-Pebble
D	UI	3	90	85	CV	G,S	Moderate	Heavy	Mixed Sediments Fine
E	UI	2	130	45	CV	P,G,S	Light	Moderate	Mixed Sediments Fine
F	LI	1	350	25	CT	P,G,S	Light	Light	Mixed Sediments Fine
G	UI	1	125	35	CT	G,S	Light	Light	Mixed Sediments Fine
H	UI	2	150	15	CV	C,P	Light	Moderate	Cobble-Pebble
I	UI	1.5	200	35	CV	C,P	Light	Moderate	Cobble-Pebble
J	LI	1.5	208	35	CV	C,P,G	Light	Moderate	Cobble-Pebble

Note: Total length of segment CZ-28 is 1,239 m.

1. Summary of Surface Oil Cover, Surface Oil Category, and Oiled Substrate Type

A meaningful summary of the detailed oil character of a segment can be developed by using the following method.

a. Use the substrate **category** of the oil zone that is the most heavily oiled. If there is more than one heavily oiled zone, then select the most common one. As shown in Table 31, the overall substrate type for segment CZ-28 is “Cobble-Pebble”.
b. Select the highest observed **surface oil cover** and **oiling category** as the segment’s overall surface oil category. As shown in Table 31, the overall oiling category is “Heavy”.

This method provides a characterization of the overall shoreline substrate type and oiling category that corresponds to the “worst oiling situation” observed during a given SCAT survey within a shoreline segment.

2. Calculating the Length of Shoreline by Surface Oil Category

The total length of oiled shoreline can exceed the length of the segment when the lengths of all the observed oil zones are totaled. The length of shoreline by surface oil category can be calculated by using the following algorithm.

a. Calculate the length of shoreline oiled for the highest observed category.
b. If this value does not exceed the total length of the shoreline, then calculate the length of shoreline oiled for the next highest surface oil category.
c. Repeat 1 and 2 until the total length of oiling reaches the total length of the shoreline.
d. If the total length of the shoreline has not been reached, then assign the category “No Oil” to the remaining length of the shoreline.

An example of the step-by step procedure used to summarize the surface oil category for shoreline segment CZ-28 is given in Figure 37.

The example in Figure 37 illustrates a situation in which the sum total of the lengths of all oil zones exceeds that of the shoreline segment. The algorithm also provides accurate oiling summaries for simpler situations such as when the sum total of the length of all observed oil zones is less than the total length of the segment. In this case, the method also calculates the length of that portion of the segment where oil was not observed. This offers an advantage as SCAT surveyors often do not assign oil zones to portions of the segment that are not oiled, i.e., any area where oil is not observed is simply left unmarked on sketches.

As summarizing the lengths of shoreline by oil category using this method can involve many calculations, it is preferable to automate the process using a computer program.

Segment CZ-28 detailed data

Oil Zone ID	*Length (m)*	*Oiling Category*
A	100	Heavy
B	150	Heavy
C	175	Heavy
D	90	Heavy
E	130	Moderate
F	350	Light
G	125	Light
H	150	Moderate
I	200	Moderate
J	208	Moderate

Total segment length: 1239 m

1 Calculate length of segment with heavy oiling

A (100 m) + B (150 m) + C (175 m) + D (90 m) = 515 m

Total length of oiled shoreline after this step: 515m

Is the total segment length reached? NO

Then:

2 Calculate Length of Segment with Moderate Oiling

E (130 m) + H (150 m) + I (200 m) + J (200 m) = 688 m

Total length of oiled shoreline after this step:
515 + 688 = 1203 m

Is the total segment length reached? NO

Then:

3 Calculate length of segment with light oiling

F (350 m) + G (125 m) = 475 m

Total length of shoreline after this step:
515 + 688 + 475 = 1678 m

Is the total segment length reached? YES

Oiled length exceed segment length by:
1678-1239 = 439 m

4 Modify the length of the lowest oil category

Corrected length of light oiling:

475 (total length of lightly oiled zones)
- 439 (length exceeding the shoreline segment length)

36 m (new length of lightly oiled portion of the segment)

Segment CZ-28 Summary

Length of shoreline by surface oil category (m)				
Heavy	Moderate	Light	Very Light	No Oil
515	688	36	0	0

Figure 37 Step-by-step Procedure used to Summarize Surface Oil Category for a Single Shoreline Segment (CZ-28)

5.1.3 Summary of Data for More than One Segment

Regional and/or survey summaries are developed using either summary tables or summary maps, both of which are described here. Summaries of multiple segments are used to illustrate or summarize the oiling conditions or other data layers in a specific geographic area. Maps and/or tables are created using several methods depending on the nature, characteristics, number of segments covered, and the complexity of the SCAT data recorded during field surveys.

1. Developing Summary Tables

Summary tables are used to summarize and synthesize data for entire surveys and sometimes for more than one survey. There are two types of tables:

- o tables that provide measurements, such as the total length of oiled shoreline by surface oil category, which is shown in Table 32; and
- o tables that list characteristics applied to each of the shoreline segments impacted by a spill, such as the list of recommended treatment methods shown in Figure 49.

Summary measurement tables use the results of shoreline oiling summaries, calculated following the methods and principles shown in Section 5.1.2. These tables are constructed by using simple lists and additions and are often broken down by operations division and survey. These tables can be created using simple spreadsheet programs or database applications. The use of “pivot” functions, which are part of spreadsheet and database systems, often simplifies production of cross-referenced tables.

Table 32 Oil Measurement Table Showing Surface Oil Category broken down by Operations Division

Operations Division	Length of Shoreline by Surface Oil Category (m)				
	Heavy	Moderate	Light	Very Light	No Oil
A	2024	3895	1304	0	16
B	1150	4514	3395	1169	0
C	515	2531	7040	1195	0
Total	**3689**	**10940**	**11739**	**2364**	**16**

Tables that provide lists and characteristics of shoreline segments generally involve additional data entry steps. For example, to create a list of recommended and applied treatment methods, the relevant information must be entered into a data table.

The main types of tables and the required processing steps are discussed in Section 5.3. To make summary tables more useful, the following general principles and standards should be followed.

- o The name of the incident, the title of the table, and the survey number should always be clearly indicated, preferably in the table header.
- o The date the table was produced and the total number of pages should be noted, preferably in the footer. In order to avoid any possible confusion, dates should always be printed using the abbreviated word for the month rather than using numbers, e.g., Oct 13, 2004 or 13-Oct-04, but not 13/10/04 or 04-10-13.
- o For certain tables, the name of the person responsible for the data and processing should also be indicated.

Examples of headers and footers for summary tables are shown in Figure 37.

Example of a report Header:

Cow Bay Simulation	Oiling Summary by Substrate Type *(SCAT Survey No : 1)*

Example of a report Footer:

Cow Bay Simulation - Oiling Summary by Substrate	16-Oct-2004	Page 1 of 1

Figure 38 Headers and Footers for Tables

2. Developing Summary Maps or Overview Maps

Developing summary maps involves selecting an attribute, e.g., oil category, and creating a "thematic map" that displays the possible values of this attribute over a selected portion of the area of the shoreline impacted by the spill. Maps with information for oil zones are referred to as overview maps and those representing summary values for each shoreline segment are called summary maps. (I added this here to clarify the difference.)

The following principles and formatting standards should be used in order to ensure the effectiveness of summary maps or overview maps.

The scale of overview maps is selected so that the map will fit on letter-size paper and be easy to distribute. Overview maps should indicate at least:

- the location of the coastline;
- the map scale and North arrow;
- prominent place names;
- the location of land versus water; (Ideally, either water or land areas should be lightly shaded. Include major roads and locations of cities or villages to provide contextual information.) and
- the boundaries of operations divisions.

If there are not too many shoreline segments, then the boundaries of the shoreline segment and the segment ID, e.g., CZ-28, should be indicated. If this is not possible, a set of multiple maps could be developed at a scale showing the boundaries and identifications of individual shoreline segments.

The following steps should be taken when creating a map.

- Always clearly print the incident name, date of production, and type of map on each output.
- Most SCAT-based overview maps present information for a specific survey. Make sure that the code and/or date of the survey are clearly indicated on the map.
- Creating labels takes time and positioning the labels depends on the size of the printed output. To save time, a set of fixed-scale map templates could be developed and formatted for specific purposes. Each set of templates should include labels, scale, and North arrow.

The following set of map templates is usually enough to meet most needs:

a. a "legal-size" map template that covers the entire area affected by the spill and is used for general overviews;
b. a template that always allows the names and boundaries of individual shoreline segments to be displayed; (The entire area affected by the spill may have to be printed on more than one legal-size map.) and
c. a set of templates covering each of the individual shoreline segments. This set of templates can be developed when material is distributed to SCAT survey teams.

When information is displayed in which each category corresponds to a level, such as "Very Light, Light, Moderate, Heavy", use the "blue to red" principle, i.e., blue, green, yellow, orange, red, to assign colours to each category and present these categories in a decreasing order of magnitude. This is shown in Figure 38. When information is displayed in which each category does not correspond to a level, use a colour scheme that maximizes the differentiation between categories as shown in Figure 39.

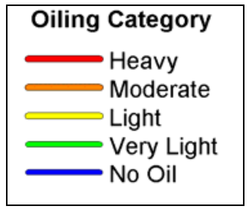


Figure 39 Legend for Representing Oil Category

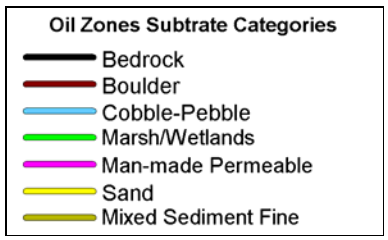


Figure 40 Legend for Representing Categories of Oil Zone Substrates

Shoreline segments are always represented by lines because the exact width of shoreline segments is generally not noted on SCAT forms and it is easy to control the width of the line representing a segment to ensure that it is always clearly visible.

Similarly, oil zones are always represented by lines since it is easy to control the width of the line representing each oil zone to ensure that it is clearly visible. In addition, when using a GIS, a representation of oil zones can be created in which the width of the displayed line is a function of the recorded width.

Shoreline boundaries can be displayed by using tick marks or single symbols such as dots or diamonds along the shoreline. Either method is adequate. Before entering segment boundaries as tick marks, however, the final display scale should be known since the tick marks may not be visible when the scale is very small. This is not an issue when a symbol is used to represent shoreline boundaries. Another advantage of indicating the shoreline boundary with a single symbol is that it can be entirely automated and the symbol can easily be enlarged if it is not visible. On the other hand, while tick marks must usually be entered by hand, they generally look better on the map.

A map illustrating some of the key points made in this section is shown in Figure 41, in which segment boundaries are presented as diamonds. This figure can be compared with Figure 57, which provides an identical representation but with the segment boundaries shown as slash marks perpendicular to the shoreline. Segment boundaries will be presented as slash marks in the rest of the examples of maps in this manual.

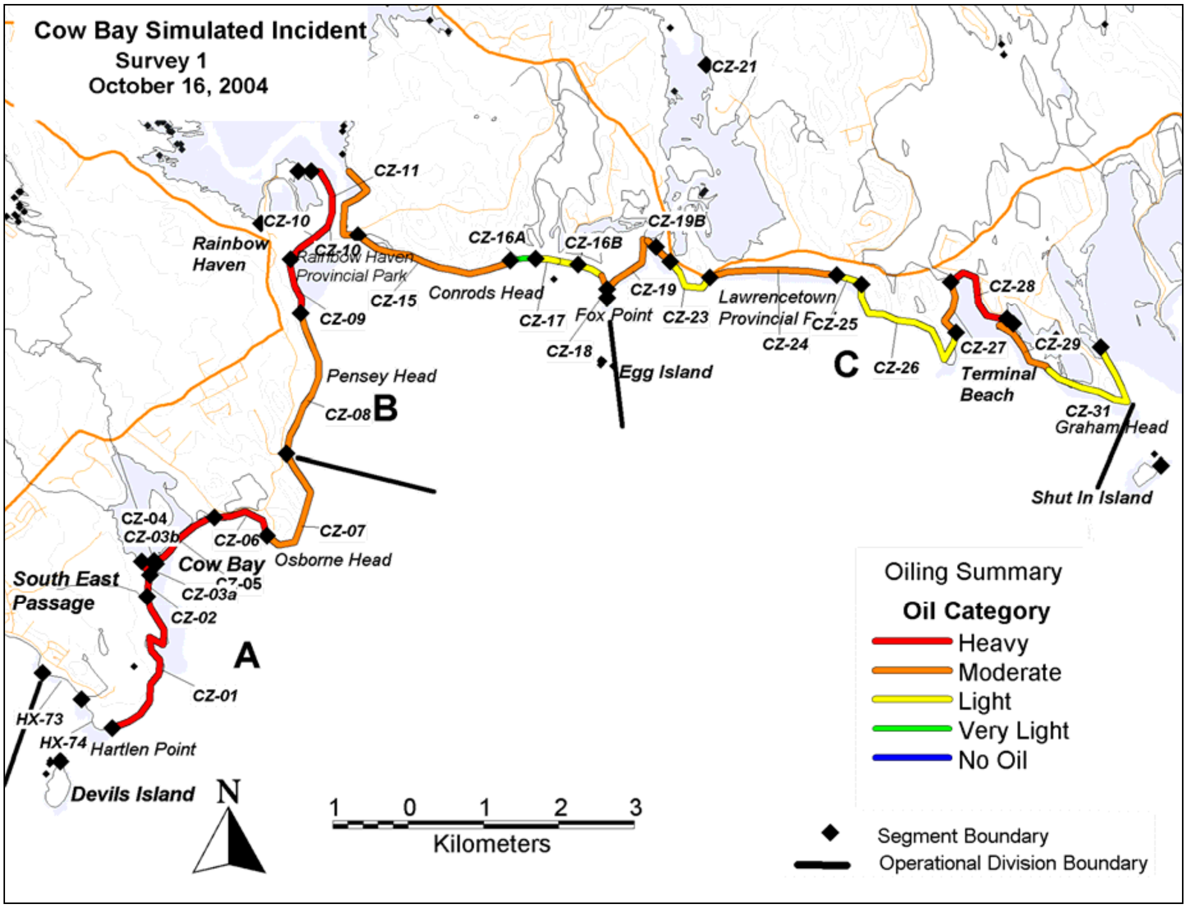


Figure 41 Map of Surface Oil Category for Each Shoreline Segment Observed during a Given Survey - Segment boundaries are represented as diamonds

5.2 Classification of SCAT Data Output

The wide variety of reports, maps, and tables derived from SCAT data fall into three main categories:

- o raw, detailed segment-by-segment field data;
- o segment-based reports and summaries; and
- o regional summaries.

Raw (detailed) segment field data are unprocessed and are used by SCAT survey and inspection teams for comparison purposes. Original unedited, but validated, information may also be used for legal purposes, sometimes to support damage assessment. Detailed segment data are also used to develop shoreline treatment recommendations. Raw segment documents include copies of SOS forms and sketches and computerized outputs of the SOS forms and sketches (entered within a GIS).

Segment-based reports and summaries organize and synthesize the raw SCAT data so it can be used to support planning and operations for shoreline treatment activities. These reports include assessments of the oil category for each oil zone and summaries for the entire segment. Segment-based reports also include detailed treatment instructions and evaluations of the treatment effort for each segment.

Segment-based reports and summaries include:

- assessments of surface oil cover, surface oil category, oil remobilization potential, and persistence;
- treatment recommendations transmittal report; and
- treatment effort assessment reports.

Regional summaries cover many different types of reports, tables, and maps. These documents are used to support the decision-making process in the following ways:

- evaluate the nature and extent of response;
- provide information to assess response priorities, i.e., where and how to respond first;
- provide information to estimate the amount of resources that will be required for the response;
- provide a general overview of what is done and where; and
- provide a general overview of the response status.

Regional summary documents include:

- overview maps that show surface and subsurface oil category, remobilization potential, oil persistence, and oil volume;
- overview maps that show the character of the oil zone substrates;
- summary tables that show the length of oiled shoreline, typically broken down by oil zone substrate type, operations division, or shoreline segment;
- summary tables that show the SCAT survey history, also broken down by operations division or shoreline segment;
- summary tables that show the treatment methods recommended and used in each shoreline segment; and
- overview maps that show the work status.

The most commonly produced outputs in the three major categories are listed in Table 33.

Table 33 SCAT-based Outputs Used Most Often

Category	Output	Users
Raw, detailed, segment field data	SOS forms (original and computerized) Sketch maps	SCAT coordinator Operations section SCAT survey team
Segment-based summaries	Treatment Recommendations Transmittal form	SCAT coordinator Planning section Operations section Stakeholders
Regional summaries	Surface Oil Category Map (detailed or summary) Oil Zone Substrate Type maps Work Status maps Length of oiled shoreline report*****	SCAT coordinator Planning section Incident Command Public groups
	Survey Summary Table	SCAT coordinator Planning section

***Broken down by oil substrate type and surface oil category*

5.3 SCAT Data Outputs

The following information is presented for each of the selected outputs, i.e., map, report, or table:

- the main purpose of the report or map;
- the response teams or groups that will probably use the document;
- probable frequency of production in the course of a response;
- the nature of the data and the processing required to create the output;
- inherent limitations of the document or outputs; and
- examples of the data outputs.

In many of the outputs presented, it is assumed that the data has already been processed with one of the methods described in Section 5.1. When this is the case, a cross-reference is made to the appropriate method for producing the output.

Most of the examples are taken from the simulated spill used throughout this manual. Segment level information uses the simulated segment CZ-28.

The outputs produced to support the field survey effort, i.e., blank forms and sketch maps, are described in Table 22 in Chapter 4.

An overview of the reports and maps derived from SCAT data is presented in Figure 41, as well as a guide to selecting the most appropriate output.

- Outputs are associated with the response phase for which they are likely to be the most useful.
- Outputs within boxes are routinely used in the course of a response.
- Outputs that are not within boxes are those that could be useful, if available.

The way to present certain types of information such as levels of oiling category or substrate type within overview maps may vary according to the nature of the data or the use of the representation. Some guidelines for selecting the most appropriate way to show overview information are given in Figure 42.

Most of the maps represent data for a single shoreline survey. Some of the SCAT data, such as the surface oil category, can be represented either in detailed format, i.e., for every oil zone observed, or in summary format, i.e., one value for each shoreline segment. The choice of representation depends on how easy it is to distinguish single oil zones within each segment.

If there is only one across-shore oil zone within each segment in a single tidal zone, then overview maps can be used to represent the information within every oil zone. In all other situations, oil bands in various tidal areas will obscure each other. There are two ways to counter this limitation. One is to use a map showing the oiling summary for entire segments, for example, Figure 58. The other is to represent the information for oil zones located in a single intertidal zone, for example, Figure 50.

A decision tree to help select the most appropriate map representation is provided in Figure 43.

All Phases		
	Overview Map Showing Operations Division and Shoreline Segments (Figure 22)	
Initial Treatment Phase		
	Overview Map of Surface Oiling (Section 5.3.1) Summary Table of Surface Oil Category (Section 5.3.2)	
Treatment Phase		
Planning	Overview Map of Surface Oil Categories* (Sections 5.3.10 and 5.3.17) Summary Table of SCAT Survey History (Section 5.3.9) Summary Tables of Surface Oil Categories Broken Down by Substrate Type (Section 5.3.16) Overview Maps of Oiled Substrate Type* (Sections 5.3.11 and 5.3.18), Remobilization Potential (Section 5.3.12) and Oil Persistence (Section 5.3.13) Summary Maps of Oil Volume (Section 5.3.19) Summary Table of Treatment Recommendations (Section 5.3.8)	
Operations	SOS Form Printout (Section 5.3.3) Hand-drawn Sketch Map (Section 5.3.4) Treatment Recommendation Transmittal Form (Section 5.3.7) Detailed Oiling Maps for a Single Shoreline Segment (Section 5.3.5) Oiling Summary for a Single Shoreline Segment (Section 5.3.6) Summary Map of Oil Volume (Section 5.3.19)	
Inspection and Post-treatment Phase		
Planning	Overview Map of Work Status (Section 5.3.20) Summary Table of Work Status (Section 5.3.21)	
Operations	Segment Inspection Report Form (Section 5.3.22)	

**Consult Figure 43 to select the best way to represent overview data on a map.*

Figure 42 Guidelines for Selecting SCAT-derived Maps and Reports

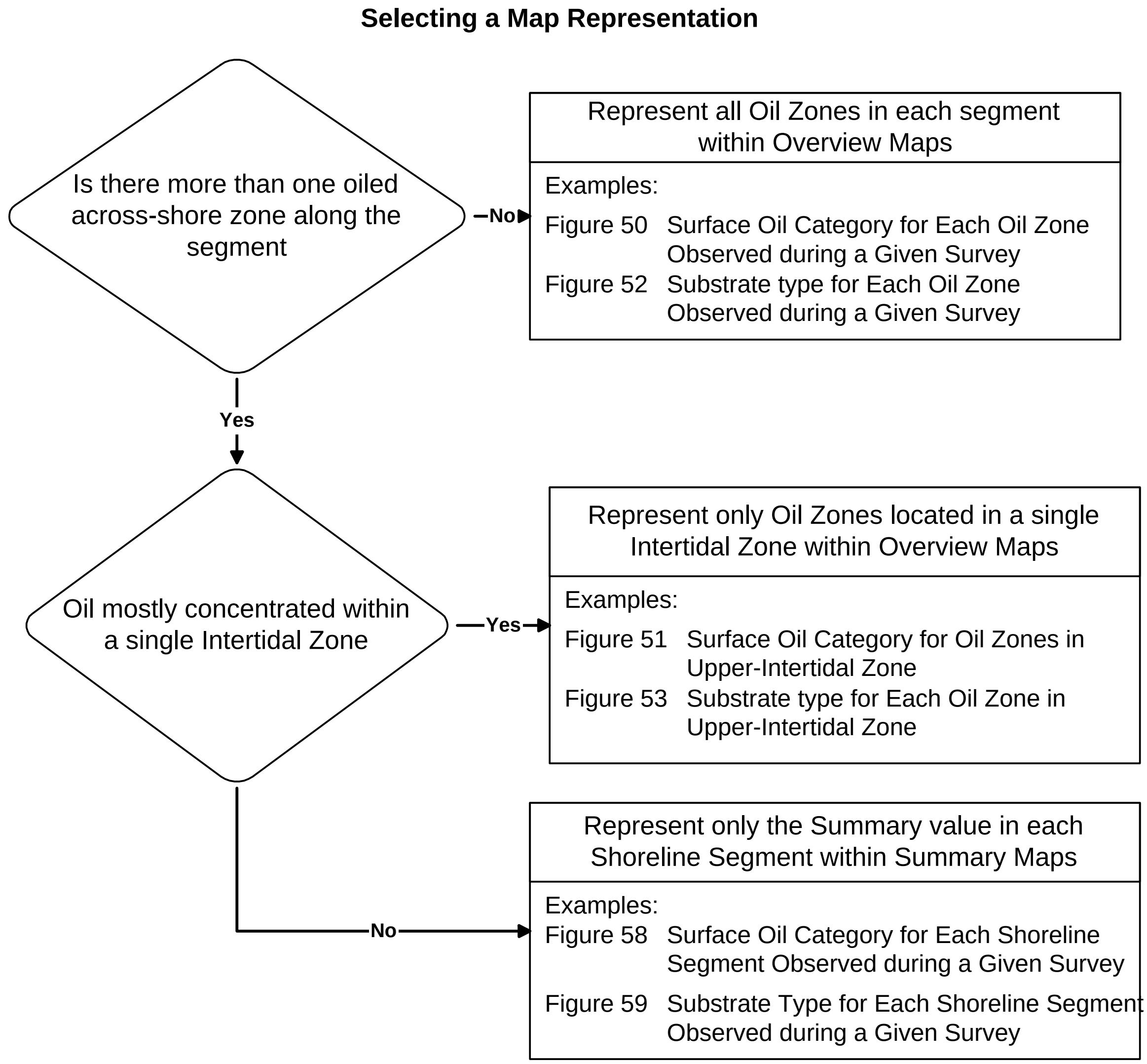


Figure 43 Decision Tree for Selecting Map Representations of Oiling Characteristics Data

5.3.1 Overview Map of Surface Oil Category from Initial Response Surveys

This overview map supports response planning by providing a general overview of the extent and degree of oiling and the location of shoreline segments. An example is shown in Figure 44.

Users

SCAT coordinator
Planning section
Incident Command
Public groups

Production Frequency

Overview maps must be produced as soon as the information is available from the field. This map is probably only produced occasionally, in the initial phase of a response.

Data

The data required to produce the map includes the start and end locations of observed oil bands; an estimate of the degree of oiling, which can sometimes be subjective; and the survey date. Additional information might include the start and end locations of shoreline segments and the shoreline type, if available.

Processing

The nature of the processing required depends on the nature of the data gathered from the field. No processing is needed if the observations are recorded as a single estimate of the degree of oiling.

For an aerial mapping survey, the observations might include the length, width, and distribution of oil zones. In this case, the map will present the surface oil cover of each oil zone, assessed using the method described in Section 4.2 (see Figure 24 and Table 17).

In the case of first responder ground surveys, the oil category can be assessed if the observer also notes the oil thickness category. In this case, the map represents the surface oil category and is created by combining surface oil cover and thickness category using the method described in item 4 of Section 5.1.1.

Limitations

The survey method provides only a general estimate of the oiling level. This level is generally accurate in term of the observed oil cover category, except for Light and Very Light oil, which usually cannot be distinguished on aerial surveys. In past experience, the general categories have matched well to the data from the subsequent SCAT ground surveys.

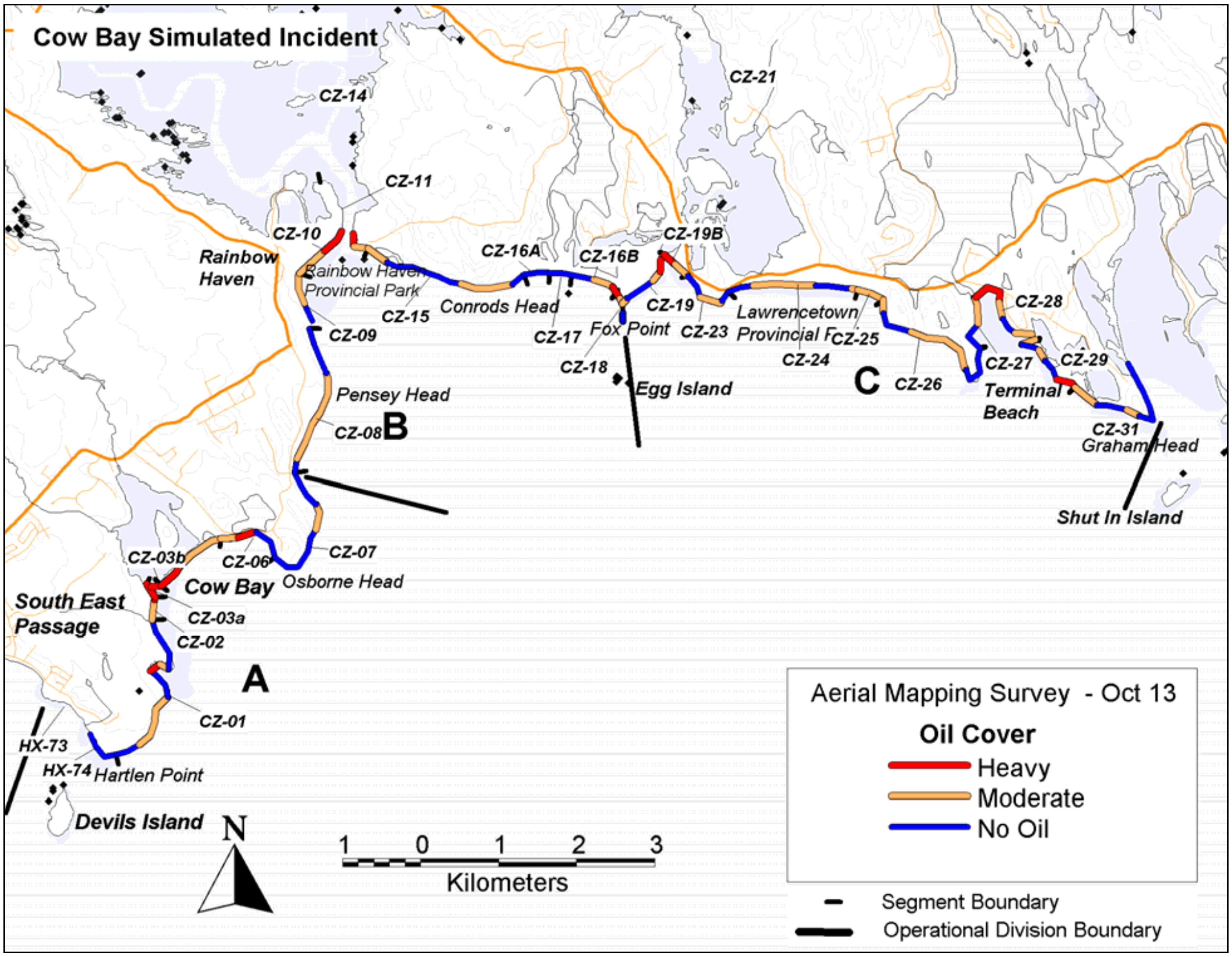


Figure 44 Overview Map of Surface Oiling from a Simulated Aerial Mapping Survey

5.3.2 Summary Table of Surface Oil Category from Initial Response Surveys

This type of table supports response planning by providing a general overview of the length of shoreline oiled by oil category. If the information can be further broken down by shoreline type, this also gives an initial indication of the type of shoreline treatment methods that may be appropriate. An example of this summary table is shown in Table 34.

Table 34 Summary Table of Surface Oil Category from Initial Response Surveys

Shoreline Type	Length of Shoreline in Kilometres			
	Surface Oil Category			Total
	Heavy	Moderate	No Oil	
Bedrock	0.00	0.40	0.26	**0.66**
Boulder Beach	0.00	0.35	1.94	**2.28**
Mixed Sediment Beach	0.98	1.89	2.39	**5.27**
Pebble/Cobble Beach	1.36	6.19	6.04	**13.59**
Sand Beach	0.87	2.16	2.11	**5.14**
Total	**3.22**	**10.99**	**12.74**	**26.94**

Users

SCAT coordinator
Planning section
Incident Command
Public groups

Production Frequency

A summary table of oil category should be produced as soon as the information is available from the field. This table is probably only produced occasionally during the initial response.

Data

The data required to produce the table includes an estimate of the degree of oiling, which can sometimes be subjective, and the length of each oil zone or oil band. The survey date is also needed to identify the printout. Additional information could include the shoreline type associated with each oil band.

Processing

First responder survey data are normally stored in tables. Two steps are necessary for the processing.

First, estimate the oiling level. During this step, the processing required is a function of the data gathered from the field. No processing is required if the observations are recorded as a single estimate of degree of oiling. For an aerial mapping survey, the observation might include the length, width, and distribution of oil zones. In this case, the oil cover of each oil zone can be assessed using the method described in Section 4.2 (see Figure 24 and Table 17).

In the case of first responder ground surveys, the surface oil category can be assessed if the observer also noted the oil thickness category. The surface oil category can be evaluated by combining oil cover and thickness category as shown in Table 26 in Section 5.1.1. A simple program can be developed from this table, translated into a set of rules, and integrated within

GIS scripts, spreadsheets, or other computer programs. An example of this is shown in Figure 34 in Section 5.1.1.

Second, use a computer or spreadsheet program to open the data table and compute the length of shoreline recorded for each oil zone by shoreline type and oil category. This can be done in a single operation in spreadsheet programs by creating a “pivot table” report.

Limitations

The survey method provides only a general estimate of the oiling level, which will probably be very different from the estimate provided by SCAT ground surveys. This level is generally accurate in terms of the observed oil cover category, except for Light and Very Light Oil, which usually cannot be differentiated in aerial surveys. In past experience, the general categories have closely matched the data from the subsequent SCAT ground surveys.

5.3.3 Printouts of SOS Forms

Shoreline Oiling Summary (SOS) forms provide a record of the detailed oiling information gathered during a SCAT ground survey in order to:

- o estimate the degree of oiling;
- o support the damage assessment effort;
- o locate a shoreline segment or oil zone; and
- o assess the access to a shoreline segment.

The printout of the SOS form for segment CZ-28 is provided in Figure 45.

Users

SCAT coordinator
Operations section
SCAT survey teams

Production Frequency

Printouts of SOS forms are provided to the SCAT coordinator as soon as the data has been entered and validated. These printouts are also provided to SCAT survey or inspection teams before a shoreline segment is resurveyed.

Personnel involved in damage assessment usually want copies of the original forms rather than printouts of the data entered within a computerized system.

Data

Printouts of SOS forms include all the non-spatial data gathered during ground surveys, as well as the geographic coordinates of shoreline segments.

Processing

SOS forms should be subjected to quality control and validation before they are distributed.

Limitations

Some of the detailed information on SOS forms, particularly that relating to oil zone characteristics, can only be understood by personnel familiar with the SCAT method and terminology or by referring to a SCAT manual.

1. General Information		Date (mm/dd/yy)	Time		Tide Height	Temperature	Wind Speed
Segment ID:	CZ-28	10/13/2004	From	13:30	Lowest	(C)	(km/h)
Operations Division:	A		To	14:30		8	15
Surveyed By:	Foot		Weather:	Clouds	Wind Direction :		

2. Survey Team # 2

Name	Organization	Phone
Sinclair Dewis	EC	
Jenny Nelson	YES	
Jean-Marie Sempel	ECRC	

3. Segment **Total Segment Length** 1239 m **Segment Length Surveyed** 1239 m **Maximum Intertidal Width** 2 m

Coordinates Dec. Deg Start Latitude: 44.64219 Longitude -63.31079 Datum/Projection WGS 84

End Latitude: 44.63781 Longitude -63.31066

4A Shoreline Type(s)

Primary: Pebble/Cobble Beach Oiled ✔ Secondary: Mixed Sediment Beach Oiled ✔

Slope Moderate Energy Level Open Coast Man-Made Features Dock,;Pier/Wharf

4B Coastal/Backshore Character Primary: Beach Bare Substrate Types C,P,G,S

Secondary: Cliff or Hill Cliff ✔ Height 6 m Man-Made Type(s) Residential

5 Operational Features Suitable Backshore Staging ☐ Access Direct from backshore ✔ Alongshore from next segment ☐

Debris ☐ Access Restrictions Road Access ;COM/ECON: wharves - boat doc king facilities

Current Dominated Channel ☐

Other Features:

6 Surface Oiling Conditions

Oiled Zone ID	Tidal Zone	Oil Cover Length (m)	Oil Cover Width (m)	Oil Cover Distrib %.	Oil Thickness Category	Oil Thickness (cm)	FR	MS	TB	PT	CR	SR	AP	NO	Substrate Type(s)	Substrate Category
A	LI	100	2	95	CV	0.5	✔								C,P	Pebble/Cobble
B	UI	150	3	65	TO	1.5	✔								C,P,G	Pebble/Cobble
C	UI	175	1	75	TO	1.5	✔								C,P,G	Pebble/Cobble
D	UI	90	3	85	CV	0.5	✔								G,S	Mixed Sediments Fine
E	UI	130	2	45	CV	0.5	✔								P,G,S	Mixed Sediments Fine
F	LI	350	1	25	CT	0.05			✔						P,G,S	Mixed Sediments Fine
G	UI	125	1	35	CT	0.05	✔								G,S	Mixed Sediments Fine
H	UI	150	2	15	CV	0.5	✔								C,P	Pebble/Cobble
I	UI	200	1.5	35	CV	0.5	✔								C,P	Pebble/Cobble
J	LI	208	1.5	35	CV	0.5	✔								C,P,G	Pebble/Cobble
K	UI	153	0	0		0								✔	C,P,G	Pebble/Cobble
L	UI	45	0	0		0								✔	C,P,G	Pebble/Cobble

7 Subsurface Oiling Conditions

Trench or Pit No	Tidal Zone	Max. Pit Depth (cm)	Oiled Zone (cm)	Oiled Zone (cm)	Oil Character	Water Table (cm)	Sheen Color	Clean Below	Substrate Type(s)	Substrate Category
1	UI	12	0	6	OP	12	Silver	Yes	C,P	Pebble/Cobble
2	UI	12	0	8	OP	12	Brown	Yes	C,P,G	Pebble/Cobble
3	UI	12	0	2	PP	12	Rainbow	Yes	G,P,C	Pebble/Cobble
4	UI	12	0	0	No	12		Yes	S,P,G	Mixed Sediments Fine
5	UI	12	2	4	PP	12	Rainbow	Yes	P,G,S	Mixed Sediments Fine
6	UI	12	0	2	PP	12	Rainbow	Yes	P,C,G	Pebble/Cobble

8 Comments (Cleanup Recommendations - ecological/recreational/cultural/economic_ issues constraints - Wildlife obs.)

Easy access by road

Sketch ✔ Pictures: Roll #/File Prefix: DSCF Number: 102104 Videotape

Figure 45 Printout of SOS Form for Segment CZ-28

5.3.4 Sketch Maps

Sketch maps provide a record of the spatial elements, i.e., location of oil zones, trenches, roads, and photographs, gathered during a SCAT ground survey for various purposes, including to:

- locate a shoreline segment or oil zone;
- assess the access to a shoreline segment;
- evaluate deployment options for treatment equipment and personnel; and
- validate data that has been entered into a data management system.

An example of a hand-drawn sketch map is shown in Figure 46.

Users

SCAT coordinator
SCAT data management team
Operations section
SCAT survey teams
Damage assessment team

Production Frequency

Printouts of sketch maps are provided to the SCAT coordinator as soon as the data has been entered and validated. These printouts are also provided to SCAT survey or inspection teams before a shoreline segment is resurveyed. Personnel involved in damage assessment usually want copies of the original sketches, rather than printouts of the data entered within a computerized system.

Data

Original sketch maps include all spatial information gathered during a ground survey, as well as surface and subsurface oil observations.

Processing

Original sketch maps should be subjected to quality control and validation before they are distributed. If the spatial information recorded on sketches is entered within a computerized system (GIS), then processing might include the evaluation of the oil zone substrate type.
The example in Figure 46 shows the location of surface and subsurface oil zones, as well as the length, width, distribution, and surface oil thickness that have been entered into a GIS. Such a printout could be used to validate data or to direct operations personnel.

Limitations

Some of the detailed information in sketches, particularly that related to oil zone characteristics, can only be understood by personnel familiar with the SCAT method and terminology or by referring to a SCAT manual.

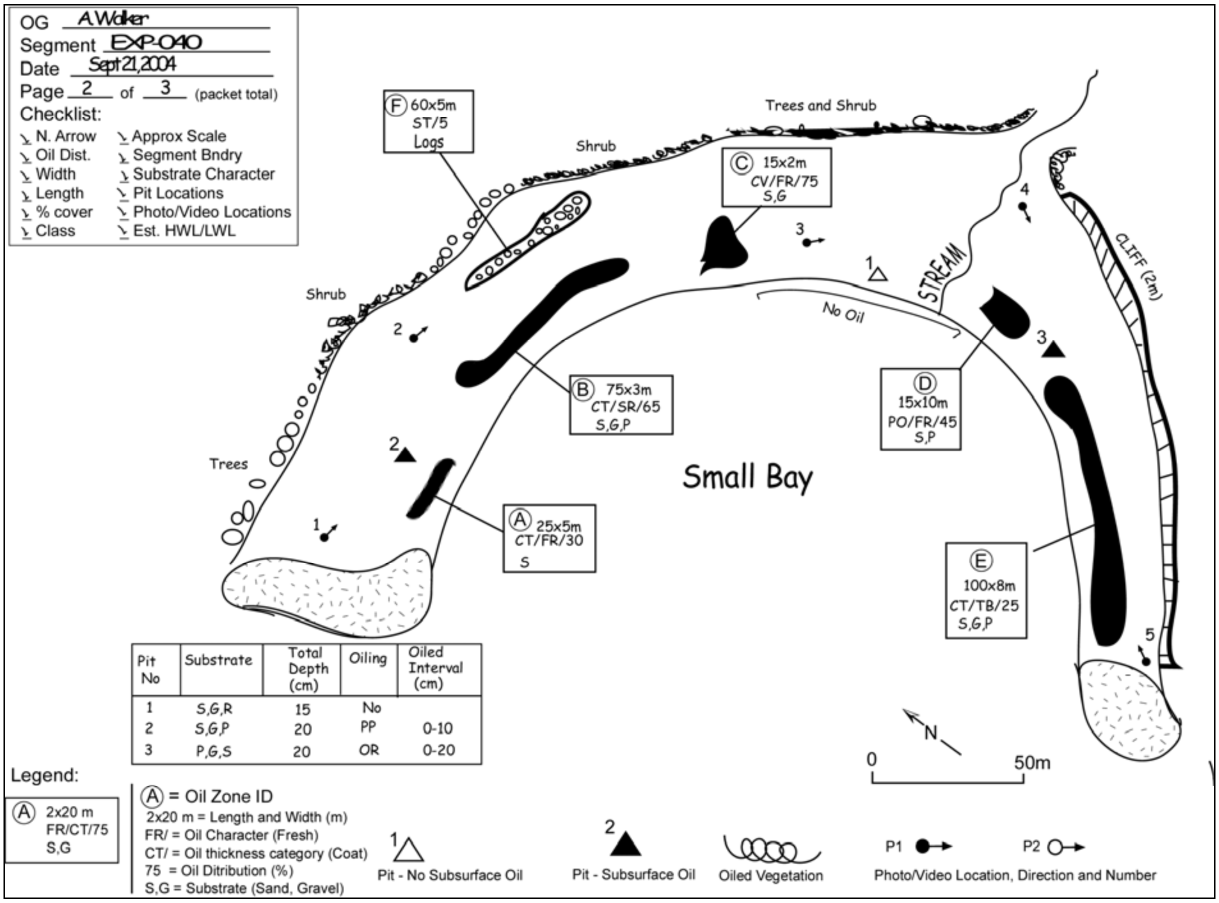


Figure 46 Hand-drawn Sketch Map

5.3.5 Detailed Oiling Maps for a Single Shoreline Segment

These maps provide a spatial overview of SCAT data and assessment for a single shoreline segment for various purposes, including to:

- locate a shoreline segment or oil zone;
- assess the access to a shoreline segment;
- evaluate deployment options for treatment equipment and personnel; and
- validate data that has been entered into a data management system.

The detailed oiling map for Segment CZ-28 is shown in Figure 47.

Users

SCAT coordinator
SCAT data management team
Operations section
SCAT survey teams

Production Frequency

Printouts of detailed oiling maps for a specific segment are provided to the SCAT coordinator as soon as the data has been entered and validated. These printouts can also be provided to SCAT survey or inspection teams before a shoreline segment is resurveyed.

Data

Detailed segment-based maps use the following data:

- boundaries of shoreline segments, which are best represented by short lines perpendicular to the coastline;
- survey code and date;
- surface oiling characteristics, including width, length, thickness, distribution, and substrate type; and
- the observed depth of oil in the subsurface oil zone.

Processing

Surface oiling characteristics, i.e., width, thickness, and distribution, are used to evaluate the surface oil cover and surface oil category of each oil zone, as described in Section 5.1.1, items 3 and 4.

The substrate type can be provided as categories of grain size.

The subsurface oil state, i.e., no oil, buried oil, or permeated oil, can be obtained from the measurements of the depth of oil penetration or burial, as described in Section 5.1.1, item 6.

Limitations

Some of the detailed information, particularly that of oil zone characteristics, can only be understood by personnel familiar with the SCAT method and terminology or by referring to a SCAT manual.

The detailed segment-based maps created by using GIS systems from automated data processing do not contain all the information recorded on the original sketches.

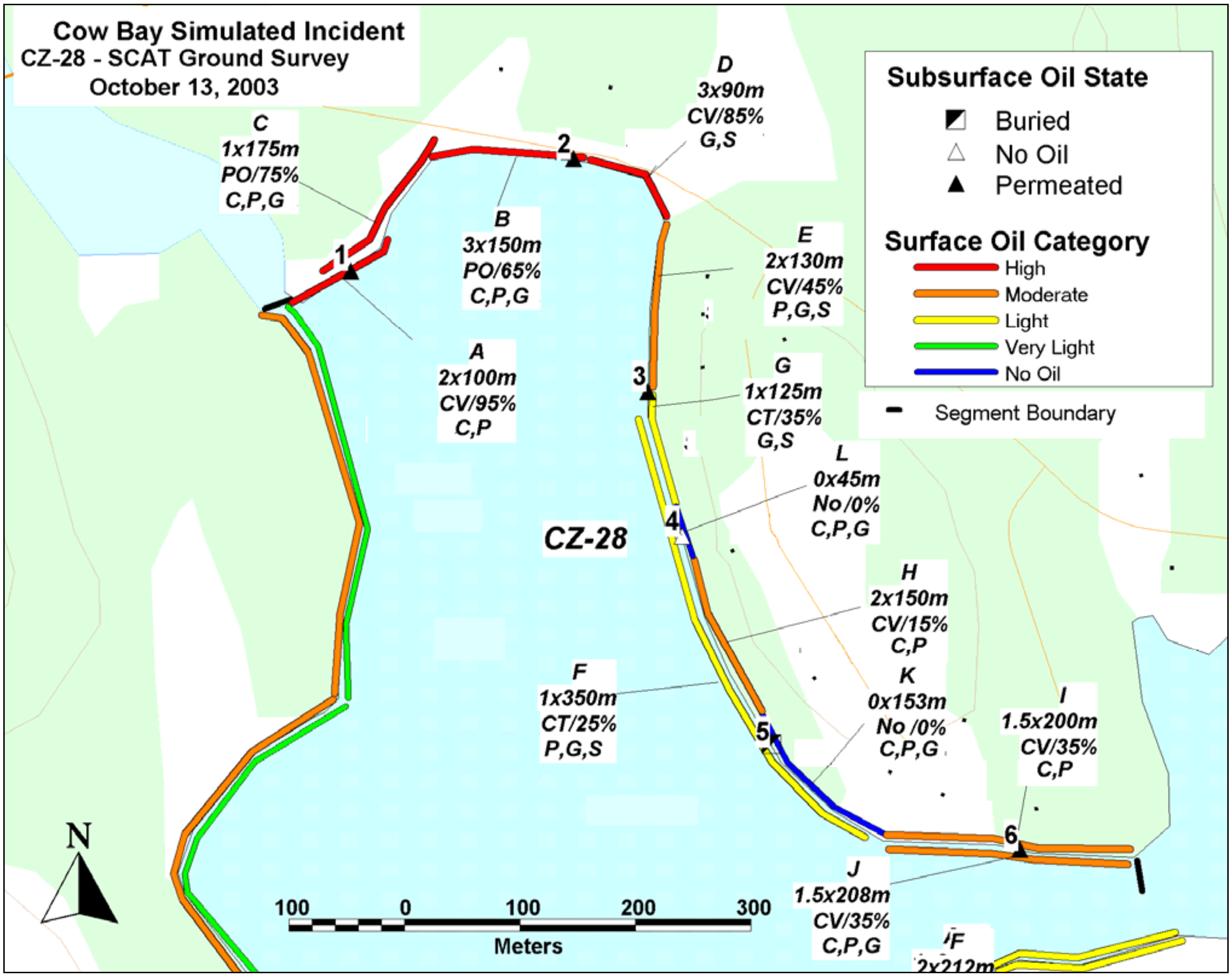


Figure 47 Detailed Oiling Map for a Single Shoreline Segment (CZ-28)

5.3.6 Oiling Summary for a Single Shoreline Segment

This form lists all oiling evaluations and assessments made from SCAT data for a single segment. This information is used to:

- o evaluate the validity of the summary oiling characteristics obtained through automated processing; and
- o provide supporting information for evaluating treatment options and estimating the required treatment effort.

Detailed oiling summaries for a single shoreline segment present the results of the data processing and are used to develop most of the decision-making support maps that show oiling evaluation results. An example of this form is shown in Figure 48.

Users

SCAT coordinator
SCAT data management team
SCAT survey teams

Production Frequency

Printouts of segment oiling assessment are provided to the SCAT coordinator as soon as the data has been entered and validated. The SCAT coordinator evaluates the validity of oiling assessment before detailed oiling summaries are distributed.

Data

Detailed segment oiling assessment summaries make use of all SCAT data necessary for basic processing of oil zones and segment levels.

Processing

Surface oiling characteristics, i.e., width, thickness, and distribution, are used to evaluate the surface oil cover and surface oil category, as discussed in Section 5.1.1, items 3 and 4. The substrate type can be assessed from the grain size category.

The subsurface oil state, i.e., no oil, buried oil, or permeated oil, can be obtained from the measurements of the depth of oil penetration or oil burial as discussed in Section 5.1.1, item 6.

Oiling summaries for the entire segment can be obtained using the methods described in Section 5.1.2.

Limitations

Some of the detailed information, particularly that relating to oil zone characteristics, can only be understood by personnel familiar with the SCAT method and terminology or by referring to a SCAT manual.

EVALUATION OF OILING CONDITIONS **Cow Bay Simulation** 13-Oct-2004 Page 1 of 1

Segment: CZ-28 Survey No: 1

Surface						Sub-Surface		
Oiled Zone ID	*Oil Cover*	*Oiling Category*	*Remobilization Potential*	*Persistence*	*Substrate Category*	*Trench or Pit no*	*Oiling Category*	*Oiling State*
A	Moderate	Heavy	Moderate	Months To Years	Pebble/Cobble	1	Moderate	Permeated
B	Moderate	Heavy	Very High	Months To Years	Pebble/Cobble	2	Moderate	Permeated
C	Moderate	Heavy	Very High	Months To Years	Pebble/Cobble	3	Light	Permeated
D	Moderate	Heavy	Moderate	Months To Years	Mixed Sediments Fine	4	No Oil	No Oil
E	Light	Moderate	Moderate	Months To Years	Mixed Sediments Fine	5	Light	Buried
F	Light	Light	Low	Weeks To Months	Mixed Sediments Fine	6	Light	Permeated
G	Light	Light	Low	Weeks To Months	Mixed Sediments Fine			
H	Light	Moderate	Moderate	Months To Years	Pebble/Cobble			
I	Light	Moderate	Moderate	Months To Years	Pebble/Cobble			
J	Light	Moderate	Moderate	Months To Years	Pebble/Cobble			
K	No Oil	No Oil	No Oil	No Oil	Pebble/Cobble			
L	No Oil	No Oil	No Oil	No Oil	Pebble/Cobble			

Oiling Summary

Substrate	*Oil Cover*	*Oiling Category*	*Remobilization Potential*	*Persistence*
Pebble/Cobble	Moderate	Heavy	Very High	Months To Years

Length of shoreline by Oiling Category m				
Heavy	*Moderate*	*Light*	*Very Light*	*No Oil*
515	688	36	0	0

	Oiled Area by Oiling Category m^2				
	Heavy	*Moderate*	*Light*	*Very Light*	*No Oil*
Total	1095	1172	475	0	0
Actual	843	376	131	0	0

Figure 48 Oiling Summary for a Single Shoreline Segment (CZ-28)

5.3.7 Treatment Recommendation Transmittal Form

This form provides treatment recommendations for the planning section on a segment-by-segment basis. An example of this form is shown in Figure 49.

Users

SCAT coordinator
Planning section
Operations section
Stakeholders

Production Frequency

Treatment recommendations are produced shortly after the SCAT surveys.

Data

The SCAT coordinator must take into account all information gathered during SCAT surveys in order to develop treatment recommendations.

Processing

The production of treatment recommendations relies primarily on the expertise of the SCAT coordinator. In addition to recommendations made by the SCAT survey personnel, treatment recommendations also take into account environmental issues and conditions such as the presence of sensitive biological resources, which are provided by other groups involved in the response.

Shoreline Treatment Recommendation Transmittal (STRT) Form — Cow Bay Simulation

Operations Division A

Segment CZ-28 **Survey Number:** 1 **Survey Date:** Wednesday, October 13, 2004

Surveyed Length 1239 m **Site Location** ATL-4

Shoreline Type

Pebble/Cobble Beach (oiled)
Mixed Sediment Beach (oiled)

Backshore Type

Beach
Cliff or Hill

Oiled Areas for Treatment

Zone A: 100m x 2m, 95% Cover on Cobble, Pebble (Category: Pebble/Cobble) - LITZ
Zone B: 150m x 3m, 65% Thick oil on Cobble, Pebble, Gravel (Category: Pebble/Cobble) - UITZ
Zone C: 175m x 1m, 75% Thick oil on Cobble, Pebble, Gravel (Category: Pebble/Cobble) - UITZ
Zone D: 90m x 3m, 85% Cover on Gravel, Sand (Category: Mixed Sediments Fine) - UITZ
Zone E: 130m x 2m, 45% Cover on Pebble, Gravel, Sand (Category: Mixed Sediments Fine) - UITZ
Zone F: 350m x 1m, 25% Coat on Pebble, Gravel, Sand (Category: Mixed Sediments Fine) - LITZ
Tar Ball Characteristics: 5 per m2 ,2.0cm Average Size ,4.0cm Maximum Size ,Sticky
Zone G: 125m x 1m, 35% Coat on Gravel, Sand (Category: Mixed Sediments Fine) - UITZ
Zone H: 150m x 2m, 15% Cover on Cobble, Pebble (Category: Pebble/Cobble) - UITZ
Zone I: 200m x 1.5m, 35% Cover on Cobble, Pebble (Category: Pebble/Cobble) - UITZ
Zone J: 208m x 1.5m, 35% Cover on Cobble, Pebble, Gravel (Category: Pebble/Cobble) - LITZ
Zone K: No Oil Observed
Zone L: No Oil Observed

Treatment Recommendations:

Sorbents	Zone A: Apply booms and sorbents to collect accumulated oil
Sorbents Vacuums	Zones B,C,D,E: Use flooding to dislodge oil from coarse sediments . Use boom to collect disloged oil. Pump oil collected in booms.
Sorbents	Zones D,E: Use sorbents to collect oil
Manual Removal	Zones F, G, H, I, J: Manual Removal with rakes and shovels to collect tar balls and debris;
	Zones K,L: No Oil. No treatment necessary

Operational - Staging - Logistical Information

Access difficult for heavy equipment. Staging area near the boat ramps

Ecological/Cultural Comments/ Constraints

Waste Issues

Remove before high tide to the designated staging area

Safety Issues

Approved:

Attached: ✔ Sketch Map ✔ SOS Form ✔ Segment Map ☐ Fact Sheet ☐ Other

Prepared by *E.H Owens* Date *Sunday, October 14, 2004*

Printed: October 13, 2004 Page 1 of 1

Figure 49 Treatment Recommendation Transmittal Form

5.3.8 Summary Table of Treatment Recommendations

This summary table provides a list of treatment recommendations for all or some shoreline segments. An example of this form is provided in Table 35.

Users

SCAT coordinator
Planning section
Operations section
Stakeholders

Production Frequency

This table is produced and updated as soon as there are modifications in the recommendations or methods for treatment selected by the planning section.

Data

The table uses the latest treatment recommendations provided on a segment-by-segment basis.

Processing

The summary table only provides a list of basic treatment methods for each shoreline segment. The list needs to conform to that used for recommending treatment as shown on a Treatment Recommendation Transmittal Form. A list of all shoreline treatment methods used for the response should be developed for this purpose.

Limitations

This type of output does not provide details on how to apply the recommended methods.

Table 35 Summary Table of Treatment Recommendations

Treatment Methods

Cow Bay Simulation

Work Plan:01
Situation Report: 02

Operations Division	*Segment*	*Oiling Characteristics*	*Recommended Methods*	*Methods Used*
A	CZ-01	Substrate: Pebble/Cobble Oil Type: C Oiling Category: Heavy	- Sorbents	- Sorbents
A	CZ-02	Substrate: Pebble/Cobble Oil Type: C Oiling Category: Heavy	- Sorbents	- Sorbents
A	CZ-05	Substrate: Sand Oil Type: C Oiling Category: Heavy	- Tilling/ Aeration - Sediment Reworking/Surf Washing - Manual Removal	- Tilling/ Aeration - Sediment Reworking/Surf Washing - Manual Removal
A	CZ-06	Substrate: Pebble/Cobble Oil Type: C Oiling Category: Heavy	- Sorbents - Flooding - Manual Removal	
A	CZ-07	Substrate: Boulder Oil Type: C Oiling Category: Moderate	- Sorbents - Manual Removal	- Sorbents - Manual Removal
B	CZ-08	Substrate: Man-made Permeable Oil Type: C Oiling Category: Moderate	- Low Pressure Flush (cold water) - Sorbents	
B	CZ-09	Substrate: Man-made Permeable Oil Type: C Oiling Category: Heavy	- Sorbents - Manual Removal	- Sorbents - Manual Removal
B	CZ-10	Substrate: Sand Oil Type: C Oiling Category: Heavy	- Tilling/ Aeration - Sediment Reworking/Surf Washing - Flooding - Sorbents	
B	CZ-13	Substrate: Pebble/Cobble Oil Type: C Oiling Category: Moderate	- Sediment Reworking/Surf Washing - Flooding - Sorbents	- Sediment Reworking/Surf Washing - Flooding - Sorbents
B	CZ-15	Substrate: Pebble/Cobble Oil Type: C Oiling Category: Moderate	- Flooding - Sorbents - Natural Recovery	- Flooding - Sorbents
C	CZ-28	Substrate: Mixed Sediments Fine Oil Type: C Oiling Category: Heavy	- Manual Removal - Sorbents - Flooding - Vacuums	- Sorbents - Flooding - Vacuums
A	CZ-03a	Substrate: Pebble/Cobble Oil Type: C Oiling Category: Heavy	- Sorbents	

ShoreAssess - Treatment Methods (Prepared by: Ed Owens; Updated By: Jane Smith) 29-11-04 Page 1/3

5.3.9 Summary Table of SCAT Survey History

This summary table provides an overview of the activity of SCAT survey teams and is used to support the planning of SCAT surveys. An example of this form is shown in Table 36.

Users

SCAT coordinator
Planning section
Operations section

Production Frequency

This table should be updated and distributed as soon as new shoreline surveys are completed.

Data

The table uses the survey date and the length of shoreline surveyed recorded on SOS forms.

Processing

The table is developed by cross-referencing shoreline segments or operations divisions with survey date and length of shoreline surveyed. This can be done in a single operation in spreadsheet programs by creating a “pivot table” report.

Table 36 Summary Table of SCAT Survey History

Segment	Date			
	13-Oct-2004	**14-Oct-2004**	**15-Oct-2004**	**16-Oct-2004**
CZ-01		2781		
CZ-02		291		
CZ-03a		208		
CZ-03b		271		
CZ-05		1005		
CZ-06		940		
CZ-07		1743		
CZ-08		2031		
CZ-09		765		
CZ-10		1602		
CZ-13		1500		
CZ-15		2190		
CZ-16A			334	
CZ-16B			628	
CZ-17			290	
CZ-18			462	
CZ-19			900	
CZ-19B			426	
CZ-23			787	
CZ-24			1683	
CZ-25			356	
CZ-26				2320
CZ-27				811
CZ-28	1239			
CZ-29				1216
CZ-31				1969
Total	**1239**	**15327**	**5866**	**6316**

Surveyed Length (m)

5.3.10 Overview Map of Surface Oil Categories

This overview map supports response planning by providing a general overview of the extent and degree of oiling and the location of shoreline segments. The example in Figure 50 shows all recorded oil zones for a given SCAT survey.

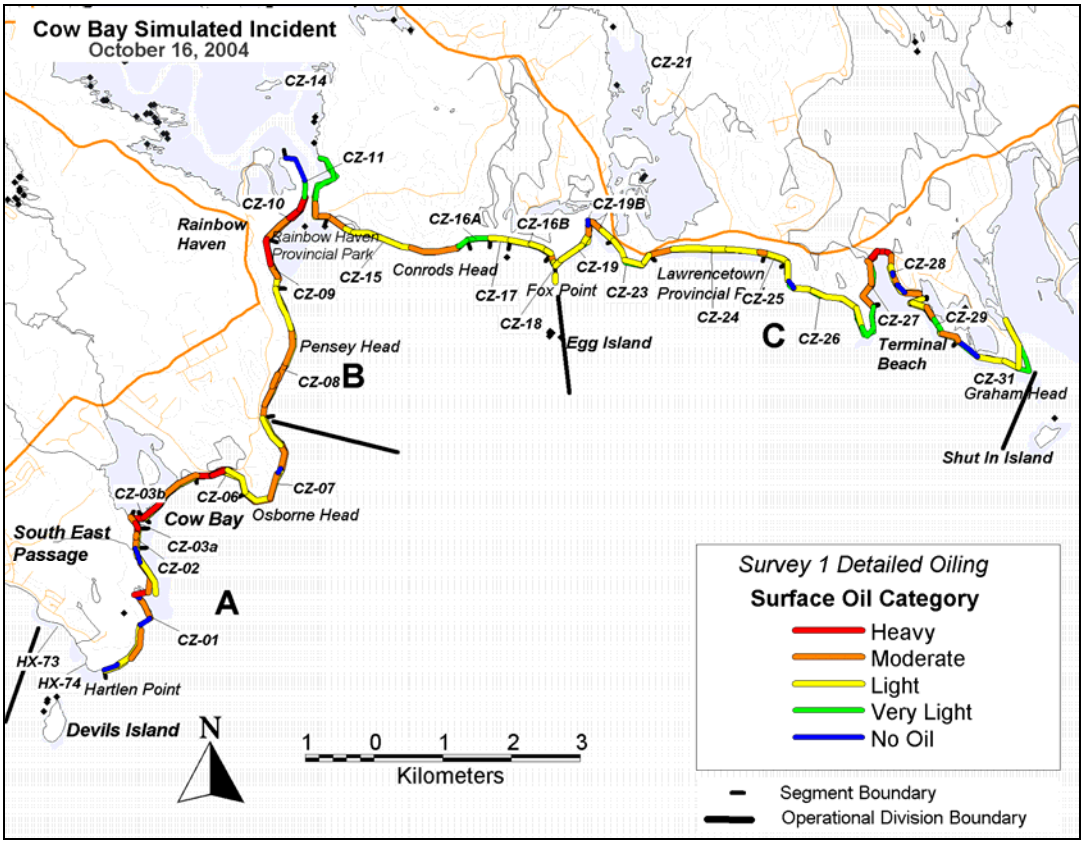


Figure 50 Overview Map of Surface Oil Category for Each Oil Zone Observed during a Given Survey

Users

SCAT coordinator
Planning section
Incident Command
Public groups

Production Frequency

Overview maps are produced as soon as the information is available from the field. This type of overview map is normally produced daily.

Data

The data required to produce this includes:

- o start and end locations of observed oil bands;
- o survey code;
- o estimate of the surface oil category, from the width, length, and thickness of each oil zone; and
- o location of each oil zone with respect to the tidal zone. This element can be used to filter the information.

Processing
The map is constructed from the surface oil category estimated within each oil zone from the oil width, distribution, and thickness, as described in Section 5.1.1, item 4.

Limitations
This type of overview map is only effective when there is one across-shore oil zone or band within each segment in a single tidal zone. When there are multiple oil bands in the same shoreline segment, oil bands in various tidal areas will obscure each other.

One way to counter this limitation is to use an overview map showing the oiling summary for entire segments as provided in Figure 57. Another way is to represent oil zones in a single intertidal zone. For example, if most of the oil and treatment activities are concentrated in the upper intertidal zone, a filter can be applied to the surface oil table so that only oil zones located in the upper intertidal zone are selected. This is shown in Figure 51.

A decision tree to help in selecting the most appropriate map for representing the surface oiling category is provided in Figure 43.

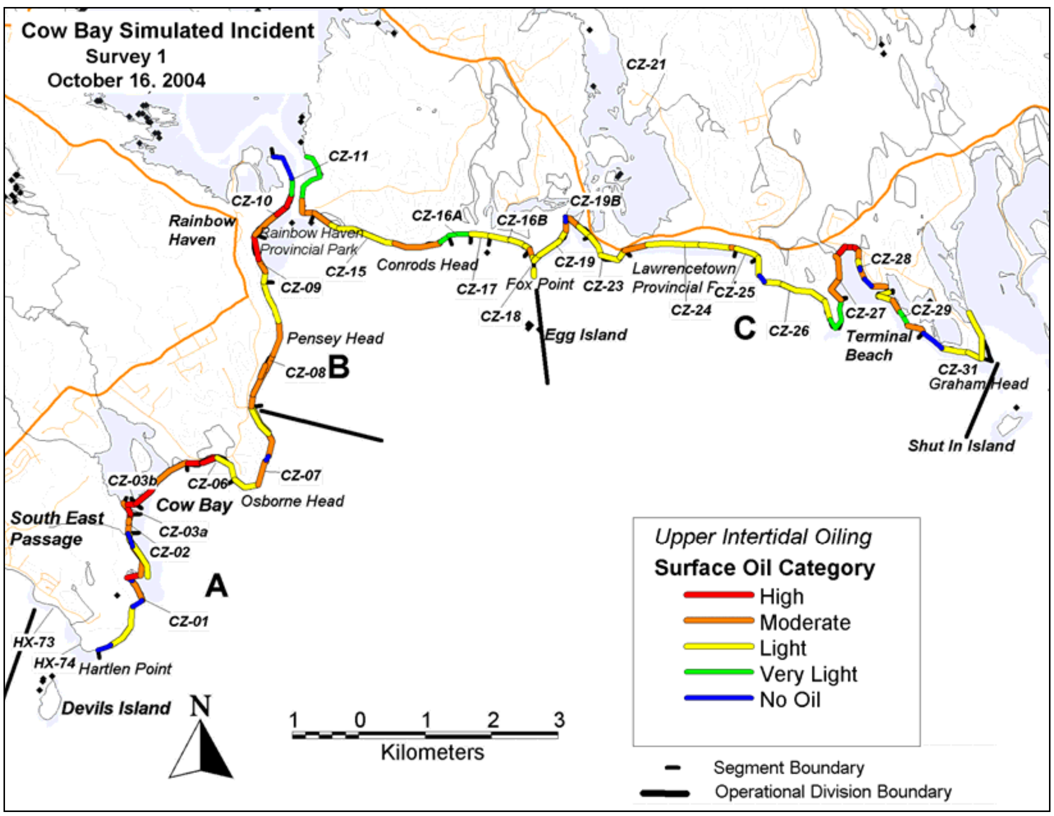


Figure 51 Overview Map of Surface Oil Category for Oil Zones in Upper Intertidal Zone

5.3.11 Overview Map of Oil Zone Substrate Categories

This overview map, shown in Figure 52, supports response planning by providing a general overview of the types of oil substrates for a given SCAT survey. This information is used to select treatment methods.

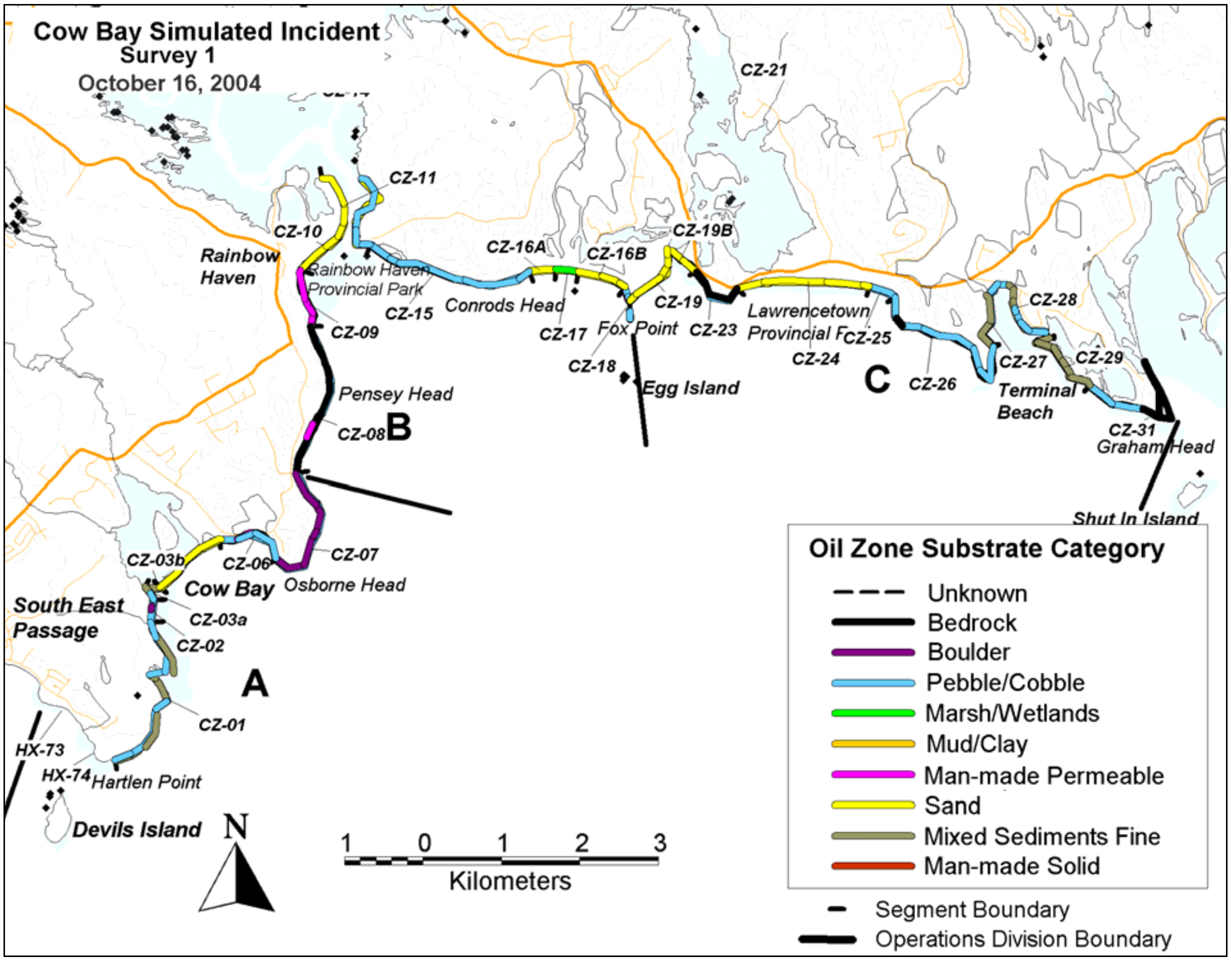


Figure 52 Overview Map of Substrate Category for Each Oil Zone Observed during a Given Survey

Users

SCAT coordinator
Planning section

Production Frequency

Overview maps are produced as soon as the information is available from the field. This more specialized representation might not be produced on a regular basis.

Data

The data required to produce the map includes:

- start and end locations of observed oil bands;
- survey code;
- estimate of overall substrate type; and
- location of each oil zone in relation to the tidal zone, which can be used to filter the information.

Processing
This map is constructed from the substrate types observed within each oil zone and evaluated from the list of substrate types, as described in Section 5.1.1, item 8.

Limitations
This type of overview can be used effectively only when the number of across-shore oil zones within each segment is limited to one band in a single tidal zone. In all other situations, oil bands in various tidal areas will obscure each other.

One way to counter this limitation is to use an overview map showing the oiling summary for each entire segment as shown in Figure 58. Another way is to represent substrate types for oil zones located in a single intertidal zone such as shown in Figure 53. For example, if most of the oil and treatment activities are concentrated in the upper intertidal zone, a filter can be applied to the surface oil table so that only bands located in the upper intertidal zone are selected.

A decision tree to help in selecting the most appropriate map for representing the surface oiling category is provided in Figure 43.

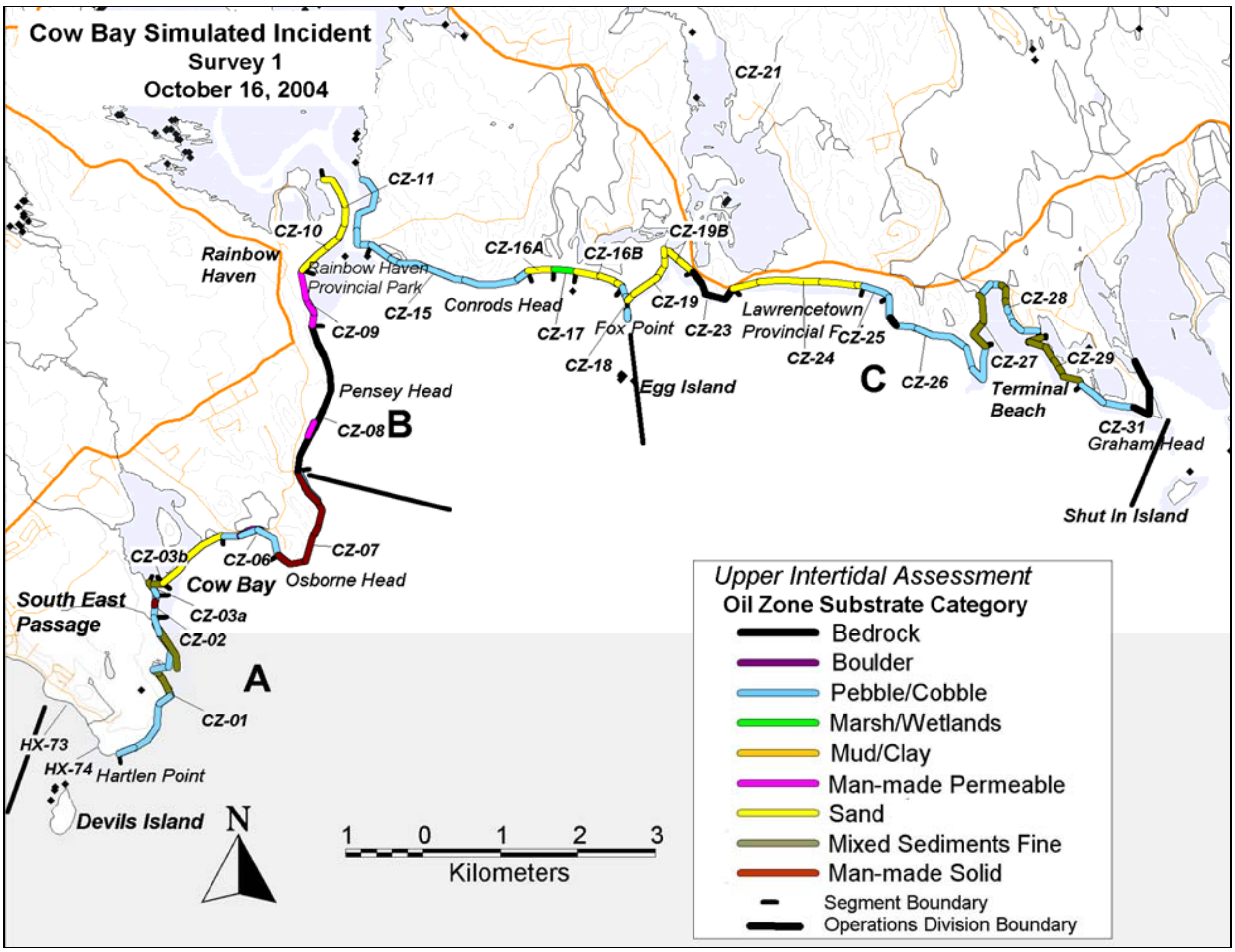


Figure 53 Overview Map of Substrate Type for Each Oil Zone in Upper Intertidal Zone

5.3.12 Overview Map of Remobilization Potential

This overview map supports response planning by providing a general overview of the estimated potential for oil remobilization in a given SCAT survey. This information is used to select treatment methods and response priorities. The example in Figure 54 shows the estimated remobilization potential in all recorded oil zones for a given SCAT survey.

Users

SCAT coordinator
Planning section

Production Frequency

Overview maps are produced as soon as the information is available from the field. This more specialized representation is usually produced after the first SCAT survey.

Data

The data necessary to produce the map includes:

- start and end location of observed oil bands; and
- estimate of the remobilization potential category.

Processing

This map is based on the estimate of the remobilization potential within each oil zone. This is an expert assessment that takes into account the oil substrate type, oil type, surface oil category, and the intertidal location of the oil zone as described in Section 5.1.1, item 9.

Limitations

This type of overview map can only be used effectively when there is one across-shore oil zone or oil band within each segment in a single tidal zone. When there are multiple oil bands in the same shoreline segment, oil bands in various tidal areas will obscure each other. In this case, a filter can be applied to the surface oiling data table so that only those oil zones with a high and very high remobilization potential are selected.

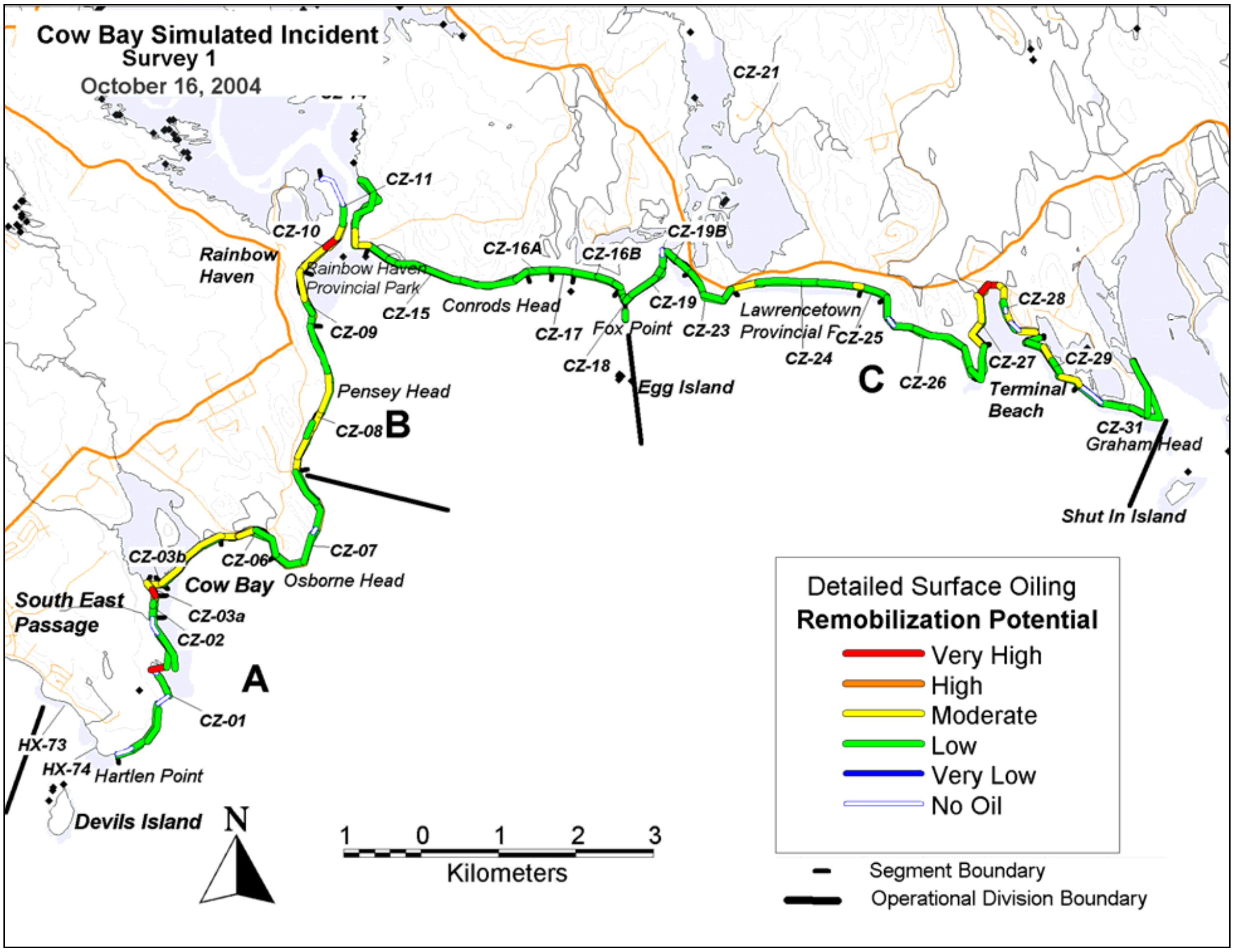


Figure 54 Overview Map of Estimated Remobilization Potential for Each Oil Zone Observed during a Given Survey

5.3.13 Overview Map of Oil Persistence

This overview map supports response planning by providing a general overview of the estimated oil persistence for a given SCAT survey. This information is used to select treatment methods and determine response priorities. The map in Figure 55 shows the estimated oil persistence in all recorded oil zones for a given SCAT survey.

Users

SCAT coordinator
Planning section

Production Frequency

Overview maps are produced as soon as the information is available from the field. This more specialized representation, if required at all, is usually produced after the first SCAT survey.

Data

The data required to produce the map includes:

- start and end locations of observed oil bands;
- survey code; and
- an estimate of the oil persistence category.

Processing

The map is based on the estimate of the oil persistence within each oil zone. This is an expert assessment that takes into account the oil type, surface oil category, and intertidal location of the oil zone as described in Section 5.1.1, item 10.

Limitations

This type of overview map is only effective when there is one across-shore oil zone or band within each segment in a single tidal zone. When there are multiple oil bands in the same shoreline segment, oil bands in various tidal areas will obscure each other.

If there are more than one across-shore oil zones within each shoreline segment, then a filter can be applied to the surface oiling data table so that only those oil bands with shorter or longer oil persistence values, depending on the nature of the oil, are selected.

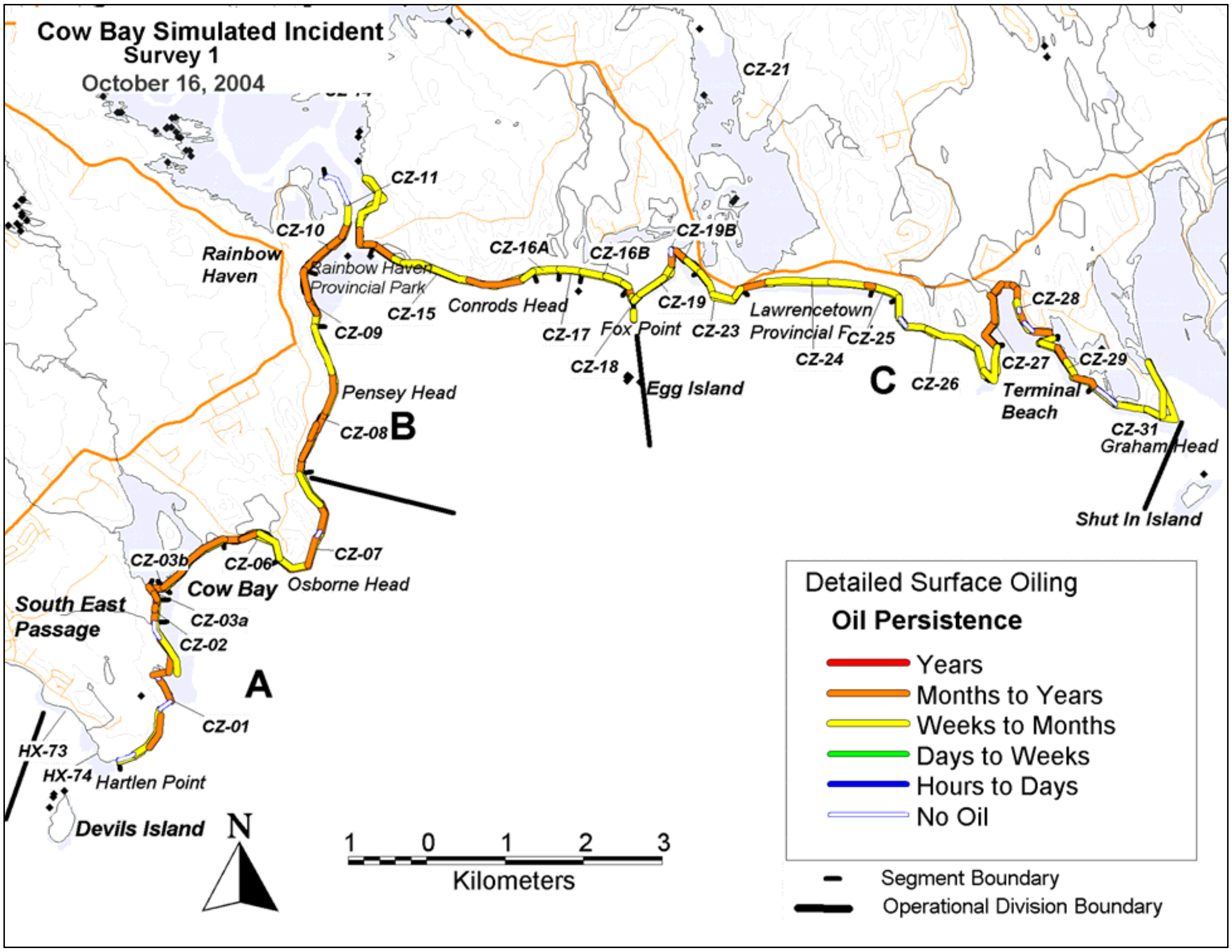


Figure 55 Overview Map of Estimated Oil Persistence for Each Oil Zone Observed during a Given Survey

5.3.14 Overview Map of Subsurface Oil Category

This overview map supports response planning by providing a general overview of the extent and degree of subsurface oiling. The map in Figure 56 shows all recorded pits and trenches for a given SCAT survey.

Users

SCAT coordinator
Planning section
Incident Command

Production Frequency

Overview maps are produced as soon as the information is available from the field. This more specialized representation is produced only upon request by the SCAT coordinator.

Data

The data required to produce the map includes:

- locations of pits or trenches;
- survey code; and
- an estimate of the subsurface oil category from the relative oil concentration and depth of penetration or thickness of oil lens in each pit or trench.

Processing

The map is based on the subsurface oil category estimated within each pit or trench from the relative oil concentration and depth of penetration or thickness of oil lens, as described in Section 5.1.1, item 7.

Limitations

This type of representation provides a general indication of areas where subsurface oil will likely need to be removed.

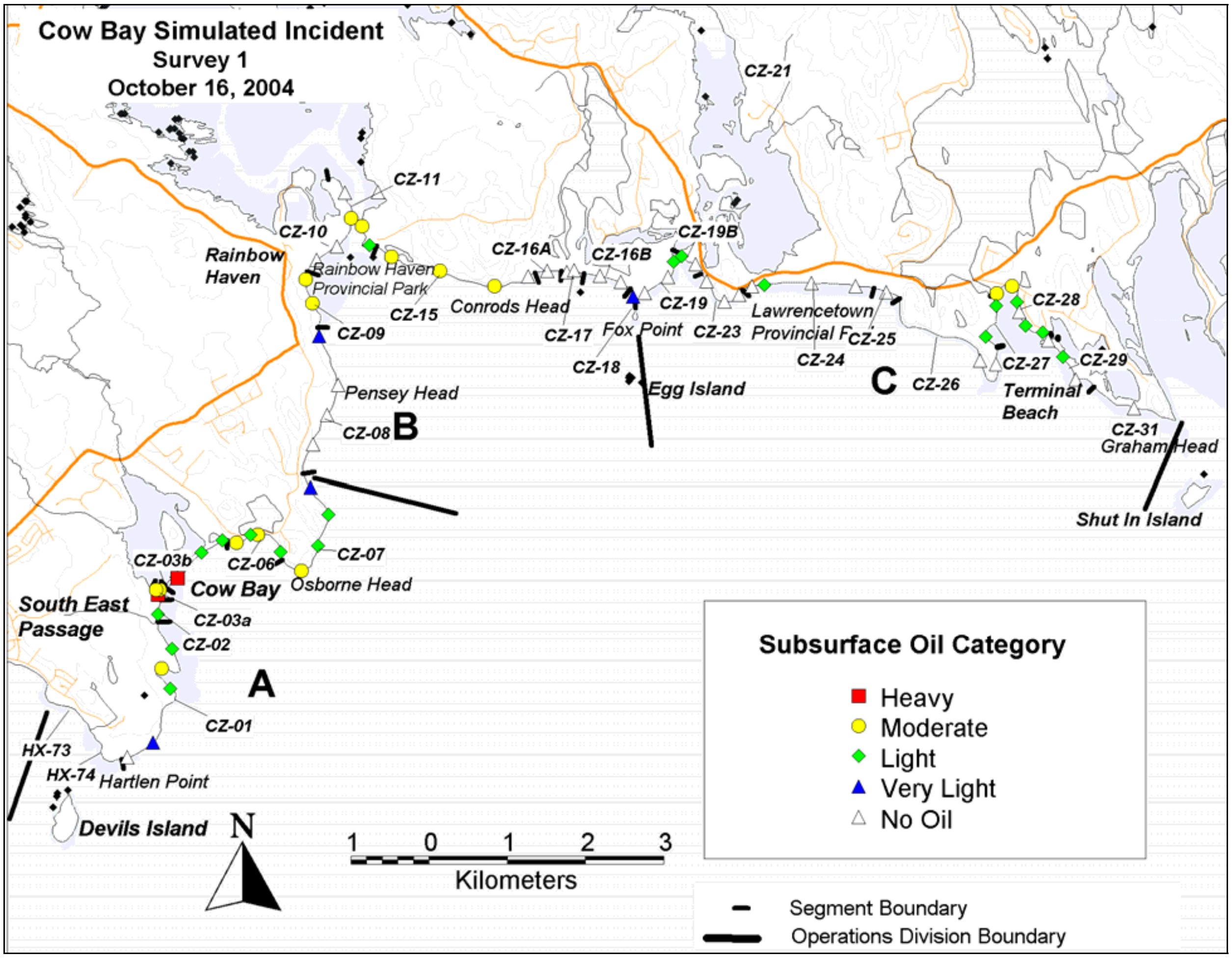


Figure 56 Overview Map of Subsurface Oil Category for Each Pit/Trench Observed during a Given Survey

5.3.15 Overview Map of Subsurface Oil State

This overview map supports response planning by providing a general overview of the extent of subsurface oiling. The map in Figure 57 shows all recorded pits and trenches for a given SCAT survey.

Users

SCAT coordinator
Planning section
Incident Command

Production Frequency

Overview maps are produced as soon as the information is available from the field. This type of representation is usually produced only upon request.

Data

The data necessary to produce the map includes:

- locations of pits or trenches;
- survey code; and
- an estimate of the subsurface oil state from the depth of penetration or thickness of oil lens in each pit or trench.

Processing

The map is constructed from the subsurface oil state observed within each pit or trench from the depth of penetration or thickness of oil lens, as described in Section 5.1.1, item 6.

Limitations

This type of representation provides a general indication of areas where subsurface oil was observed. It is often the only type of representation possible when the relative oil concentration value is either missing or unreliable.

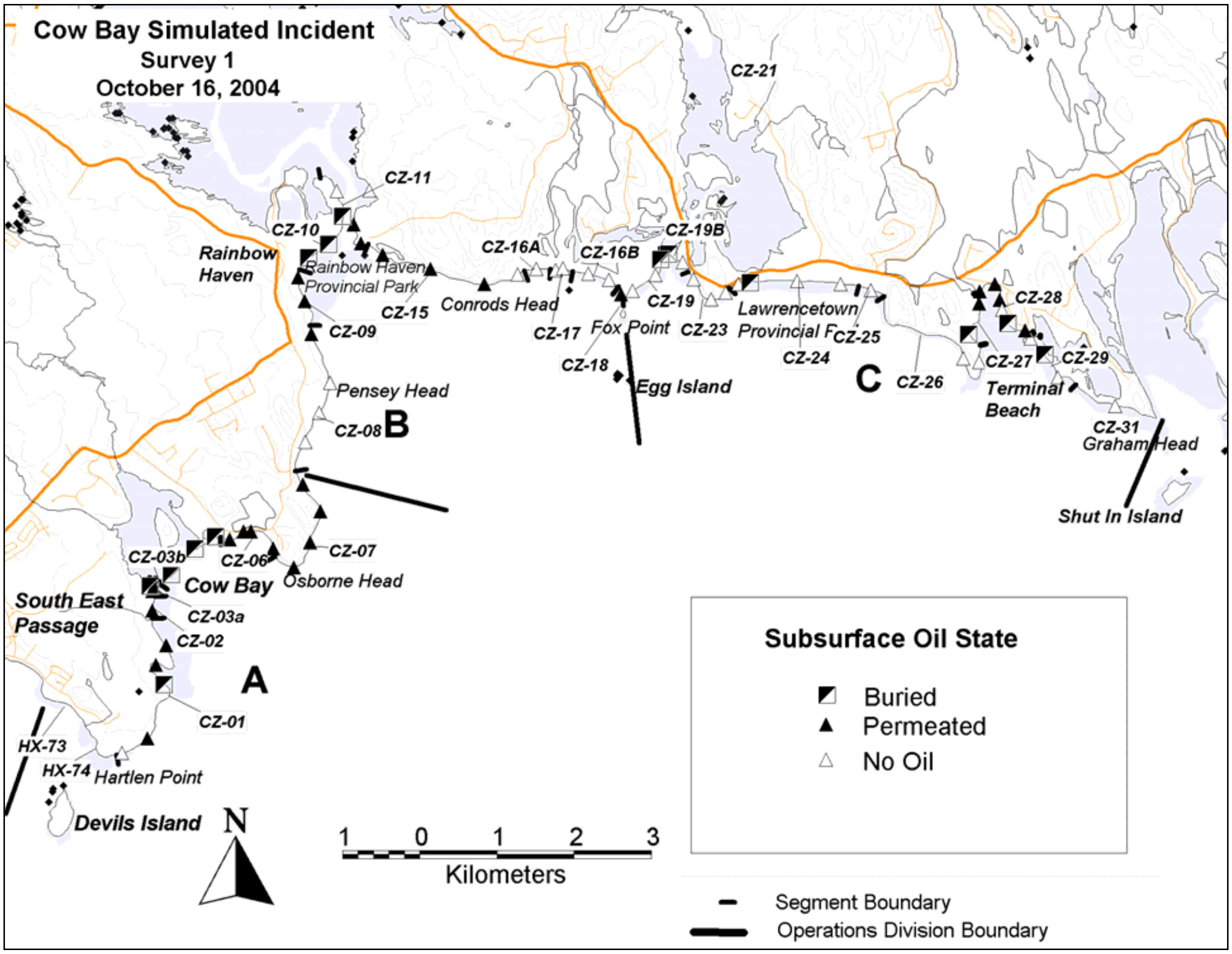


Figure 57 Overview Map of Subsurface Oil State for Each Pit/Trench Observed during a Given Survey

5.3.16 Summary Tables of Surface Oil Category

These summary tables support response planning by providing a general overview of the length of shoreline oiled by the surface oil category. Information that is further broken down by shoreline type indicates appropriate shoreline treatment methods and potential level of effort required. An example of such a map broken down by types of substrate is given in Table 37.

Table 37 Summary Table of Surface Oil Categories broken down by Substrate Type

Substrate Type	Length of Shoreline by Surface Oil Category (km)				
	Heavy	Moderate	Light	Very Light	No Oil
Bedrock	0.00	0.00	2.37	0.39	0.00
Boulder	0.00	1.62	0.12	0.00	0.00
Pebble/Cobble	1.44	3.13	4.86	1.62	0.00
Marsh/Wetlands	0.00	0.00	0.29	0.01	0.00
Man-made Permeable	0.38	1.97	0.45	0.00	0.00
Sand	1.23	2.13	2.88	0.34	0.00
Mixed Sediments Fine	0.64	2.09	0.78	0.01	0.02
Total	**3.69**	**10.94**	**11.74**	**2.36**	**0.02**

Users

SCAT coordinator
Planning section
Incident Command
Public groups

Production Frequency

A summary table of the surface oiling category is produced daily as soon as the information is available from the field.

Data

The data necessary to produce the table include:

- the summary length of oiled shoreline by surface oil category for each shoreline segment; and
- the overall substrate type for each shoreline segment.

The following additional information may be useful to further break down the results:

- the operations division; and
- the shoreline segment ID.

Processing

First responder survey data is normally stored in tables. This data is processed in two steps. First the summary length of shoreline by surface oiling category and the summary substrate type are estimated for each shoreline segment surveyed using the methods described in Section 5.1.2, item 2.

It is best to develop the table by using a computer or spreadsheet program that accesses the data in the survey summary table and computes the length of shoreline recorded for each oil zone by shoreline type and surface oil category. This can be done in a single step by using a spreadsheet program and creating a “pivot table” report.

Limitations

Since oiled substrate type for each segment must be summarized, the length of shoreline associated with the substrate type might not accurately reflect all the shoreline types that have been oiled within single shoreline segments.

A summary table of surface oil categories can be created only from a single survey within each shoreline segment. If some shoreline segments have been resurveyed, the results of the latest SCAT survey performed within each shoreline segment provide a more accurate portrait of the “current” oiling situation.

The length of shoreline by surface oil category is frequently also broken down and presented by operations division, as shown in Table 38 and by survey number as shown in Table 39, in order to show the evolution of oiling. It is sometimes even presented by shoreline segment, if there are not too many segments.

Table 38 Summary Table of Surface Oil Categories broken down by Operations Division

Operations Division	Length of Shoreline by Surface Oil Category (km)				
	Heavy	Moderate	Light	Very Light	No Oil
A	2.02	3.90	1.30	0.00	0.02
B	1.15	4.51	3.40	1.17	0.00
C	0.52	2.53	7.04	1.20	0.00
Total	**3.69**	**10.94**	**11.74**	**2.36**	**0.02**

Table 39 Summary Table of Surface Oil Categories broken down by Survey Number

Survey No.	Length of Shoreline by Surface Oil Category (km)				
	Heavy	Moderate	Light	Very Light	No Oil
1	3.69	10.94	11.74	2.36	0.02
2	0.37	0.13	1.14	3.24	10.00

5.3.17 Summary Map of Surface Oil Categories

This map supports response planning by providing a summary of the extent and degree of oiling within each shoreline segment for a given SCAT survey. The map in Figure 58 shows a single category of surface oil for each shoreline segment.

Users

SCAT coordinator
Planning section
Incident Command
Public groups

Production Frequency

Summary maps of surface oil categories are produced daily as soon as the information is available from the field.

Data

The data necessary to produce the map include:

- start and end locations of shoreline segments;
- survey code; and
- estimation of surface oil category within each shoreline segment.

Processing

The map is constructed from the surface oil category within each shoreline segment, summarized from all the oil zones present in each segment, following the method described in Section 5.1.2, item 1.

The survey data table is filtered to select a single survey for each shoreline segment.

Limitations

This type of summary provides an image of the "worst surface oil categories" over the entire spill area for a given shoreline survey. The map can only represent the summary of a single shoreline survey within each segment. If certain shoreline segments have been resurveyed, a map showing the summary surface oil category based on the latest survey done in each segment provides a better representation of the current oiling situation.

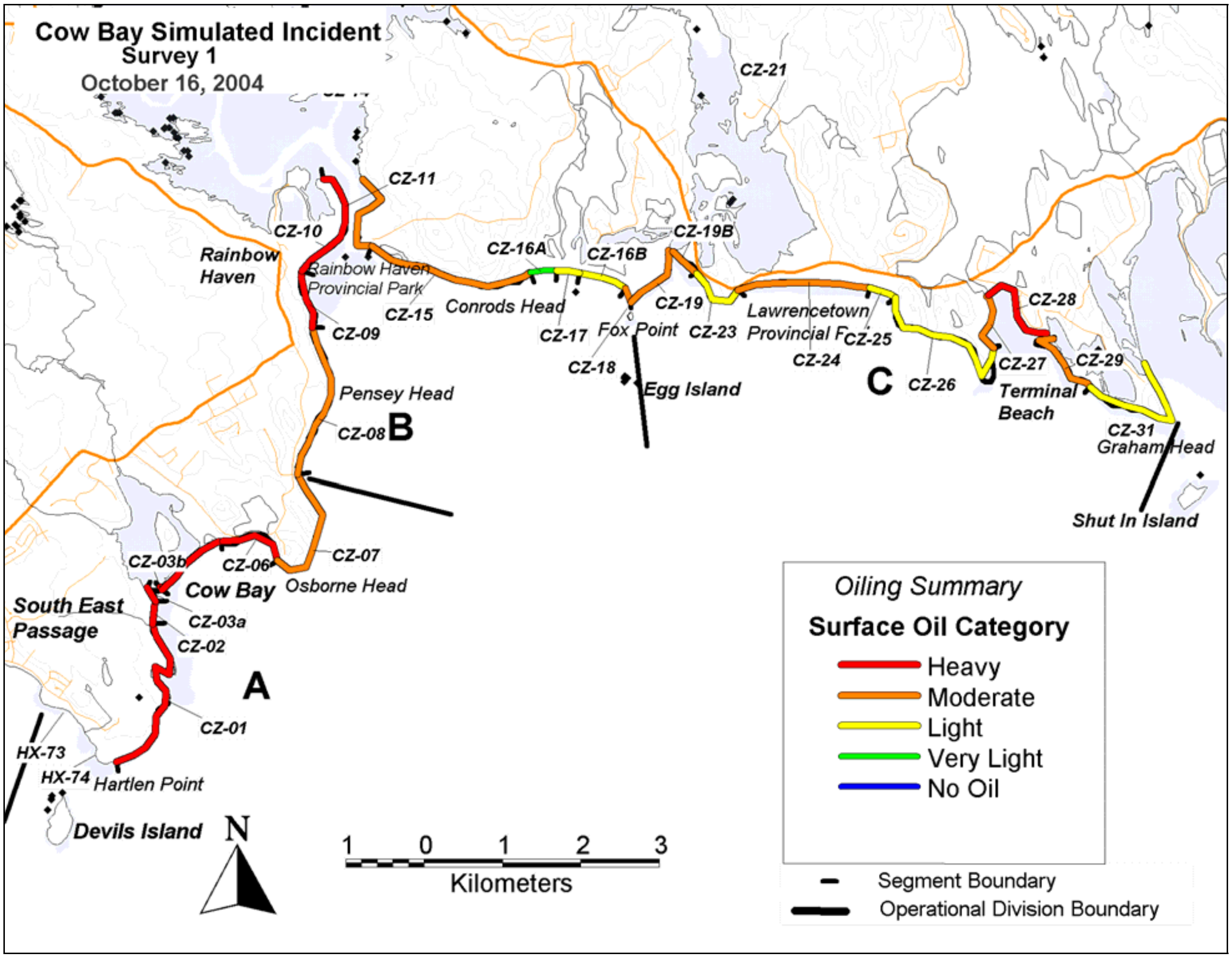


Figure 58 Summary Map of Surface Oil Category for Each Shoreline Segment Observed during a Given Survey

5.3.18 Summary Map of Oiled Substrate Type

This map supports response planning by providing a summary of the oiled substrates within each shoreline segment for a given SCAT survey. The map in Figure 59 shows a single substrate type for each shoreline segment.

Users

SCAT coordinator
Planning section

Production Frequency

Summary maps of oiled substrate type are produced as soon as the information is available from the field. This more specialized representation may or may not be produced on a regular basis.

Data

The data required to produce the map includes:

- start and end locations of shoreline segments;
- survey code; and
- an estimate of the predominant or primary substrate type within each shoreline segment.

Processing

The map is constructed from the substrate type within each shoreline segment, summarized from all of the oil zones present in each segment, following the method described in Section 5.1.2, item 1.

The survey data table is filtered to select a single survey for each shoreline segment.

Limitations

This type of summary provides an indication of the "substrate types with the worst surface oil category" over the entire spill area for a given shoreline survey.

The overview map can only represent the summary of a single shoreline survey within each segment. If some shoreline segments have been resurveyed, then a map showing the summary substrate type within the latest survey of each segment is a better representation of the current situation.

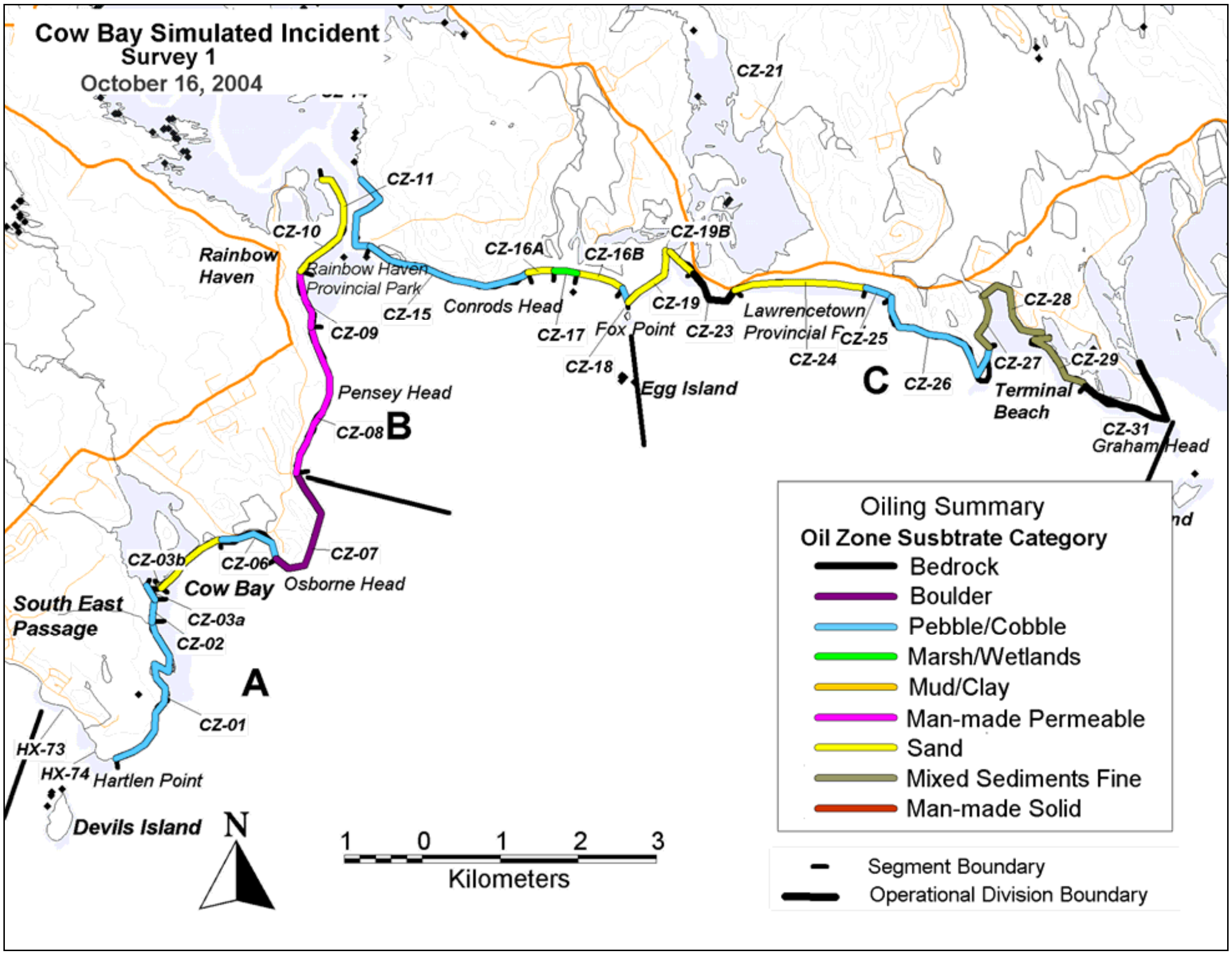


Figure 59 Summary Map of Substrate Type for Each Shoreline Segment Observed during a Given Survey

5.3.19 Summary Maps of Oil Volume

These maps support response planning by displaying the results of oil volume calculations from SCAT data. An example is shown in Figure 60.

Users

SCAT coordinator
Planning section

Production Frequency

The summary map of oil volume is produced as soon as the information is available from the field. Since estimates of oil volumes can be very inaccurate, this type of map should only be created on demand and its use should be restricted.

Data

The data necessary to produce the map includes:

- location of shoreline segments;
- survey code; and
- an estimate of the oil volume within each shoreline segment.

Processing

This map is constructed from the estimated oil volume within each shoreline segment, calculated from the width, length, distribution, and thickness of the oil within each of the oil zones present in each segment, following the method described in Section 5.1.1, item 5.

As was demonstrated in Table 27, oil volumes are usually not precise. This should be reflected in the way the volumes are represented on a summary map. The example provided in Figure 59 represents oil levels by a single symbol whose size is a function of the square root of the calculated volume.

The survey data table is filtered to select a single survey for each shoreline segment.

Limitations

Due to the imprecision in oil volume calculations from SCAT data, the map legend should clearly state that the data are presented to indicate only the location of oil concentrations rather than a specific or precise volume of oil within each segment.

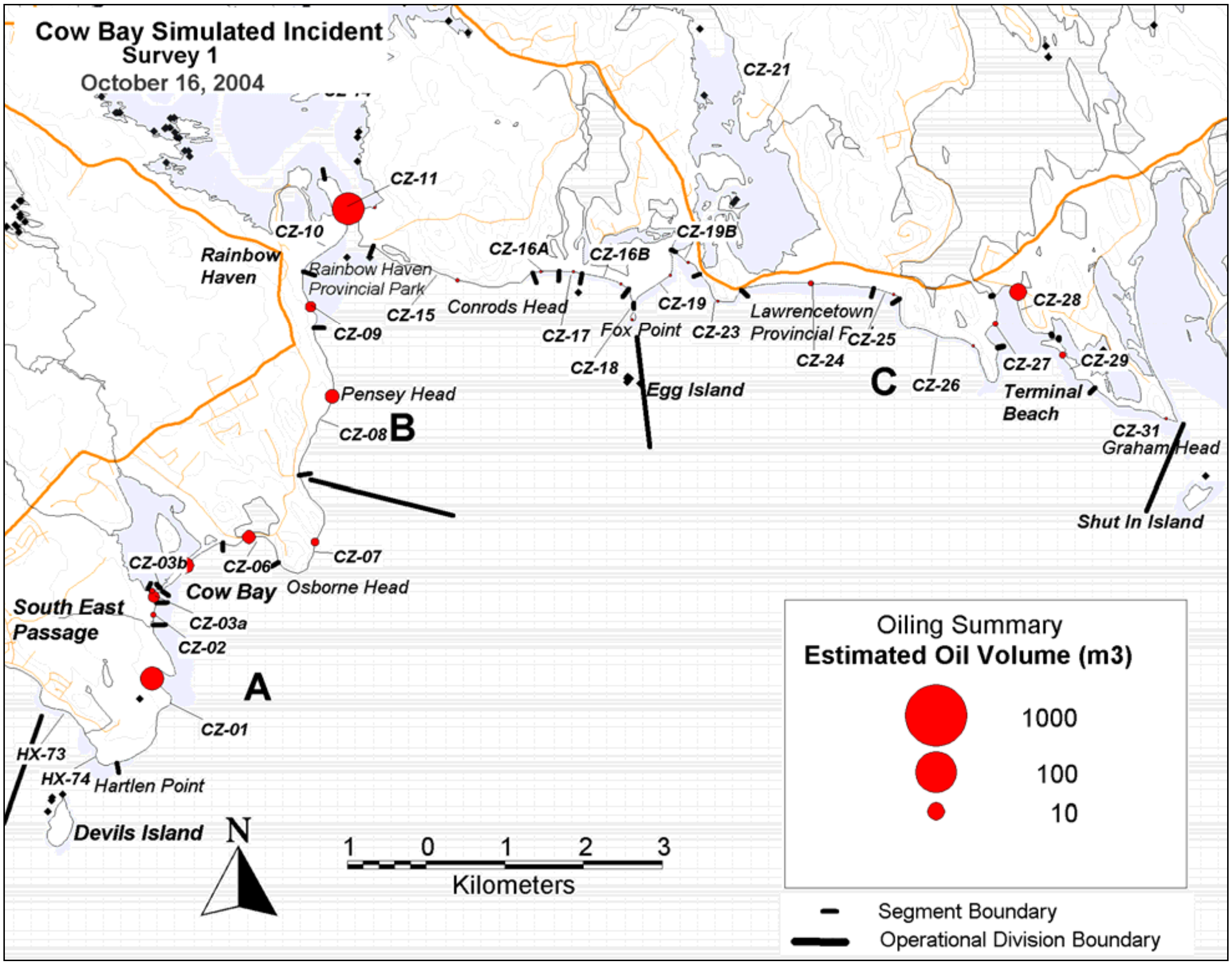


Figure 60 Summary Map of Oil Volumes Estimated for Each Shoreline Segment in a Given Survey

5.3.20 Overview Map of Work Status

This type of overview map supports response planning by indicating the state of the activities performed in each shoreline segment at a given date. An example is given in Figure 61.

Users

SCAT coordinator
Planning section
Incident Command
Public groups

Production Frequency

Work status maps are normally updated daily or after incident action plans are completed.

Data

The data required to produce the map include:

- location of shoreline segments;
- date; and
- work status category.

Processing

The "Work Status Category" must be updated before the map can be revised. Work status categories are likely to vary between organizations, and even between spills, to take into account situations that might be unique for a given spill.

Our example shows seven (7) status categories that are based on the following work organization:

a field SCAT survey;
development of a treatment work plan;
approval of the treatment plan;
completion of treatment within a segment;
inspection of the treated shoreline segment; and
approval of completion of the treatment activities in the segment.

These steps might vary from spill to spill. For example, the inspection process might include other steps such as:

- inspection by SCAT team;
- inspection by stakeholders;
- final approval and sign-off; and
- demobilization from a segment.

Limitations

Work status maps need to be approved by both the SCAT coordinator and the Planning Section chief before they are distributed.

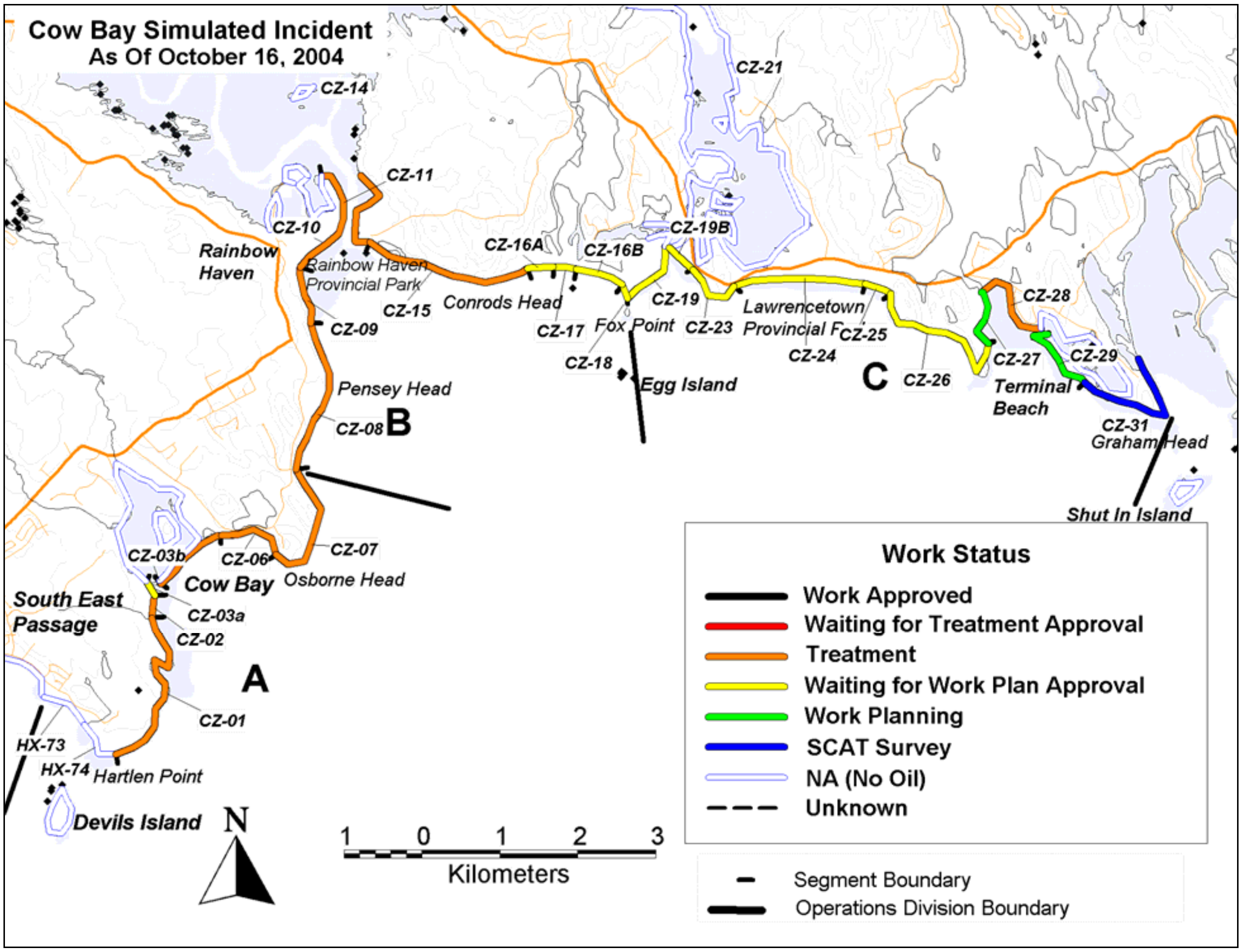


Figure 61 Overview Map Showing Work Status for Shoreline Segments by Date

5.3.21 Summary Table of Work Status

This summary table supports response planning by providing a list of the state of the activities performed in each shoreline segment on a given date. An example is provided in Figure 62.

Users

SCAT coordinator
Planning section
Incident Command
Public groups

Production Frequency

Work status tables are normally updated daily, or following the production of incident action plans.

Data

The data required to produce the map includes:

- date; and
- the current work status category of each shoreline segment.

Processing

The work status category is updated for each shoreline segment before the report can be produced. Work status categories often vary between organizations and even between spills to take into account unique situations for a given spill.

The selection of work status categories is briefly discussed in Section 5.3.20.

Limitations

Before distribution, work status tables must be approved by both the SCAT coordinator and the chief of the planning section.

Work Plan

Cow Bay Simulation

Work Plan:01
Situation Report: 01

Operations Division	Segment	Response Category	Treatment Step	Dates (dd mmm yyyy)						
				SCAT Survey Completed	Treatment Plan Completed	Treatment Plan Approved	Treatment Finished	Inspection Finished	Further Treatment Required	Treatment Approved
A	CZ-01	A	Being Treated	14 Oct 2004	15 Oct 2004	16 Oct 2004				
A	CZ-02	A	Being Treated	14 Oct 2004	15 Oct 2004	16 Oct 2004				
A	CZ-05	B	Being Treated	14 Oct 2004	15 Oct 2004	16 Oct 2004				
A	CZ-06	A	Being Treated	14 Oct 2004	15 Oct 2004	16 Oct 2004				
A	CZ-07	B	Being Treated	14 Oct 2004	14 Oct 2004	15 Oct 2004				
B	CZ-08	C	Being Treated	14 Oct 2004	14 Oct 2004	15 Oct 2004				
B	CZ-09	A	Being Treated	14 Oct 2004	14 Oct 2004	15 Oct 2004				
B	CZ-10	A	Being Treated	14 Oct 2004	15 Oct 2004	16 Oct 2004				
B	CZ-13	B	Being Treated	14 Oct 2004	14 Oct 2004	15 Oct 2004				
B	CZ-15	B	Being Treated	14 Oct 2004	14 Oct 2004	15 Oct 2004				
C	CZ-28	A	Being Treated	13 Oct 2004	14 Oct 2004	15 Oct 2004				
A	CZ-03a	C	Waiting for Treatment Plan Approval	14 Oct 2004	15 Oct 2004					
A	CZ-03b	B	Waiting for Treatment Plan Approval	14 Oct 2004	15 Oct 2004					
B	CZ-16A	C	Waiting for Treatment Plan Approval	15 Oct 2004	16 Oct 2004					
B	CZ-16B	C	Waiting for Treatment Plan Approval	15 Oct 2004	16 Oct 2004					
B	CZ-17	C	Waiting for Treatment Plan Approval	15 Oct 2004	16 Oct 2004					
B	CZ-18	B	Waiting for Treatment Plan Approval	15 Oct 2004	16 Oct 2004					
C	CZ-19	B	Waiting for Treatment Plan Approval	15 Oct 2004	16 Oct 2004					
B	CZ-19B	B	Waiting for Treatment Plan Approval	15 Oct 2004	16 Oct 2004					
C	CZ-23	C	Waiting for Treatment Plan Approval	15 Oct 2004	16 Oct 2004					
C	CZ-24	B	Waiting for Treatment Plan Approval	15 Oct 2004	16 Oct 2004					
C	CZ-25	C	Waiting for Treatment Plan Approval	15 Oct 2004	16 Oct 2004					
C	CZ-26	C	Waiting for Treatment Plan Approval	15 Oct 2004	16 Oct 2004					
C	CZ-27	B	Planning Treatment	16 Oct 2004						
C	CZ-29	B	Planning Treatment	16 Oct 2004						
C	CZ-31	C	Planning Treatment	16 Oct 2004						

ShoreAssess - Work Plan(Prepared By: Ed Owens; Updated By: Jane Smith)

29-11-04 Page 1/1

Figure 62 Summary Table of Work Status

5.3.22 Segment Inspection Report Form

This form provides comments and instructions from shoreline inspection teams after treatment. An example is provided in Figure 63.

Users

SCAT coordinator
Planning section
Operations section
Stakeholders

Production Frequency

Inspection reports are produced to officially confirm the shoreline oiling conditions after treatment, i.e., either that no treatment is necessary or that additional work is needed.

Data

No previous data is necessary other than the shoreline segment identification and location.

Processing

Shoreline inspection reports do not usually require any additional processing.

5.3.23 Compilations of SCAT Data

Many other reports, maps, and tables can be produced from SCAT data. The following lists have been produced occasionally in response to a unique or special requirement:

- all cleanup recommendations made in the course of a spill response;
- the maximum surface oil categories observed in the course of a spill response; and
- changes in composition of SCAT teams in the course of a spill response.

Segment Inspection Report (SIR) Cow Bay Simulation

Operations Division	B
Segment ID:	**CZ-16A**
Length:	**334** m

Inspection Date:	15-Oct-2003
Tide Stage:	Low
Weather	Sun-Clouds

Inspection Team

Name (Agency):	Signature
Climber, L. (EC)	[signature]
Hiker, A. (PNB)	[signature]
Walker, A. (ISA)	[signature]

Pre-Treatment Oiling Conditions ☑ attached

Zone A: 323m x 1m, 5% Coat (Dominant: Sand)
Tar Ball Characteristics: 5 Total ,2.0cm Average Size ,3.0cm Maximum Size ,Weathered - Collected
Zone B: 327m x 1m, 10% Coat (Dominant: Sand)
Tar Ball Characteristics: 1 per m2 ,1.0cm Average Size ,3.0cm Maximum Size ,Weathered - Collected

Treatment Method or Plan ☐ attached

Treatment Endpoint Criteria ☐ attached

No Remobilizable Oil

Observations and Recommendations ☐ Entire Segment Inspected

☑ Segment meets endpoint criteria and conditions

NO further treatment required

☐ segment DOES NOT MEET endpoint criteria and conditions

☐ Specific treatment actions attached

Approved By:

FOSC	POSC	RP
[signature]	[signature]	[signature]

☑ First Nation, Landowner or other stakeholder attached

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Figure 63 Segment Inspection Report Form

Chapter 6 Developing SCAT Databases

This chapter describes the elements and characteristics of a database that make it appropriate for storing and retrieving SCAT data gathered during a spill response. The following subjects are covered:

- data structures best suited for storing SCAT data;
- data elements included in a SCAT database; and
- data structure and content of pre-spill SCAT databases.

6.1 SCAT Database

The term SCAT database refers to an organized set of all data collected by SCAT teams during field surveys, including any additional information required or useful for data processing. In this section, organizing SCAT data as a set of linked data tables is discussed. Details about each data table are presented and essential and useful data elements or attributes are listed.

6.1.1 Structure of SCAT Data

SCAT data can be grouped into five information categories as shown in Figure 64 and outlined here.

- **General Incident Data** includes details about the incident, such as the location and name of the spill and the nature and quantity of the oil that was spilled. Data describing the general nature of the incident are usually entered once and may be updated occasionally to reflect the latest information about certain aspects of the spill, such as the amount of oil released, which is generally not known at the start of a response.
- **Shoreline Segment Characteristics** include data that describe the unique aspects of each shoreline segment, such as the code; location, segment boundaries, operations division; primary and secondary shoreline types; wave exposure; slope; primary and secondary backshore types; character traits of the primary backshore type; and various other features such as accessibility and the presence of debris. Shoreline segment data are usually entered when the segment is defined, either while developing a pre-spill database or when the segment is first surveyed.
- **Survey Characteristics** include data such as the date surveyed; the segment visited; how the survey was carried out, i.e., on foot, by boat or helicopter, etc.; weather conditions; and the composition of the survey team. Data describing each survey are entered and updated after the survey is completed.
- **Surface Oiling Characteristics** include data gathered for each oil zone on observations within a specific segment during a survey. Surface oiling characteristics should include an oil zone code, length and width of the zone, oil cover, oil distribution, oil thickness, character, and substrate type(s). Any number of oil zones can be recorded within a shoreline segment during a survey.
- **Subsurface Oiling Characteristics** include oiling observation data gathered for each pit or trench dug along a segment during a specific survey. For each pit or trench, subsurface data should include the zone in which the trench/pit is located, the subsurface oil character, thickness of the oil lens, and substrate types.

These five categories form a hierarchy of data. During each spill incident, one or more shoreline segments may be oiled. Each shoreline segment may be surveyed on one or more occasions and during each survey, one or more surface oil zones and subsurface trenches or pits may be observed and characterized.

SCAT Data Categories

1 — General Incident Data

Essential data:
- Incident Name

2 — Shoreline Segment Characteristics

Essential data:
- Segment ID
- Length
- Primary Shoreline Type
- Wave Exposure
- Primary Coastal Character

3 — Survey Characteristics

Essential data:
- Segment ID
- Survey Code
- Date
- Length of Segment Surveyed
- Oiled Debris
- Oiled Debris Quantity
- Oiled Debris Units

4 — Surface Oiling Characteristics

Essential data:
- Segment ID
- Survey Code
- Oil Zone ID
- Tidal Zone
- Length
- Width
- Surface Distribution
- Surface Oil Thickness
- Surface Oil Character
- Substrate Type(s)

5 — Subsurface Oiling Characteristics

Essential data:
- Segment ID
- Survey Code
- Pit/trench Number
- Tidal Zone
- Oiled Zone
- Sheen Color
- Substrate Type(s)

Figure 64 SCAT Data Categories (including a list of essential data)

Each of the primary elements within each category, that is, incident name, shoreline segment, survey, surface oil zone, and subsurface trench/pit, includes spatial attributes, such as geographic location and non-spatial ones such as any other data.

Each category can also be thought of as a table. Within each table, every occurrence of a primary element corresponds to a row and each attribute of that element corresponds to a column. For example, the “Shoreline Segment” category can be represented by a table in which each row corresponds to a different shoreline segment and each column contains the unique characteristics of that segment.

This leads to an approach in which the SCAT data can be represented as a collection of linked tables, as shown in Figure 65. The representation, which is the typical method to describe the structure of a relational database, shows that there is a “none or more” hierarchical relationship between linked tables. This means that for each entry/row within a table, there can be one or multiple entries within a table that are lower in the hierarchy. For example, for each shoreline segment entered in the Shoreline Segments table, there can be one or multiple entries within the Survey table and for each entry within the Survey table, there can be one or multiple entries in the Surface Oil Zone table as one or any number of oil zones can be observed during a given survey.

The data structure shown in the figure does not provide details about the content of each of the tables that would make up a SCAT database, other than the data element, which is also referred to as “data field”, that is used to index each of the tables. In order to simplify the index of each data table related to the General Incident data table, the index does not indicate the Incident Name, as incidents are usually managed one at a time.

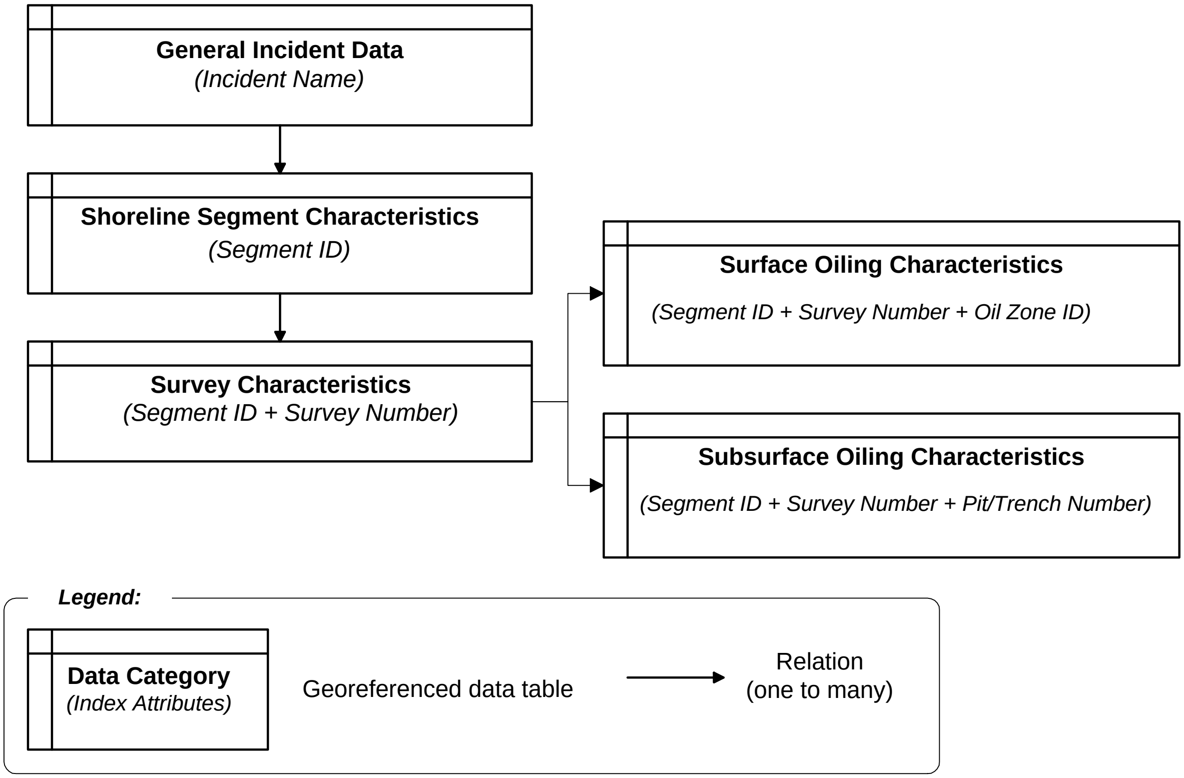

Figure 65 A Relational Data Structure that Accommodates SCAT Data

In order to create a SCAT database, it is necessary to create each of the data tables that will contain the data. Each data table is described in the next sections, including a list of the data attributes that form the set of data elements of each row of the table. These data attributes are also referred to as "data fields". Each attribute corresponds to an observation recorded by SCAT teams on shoreline oiling forms.

6.1.2 General Incident Data

Each row of the General Incident data table, shown in Table 40, includes the attributes of a single incident. Although the incident name is the only attribute that is truly essential, some additional general information about the incident may be useful, such as the location (latitude and longitude) of the area where oil was spilled, the type and estimated quantity of oil released, the time zone, and the units used to record observations. It is particularly important to know the measurement units used to record observations in order to prevent mistakes in data processing.

1. Incident Name

This is the only essential data element in the general incident table. The incident name is normally provided by Incident Command and is generally created either from the location of the spill or the name of the vessel or facility that was the origin of the spilled oil. The incident name appears on all outputs produced in the course of a response.

2. Date

The date is that of the occurrence of the spill. While this is usually straightforward, the exact date of the spill is sometimes uncertain as the oil may have started to flow on a different date than when the incident was reported and the incident command structure was implemented. It might take a few days for an "official" spill date to be released.

Table 40 Attributes of General Incident Data

Data Attribute	Description	Type
1. Incident Name	Name of the incident	Text
2. Date	Date of occurrence of the spill	Date
3. Region	Geographic region of occurrence of the spill	Text
4. Time Zone	Local time zone (generally using the Universal Time Zone)	Text
5. Longitude Latitude	Geographic coordinate of the spill Stored as decimal degrees	Number Number
6. Oil Type	Nature of the released oil	Text
7. Quantity Released	Estimated amount of oil released	Number
8. Quantity Units	Units of measurement used to report the quantity of oil released	Text
9. Segment Length Unit	Units of measurement used to report length of shoreline segments	Text
10. Surface Oil Zone Length Unit	Units of measurement used to report length of surface oil zones	Text
11. Surface Oil Zone Width Unit	Units of measurement used to report width of surface oil zones	Text
12. Pit/Trench Depth Unit	Units of measurement used to report depth of oil observed in pits or trenches	Text
13. Datum	Datum of the map coordinates used to record positions of spatial features. If not mentioned, this will be assumed to be WGS84.	Text

Note: *Essential attributes are shown in bold.*

3. Region
It is sometimes helpful to enter a brief description of the location where the spill occurred, e.g., 2 km southwest of the Cow Bay area, near Halifax, Nova Scotia.

4. Time Zone
This refers to the local time zone in the area where the spill occurred. Time zones are usually noted as a number indicating the difference in terms of Universal Time (UT), also referred to as “Z time”. For example, New Zealand time zone is noted as +12, Vancouver as –8, and Halifax as –4.

5. Longitude and Latitude
This records the longitude and latitude of the location of the spill, which should be stored in decimal degrees. This value can change with time in the early stages of an incident that originates from a moving location such as a ship.

6. Oil Type
The oil type indicates the nature of the oil that was released. It should be possible to enter more than one type of oil as more than one type is sometimes released from a single source. For example, a tanker could be carrying crude oil or product and a fuel oil, both of which could be released if the vessel runs aground.

7. Quantity Released
This refers to the estimated amount of oil released. This value is entered as a number and may change in the course of the response as more accurate information is gathered from the spill site.

8. Quantity
The quantity of oil released can be provided in a number of different units, e.g., barrels, Imperial gallons, metric tons, litres (L), US gallons, or US tons. The units should be specified along with the quantity released.

9. Segment Length
This refers to the default units used to specify the length of shoreline segments. In Canada, units for length are either kilometres (km) or metres (m).

10. Surface Oil Zone Length
This refers to the default units used to specify the length of surface oil zones. In Canada, this is recorded in metres (m).

11. Surface Oil Zone Width
This refers to the default units used to specify the width of surface oil zones. In Canada, this is recorded in metres (m).

12. Pit/Trench Depth
This refers to the default units used to specify the depth of penetration of subsurface oil observed within pits or trenches. In Canada, depth measurements are recorded in centimetres (cm).

13. Datum
A datum describes the model used to match the location of features on the ground to coordinates and locations on a map. GPS units usually provide location data using the WGS84 datum. In Canada and the United States, paper and digital maps normally use either WGS84 or NAD27 datum. In North America, the difference in location between WGS84 and NAD27 can be as much as 200 m.

6.1.3 Shoreline Segment Attributes

Each row in the Shoreline Segments table includes the attributes that characterize a single shoreline segment. Segment characteristic attributes provide information about the identity and location, geomorphology, and operational features of the segment. The most important segment attributes include the unique segment code, the length, the nature of shoreline type, wave exposure, and the segment boundaries, i.e., start and end coordinates. The core shoreline attributes that apply to a marine shoreline environment in temperate climates are listed in Table 41, with the essential attributes shown in bold. Additional attributes used on SOS forms for other types of environments are listed in Appendix 1.

1. Segment ID
Every shoreline segment defined along a coastline is assigned a unique segment identification code. This code is generally an alphanumeric sequence, starting with a three- or four-character alphabetic prefix for the segment group and followed by a sequence number within that group, for example, TRT-010, TRT-020. Since segments can be subdivided in the course of a response, it is recommended that a number larger then one be used when creating segment codes.

Table 41 Attributes of Shoreline Segments

Data Attribute	Description	Type
1. Segment ID	Segment ID code (usually three letters followed by a number)	Text
2. Operations Division	Code of the operations division in which the segment is located	Text
3. Region	Region where the segment is located	Text
4. Date	Date when segment attributes were last updated	Date
5. Place Name	Local place name of the area where the segment is located	Text
6. Start Coordinates (Longitude and latitude)	Geographic coordinates of the boundary at one end of the segment (stored as decimal degrees)	Number
7. End Coordinates (Longitude and latitude)	Coordinates of the boundary at the other end of the segment (stored as decimal degrees)	Number
8. Length	Length of the shoreline segment	Number
9. Average Width	Average or most common width of the intertidal zone along the shoreline segment	Number
10. Primary Shoreline Type	Nature of the most common shoreline type observed in the segment	Text
11. Secondary Shoreline Type(s)	Nature of secondary shoreline types observed in the segment	Text
12. Wave Exposure	Observed wave exposure category of the segment	Text
13. Slope	Average across-shore elevation in the segment	Text
14. Primary Coastal Character	Nature of the predominant type of coastal character observed in the segment	Text
15. Secondary Coastal Character	Nature of secondary types of coastal characters observed in the segment	Text
16. Cliff Height	Average or most common height of a cliff (if present)	Number
17. Cliff Height Units	Units used to record the height of the cliff	Text
18. Direct Backshore Access	Indicates whether shoreline is accessible from the backshore	Yes/No
19. Alongshore Access	Indicates whether shoreline is accessible from the next adjacent segment	Yes/No
20. Current-dominated Channel	Indicates presence of a strong current along the shoreline	Yes/No
21. Suitable Backshore Staging Area	Indicates if there is a space for the temporary storage of equipment or waste.	Yes/No
22. Debris Present	Indicates whether there is debris along the shoreline	Yes/No
23. Debris Quantity	If there is debris, this indicates the quantity	Number
24. Debris Units	Debris units (bags or cubic metres)	Text
25. Access Restrictions	Factors that might restrict access to the shoreline segment	Text
26. Other Access Features	Any features that will influence access to the segment	Text
27. Substrate Types	Nature of the most common substrate types observed within the segment. The substrate type is usually recorded as a combination of the following letters: R, B, C, P, G, S, M, O, MMS, MMP, U and VEG. These are defined in Section 6.1.3, item 27.	Text
28. Vegetation Cover	Indicates the presence and amount of vegetation along the segment	Text
29. Man-made Shoreline Features	Indicates the nature of man-made structures along the segment	Text
30. Man-made Coastal Character or Usage	Indicates the nature of man-made features or usage category(ies) along the segment	Text

Note: *Essential attributes are shown in bold.*

2. Operations Division
For organizational and planning purposes, the area affected by the spill is usually divided into regions called operations divisions. Resources are often allocated on the basis of the number of operations divisions. Each operations division within the area affected by a spill is generally identified by a single letter, e.g., A, B, C. Many reports, maps, and tables present information sorted or grouped according to operations division.

3. Region
Shoreline segments are usually located in a geographical region, such as a municipality, county, or township. Some information can be usefully sorted, filtered, grouped, or otherwise presented by regions.

4. Date
The date corresponds to the last time the data was updated or segment attributes were added. Documenting the modification date can be useful to help ensure data integrity when restoring or backing up data.

5. Place Name
It is sometimes useful to know the local place name of the area where a spill is located in a shoreline segment.

6. Start Coordinates
The geographic coordinates (longitude and latitude) of the start of the shoreline segment should be noted in decimal degrees. This information is useful to field personnel who need to find a shoreline segment with the assistance of a Global Positioning System (GPS) and to the data manager who can use the information to georeference each row of the segment table within a Global Information System (GIS).

7. End Coordinates
As in item 6 above, the geographic coordinates (longitude and latitude) of the end, i.e., the other boundary, of the shoreline segment should be noted in decimal degrees. Again, this information is useful to field personnel who need to find a shoreline segment with the help of a GPS and to the data manager who can use the information to georeference each row of the segment table within a GIS.

8. Length
The length of the shoreline segment combined with the primary shoreline type is used during planning to estimate the effort and resources needed for the response.

9. Average Width
The average width of a shoreline segment is an estimate of the across-shore dimension, perpendicular to the shoreline. In a marine environment, the width corresponds to the size of the intertidal zone.

10. Primary Shoreline Type
The primary shoreline type usually refers to the character of the upper intertidal zone in marine environments, also known as the “foreshore”, the upper swash zone on lakes, or the upper bank on rivers and streams. This is the zone where oil usually becomes stranded and treatment or cleanup activities take place. There can be only one overall primary shoreline type, but there may be several secondary shoreline types within a shoreline segment.

Select the primary shoreline type to correspond to the clearly predominant shoreline character located in the upper intertidal zone. If there is no clearly predominant character in the upper intertidal zone, select the most sensitive shoreline type. If wetlands are predominant, select this as the primary character.

Shoreline types are generally created from a combination of substrate type and shoreline form. They do not include processes like wave energy, environmental sensitivity, or backshore characteristics. Shoreline types may vary due to geographic location, i.e., temperate, tropical, or Arctic, and the size of the incident. For example, one spill may impact only mangroves and mud flats, while another may encompass 20 different types of sediment beaches, flats, bedrock, and man-made structures.

A standardized set of Environment Canada marine and freshwater shoreline types are provided in Tables 42 and 43. This classification is reflected in the selection for standard shoreline types on the Shoreline Oiling Summary (SOS) forms. While these shoreline types should cover most incidents, there will be scenarios in which incident-specific additions are needed or when existing shoreline types must be subdivided. Further details on the nature of 'man-made' shoreline types is most often specified as possibly having an impact on operations or treatment method (see item 29 in this section). Other shoreline types that are often subdivided include mixed sediment (fine or coarse) and wetlands/marshes.

Table 42 Environment Canada Standard SCAT Shoreline Types – Marine

Marine – All Seasons
Bedrock – Cliff/vertical
Bedrock – Sloping/ramp
Bedrock – Platform
Man-made Solid
Man-made Permeable
Glacier/Ice Shelf
Sand Beach
Mixed Sediment Beach
Pebble/Cobble Beach
Boulder Beach
Mud Flat
Sand Flat
Mixed Sediment Flat
Pebble/Cobble/Boulder Flat
Wetland
Peat Shoreline
Tundra Cliff – Ice-rich
Tundra Cliff – Ice-poor
Inundated Low-lying Tundra
Winter Only (Temporary)
Ice Foot/cover
Snow
Frozen Swash
Frozen Spray/Splash
Grounded Ice Floes

11. Secondary Shoreline Type(s)

If more than one shoreline type is observed within a shoreline segment, these are described as secondary shoreline types. There can be only one primary shoreline type but there may be several secondary types within a segment. Secondary shoreline types can be associated with any of the intertidal zones, not just the upper intertidal zone. They may also represent the proportion of the total segment length of each shoreline type. When this additional information is recorded, it is best to include it as an additional sub-table or drawing.

Table 43 Environment Canada Standard SCAT Shoreline Types – Freshwater

Freshwater – All Season
Bedrock - Cliff/ramp
Bedrock - Platform/shelf
Man-made Solid
Man-made Permeable
Sediment Cliff
Mud/Clay Bank
Sand Beach or Bank
Mixed Sediment Beach or Bank
Pebble/Cobble Beach or Bank
Boulder Beach or Bank
Peat/Organic Beach or Bank
Mud Flat
Sand Flat
Mixed Sediment Flat
Vegetated Bank
Marsh
Swamp
Bog/Fen
Wooded Upland
Winter Only (Temporary)
Ice Foot/cover
Snow
Frozen Swash
Frozen Spray
Grounded Ice Floes

12. Wave Exposure

This indicates the level of wave energy to which the shoreline segment can be exposed. The wave energy level is an important factor in determining the oil remobilization potential, a measure of the likeliness that oil can be re-floated and potentially affect another area of the shoreline. The estimated wave energy level on a segment is a function of the angle at which a section of shoreline is open to incoming waves (fetch window) and the length of the open-water area in that fetch window (fetch distance). Wave exposure is usually recorded using the general categories of open coast, partially exposed, or sheltered.

13. Slope

The slope is defined as the across-shore change in intertidal elevation within the shoreline segment. The slope is one of the factors used to estimate the persistence of stranded oil. It is usually recorded using the following three categories:

- o steep/vertical: very abrupt, i.e., cliff, channel banks, >60°;
- o moderate: an intermediate situation, <60° but >30°; or
- o low/flat: low angle or flat, <30°.

14. Primary Coastal Character

The coastal character is a broad description of the shore zone as a whole, including the area inland of the zone of influence of aquatic process. For the purpose of SCAT, the term includes the area of the coast in which operational activities take place. It can embody both the zone that is occasionally under the influence of water (supratidal) as well as the higher backshore and may extend further back if there are features that affect access or staging. It is not based on the land/water interface where oiling takes place.

The primary coastal character is the one that is clearly predominant within the shoreline segment. An example of categories for coastal character that accommodate the standard shoreline type categories of a Shoreline Oiling Summary form is shown in Table 44.

Table 44 Examples of Classification of Coastal Character

Marine or Lake	River or Stream Valley
Cliff or hill (>45°)	Cliff
Sloped (>5° to <45°)	Sloped
Flat or lowland (<5°)	Canyon
Beach	Straight
Delta	Confined or leveed
Dune	Meander
Lagoon	Flood plain valley
River inlet or channel	Braided
Marsh/wetland	Oxbow
Man-made	Man-made

15. Secondary Coastal Character

If more than one type of coastal character is observed within a shoreline segment, it is useful to note the less predominant ones, since these could also affect treatment operations, selection of treatment method(s), and access to the site. As with primary shoreline types, it may be useful to record secondary coastal characters within a sub-table.

16. Cliff Height

If there is a cliff along the segment backshore, its estimated height can affect the selection of treatment techniques and access methods.

17. Cliff Height Units

This indicates the unit used to record the average height of a cliff. In Canada, metres are used to report cliff height.

18. Direct Backshore Access

This indicates whether the shoreline can be easily accessed from the backshore. This is an important item that is used to refine the selection of treatment methods and to plan on-site operations.

19. Alongshore Access
This indicates whether the shoreline can be accessed from one of the adjacent segments. This information is used to plan on-site operations.

20. Current-dominated Channel
This indicates whether there is a strong current along the shoreline segment. This information is used to refine the selection of treatment methods and to plan on-site operations.

21. Suitable Backshore Staging Area
A "staging area" is a location on the ground where equipment or waste can be stored. The presence of a staging area along the backshore of a shoreline segment has important logistical consequences and greatly affects the planning of on-site operations.

22. Debris Present
There may be debris such as wood, algae, or kelp on a shoreline which may affect the operation. For example, large debris such as tree trunks or logs may restrict access to the shoreline.

23. Debris Quantity
It is helpful in planning the response to know the amount of debris along the shoreline.

24. Debris Units
This indicates the unit used to record the amount of debris observed within the segment. Units commonly used include bags, cubic metres, and even containers.

25. Access Restrictions
This refers to any special factor(s) that may affect shoreline access. Access restrictions can be physical, i.e., water access only or organizational, i.e., a fence or private property restricting access from the backshore. Access restrictions are noted in short, free-form text.

26. Other Access Features
Any other feature that will influence access should be noted, such as the presence of a road.

27. Substrate Types
This describes the nature of the predominant types of substrate observed within the segment. Substrate types are defined by the size of the sediment particles in the following manner.

- R – Bedrock
- B – Boulder (>256 mm diameter)
- C – Cobble (64 to 256 mm diameter)
- P – Pebble (4 to 64 mm diameter)
- G – Granule (2 to 4 mm diameter)
- S – Sand (0.06 to 2 mm diameter)
- M – Mud/Silt/Clay (<0.06 mm diameter)
- O – Organic/Peat/Soil
- U – Unconsolidated
- MMS – Man-made solid
- MMP – Man-made permeable

Substrate types are recorded in order of decreasing predominance. The substrate type is also noted for each oil zone observed within the segment.

28. Vegetation Cover

The presence of vegetation along the segment is noted as forested, vegetated, and bare.

29. Man-made Shoreline Features

Permeable or solid man-made types of shoreline are further subdivided as they often have a bearing on treatment tactics or operations. Man-made features include docks, piers, wharves, seawalls, breakwater, bridges, causeways, and gabian baskets. Any other man-made features observed along the segment that could affect the cleanup operation should also be noted.

30. Man-made Coastal Character or Usage

The general nature of human use of the backshore of the shoreline segment should also be noted as it could greatly influence the response priority and treatment method. The following are some common categories of human use.

- [R] Residential (private housing and cottages)
- [I] Industrial (landfill, dumps, and log sorts)
- [C] Commercial (hotels, parking lots, roads, and airstrips)
- [A] Agricultural (fields and parks)
- [M] Marina/ports
- [H] Historical/cultural (early settlement/heritage features)

6.1.4 Survey Attributes

Each ground survey is characterized by a number of attributes, which are listed in Table 45. The most important are the segment ID code, the survey code, survey date, length of the portion of segment surveyed, and the survey mode. If the survey is in a coastal marine environment, it is very important to note the tide level even though SCAT surveys are typically performed only during the low-tide slack.

1. Segment ID

This identifies the shoreline segment where the survey was carried out. This is discussed in more detail in Section 6.1.3, item 1. It usually consists of three letters, followed by a number.

2. Survey Code

The survey code identifies each visit to a shoreline segment. While the survey code is not noted on the Shoreline Oiling Summary (SOS) form, it should be created by the SCAT data manager. This code is essential for sorting and filtering information when creating maps, tables, and other types of outputs. This code, combined with the segment ID, provides a unique identification for each survey, which can be used to index the survey table.

While the survey code can consist of any sequence of characters, using consecutive numbers simplifies data management by identifying how many times a specific shoreline segment has been surveyed. It is important to use a consistent method for survey coding. As it often takes more than one day to survey the entire area affected by a spill, each code should correspond to the number of times that a ground survey is conducted on a shoreline segment, regardless of the survey date.

3. Date

This indicates the date the shoreline segment was surveyed.

4. Survey Start Time

This indicates the approximate time that the survey activities began.

Table 45 Survey Attributes

Data Attribute	Description	Type
1. Segment ID	Segment ID code (usually three letters followed by a number)	Text
2. Survey Code	Code, usually a number, that identifies the survey	Text
3. Date	Date of the survey	Date
4. Survey Start Time	Approximate time survey activities started	Text
5. Survey End Time	Approximate time survey activities ended	Text
6. Local Time	Indicates whether time is provided as local or Universal Time (UT)	Yes/No
7. Tide Height	Height of the tide prevalent during survey, obtained from a tide table	Text
8. Survey Mode	**Indicates whether survey was carried out from an overlook, by foot, or by some other transportation method**	**Text**
9. Weather	Prevailing weather conditions during the survey	Text
10. Wind Speed	Prevalent wind speed at ground level during the survey	Number
11. Air Temperature	Air temperature during the survey	Number
12. Survey Team	List of personnel involved in the survey	Text
13. Length of Segment Surveyed	Length of the segment surveyed	Number
14. Oiled Debris	Presence or absence of oiled debris	Yes/No
15. Oiled Debris Quantity	Estimated quantity of oiled debris	Number
16. Oiled Debris Units	Units used to record the quantity of oiled debris	Text
17. Comments	Additional information, observations, and recommendations related to the survey	Text

Note: *Essential attributes are shown in bold*

5. Survey End Time
This indicates the approximate time that the survey activities ended.

6. Local Time
This indicates whether the time is in local or Universal Time (UT).

7. Tide Height
In a marine environment, the tide height indicates the tide level prevalent during the survey. The tide height is usually obtained from a tide table and should be recorded as a number or a range, including units.

8. Survey Mode
This refers to the transportation platform from which survey observations were made. Possible categories include on foot or from an all-terrain vehicle (ATV), overlook, boat, or helicopter. This attribute should be open to accommodate other inventive types of survey modes such as airboats. The type of survey mode may directly affect the quality of the survey data.

9. Weather
This refers to the prevailing weather conditions during the survey, which may affect the quality of the survey data collected. Possible categories include any combination of sun, clouds, fog, rain, and snow.

10. Wind Speed
The wind speed indicates the estimated prevalent wind speed at ground level during the survey. This value may be important when estimating the persistence of more volatile types of oil such as gasoline or diesel.

11. Air Temperature
The air temperature during the survey can be used to estimate the persistence of more volatile types of oil.

12. Survey Team
This attribute is used to enter the name, phone number, and organization of each member of the survey team. The survey team is often identified by a number, e.g., Team A, which should also be noted in the database. The composition of the survey team can be entered either as a large free-form text or as a sub-table, whereby the name, organization, and phone number of each team member associated with each survey becomes a different attribute.

13. Length of Segment Surveyed
This is a measure of the length of the shoreline segment that was surveyed. This value is very important since it is used to generate shoreline summary data.

14. Oiled Debris
This indicates whether or not oiled debris is observed within the shoreline segment. The presence and quantity of oiled debris directly affect the treatment method.

15. Oiled Debris Quantity
This is the estimated amount of oil along the shoreline. Knowing this amount helps in planning the response.

16. Oiled Debris Units
This indicates the unit used to record the amount of oiled debris observed along the shoreline. Commonly used units include bags, cubic metres, and even containers.

17. Comments
Comments include any additional information or observations related to the survey. The presence and nature of oiled resources or treatment suggestions are often entered as comments. Some additional attributes used to store the results of data processing are shown in Table 46. These attributes are detailed in Chapter 5, Section 5.1.2.

Table 46 Additional Survey Attributes (continued from Table 45)

Data Attribute	Description	Type
18. Summary Substrate Category	A term derived from the substrate types in the oil zone that describes the predominant nature of the oiled material	Text
19. Total Surface Oil Volume	A value calculated from the length, width, surface distribution, and thickness of all oil zones observed within the shoreline segment	Number
20. Summary Surface Oil Cover	The maximum surface oil cover observed within all the surface oil zones of a shoreline segment	Text
21. Summary Surface Oil Category	The maximum surface oil category observed within all the surface oil zones of a shoreline segment	Text
22. Total Oiled Area	A value calculated from the length and width of the oil zone that indicates the scale of the overall affected area	Number
23. Length of Heavily Oiled Shoreline	Total length of the segment with heavy surface oiling category	Number
24. Length of Moderately Oiled Shoreline	Total length of the segment with moderate surface oiling category	Number
25. Length of Lightly Oiled Shoreline	Total length of the segment with light surface oiling category	Number
26. Length of Very Lightly Oiled Shoreline	Total length of the segment with very light surface oiling category	Number
27. Length of Unoiled Shoreline	Total length of the segment with no oil	Number

6.1.5 Surface Oiling Attributes

Surface oiling attributes refer to the data reported for each oil zone observed within a shoreline segment during a specific shoreline survey. As a result, each row of the table must include the data required to uniquely identify each of the surface oil zones, namely the segment ID, survey code, and a code for each oil zone. Most of the data recorded for each oil zone can be considered essential as they are used directly for selecting the most appropriate treatment method and for evaluating the oil quantity and other surface-oiling attributes. An example of such a table is given in Table 47, in which the essential attributes are shown in bold.

1. Segment ID

This identifies the shoreline segment surveyed in which the surface oil zone was observed More details about the segment ID are given in Section 6.1.3, item 1.

2. Survey Code

This identifies the survey during which the surface oil zone was observed. It is described in more detail in Section 6.1.4, item 2.

3. Oil Zone ID

This identifies the oil zone for which surface oiling characteristics have been observed. Oil zone codes are made up of a single capital letter, starting with “A”.

4. Oil Zone Start Coordinates

The geographic coordinates (longitude and latitude) of the start of the surface oil zone should be noted in decimal degrees. This information can be very useful in order to georeference each row of the surface oil zone table within a GIS or to find a specific surface oil zone within a large shoreline segment with the help of a GPS.

Table 47 Surface Oiling Attributes

Data Attribute	Description	Type
1. Segment ID	Segment ID code (usually three letters followed by a number)	Text
2. Survey Code	Code of the survey during which the surface oiling was observed	Text
3. Oil Zone ID	Code of the surface oil zone (a single letter, starting with "A")	Text
4. Oil Zone Start Coordinates	Longitude and latitude at the start of the oil zone	
• Longitude		Number
• Latitude		Number
5. Oil Zone End Coordinates	Longitude and latitude at the end of the oil zone	
• Longitude		Number
• Latitude		Number
6. Tidal Zone	Tidal zone where the oil zone is located	Number
7. Length	Length of the oil zone	Number
8. Width	Width of the oil zone	Number
9. Surface Distribution	Percentage of the surface covered by oil	Number
10. Surface Oil Thickness	Average thickness of the oil zone:	
Category	Thickness category	Text
Value	Value corresponding to the middle of the interval within the selected category or actual average thickness observed	Number
11. Surface Oil Character	Qualitative description of the form of oil under the following categories:	
FR	Fresh	Yes/No
MS	Mousse	Yes/No
TB	Tar balls	Yes/No
PT	Tar patties	Yes/No
TC	Tar	Yes/No
SR	Surface oil residues	Yes/No
AP	Asphalt pavement	Yes/No
NO	No oil observed	Yes/No
12. Substrate Type(s)	Nature of the shoreline usually recorded as a combination of the following letters: R, B, C, P, G, S, M, O, U, MMS, MMP, VEG, as described in Section 6.1.5, item 12.	Text
13. Substrate Category	Predominant category of oiled substrate	Text
14. Oil Type	Category of oil observed	Text
15. Stickiness	Indicates whether oil sticks to the substrate	Yes/No
16. Water Level Recurrence	Indicates when the water will next reach the oil zone	Text

Note: *Essential attributes are shown in bold*

5. Oil Zone End Coordinates

Similar to item 4 above, the geographic coordinates (longitude and latitude) of the end, i.e., other boundary, of the surface oil zone should be noted in decimal degrees. Again, this information can be very useful to find a specific oil zone within a large shoreline segment with the help of a GPS and to georeference each row of the surface oil zone table within a GIS.

6. Tidal Zone

This refers to the location of the surface oil zone in relation to the tidal zones and is classified in the following manner.

- **LITZ** (Lower Intertidal Zone) is approximately the lower one-third of the intertidal zone.
- **MITZ** (Mid-intertidal Zone) is approximately the middle one-third of the intertidal zone.
- **UITZ** (Upper Intertidal Zone) is approximately the upper one-third of the intertidal zone.
- **SUTZ** (Supratidal Zone) is the area above the mean high water level where wave action occasionally occurs. This is also known as the splash zone.

Tidal zones are used only in marine environments. In freshwater environments, swash zones are used for lakes and bank zones are used for rivers.

7. Length
This is a measure of the alongshore length of oiled shoreline within an oil zone.

8. Width
This refers to the average across-shore width of the intertidal oil band within a surface oil zone.

9. Surface Distribution
This represents the actual percentage of the surface covered by oil within a fixed area.

10. Surface Oil Thickness
This refers to the average or dominant oil thickness within the oil zone and is described according to the following categories.

- **TO** - **Thick oil** generally consists of fresh oil or mousse accumulation >1 cm thick and is reported as actual oil thickness.
- **CV** - **Cover** is from >0.1 to <1 cm thick
- **CT** - **Coat** is from >0.01 to <0.1 cm thick. On coarse sediments or bedrock, it can be scratched off with fingernails.
- **ST** - **Stain** is <0.01 cm thick. On coarse sediments or bedrock, stains cannot easily be scratched off.
- **FL** - **Film** is a transparent or translucent film or sheen.

11. Surface Oil Character
This provides a qualitative description of the character of the stranded oil according to the following categories.

- **FR** – **Fresh:** unweathered, low viscosity oil.
- **MS** – **Mousse**: emulsified oil (oil and water mixture) existing as patches or accumulations or within interstitial spaces.
- **TB** – **Tar Balls**: discrete balls, lumps, or patches on a beach or adhering to substrate. Tar balls are generally less than 10 cm in diameter.
- **PT** – **Tar Patties**: discrete lumps or patches larger than 10 cm in diameter found on a beach or adhering to substrate.
- **TC** – **Tar**: weathered coat or cover of tarry, almost solid consistency.
- **SR** – **Surface Oil Residues**: non-cohesive oiled surface sediments, either in continuous patches or in the interstices of coarse sediments.
- **AP** – **Asphalt Pavement**: cohesive mixture of oil and sediments.
- **NO** – **No Oil Observed.**

Since there may be more than one type of oil character on a single surface oil zone, each surface oil character category is best defined as a separate attribute.

12. Substrate Type(s)
This describes the nature of the substrate observed within the surface oil zone. The type of substrate is defined by the size of the sediment particles and is usually recorded as a combination of the following letters.

- **R** – **Bedrock Outcrops**
- **B** – **Boulder** (>256 mm in diameter)
- **C** – **Cobble** (64 to 256 mm in diameter)
- **P** – **Pebble** (4 to 64 mm in diameter)
- **G** – **Granule** (2 to 4 mm in diameter)
- **S** – **Sand** (0.06 to 2 mm in diameter)
- **M** – **Mud/Silt/Clay** (<0.06 mm in diameter)
- **O** – **Organic/Peat/Soil**
- **U – Unconsolidated sediment**
- **MMS**– **Man-made Solid**
- **MMP – Man-made Permeable**
- **VEG – Live vegetation**

There may be other types of substrate such as shell hash (broken seashells), organic matter such as peat and soil, vegetation (plants), snow, or ice. These can be defined if necessary for the spill incident.
More than one type of substrate can be present in a single surface oil zone. Types of substrate are usually noted in order of decreasing predominance. For example, “P, B” indicates a substrate containing predominantly pebbles with a secondary boulder fraction.

13. Substrate Category
This refers to the nature of the predominant type of substrate observed within an oil zone. This data element should be used for mapping purposes, since only one substrate type can be shown on maps. The following are the substrate categories and their abbreviations.

- **Bedrock: R**
- **Boulder: B**
- **Pebble/Cobble: P,C**
- **Mixed Sediments Coarse: C,G,S**
- **Mixed Sediments Fine: P,C,G,S**
- **Mud: M**
- **Man-made Solid: MMS**
- **Man-made Permeable: MMP**

14. Oil Type
This refers to the nature of the type of oil observed in the surface oil zone and is described according to the following categories.

- **Type A: Low Pour Point/Volatile**, e.g., gasoline
- **Type B: Low**, e.g., diesel
- **Type C: Medium**, e.g., medium crude, lube oil
- **Type D: High**, e.g., Bunker B or C, marine fuel
- **Type E: Semi-solid/Solid**, e.g., asphalt

The oil type generally corresponds to that of the original source oil spilled. The characteristics of the oil in the environment can change, however, after it has weathered and can therefore be different than those of the spilled oil. Oil type is one of the factors used to estimate the persistence and remobilization potential of the oil and to select the treatment method(s).

15. Stickiness

Oil may or may not adhere to the shoreline material. The stickiness of the spilled oil greatly influences its remobilization potential.

16. Water Level Recurrence

This defines the next time that the water level will come into contact with the oil and thus enable wave action to degrade or remobilize and remove stranded oil. This attribute is used to evaluate the remobilization potential. Possible values for this attribute include: **Days to Weeks** and **Months to Years.**

The surface oiling characteristics table should also include a few attributes used to store the results of data processing. These are shown in Table 48 and detailed in Chapter 5, Section 5.1.1.

Table 48 Additional Surface Oiling Attributes (continued from Table 47)

Data Attribute	Description	Type
17. Oil Zone Substrate Category	A term derived from the oil zone substrate types, which describes the nature of the material that has been oiled.	Text
18. Surface Oil Volume	A value calculated from the length, width, surface distribution, and thickness data for the oil zone.	Number
19. Surface Oil Cover	A matrix term derived from the width and surface distribution of each oil zone that provides a general index of the degree of surface oiling.	Text
20. Surface Oil Category	A matrix term derived from the surface oil cover and oil thickness in each oil zone that provides a more specific index of the degree of surface oiling.	Text
21. Oil Remobilization Potential	An estimate derived from the oiled substrate type, oil character, surface oil cover or surface oil category, and the intertidal location of the oil zone that provides an assessment of the likelihood that the oil could be refloated by rising water levels.	Text
22. Oil Persistence	An estimate derived from the oil character, surface oil cover or surface oil category, and the intertidal location of the oil zone that provides an assessment of the length of time that the oil may remain if allowed to weather naturally.	Text
23. Total Oiled Area	A value calculated from the length and width of the oil zone that indicates the scale of the overall affected area.	Number
24. Actual Oiled Area	A value calculated from the length, width, and surface oil distribution within the oil zone that is a measure of the actual surface area covered by oil (also known as the "equivalent area" oiled).	Number

6.1.6 Subsurface Oiling Attributes

Subsurface oiling attributes refer to the observations reported for each pit or trench dug within a shoreline segment during a specific shoreline survey. These are listed in Table 49, with the essential attributes shown in bold. Each row in the table must include the data necessary to uniquely identify each pit or trench, namely the segment ID, survey code, and a code for each pit/trench. The most important data recorded for each pit/trench include: the tidal zone, oiled zone, oil character, sheen colour, and substrate type(s). These attributes are used to evaluate the quantity of subsurface oil and to select the treatment method(s).

Table 49 Subsurface Oiling Attributes

Data Attribute	Description	Type
1. Segment ID	Segment ID code (usually three letters followed by a number)	Text
2. Survey Code	Code of the survey during which the surface oil zone was observed	Text
3. Pit/Trench Number	Pit/trench identification code (a single letter, starting with "1")	Text
4. Pit/Trench Coordinates	Longitude and latitude of the pit or trench	
Longitude		Number
Latitude		Number
5. Tidal Zone	Tidal zone where the pit/trench is located	Text
6. Maximum Pit Depth	Depth of the pit/trench	Number
7. Oiled Zone	Vertical width or thickness of the oiled sediments	
Top Boundary	Depth at the start of the oil lens	Number
Bottom Boundary	Depth at the bottom of the oil lens	Number
8. Oil Character	Qualitative description of the character or quantity of oil (Note: In the text	Text
9. Water Level	Observed depth of the water level in the pit/trench	Number
10. Sheen Colour	Colour of the sheen on subsurface oil	
11. Clean Below	Indicates whether there is oil below the depth of the pit/trench	Yes/No
12. Substrate Type(s)	Nature of the shoreline material where the pit/trench was dug	Text
13. Oil Type	Category of oil observed	Text

Note: *Essential attributes are shown in bold*

1. Segment ID

This identifies the surveyed shoreline segment in which the surface oil zone was observed. More detail is provided in Section 6.1.3, item 1.

2. Survey Code

This attribute identifies the survey during which the surface oil zone was observed. More detail is provided in Section 6.1.4, item 1.

3. Pit/Trench Number

This refers to the code used to identify each of the pits or trenches dug in the course of a survey. This code should be a number, starting with “1”.

4. Pit/Trench Coordinates
The geographic coordinates (longitude and latitude) of the location of the pit or trench should be noted in decimal degrees. This information can be very useful to georeference each row of the subsurface oiling table within a GIS or to locate a pit or trench within a shoreline segment.

5. Tidal Zone
This refers to the location of a pit or trench in relation to the tidal zones. These zones are classified in the following manner.

- **LITZ** - Lower Intertidal Zone is approximately the lower one-third of the intertidal zone
- **MITZ** - Mid-intertidal Zone is approximately the middle one-third of the intertidal zone
- **UITZ** - Upper Intertidal Zone is approximately the upper one-third of the intertidal zone
- **SUTZ** - Supratidal Zone is the area above the mean high water level where wave action occasionally occurs. This is also known as the splash zone.

Tidal zones are used only in marine environments. In freshwater environments, swash zones are used for lakes and bank zones are used for rivers.

6. Maximum Pit Depth
This indicates the depth of the pit or trench.

7. Oiled Zone
This refers to the vertical width or thickness of the oiled sediment (subsurface) layer when viewed in profile by digging a pit or trench. The top and bottom boundaries of the lens are recorded. The **bottom boundary** is equal to the maximum depth of oil penetration. The **top boundary** may equal 0 (the beach surface) or a greater number depending on whether clean sediments have been deposited on top of the oiled sediment. (See Figure 3.4 in Owens and Sergy, 2004)

8. Oil Character
This provides a qualitative description of the character or quantity of the subsurface oil and is described according to the following categories.

- **SAP** – **Subsurface Asphalt Pavement**: Cohesive mixture of weathered oil and sediments situated completely below a surface sediment layer. This is often characterized by oil flowing out when sediments are disturbed.
- **OP** – **Oil-filled Pores**: Pore spaces in the sediment matrix are completely filled with oil.
- **PP** – **Partially Filled Pores**: Pore spaces are filled with oil, but oil does not generally flow out when exposed or disturbed.
- **OR** – **Oil Residue as a cover** (>0.1 to 1 cm) **or coat** (0.01 to 0.1 cm) of oil on sediments and/or some pore spaces partially filled with oil. It can be easily scratched off with fingernail on coarse sediment.
- **OF** – **Film or Stain** (<0.01 cm) of oil residue on the sediment surface. Non-cohesive. It cannot be easily scratched off on coarse sediment.
- **TR** – **Trace**: discontinuous film or spots of oil on sediments or an odour or tackiness with no visible evidence of oil.
- **NO** – **No Oil**: No visible or apparent evidence of oil.

9. Water Level
This refers to the observed depth to which the water level rises after digging a pit or a trench.

10. Colour of Sheen
This refers to the colour of the sheen of the subsurface oil which indicates the amount of subsurface oil. It can be defined as Silver, Rainbow, Brown, or None.

11. Clean Below
This indicates whether subsurface oil is observed below the maximum depth of the pit or trench.

12. Substrate Type(s)
This describes the nature of the substrate observed within the pit or trench and is defined in the following manner according to the size of the sediment particles.

- **B** – **Boulder** (>256 mm in diameter)
- **C** – **Cobble** (64 to 256 mm in diameter)
- **P** – **Pebble** (4 to 64 mm in diameter)
- **G** – **Granule** (2 to 4 mm in diameter)
- **S** – **Sand** (0.06 to 2 mm in diameter)
- **M** – **Mud/Silt/Clay** (<0.06 mm in diameter)
- **MMP – Man-made Permeable**

13. Oil Type
This refers to the nature of the type of oil observed within the pit or trench and is described according to the following categories.

- **Type A: Low Pour Point/Volatile**, e.g., gasoline
- **Type B: Low**, e.g., diesel
- **Type C: Medium**, e.g., medium crude, lube oil
- **Type D: High**, e.g., bunker B or C, marine fuel
- **Type E: Semi-solid/Solid**, e.g., asphalt

The oil type generally corresponds to that of the original source oil spilled. The characteristics of the oil in the environment can change, however, after it has weathered and can therefore be different than those of the spilled oil.

The subsurface oiling characteristics table should also include a few attributes to enable data processing results to be stored. These are shown in Table 50 and detailed in Chapter 5, Section 5.1.1.

Table 50 Additional Attributes for Subsurface Oiling (continued from Table 49)

Data Attribute	Description	Type
14. Subsurface Oil Thickness	A value derived from the observed depth of penetration or the observed thickness of the subsurface oil lens data.	Text
15. Subsurface Oil Category	A matrix term derived from the subsurface oil character/relative oil concentration and the depth of penetration or the thickness of a buried oil layer. This provides a general index of the degree of subsurface oiling.	Text

6.2 Pre-spill SCAT Database

Pre-spill SCAT databases are used to organize, store, and retrieve data on shoreline segment characteristics, which are collected to support planning activities or response operations. Pre-spill data collection programs often include information that is not strictly related to SCAT, but that may be useful during the decision-making process. This additional information can vary between organizations according to local geographical or geopolitical characteristics. Only the essential minimal set of data that could be part of a pre-spill SCAT database is described here.

Pre-spill SCAT databases generally describe the characteristics of shoreline segments. This information is equivalent to the Shoreline Segments Characteristics category of SCAT ground survey data and can usually be stored in a single table with the same attributes, with the exception of Operations Divisions, which are defined only if a spill occurs.

Pre-spill SCAT databases should be either georeferenced or contain the required information to facilitate georeferencing.

To summarize, a pre-spill SCAT database should contain, at a minimum, all the information associated with shoreline segment characteristics with the following modifications:

- the operations division attribute is not required; and
- the precise start and end coordinates of each of the shoreline segments are not essential.

Chapter 7 SCAT Data Management Support Tools

This chapter focuses on selecting SCAT data management tools and discusses their combined use within a SCAT data management system. The chapter is divided into the following three sections as shown in Figure 66. Section 7.1 reviews the basic tools available to support SCAT data management. Combining these tools into a system to support the various SCAT data management tasks is discussed in Section 7.2 and training for SCAT data managers to ensure that optimal support is provided during a spill response is covered in Section 7.3.

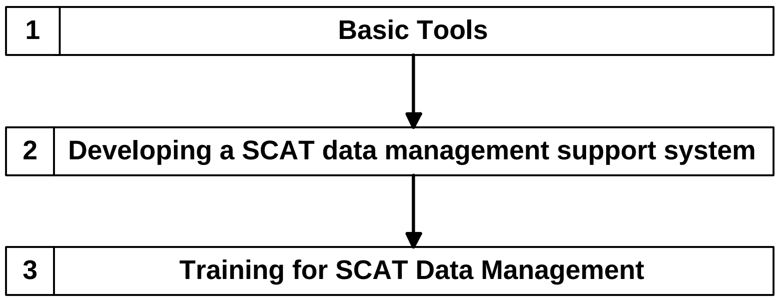

Figure 66 Topics in Chapter 7

7.1 Basic Tools

The basic tools for SCAT data management and processing tasks are listed in Table 51. Their main characteristics, strengths and weaknesses, and most appropriate use for SCAT data management are discussed in this section.

Table 51 Basic Data Management and Processing Tools

Tool	Optimal Use
Pencil and paper	Capture of SCAT field observations on forms and sketch maps
Spreadsheet programs	Reports and data processing
Databases systems	Data management (data entry and reports)
Geographic Information Systems (GISs)	Data processing (production of overview and summary maps)
Specialized programs	Data processing (automation of certain types of processing)
Word processors	Organization of processed data (production of comprehensive reports, including tables and other types of outputs)
Web-based applications	Distribution of processed data
Portable applications	Field data acquisition

7.1.1 Pencil and Paper

All SCAT data management tasks, from data acquisition to data processing, can be performed manually using pencil and paper. In fact, this has been the traditional approach to SCAT data management. During spills with even moderate amounts of SCAT activity, for example, data from more than five shoreline segments per day, however, the task can quickly become overwhelming when using manual methods.

Almost all data management tasks can now be done using electronic tools. The use of automation increases performance, particularly in terms of quality of data processing and the speed and quantity in producing decision-making documents. Without this processing power, SCAT-derived information is often under-utilized.

Nevertheless, pencil and paper are still the most flexible and reliable method as they can be used when all else fails. Pencil and paper will probably always be used for field data acquisition, especially for producing sketches. For this reason, SCAT data managers should be able to perform all SCAT data management tasks using pencil and paper.

7.1.2 Spreadsheet Programs

Spreadsheet programs can be used for many SCAT data management tasks and have the following advantages.

- They can easily create and set up data tables to store SCAT data.
- As spreadsheets are basically calculation tools, they can incorporate automated processing programs.
- They include many functions that enable and simplify the production of formatted tables.
- They are ideal for various kinds of data analysis, including the production of simple graphics.
- Spreadsheet-derived tables can easily be incorporated into word processing documents.

Spreadsheet programs are designed primarily for business calculations and analysis and are not data storage and retrieval tools. This leads to the following weaknesses.

- Only a limited amount of data can be stored.
- There is no simple way to develop data entry forms with data validation rules.
- They cannot be directly linked to Geographic Information Systems.

As a result, spreadsheet programs are best suited to data processing and formatting. Due to their flexibility, they are ideal for developing and implementing data processing systems suitable for the unique situations that occur during larger spills. For example, a spreadsheet-based system was first developed and implemented to manage and process tar ball data during the *New Carissa* response (Owens et al., 2002).

7.1.3 Database Systems

Database systems are specifically designed to enable and simplify data storage and retrieval. They include many functions and mechanisms that make them ideal for:

- efficiently developing and creating data storage structures, such as sets of linked tables;
- ensuring data integrity;
- providing data entry forms that include many validation tools, such as validation rules and pull-down lists;
- supporting the production of various types of reports;
- making it possible to automate data processing through the use of embedded programs; and
- usually easily linking to Geographic Information Systems.

The tradeoff when using database systems, however, is the time required to develop the components of the database. This includes creating tables, data entry forms, and reports and developing the programs used for data processing. A sophisticated database system designed for managing SCAT data, which includes validation rules and report-generating mechanisms, requires a small team and several months to develop.

7.1.4 Geographic Information Systems

Geographic information systems (GISs) are designed primarily to support the integration of spatial data through the use of maps. For SCAT data management, these systems are ideally suited to displaying and analyzing summary and overview decision-making support maps, such as those presented in Chapter 5.

To use GIS technology for a spill response, however, all information must first be assigned a position in space, which is referred to as georeferencing. This operation can be one of the most time-consuming parts of the data entry process, as each SCAT element, i.e., shoreline segments, surface oil zones, and pits/trenches, must be located and entered, often manually. GIS systems often benefit from any type of support for this data entry. It takes time and effort, however, to develop SCAT-specific data entry tools.

When data has been georeferenced, a GIS is particularly valuable for producing summary or overview maps to support the decision-making process. Map production can be very time-consuming without any electronic support, as the operator must select a specific data element to map and a scheme to display the data as well as enter labels, scale bars, and North arrows. Automating the map production process greatly enhances the use of a GIS, but also takes time and effort.

7.1.5 Specialized Programs

There are two types of specialized programs that can be used to automate assessments and computations: those that implement more complex computation algorithms, for example, calculating total length of oiled segment by surface oiling category and expert or rule-based systems that use rules to make assessments, for example, assessing surface oiling category. Specialized programs are ideally suited to automating well-defined data processing that is not based on simple computations. These are best used as tools hidden or embedded within other programs, such as spreadsheets, GISs, or databases that store the data to be processed.

7.1.6 Word Processors

Word processors are powerful and flexible tools that are ideal for organizing processed information. They are used to integrate outputs, images, maps, and tables of various origins within a single document.

7.1.7 Internet-based Applications

Internet-based applications provide access to information to anyone who is connected to this global network. The internet is often used during spill response to disseminate processed information, such as overview maps, incident action plans, or over-flight images.
Some organizations have developed internet-based data and information systems that incorporate outputs and even validated data produced by the SCAT data management team.

7.1.8 Portable Applications

Portable applications refer to database or GIS systems designed to function on Personal Digital Assistants (PDAs) or other similar small computing devices. PDA-based systems, linked to a Geographic Positioning System (GPS), provide a relatively inexpensive solution to the bottleneck experienced when entering paper-based data within computerized systems.

Portable applications for data acquisition are complete systems that may include databases, small GISs, and communication programs. Although they cannot totally replace pencil and paper, particularly for producing sketches, PDA-based systems can greatly reduce SCAT data acquisition and processing times (Lamarche et al., 2004).

7.2 Developing a SCAT Data Management Support System

A SCAT data management support system refers to the suite of tools and processes used to organize data and make it available in the most appropriate form to support the decision-making process. The overall system includes the following components:

- a field data acquisition system;
- some mechanism for storing data tables, paper files, and GIS;
- data processing methods and tools; and
- support tools for distributing data.

This section focuses on how basic management tools can best support the SCAT process. The main SCAT data management tasks are outlined in Figure 67 and briefly discussed here. Capturing SCAT data in the field, although not exactly a data management task, is included since this is an important part of the entire system.

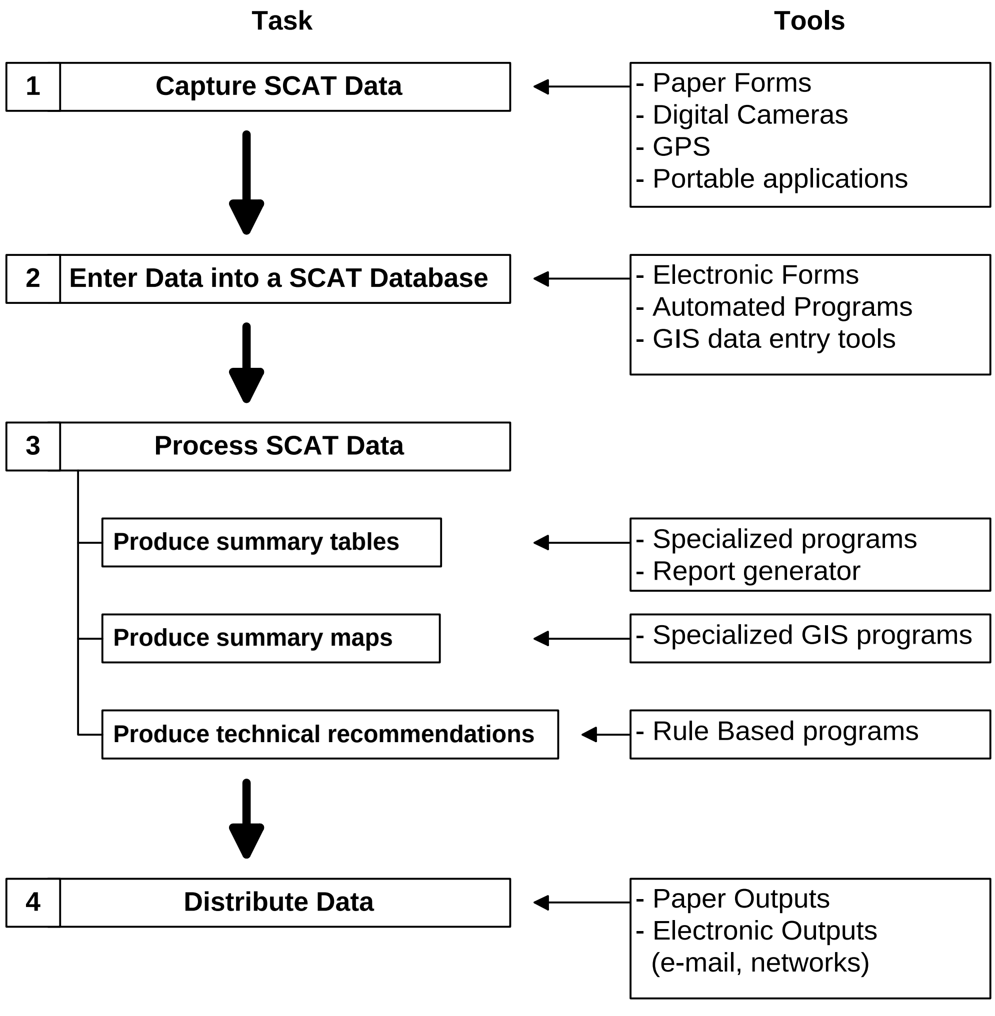

Figure 67 SCAT Data Management System Tasks and Support Tools

7.2.1 Capturing SCAT Data

Two basic methods are used to capture SCAT data: (1) pencil and paper to fill in SOS forms and create sketches and (2) dedicated portable applications. Field personnel also use digital cameras and a GPS to record positions.

For small spills, pencil and paper are the perhaps the most useful and efficient method for recording SCAT data. Due to the volume of data collected in larger spills, however, this method can cause a bottleneck when transcribing data from hard copy to the data management system. Computerized portable systems, including weatherized Personal Digital Assistants. (PDAs equipped with GPS units can alleviate such issues as the data is directly uploaded into the SCAT data management system.)

7.2.2 Entering Data into a SCAT Database

Support tools for entering data into a set of computer files (the SCAT database) must be quick and accurate. Electronic forms offer options that can reduce the possibility of mistakes and increase accuracy when entering data from paper material. These methods include:

- using data entry lists within list boxes for data entry categories;
- using internal validation programs when data values are incompatible, for example, the top value of a subsurface oil zone cannot be higher than the bottom one or all data associated with surface oiling should be set to “0” or “nil” if “No Oil” is observed along a segment; and
- automatically providing values to certain data elements, for example, the shoreline segment ID. Some of these methods also increase the speed of data entry. One of the best ways to increase the speed of data entry, however, is to take advantage of the fact that the value of certain data tends to be similar from one entry to the next. For example, oil type generally stays the same for all surface oil zones at the same incident. Similarly, the composition of the SCAT survey team stays the same for all surveys carried out by that team.

Electronic forms, which are usually a function of database systems such as Microsoft Access, can also be created to simplify data entry within GIS systems.

Data entry forms and additional functions within GIS systems can also be used to increase the speed of data entry. For example, shoreline segments can be delineated faster and easier through a “copy-paste” tool that enables the user to select a portion of a coastline from a “coastline” layer, copy it to memory, and paste it to define the new segment.

The example in Figure 68 demonstrates these various mechanisms. The example is from a shoreline segment data entry mechanism that is incorporated in the ArcMap GIS interface of the ShoreAssess system. The system includes a “copy/paste” function that works in the following way.

- The GIS operator uses the tool to draw a polygon around a portion of the coastline that will constitute a new shoreline segment.
- The system clips the portion of the segment located within the polygon and transfers this to the “shoreline segment” layer.
- The system automatically assigns a new code to the shoreline segment.
- A data entry window opens, allowing the operator to enter data about this new segment.

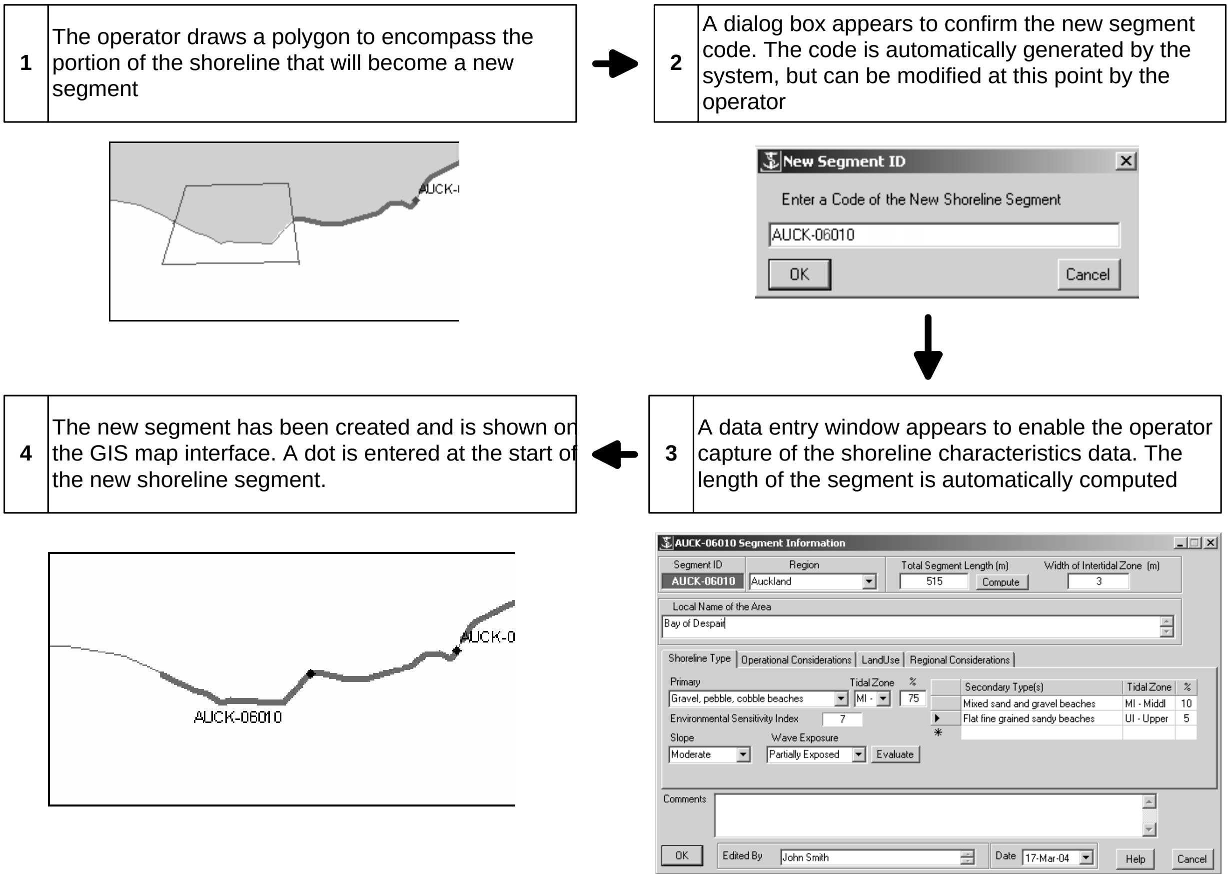

Figure 68 Copy/Paste Mechanism for Data Entry within the GIS Interface of the ShoreAssess SCAT Data Management System

7.2.3 Processing SCAT Data

The most appropriate tool for SCAT data processing varies according to the general subtask category.

Summary tables are best produced using report generators, which are usually an integral part of database systems, and specialized processing. These systems simplify data formatting to develop reports. The nature of SCAT data requires some specialized processing as shown in Chapter 5, where processing algorithms are also presented. This processing can be incorporated within subprograms of database systems.

Summary tables can also be produced using spreadsheet programs. If data is stored in database systems, exporting it to a spreadsheet is usually straightforward.

Summary maps are best produced by using the capabilities of GIS systems. Developing GIS-specific programs to automate map production considerably reduces data-processing time and also helps to standardize map outputs. The benefits of standardization are that the same types of lines and colours are consistently used for similar categories and certain important elements of the map, such as the scale bar, incident name, survey code, or the North arrow, are less likely to be omitted. Standardization can also be achieved by using "map templates".

Technical recommendations are best produced by using the expertise of shoreline treatment specialists. The selection of treatment methods can also be supported by using specialized rule-based programs, such as ShoreAssess®. In addition, if a standardized description of treatment methods is included in the SCAT data management system, the production of recommendations will be much faster. The treatment specialist can use these basic treatment descriptions as a starting point to write up recommendations using a word processor.

7.2.4 Distributing Data

The results of data processing usually take the form of paper outputs and their electronic equivalent. Distributing paper output is straightforward and allows the SCAT data manager to ensure the accuracy of the outputs before their release. Some summary or overview maps can be printed, preferably on large paper, and posted on walls. Finally, it is often simpler to create incident action plans by putting together and photocopying paper outputs rather than producing an electronic document.

The electronic equivalent of processed data can be distributed in a variety of ways, which should be tested and agreed upon by those who will use them. Some validation process, such as having the outputs scrutinized by the SCAT coordinator, should be developed before distribution.

Often, the fastest way to distribute electronic documents is to make them available through a local area network. In this case, the files to be distributed should be given obvious names and located in a clearly identified directory folder. One way to ensure that outputs are always clearly identified is to regroup them within a single document, such as a word processing file. This method has some added benefits to the data user, who often produces incident action plans with a word processor. Integrating outputs is simplified if it is already in word processing format.

The pertinent data can also be e-mailed to the intended user. This is particularly helpful if the user is not part of the spill response local area network. Outputs can also be distributed by copying the information on removable media, such as a CD or a diskette, although most of the data output files are generally too large to fit on a diskette.

Processed data and outputs can be posted on a website dedicated to the spill and is a practical way to distribute observations and evaluation results to a large audience. This is feasible, however, only if the data users have fast Internet connections and some personnel are dedicated to maintaining and updating the site.

A simple and practical way of distributing the data gathered during SCAT surveys is to scan them and assemble them into indexed documents such as Adobe pdf files.

7.3 Training for SCAT Data Management

SCAT data management training should focus on the need for the SCAT data management team to support the response effort adequately regardless of unforeseen circumstances. Some situations that could possibly affect the efficiency of the SCAT data management team include:

- equipment breakdown;
- software corruption; and
- overwhelming amounts of data.

7.3.1 Equipment Failure

It is always possible that equipment such as portable computers and printers could fail. Even with the best possible safeguards, such as having a second computer with a backup of all the software and data, computerized equipment can still be out of service for variable periods of time.

The SCAT data management team should be prepared for equipment failure and be able to produce at least a minimum amount of data management services using only pencil and paper. Training should include how to determine the minimum tasks that should be performed by the management team while the equipment is down and ensuring these tasks are completed in an acceptable amount of time. Such training should also help SCAT data management personnel to develop non-computerized documentation and processing methods, which would also increase their understanding of the user’s needs.

7.3.2 Software Corruption

Although software corruption is a less severe form of general system failure, it can lead to problems as SCAT data management personnel may not be aware of it immediately. The evidence that something is wrong will often come from strange or unexpected processing results, which is why it is so important to validate outputs.

Once it is established that some of the software is not working properly, alternative means should be developed to ensure that the work is completed with an acceptable level of efficiency. This could mean resorting to more rugged programs, developing temporary spreadsheet-based solutions for data processing, or even using pencil and paper to generate the necessary outputs. Training for disaster scenarios should cover work practices that prevent a sudden and complete breakdown and result instead in a gradual degradation of SCAT data management performance.

7.3.3 Overwhelming Amounts of Data

Training for dealing with overwhelming amounts of data, i.e., information overload, can be useful in determining the processing capacity of a SCAT data management team. If the amount of data clearly exceeds the team's processing capability, team members must learn how to prioritize their activities and develop shortcuts to ensure that the SCAT data can be made available in an acceptable form to those who need it.

SCAT data management teams should also be involved in full-scale exercises so that members of the response organization understand what to expect from the SCAT data management effort. Finally, members of the SCAT data management team should understand their tools so they know how to recover information if the system fails. Team members should also understand the user's needs so they can provide adequate services even when only pencil and paper are available.

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Appendix 1 Additional Data Attributes used in SOS Forms for Other Types of Environments

The shoreline segment data attributes listed in Table 42 include only the basic shoreline characteristics used to report oiling conditions along a marine shoreline in temperate latitudes. The following two tables list additional attributes used in SCAT forms for other types of environments. Attributes used in the Arctic SOS form are all associated with shoreline segment characteristics. Attributes used in other types of forms can be associated with either the shoreline segment or the survey or surface oiling characteristics, as specified in the last column of the table.

Attributes used in the Arctic SOS Form

Data Attribute	Type
Snow Cover (%)	Number
Snow Thickness (cm)	Number
Fresh Snow	Yes/No
Compacted Snow	Yes/No
Snow Location (L M S U)	Text
Frozen Spray Width (m)	Number
Frozen Spray Thickness (cm)	Number
Frozen Swash Width (m)	Number
Frozen Swash Thickness (cm)	Number
Frozen Swash Location (L M S U)	Text
Ice Foot Width (m)	Number
Ice Foot Thickness (cm)	Number
Ice Foot Location (L M S U)	Text
Ice Push Ridge Width (m)	Number
Ice Push Ridge Thickness (cm)	Number
Ice Push Ridge Location (L M S U)	Text
Glacier Ice - Height of Ice Front (m)	Number
Glacier Ice - Floating Front	Yes/No
Grounded Floes - Average Length (m)	Number
Grounded Floes - Average Thickness (cm)	Number
Grounded Floes - Location (L M S U)	Text
Nearshore Ice Conditions - Concentration	Text
Nearshore Ice Conditions - Form	Text
Nearshore Ice Conditions - Age and Thickness (cm)	Number
Nearshore Ice Conditions - Fast Ice	Text
Nearshore Ice Conditions - Tidal Cracks	Text

Attributes used in SOS Forms other than Arctic

SOS Form	Data Attribute	Type	Data Category
Tar Ball	Tar Ball Observed	Yes/No	Surface Oiling Characteristics
	Average Number of Tar Balls within Area	Number	Surface Oiling Characteristics
	Average Size of Tar Ball	Number	Surface Oiling Characteristics
	Size of Largest Tar Ball	Number	Surface Oiling Characteristics
	Type of Tar Ball – Weathered	Yes/No	Surface Oiling Characteristics
	Type of Tar Ball – Sticky	Yes/No	Surface Oiling Characteristics
	Tar Balls Collected	Yes/No	Surface Oiling Characteristics
Wetlands	Surface Bearing Capacity	Text	Shoreline Segments Characteristics
Tidal Flats	Surface Bearing Capacity	Text	Shoreline Segments Characteristics
River Bank and Stream Bank	River Channel Character – Width (m) River Channel Character – Water Depth (m)	Number Number	Shoreline Segments Characteristics Shoreline Segments Characteristics
	Shoal Present	Yes/No	Shoreline Segments Characteristics
	Point Bar Present	Yes/No	Shoreline Segments Characteristics
	Bar/Shoal Substrate	Text	Shoreline Segments Characteristics
	Seasonal Water Level	Text	Shoreline Segments Characteristics
	Estimated Change over next 7 days	Text	Shoreline Segments Characteristics
	Oiled Trees/Shrubs	Yes/No	Survey Characteristics
	River Current Strong	Yes/No	Shoreline Segments Characteristics
	Rapid Current	Yes/No	Shoreline Segments Characteristics
	River Bank Zone (MS/LB/UB/OB)	Text	Surface Oiling Characteristics
	Stream Bank Zone (MS/LB/UB/OB)	Text	Surface Oiling Characteristics
Lake	Swash Zone (SSZ/USZ/LSZ)	Text	Surface Oiling Characteristics

Appendix 2 Examples of Actual SCAT Data Management Results

This section provides examples of actual results of SCAT data management efforts. Each example was selected to illustrate the variety in the nature and appearance of the decision-making support documents developed in the course of a response.

Examples Overview

1	Survey Summary

Use of Operations Division to summarize SCAT data

2	Shoreline Inspection Reporting Sketch Sheet

Use of aerial photographs to report problem areas

3	General Location Map

Use of a topographic map as a base to indicate the location of operations divisions

4	Oiling Summary Map

Overlay of SCAT derived oiling categories on top of an aerial photograph - to allow more precise assessment of length of oiling

5	Monitoring Results Graphs

Provide an unbiased assessment of the changes in small amounts of oiling

6	Use of a Pre-Spill Segmentation Database

Support the planning effort in the early moment of a response

7	Works Status Map

Show the general state of the response at a given moment in time

8	Submerged Tar Ball Distribution Map

Special representation created to help operations personnel locate and remove of submerged tar balls

9	Timed oiling summary map

To provide a "snapshot" of the observed oiling categories at a given moment in time

10	Georeferenced Notes

To report "hot spots" typical of a post-treatment conditions

11	Selendang Ayu Incident Inspection Report Form

To document the shoreline inspection results

Example 1 Survey Summary

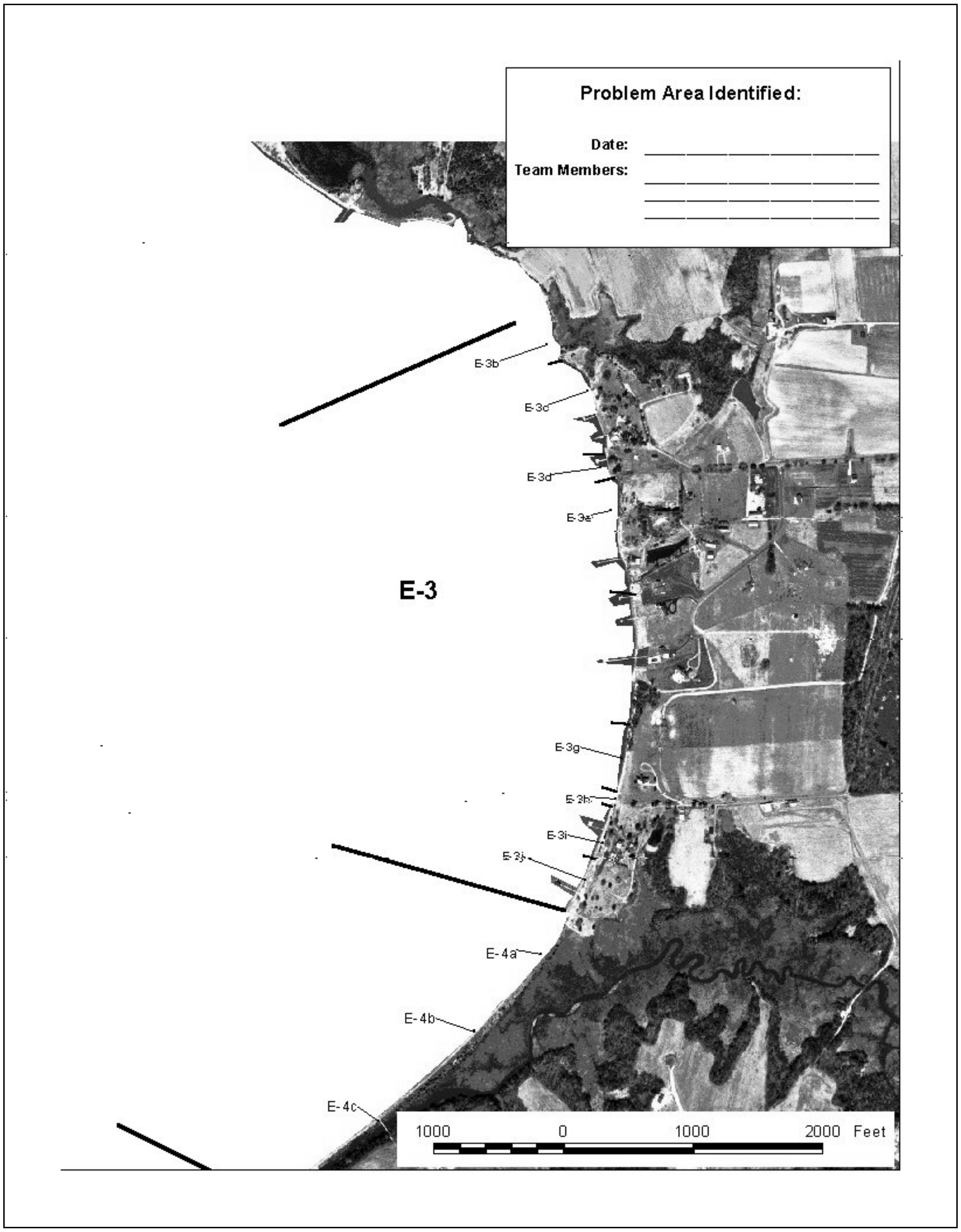
The following example of a survey summary table was developed during a response to a pipeline break. The area affected by the spill, a river, was covered with hundreds of shoreline segments but divided into about 40 operations division. Most of the summaries were made at the operations division level because of the large number of shoreline segments. The table indicates the length of shoreline covered in each division during a number of SCAT surveys.

Division	Survey Date									
	Apr-14	Apr-15	Apr-16	Apr-17	Apr-18	Apr-19	Apr-20	Apr-21	Apr-22	Apr-23
NE-1					2611					
E-1		4800			4800					
E-2		5600	5950			1300	3354			
E-3			1590			790				
E-4		1000	3			754			754	
E-5		3600	800				300			
E-6		2500								
E-7		4491								
E-8		3600								
E-9										
E-10										
E-11										
E-12			14700							
E-13				650						
E-14				4800						
E-15				3000						
W-1									7006	
W-2			3545							
W-3				1794						
W-4	5300			853						
W-5	3340									
W-6		3400					1311			
W-7	4985			1340						
W-8	2086	6350								5345
W-9	4710					2605				
W-10	1957						3444			
W-11		3100								
W-12										
W-13							3090			
W-14							726			
W-15			2929							
W-16										
W-17					1000					
W-18					1000					
W-19				807						
W-20				9000				3019		

Example 1 Survey Summary

Example 2 Shoreline Inspection Reporting Sketch Sheet

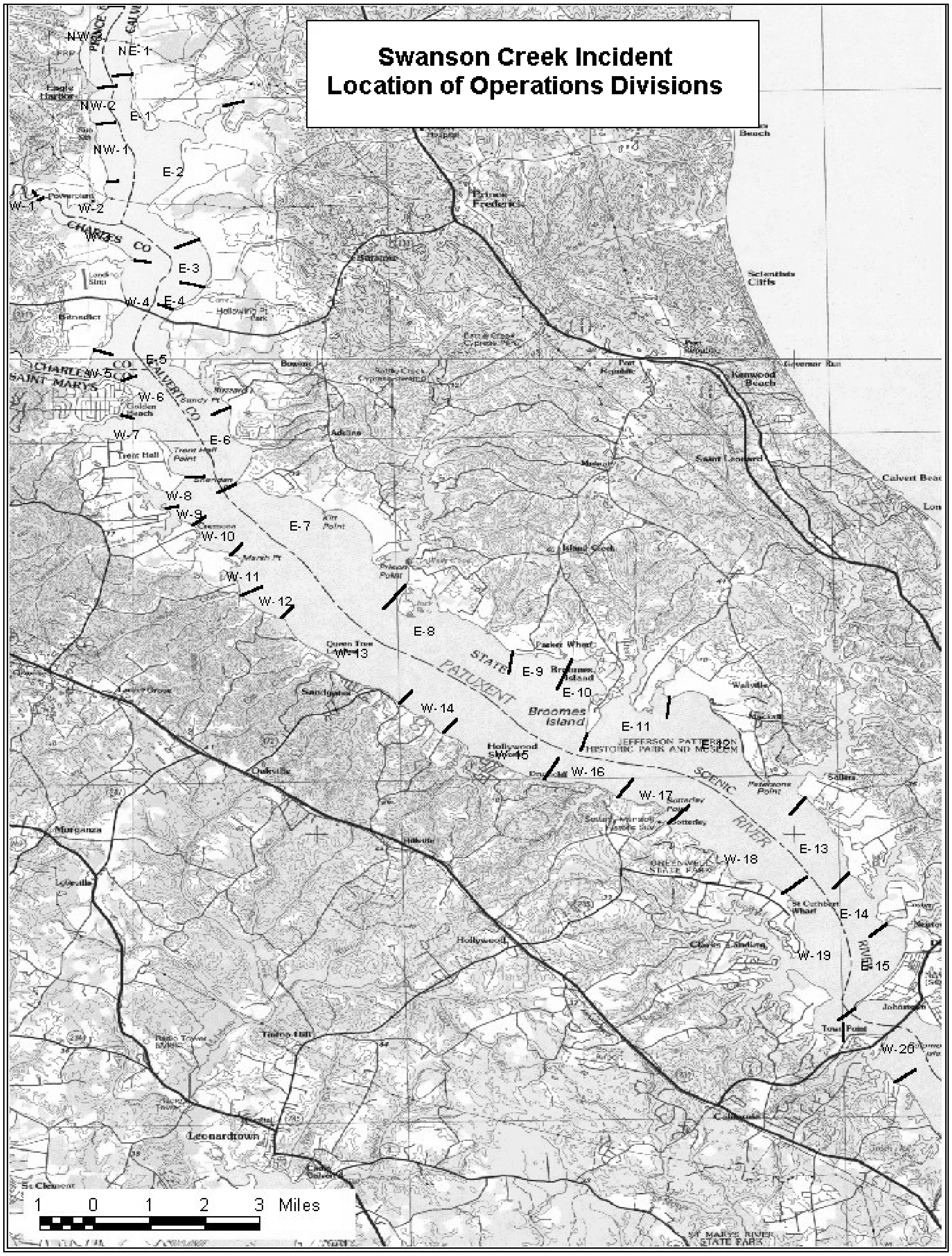
In this example, the availability of 1-m resolution, georeferenced digital photographs (also called Digital Orthophoto Quadrangles, or DOQs) was used to develop a form for reporting inspection results. The map allowed the user to pinpoint areas that needed the attention of cleanup personnel, such as large tar patties or concentrations of tar balls.



Example 2 Shoreline Inspection Sketch Sheet

Example 3 General Location Map

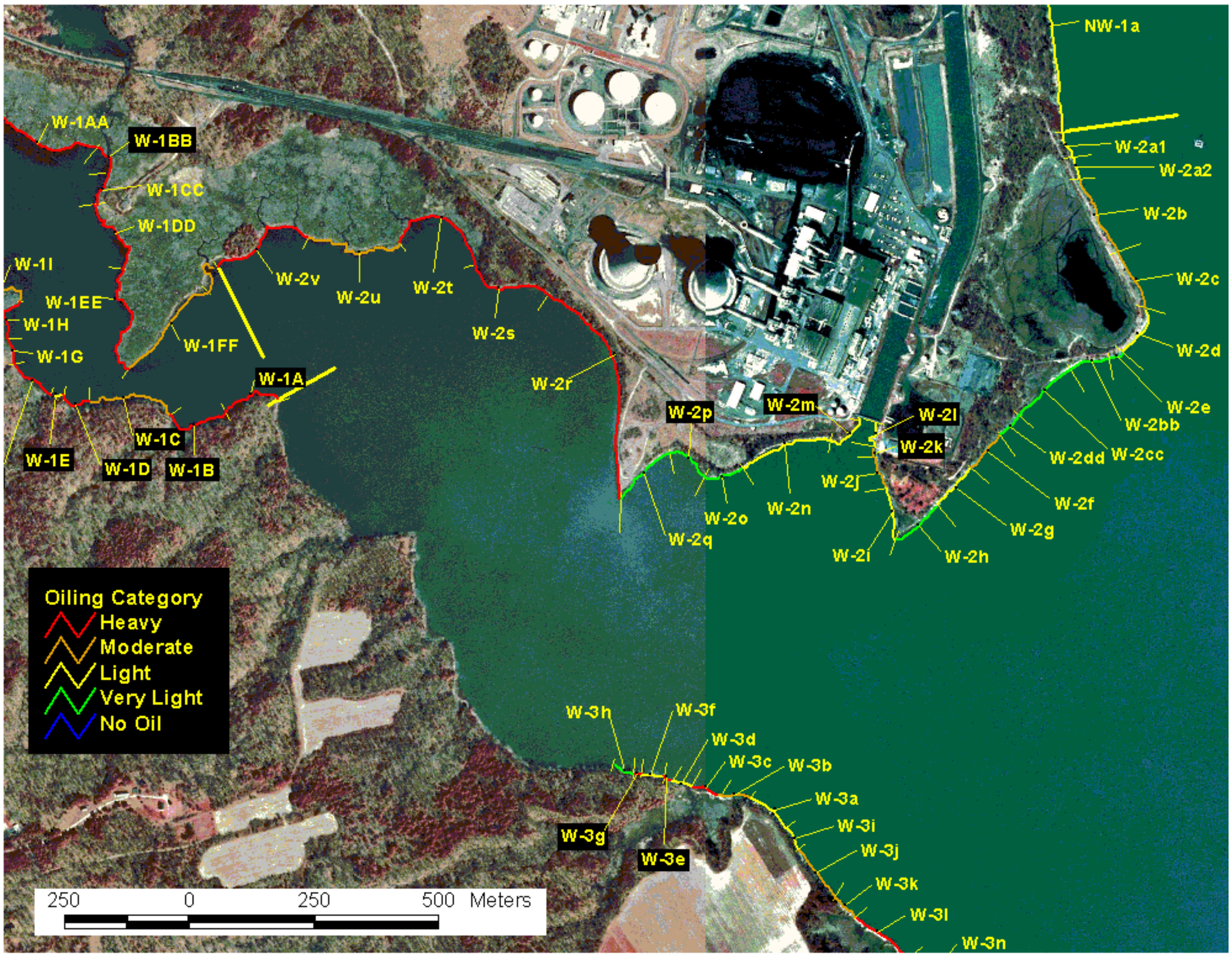
Topographical maps are very useful for general orientation and localization. Example 3 is used to indicate the location of the operations divisions. This particular map was used as a reference to all personnel during the spill and hundreds of copies were reproduced.



Example 3 General Location Map showing Operations Divisions

Example 4 Oiling Summary Map

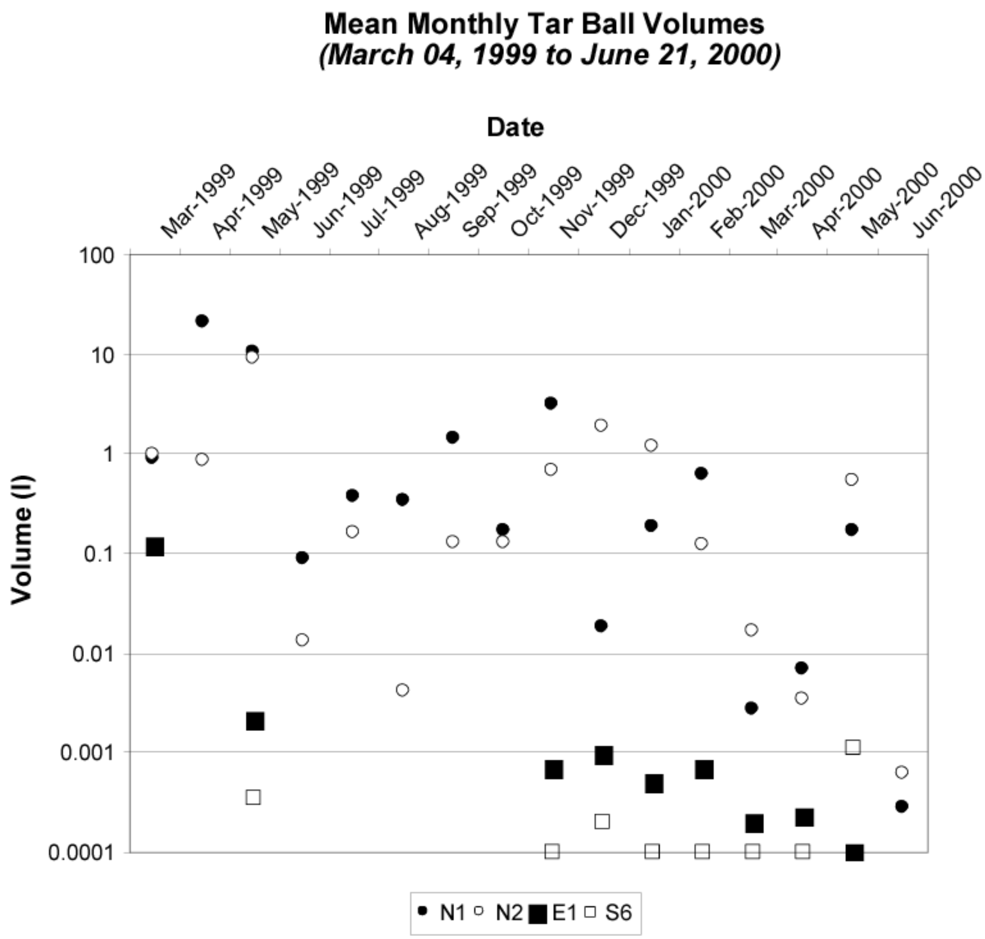
This example shows the delineation of shoreline segments and their associated oiling category superimposed over a georeferenced aerial photograph. This was done to obtain a more precise estimate of the lengths of shoreline impacted by oiling category.



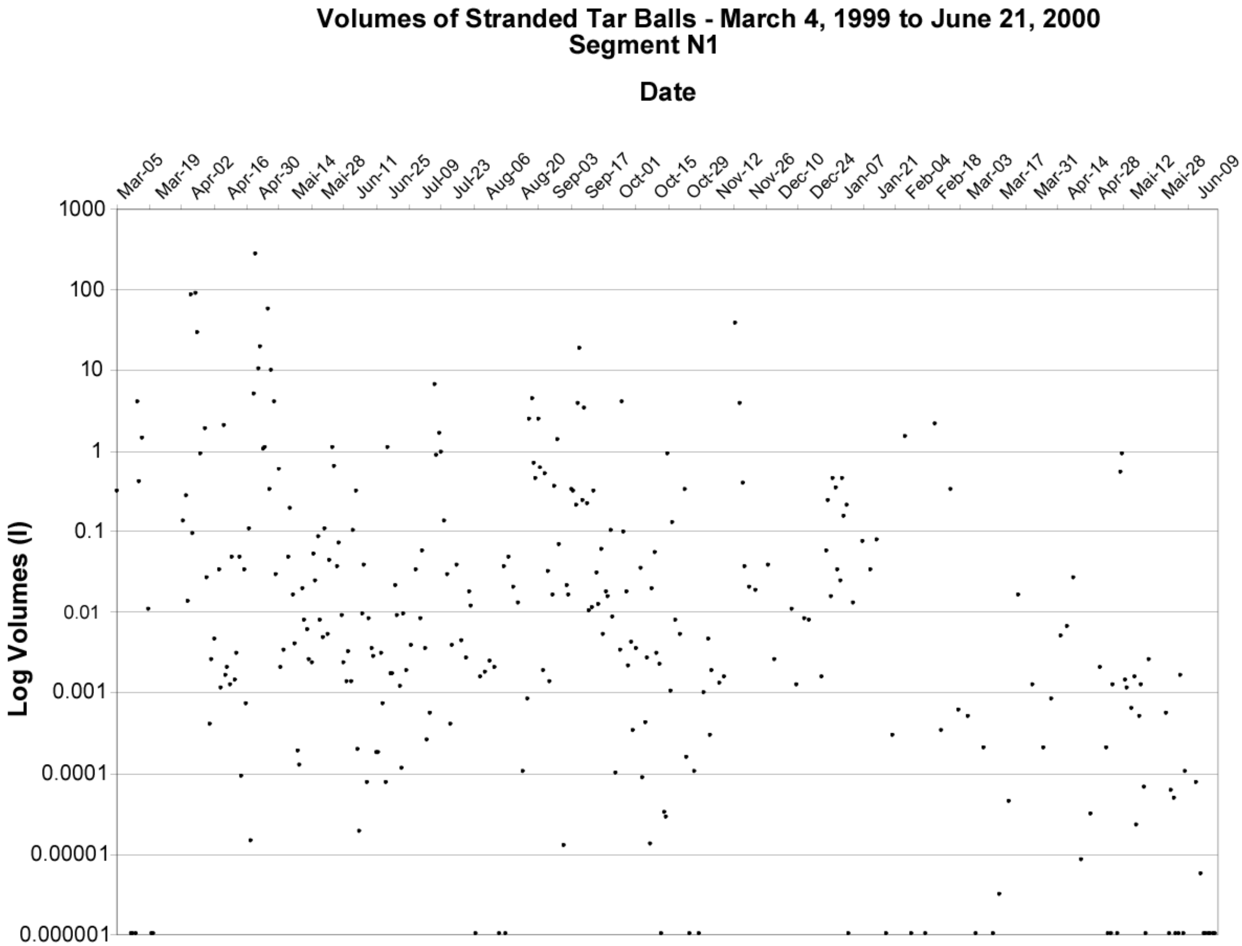
Example 4 Portion of an Oiling Summary Map - developed over a 1-metre resolution georeferenced aerial photograph

Example 5 Monitoring Results Graphs

The following graphs summarize the results of hundreds of observations taken during a tar ball monitoring program after a spill along the Oregon coast. In this case, the issue was to find a way to present the information in an "unbiased" manner that would also enable the user to see long-term changes in the oiling levels. The volume of the tar balls is presented on a logarithmic scale in order to show the evolution in very small levels of oil, both monthly (Example 5.1) and detailed (Example 5.2).



Example 5.1 **Monthly Summary of Volume of Tar Balls in Four Shoreline Segments (N1, N2, E1, and S6)**

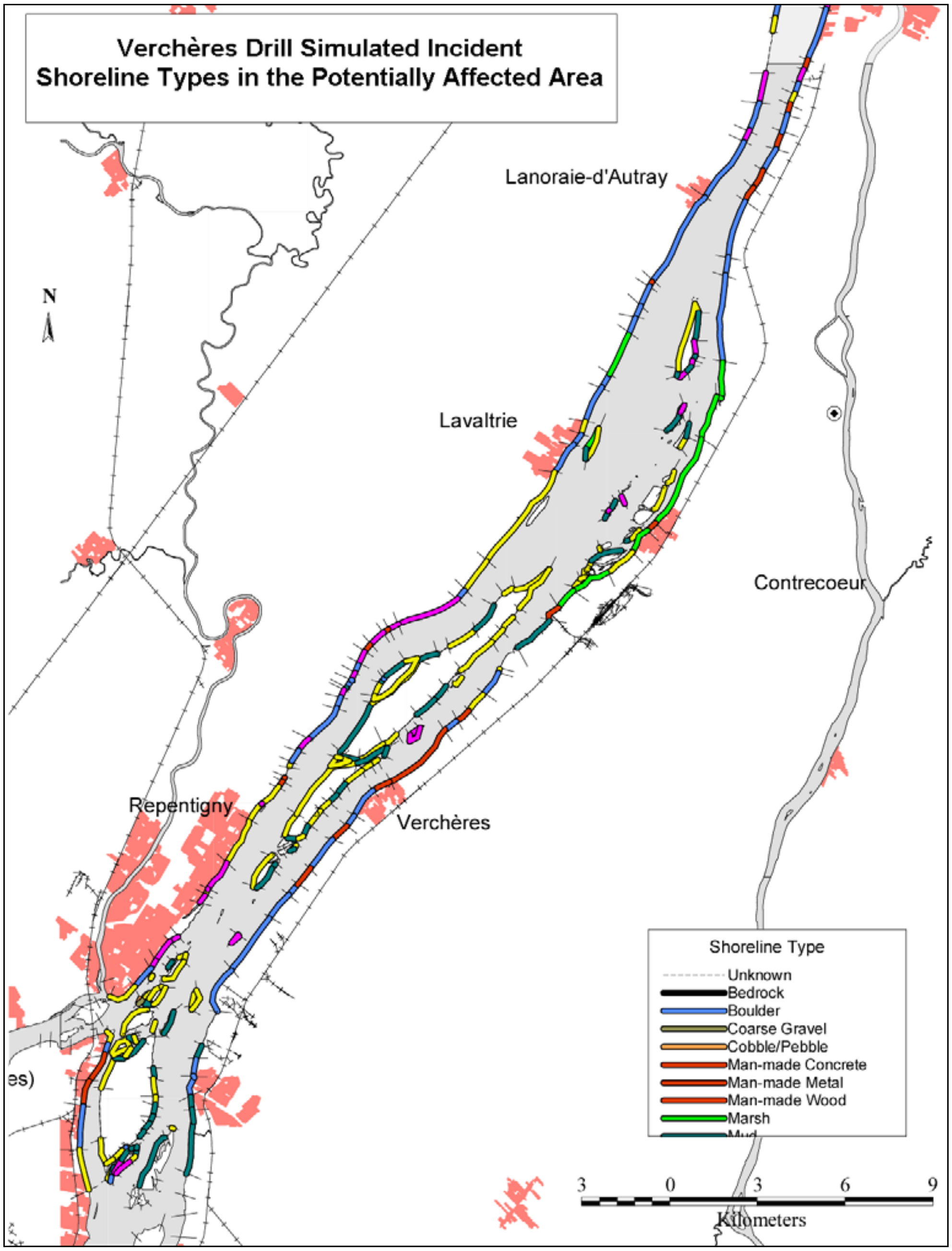


Example 5.2 **Detailed Volume of Tar Balls Observed Along One Shoreline Segment over a 14-month Period**

Example 6 Use of a Pre-Spill Segmentation Database

Pre-spill segmentation databases can be used to quickly create maps showing the segments that can be impacted by a spill. The following example shows a representation used during a drill in Verchères (Quebec, Canada). Example 6.1 is a map, created by importing pre-spill SCAT segment data into an incident database, indicating the location of shoreline segment boundaries and the nature of the shoreline types that could be impacted.

This information was used to develop a table indicating the length of shoreline that would potentially need to be surveyed (Example 6.2) to support planning of the SCAT survey effort.



Example 6.2 Shoreline Types and Shoreline Segments Along an Area Potentially Impacted by a Spill

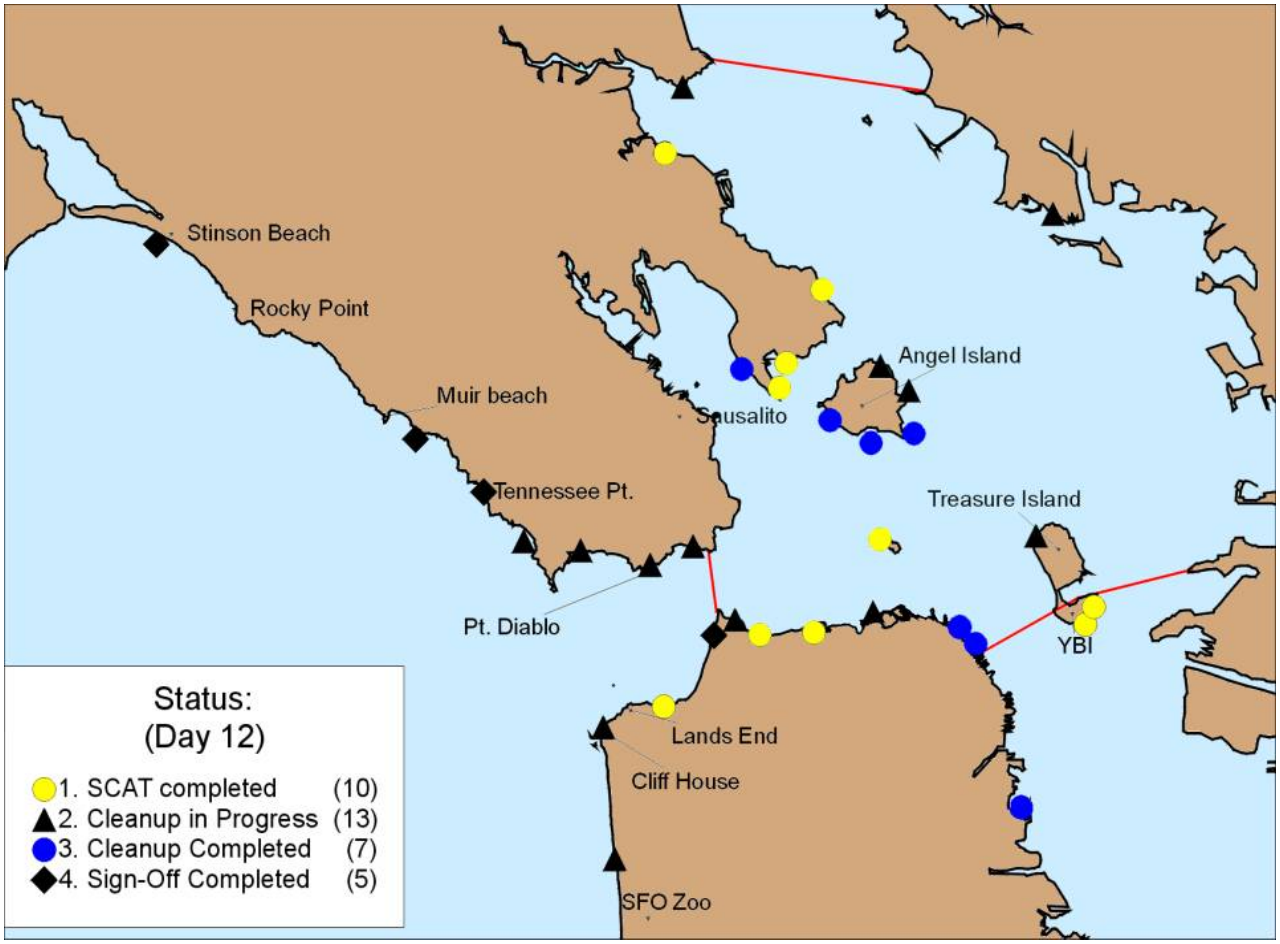
Example 6.2 Summary Table of Length of Shoreline Potentially Impacted broken down by Shoreline Type

Length of Shoreline to be Surveyed by Shoreline Type

Shoreline Type	Length (km)
Boulder	49
Cobble/Pebble	0
Man-made Concrete	13
Marsh	13
Mud	34
Rip-rap	21
Sand	80
TOTAL	**210**

Example 7 Work Status Map

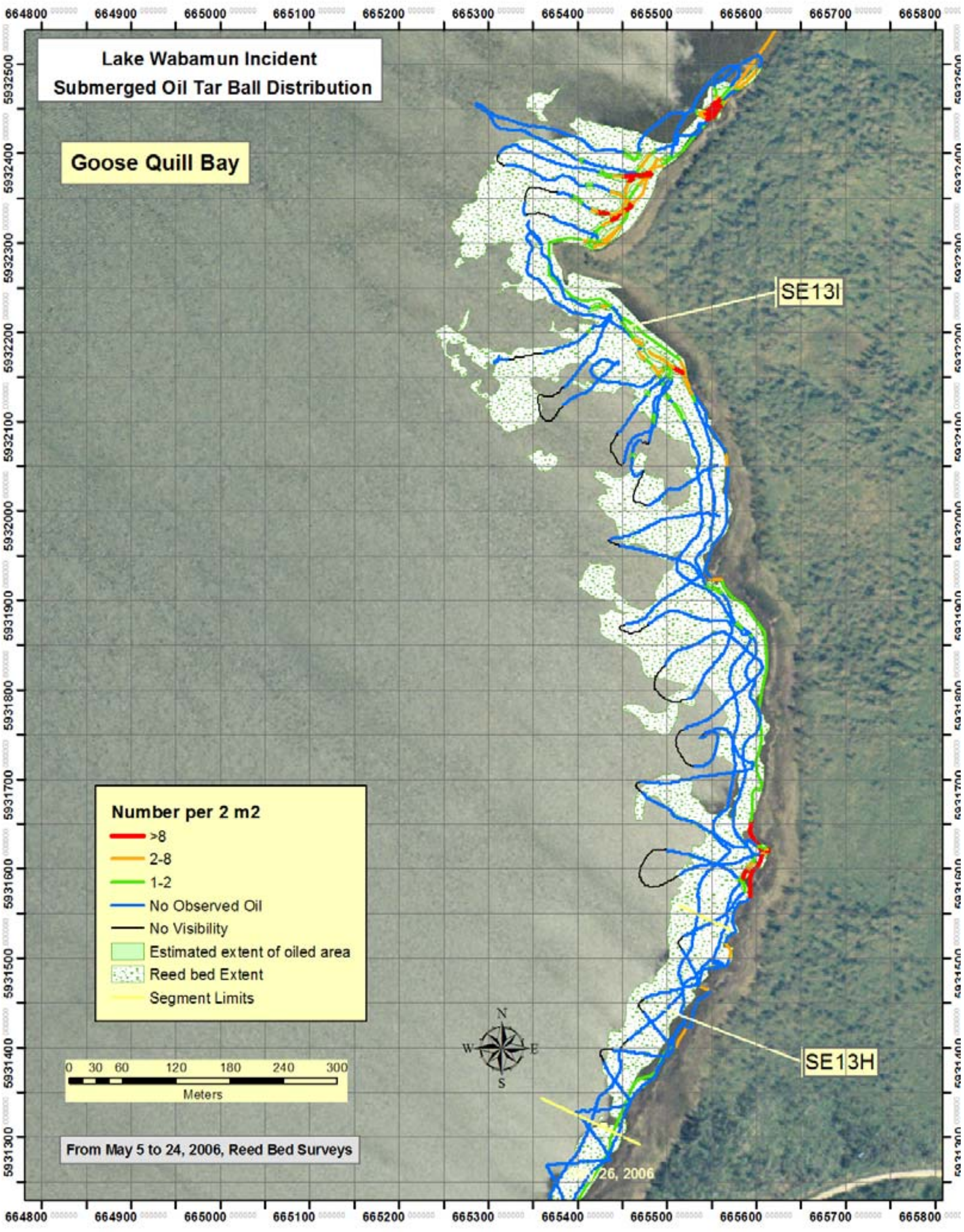
The map shown in Example 7 summarizes the work status on day 12 of the response operations after the Cape Mohican incident in San Francisco, California in 1996. This simple representation provides an instant picture of the state of the response.



Example 7 Work Status Map

Example 8 Map Showing Distribution of Submerged Tar Balls

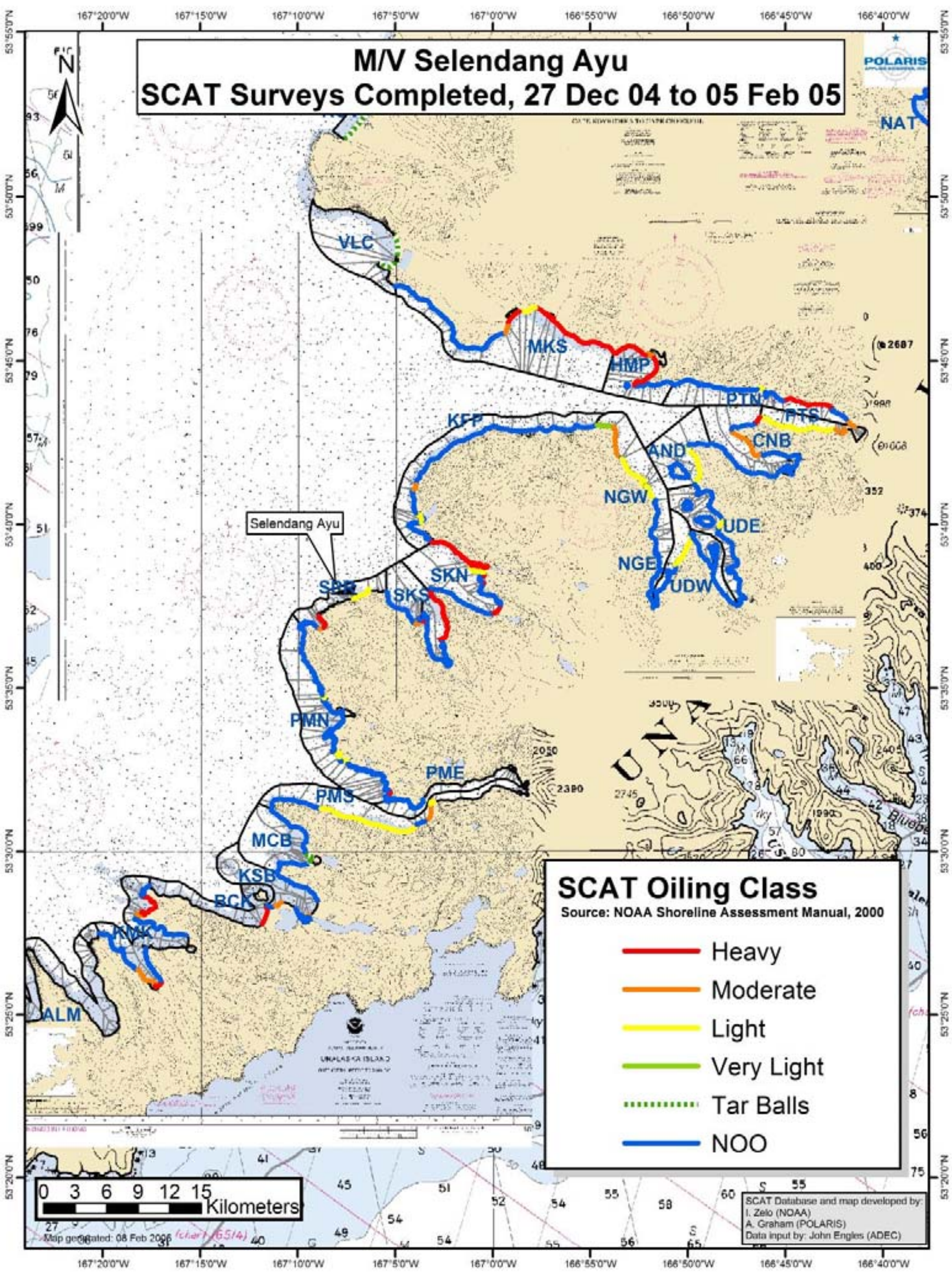
Submerged tar balls are not usually an issue in marine spills, but they became a concern in a spill of heavy oil on a large inland lake. A special survey program was developed to record the density of submerged tar balls along the shoreline and within reed-beds. The method led to the development of a representation of the density of submerged tar balls that was used by cleanup personnel to locate and remove tar balls. The map in Example 8 shows a 50-m resolution grid with UTM coordinates. These were used, along with GPS units, to locate areas of higher concentration of tar balls in the field.



Example 8 Map Showing Distribution of Submerged Tar Balls

Example 9 Timed Oiling Summary Map

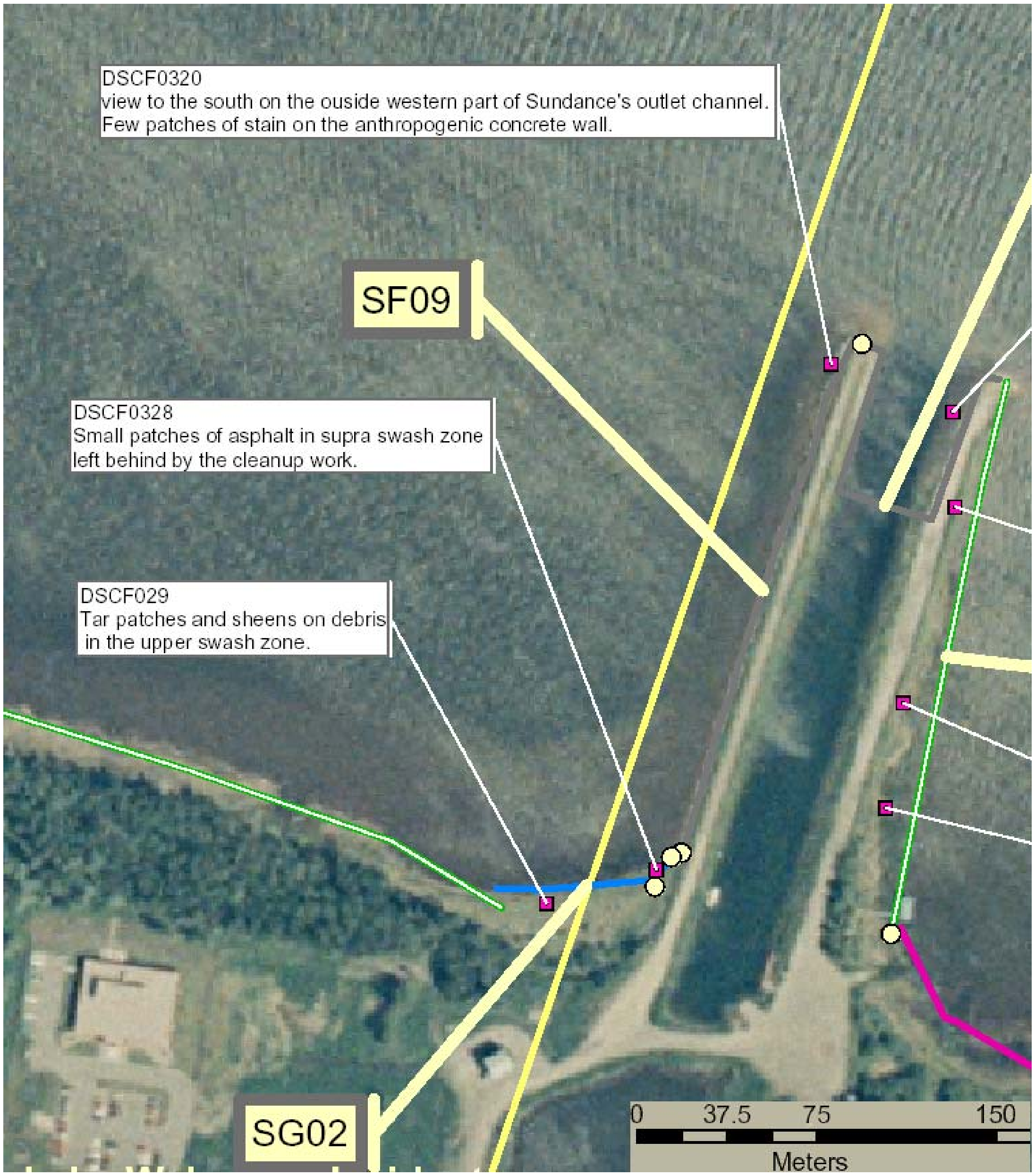
SCAT-derived oiling summary maps are produced at regular intervals in the course of a spill. These maps have many uses such as indicating the necessary treatment effort and the effectiveness of the treatment. Example 9 shows a map produced during the response to the *Selendang Ayu* incident. These maps were provided on an internet website on a regular basis, allowing anyone interested to see the progress of the treatment teams.



Example 9 Oiling Summary Maps Produced during Response to the *Selendang Ayu* Incident

Example 10 Georeferenced Notes

It is always challenging to report the oiling situation after an area has been treated when only traces of oil and a few problematic spots are left. The following representation uses a high-resolution aerial photograph to report the results of shoreline inspection. Each point was determined with the help of a GPS unit and is also linked to a photograph of the described feature.



Example 10 Portion of a Map showing "Post-treatment" Oiling Conditions