Shoreline and Surveillance Surveys on the M/V Selendang Ayu Spill Response, Unalaska Island, Alaska

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Abstract

The grounding of a bulk carrier on Unalaska Island in the Aleutian Chain, Alaska, on 8 December 2004, resulted in a spill of fuel oil that affected approximately 300 km of coastline in a remote area. Initial tracking of the spill commenced at the first opportunity on 11 December using a fixed-wing aircraft to conduct low-altitude surveys during weather windows. As the volume and condition of oil remaining on the vessel was not known due to access difficulties caused by weather and sea conditions, the surveillance program was continued on a regular basis throughout the winter to monitor for possible releases from the vessel. A low-altitude helicopter survey was conducted on 15/16 December, and a map of the distribution of visible surface oil on the shoreline was produced on 17 December to provide the basis for a limited winter cleanup program. A selective ground Shoreline Cleanup Assessment Technique (SCAT) survey was carried out in January and February in key areas to support this operation and to assess the distribution, amount, and character of the stranded oil. A systematic, complete ground SCAT survey was implemented in April 2005, which covered approximately 800 km of coast, to provide information to develop the spring/summer shoreline cleanup program. As part of this spring/summer shoreline survey, Operations personnel accompanied the two teams surveying outside of the "core" area to remove small amounts of oil. This was, in effect, a "*clean as you go*" and a "*sign off as you go*" strategy to obviate the need to survey, then return to cleanup, and then to inspect the completed cleanup in the segment.

A cultural resources program was integrated into both the winter and spring/summer surveys. The spring SCAT program was unusual in the context of a spill response as there was a two-month lead-time to plan and organize the field operation. Data management involved the creation of a physical shoreline character and oiling database for the winter and spring surveys that was linked to a Geographic Information System (GIS), a digital photograph library, and aerial videotape imagery.

1 Introduction – The Response Operation

The M/V Selendang Ayu lost power in the Bering Sea and drifted south towards Unalaska Island, in the Aleutian Chain, where it ran hard aground several days later on 8 December 2004 during a severe storm. The grounding occurred on a headland coast on the remote western side of the island. The Command Post was established at the nearest community, Dutch Harbor, approximately 50 km to the northeast of the grounding site.

The vessel carried approximately 480,000 gallons of fuel oil, and a rupture of one or more of the fuel tanks caused an immediate release of oil. One of the first actions of the Environmental Unit was to segment the area around the site of the grounding, using hydrographic charts and topographic maps. An interagency, fixed-wing, aerial surveillance program was initiated on 11 December, the first day that flights were possible after the storm, initially on a daily basis, weather permitting, to locate and track any free-floating oil. A low-altitude helicopter videotape shoreline survey on 15/16 December documented locations of visible surface oil.

It was not possible to determine how many, or which, fuel tanks had been ruptured or compromised, so a boat-based operations team was mobilized to be on site to contain and recover oil in the event of a further release or releases from the vessel. Rather than simply having the operations crews on standby in case of a release, the Unified Command (UC) decided that these crews could clean some of the more heavily oiled shorelines during weather windows. The winter cleanup program began on 20 December using the information obtained from the 15/16 December helicopter shoreline reconnaissance to establish the initial cleanup priorities. Later, in early January, an interagency SCAT team began a limited ground shoreline survey of those oiled segments identified in the December aerial reconnaissance.

Lightering of the vessel began in early January and 140,000 gallons of diesel and IFO 380 were removed by 10 February. The UC determined that it was highly unlikely that any oil remained on the vessel as a result of lightering. This judgment was corroborated by an underwater survey conducted on 4 February. Following this decision, the shoreline cleanup activities were suspended and the operations field crews demobilized due to safety concerns regarding continued winter storm activity, on the understanding that a more thorough cleanup would recommence with anticipated better weather conditions in April. The interagency aerial surveillance program continued through February and March on an approximately twice weekly basis.

At the time of the winter demobilization, the UC scheduled the resumption of shoreline cleanup for 15 April. Four SCAT teams were deployed on 6 April to launch a systematic survey in support of the cleanup operation.

The purpose of this paper is to describe the strategy and design of the interagency field surveys that supported the SCAT program and to outline some characteristics of the data management activities rather than to present the actual survey results themselves.

The SCAT survey is ongoing at the time of writing (mid-April) so that many of the results are ephemeral. The program is scheduled to continue through the 2005 spring and summer months to support the shoreline cleanup operation.

2 Surveillance Overflights

Initial observations of oil distribution were made from a US Coast Guard (USCG) Search and Rescue helicopter immediately following the grounding. On 11 December the UC initiated a regular aerial surveillance program over the next 16 weeks. Due to the lack of locally-available rotary-wing aircraft, these surveillance surveys were conducted initially using a commercial, fixed-wing, twin-engine Grumman Goose that was stationed at Dutch Harbor. The Goose had the advantage of carrying 6 observers with an unobstructed view due to its high wing configuration. An in-flight communications system was installed that allowed all observers to talk to each other throughout the survey so that items or issues could be discussed while at a location of interest which all could view at the same time. The Goose also provided a safety factor of being a twin-engine amphibious aircraft with the ability to fly slowly (70 knots), with an endurance of over five hours, and could land in remote protected waters for surface water sampling.

The length of flight lines varied and depended upon the weather, mission objectives, and aircraft capabilities. Mission lengths varied anywhere from 30 to 500 km. The primary objectives of the program were to observe oil on the surface of water, new releases of oil from the vessel (if any), and changes in vessel condition; check that booming strategies were in place and functional; and monitor the distribution of the soybean cargo. Observations of new onshore or nearshore oil accumulations were also noted.

Even after helicopters became available for response overflights, a core team of UC observers representing the Responsible Party (RP), USCG, and the state of Alaska continued to use the Goose for routine surveillance, particularly for sites further afield from the core area. All observations were calibrated amongst this multi-agency group by consensus and agreed upon in the aircraft prior to departing the survey area. In this manner, all discrepancies were resolved on-site and the groups' eyes became calibrated to each other. When replacement personnel cycled in, a calibration flight was made with the new person and at least two of the existing core team members.

Geographical Positioning System (GPS) data were collected every 25 meters along the flight track lines. These data facilitated accurate location of observations and documentation of the area observed. Additionally, large areas of sheen or anomaly could be defined by over-flying the perimeter of the area and post-calculating surface area observed by circumnavigation. Synchronization of high-resolution digital photographs with the GPS clock allowed for automatic geo-referencing of photographs.

Approximately 60 fixed- and rotary- wing surveillance over-flights were completed over the 16-week period to 1 April 2005.

3 Winter Shoreline Surveys and Database

The storm associated with the grounding of the vessel lasted several days and, during this period, the shorelines of the area around the site of the grounding were segmented using hydrographic charts and topographic maps (Figure 1). The coast of

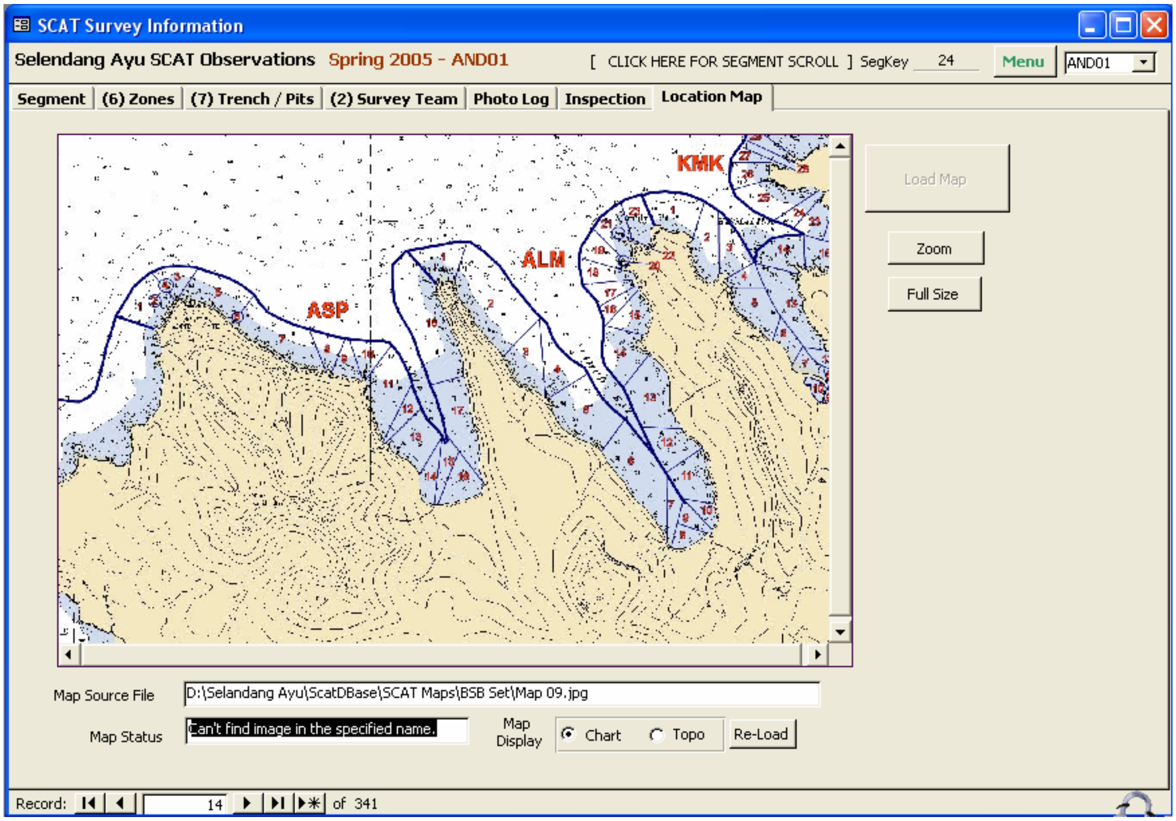

Figure 1 Pre-survey Segmentation Displayed in the Spring SCAT Database

central northern Unalaska Island was initially divided into 460 segments, and all subsequent aerial and ground shoreline observations were keyed to these segments.

The first helicopter arrived on site 14 December and a "low and slow" or "10 and 10" (10-m altitude and as slow as 10-knot air speed) visual reconnaissance survey of the shorelines adjacent to the grounded vessel was conducted the following day. A low-altitude videotape shoreline survey of the areas in which surface oil had been observed was conducted on 15/16 December and a "Shoreline Oiling" map of the Surface Oil Categories was produced and distributed the following day. One valuable feature of the survey videotape images was the development of a link to the Oziexplorer™ navigation software. A user could view the flight track line on a map or chart and click on that line to pull up a video frame or multiple frames of that location. This link provided easy and immediate access to view any section of the shoreline.

In January and early February, an interagency SCAT team deployed by helicopter based out of Dutch Harbor conducted a ground survey of 289 selected segments that covered approximately 300 km in a "core" area around Makushin Bay and Skan Bay (Figure 5). The purpose of this survey was to support the winter shoreline cleanup operations in this area. The survey data showed that 55 km (34 miles) of shoreline in 86 segments had some form of oiling (Table 1). Based on the initial aerial reconnaissance and on the preliminary ground SCAT data, 34 segments with Heavy or Moderate oiling conditions were identified for consideration for gross oil removal by cleanup crews during the winter operations phase in these areas. A benefit of this winter ground SCAT database is that comparisons can be made with the spring SCAT data to evaluate natural attenuation between surveys. Also, this winter survey, though limited in time and space, provided a clear picture of where oil was concentrated in Makushin and Skan Bays. The majority of the shoreline oil was deposited in approximately 10 segments in this “core” area.

Table 1 Winter Survey Shoreline Oiling Lengths

Surface Oil Category	Kilometers	Miles
Heavy	14.0	8.7
Moderate	5.0	3.1
Light	13.4	8.3
Very Light	0.6	0.4
Tar Balls	21.2	13.2
No Observed Oil	241.4	150.0
Total Length Oiled	54.2	33.7
Total Length Surveyed	295.6	183.7

A database was developed once it was apparent that the amount of data generated during winter SCAT operations would be difficult to organize and access in a simple spreadsheet. Microsoft Access™ software was used to build tables and an entry form that allowed SCAT data to be quickly entered into the database and accessed. Since the primary goal of the database was to store basic segment and oiling information and aid in the access of this data, the database did not have inputs for all possible entries from the SCAT form. General survey information, segment number, shoreline characteristics, oiling zones, and trench information were included in the database but other SCAT form information (e.g., weather, personnel involved) were omitted to streamline operation of the database. To compensate for this omission of data, the SCAT forms for each segment were scanned and a hyperlink to each scanned form was included as a data entry for the corresponding segment in the database. This allowed the SCAT forms to be easily viewed if additional information for a segment was required. Digital photographs for segments were also linked to the database by a hyperlink.

Data for each segment were entered into the database by a member of the SCAT team. The database was a very fluid and evolving tool, and additional data entry options were added to the database that were not on the original SCAT forms. An example of this is the “Remobilized Oil” option for each oil zone. This option was added when it became apparent during the winter SCAT survey that oil from heavily oiled shorelines was being remobilized and deposited on previously unoiled beaches. In order for the SCAT team members to differentiate primary oiled beaches from beaches affected by this secondary remobilized oil, the “Remobilized Oil” option was added to the database as a simple “Yes/No” checkbox for each oiled zone. This information could be easily mapped to identify the locations of beaches affected by remobilized oil.

Each shoreline segment was defined on a map using ArcMap™ software and linked to the SCAT database. This link allowed current maps of the Surface Oil Category (Heavy; Moderate; Light; No Observed Oil - “NOO”) to be produced as the database was updated. Other characteristics, such as shoreline character or the above-mentioned "Remobilized Oil", could also easily be mapped and distributed.

Additional oil observations were recorded by other field teams who visited the shorelines of the area, for example, as part of the wildlife capture program. However, many of these "incidental observations" could not be entered into the database as the terminology was different from that used by the SCAT teams or because information was lacking, such as the exact location on the coast or in the tidal zone, or the dimensions of the oil deposit.

4 Spring SCAT Survey

The scheduled resumption of shoreline cleanup for 15 April provided time between mid-February and the end of March to design a thorough and comprehensive survey with input and agreement from all UC representatives and stakeholders. This included:

- QA/QC of the winter SCAT survey data,
- a thorough upgrade of the database that had been created at the Command Post,
- completion of pre-survey segmentation of the expanded survey area,
- working through necessary permitting and consultation issues with appropriate agencies, and
- planning, organization, and then scheduling of the composition and activities of the field teams among all of the key players.

The RP consultants took the lead in overall coordination and management of the survey design, however, each component of the program was generated with regular and detailed dialogue with all affected agencies. Examples of contributions that agencies brought to the survey design included:

- US Fish and Wildlife Service (USFWS) input on the definition of Ecological Constraints.
- Alaska state input on cleanup end points and appropriate cleanup treatment methods and on survey priorities.
- Alaska Department of Natural Resources (DNR) input on permitting of work in anadromous fish streams.
- Alaska Department of Environmental Conservation (DEC) coordination amongst all Alaskan state agencies to help determine overall Alaskan state priorities.

The expanded spring/summer pre-survey segmentation built on the segments defined for the winter program and created a total of 43 Segment Groups and 794 individual segments for the study area. The survey was designed to cover a total of approximately 800 km of coast. Due to the lack of available detailed shoreline information for the entire expanded survey area, such as aerial videotapes, the segmentation was again based on hydrographic charts and topographic maps with the expectation that the predefined segment boundaries may not in all cases coincide with real physical shoreline units. The field teams were instructed to redefine the segment boundaries, using GPS coordinates as appropriate. For example, if more than one primary shoreline type were identified within a predefined segment then boundaries should be adjusted. Segment lengths were accurately determined from the GIS map of the segment boundaries to minimize random miscalculations of estimates made in the field.

The spring SCAT program was initiated by training and calibration on 5 April and mobilization of four field teams the following day, although poor weather delayed the first field surveys for four days. Two helicopter-based teams worked out of Dutch Harbor to initially survey priority segments containing anadromous fish streams in which shoreline oil had been observed during the winter survey. These segments were the highest priority for cleanup. Once completed, the schedule involved surveys of other segments with observed oil that did not have anadromous fish streams, and then segments near the site of the grounding with anadromous fish streams where oil had not been observed in the winter program. One of the two helicopter-based teams was demobilized, as scheduled, after completion of the priority segments in the "core" area. Two boat-based teams worked farther afield to the west and then to the east of the central area. A cultural resources person was present on the team for segment surveys selected by the Historic Properties Specialist (HPS).

The field SCAT teams were composed of a Federal On-Scene Coordinator (FOSC) representative (either USCG or the National Oceanic and Atmospheric Administration), a State On-Scene Coordinator (SOSC) representative (DEC), and an RP representative (Polaris Applied Sciences, Inc.) who were empowered with signatory authority to determine whether a segment was appropriate for sign-off. Other occasional members of the SCAT teams included representatives of the land managers or landowners (e.g., Tanadgusix Corporation, St. George Tanaq Corporation, Atxam Corporation, and USFWS), Cultural Resource specialists, and a DNR representative to help determine permitting issues for segments containing anadromous fish streams.

The field observations were recorded on standard Shoreline Oiling Summary (SOS) and Tar Ball Oiling Summary (TBS) forms. Command Post support for the field teams was provided by a SCAT Program Manager and a SCAT Field Coordinator/Data Entry Manager. The completed field documentation (forms and sketches) from the helo-based teams were inspected at the Command Post for QA/QC the same day to ensure that any necessary revisions were made prior to the surveys of the next day. The completed field documents from the boat-based teams were inspected by the Oil Geomorphologist (OG) of the other team for QA/QC on the same day as the survey to ensure that any necessary revisions were made prior to the surveys of the next day. The completed field documents were forwarded to the Command Post as soon as practical.

The decision process for the shoreline cleanup operations was driven, in part, by a "Shoreline Treatment Recommendation Transmittal" (STRT) form (Figure 2). The form contained recommendations for treatment tactics as well as ecological and cultural resource constraints that might be appropriate for the oiled area. This form was completed in the field and forwarded to the Command Post for review initially by (1) the Safety Officer for safety concerns and (2) an Operations representative for feasibility and practicality. The form then was reviewed and approved by (3) the HPS, (4) the Environmental Unit Leader (EUL) for environmental risk and environmental priority assignment, and finally approved by (5) the Unified Command. The approved form was then forwarded for implementation to Operations via the EUL. Digital photographs with annotations and oil locations accompanied many of the STRTs (Figure 3).

During the winter survey, only scattered tar balls and occasional tar patties or mats had been observed beyond the "core" area of Makushin and Skan Bays where the majority of the oil had stranded following the spill. One unique element of the SCAT

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Shoreline Treatment Recommendation Transmittal Form [(1)]

Site Location:

Segment: **Length (m):** **Survey Date:**

Shoreline Type: **Substrate:** **Coastal Character:**

Box 1 Oiled Area for Treatment (EU)

Box 2 Treatment Recommendations (EU)

Box 3 Recommendations / Staging and-or Logistic Constraints / Waste Issues (OPS)

Box 4 Ecological Resurce Comments

Constraint:

Box 5 Cultural Resources Comments (HPS)

Constraint:

Box6 Safety Issues (EU/OPS/SSO)

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

FINAL APPROVALS:

Environment Unit Lead	**Planning Section Chief**	**Historic Property Specialist**
RP	**SOSC**	**FOSC**

Prepared By: **Date Prepared:**

To Ops	**To HPS**	**To DNR**	**To SOS**	**To EUL**	**To PLN**	**To UC**

Final Approval to OPS

Final Approval to EUL

1- Complete all Boxes and forward to appropriate party for comments / approval via tracking

Figure 2 Shoreline Treatment Recommendation Transmittal (STRT) Form

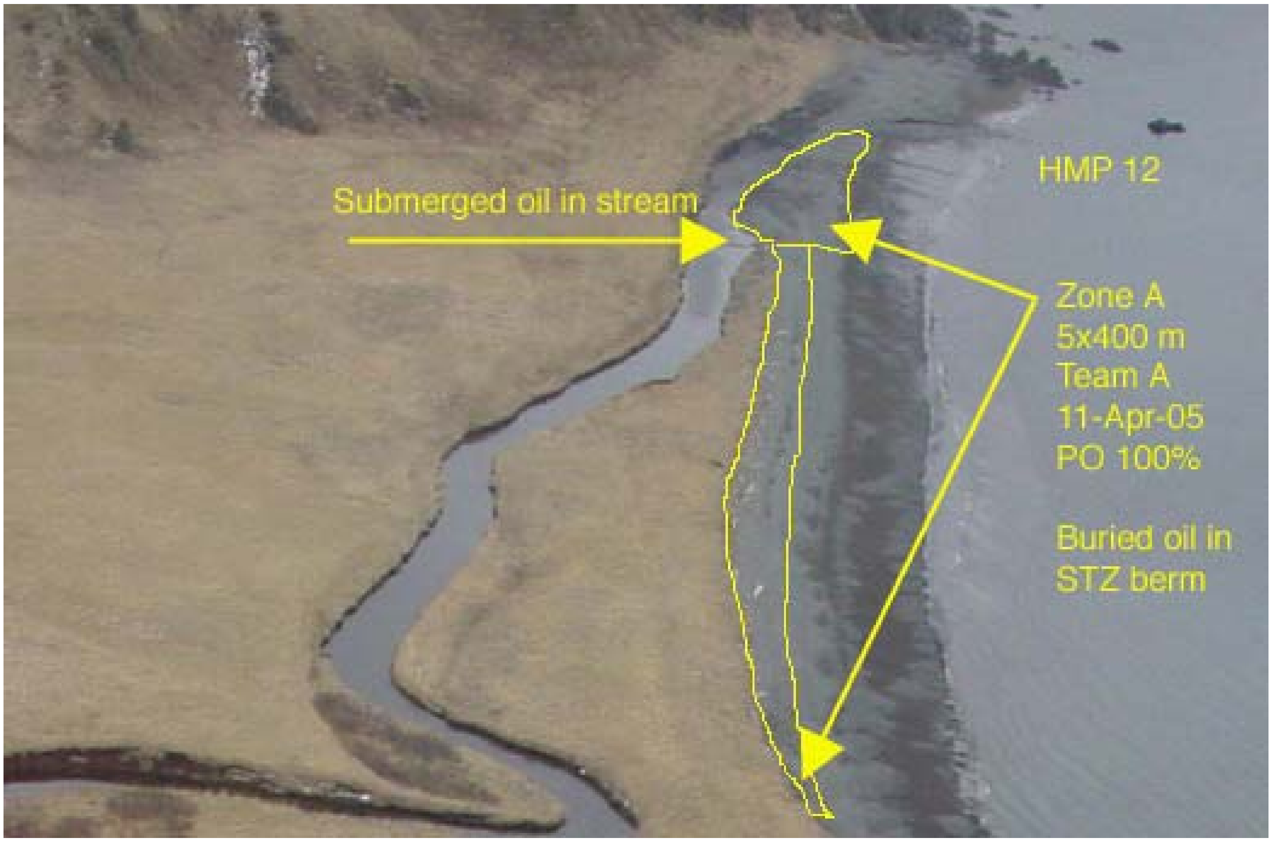

Figure 3 Example of Annotated Segment Photograph Provided with the STRT form

program on this response was that, for these very lightly oiled areas, the boat-based SCAT teams were accompanied by an Operations person to recover this minimal oiling during the segment inspection. As part of the survey in these remote areas, these teams also completed a "Segment Inspection Report" (SIR) form (Figure 4) to recommend to the UC that no cleanup would be required in a segment where no oil was present or that no further treatment was required once the cleanup end-point criteria were met. The cleanup end points were defined in the document "M/V Selendang Ayu Shoreline Cleanup Termination End Points 2005" approved by the UC at the outset of the spring cleanup program. This was, in effect, a "*clean as you go*" and a "*sign off as you go*" strategy to obviate the need to survey, then return to cleanup, and then return again to inspect the cleanup in the remote segments. For segments where cleanup had been completed but that did not meet cleanup end-point criteria by unanimous agreement of the three UC representatives, an SIR was completed noting specific details of further cleanup work to meet these end points.

Treatment techniques were discussed at length during the break between the winter and spring operational phases amongst the agencies representing the UC on the SCAT program. A number of "routine" treatment methods were agreed upon as most appropriate for use on the affected shorelines in this area, given the concerns over numerous sensitive resources including endangered bird and mammal species and several very important fisheries. These treatment techniques were listed in the SCAT Manual in a table by segment groups, shoreline character, and oiling conditions as a guide to help select the best method of removing oil to enhance natural recovery and minimize additional impacts to sensitive resources.

Once SCAT teams submitted the completed forms to the SCAT Coordinator and they had been through the QA/QC process and entered into the database, the forms were packaged by segment group and by recommendation (either SIR or STRT) and routed through a Shoreline Treatment Advisory Group (STAG) before they were forwarded to the UC for signature. The SIRs did not require initials or input from the same number of individuals as the STRT (Safety, Operations, etc.), but agency representatives in the EU had the opportunity to provide input to ensure that land managers or land owners were made aware of the recommendation. The STRTs, packaged along with sketches and other supporting data, were reviewed by the STAG and then forwarded to the UC for approval. The STAG met typically on a weekly basis to review with the STRTs in batches.

The shoreline treatment recommendations generated by the SCAT program fell into four categories:

NO TREATMENT RECOMMENDED: The segment had no observed oil or met the end-point criteria without treatment. An SIR form was completed for the segment.

NO FURTHER TREATMENT RECOMMENDED: The oil observed in the segment was removed by Operations during the survey of that segment and met the end-point criteria without further treatment. An SIR form was completed for the segment.

ROUTINE TREATMENT: The treatment tactics recommended for the segment were non site-specific standard techniques. An STRT form was completed for the segment.

NON-STANDARD TREATMENT: There were a number of segments for which the standard techniques were not applicable. A specific treatment plan for each of these segments was prepared by the Environmental Unit in consultation with Operations in order to achieve the end-point criteria assigned for that segment. This site-specific plan was attached to the STRT for the segment.

The objective in establishing these four categories was to expedite the decision process for the segments where no treatment was considered necessary or where pre-approved techniques applied. This process then acknowledged the importance of debate and discussion between all stakeholders and Operations for those areas where competing resources at risk were involved or where the standard treatment tactics might not be applicable or adequate.

5. Spring Data Management

The SCAT database was revised following the completion of the winter survey and the data subject to a quality control review. The structure of the winter database was based on the general characteristics of the standard SOS form. Selected fields that were important at the time of the survey were included and summary data established. A segmented shoreline structure was created within the spill area to provide a standard operational division and segment hierarchy. Although this initial database was sufficient at the time, it had some limitations and omissions that would have been restrictive for long-term documentation and evaluation of the affected shorelines, including:

M/V Selendang Ayu

Segment Inspection Report

Segment ID [ ]

SCAT Team ( ) Members

If no further treatment is required, each UC rep sign below.

Name		Signature
	FOSC rep	
	SOSC rep	
	RP rep	

Date of Survey [ ]

Time of Survey [ ]

Tide Stage [ ]

Weather [ ]

Inspection Completed Along Entire Segment? YES / NO

Treatment Endpoint Criteria:

Is treatment or further treatment required? (circle one)

YES - define below specific treatment action(s) and specific locations within the segment where required. Provide sketches, maps, GPS coordinates to OPS.

NO - each UC rep sign appropriate signature box above

Comments:

FOSC__________________ SOSC______________________ RP________________________

Figure 4 Shoreline Inspection Report (SIR) Form

- A segment hierarchy was used but the main data entry was based on oiled zones
- The trench/pit data were linked to zones and not to the shoreline segment.
- No structural allowance was made for multiple surveys.
- Several informational fields were omitted that might be important for on-site operations and for comparisons between surveys.

The main data input was structured around the zone level on the SOS form rather than on segments. Much of the shoreline information, for example, backshore character and operational features, are better represented at a segment level whereas oiled zones need only contain the information related to a specific oiled location within the segment.

After completion of the winter program the architecture of the database was upgraded to provide easier data entry and output procedures and to facilitate some of the data manipulations and transitions. The database was set up to include the winter physical shoreline character and oiling data, digital photograph library, and aerial videotape imagery from the winter program as well as allowing for data entry of the spring observations, the STRT form, the SIR form, and photograph logs.

The data entry screens shown in Figure 5 illustrate the choice between access to the existing winter database or to a series of data entry screens for the spring survey data. The key characteristics of the new system were:

- A hierarchy that allowed multiple surveys, with multiple independent zones and pits within surveyed segments.
- Additional data forms could be appended as required, for example, tables can be added for ecology, archaeology, operations, and cleanup. These are linked to the existing data entry forms.
- The existing winter survey data set was imported into the new structure to allow comparisons between this and any new data sets collected.
- Comparison summaries and reports could be created within and between surveys.
- Data outputs that were part of the winter survey could be maintained as required and new queries created to support the spring operations.
- Menu-driven data entry and processing screens simplified the program and made it easier to operate by persons not directly familiar with database concepts.
- The data input screens were modeled after the layout of the field SOS forms, making it easy to transfer the data from the forms to the database.
- Data table views of the information were provided for experienced users.

A key feature of many of the input boxes on the data entry screens (Figure 6) is the use of pull-down menus so that the person entering the data must use standard terms and definitions that parallel those on the SOS and other forms. The inputs to the database are presented schematically in Figure 7 and the database character is shown in Figure 8.

6. Cultural Resources Program

Within hours of the vessel grounding, the USCG activated a term contract with Northern Land Use Research, Inc. (NLUR) to provide Historic Property Specialists (HPS) for the FOSC under the terms of the *Alaska Implementation Guidelines for the Programmatic Agreement on Protection of Historic Properties during Emergency Response under the National Oil and Hazardous Substances Pollution Contingency Plan* (PA).

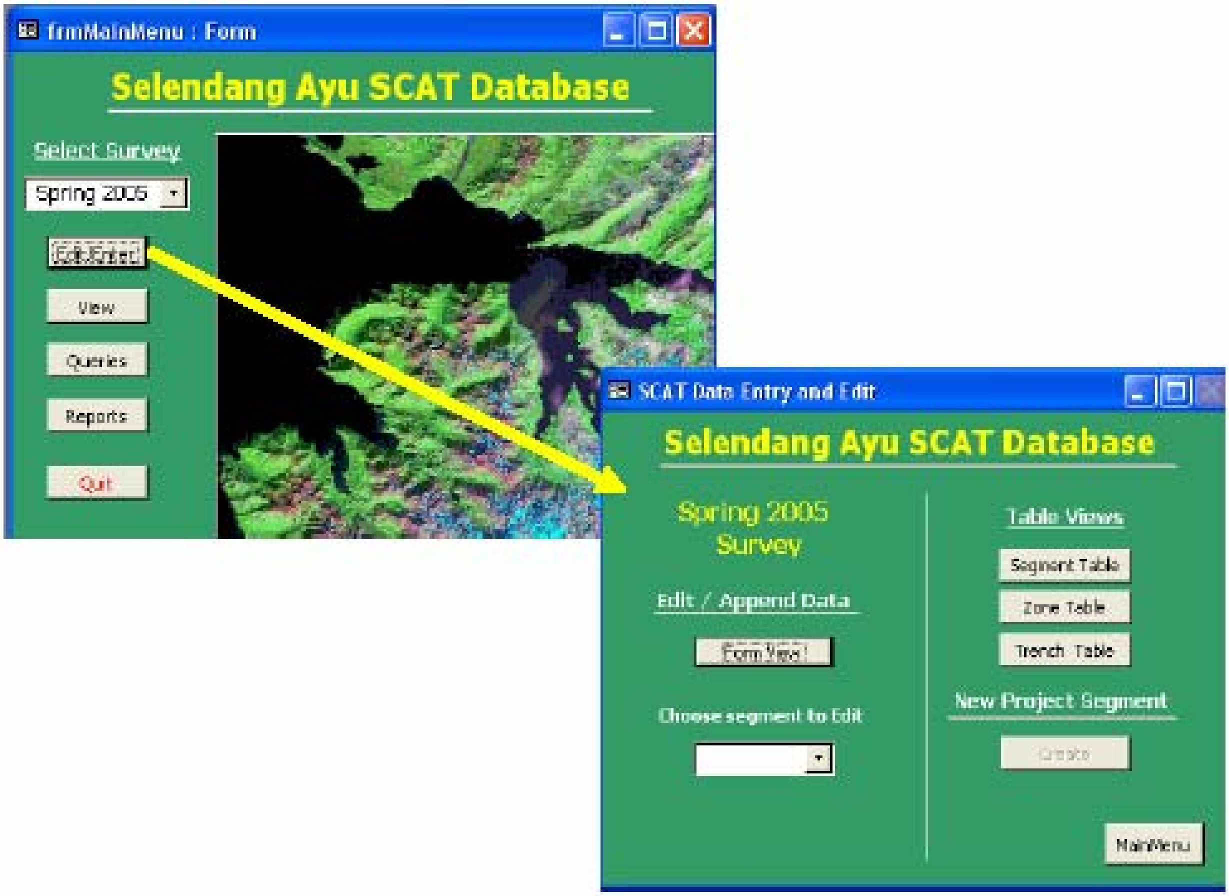

Figure 5 Spring SCAT Program Database Entry Screens

NLUR personnel traveled to Unalaska within days of the spill and one archaeologist was on site throughout the winter cleanup operations and participated in shoreline assessments. The RP contracted Chumis Cultural Resource Services (CCRS) for archaeological consulting assistance to assist the HPS with various tasks and advice as the emergency response was initiated and throughout the winter operations.

The winter response remained small enough that a single archaeologist was able to conduct the necessary field tasks prior to the commencement of spring operations. The HPS handled multiple duties with the daily assistance of the RP Archaeologist in Anchorage and further help, as needed, from other NLUR staff in Fairbanks. These duties included consulting with landowners and with tribal, state and federal agency personnel including the State Historic Preservation Officer (SHPO); obtaining archaeological permits from the state and federal landowners; helping the UC obtain necessary permits; implementing a response-specific Cultural Resource Policy (signed by the UC and included in all Incident Action Plans); providing cultural resource training to all winter and summer operations field personnel, including showing a 7-minute video which CCRS had produced for that purpose.

In the field, the HPS participated in the winter shoreline surveys in order to identify and assess any cultural resource sites potentially affected by direct spill impacts

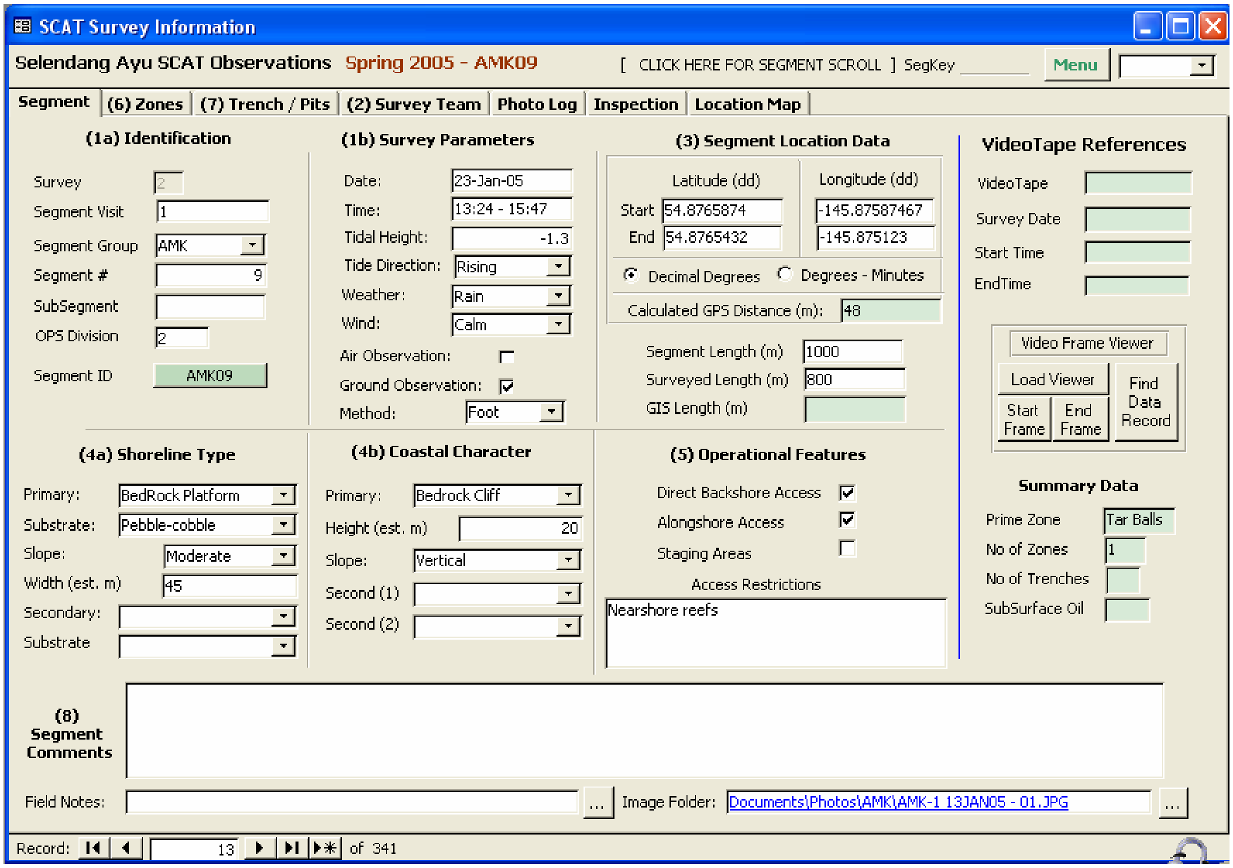

Figure 6 Example of a Data Input Screen in the Spring Program Database

or associated cleanup. Site locations were verified so that direct impacts could be avoided when specific segments were identified for cleanup. More detailed site assessments were postponed until spring operations. The HPS provided cultural resource constraints and generic information that served to protect known sites and high potential areas identified for cleanup by SCAT and noted in Operations plans. Site data were carefully tracked to avoid duplication of effort in subsequent surveys. When multiple SCAT teams were operating in one day, the HPS provided a general briefing to the second SCAT leader to help him avoid impacting cultural resources. As cleanup was conducted, the HPS and RP Archaeologists monitored progress to ensure unanticipated impacts did not occur, particularly from ancillary activities such as material storage and transportation infrastructure.

Progress was reported informally to landowners daily, and formal summary reports were submitted weekly. In the office, the HPS and the RP Archaeologist reviewed plans and progress reports to ensure that all direct impacts of the project had considered the possibility of archaeological or historic sites. Groundwork was laid for future project issues such as artifact curation, permission for upland access, etc. The Winter Operations and Spring/Summer Operations and SCAT plans were reviewed and cultural resource content was drafted as appropriate.

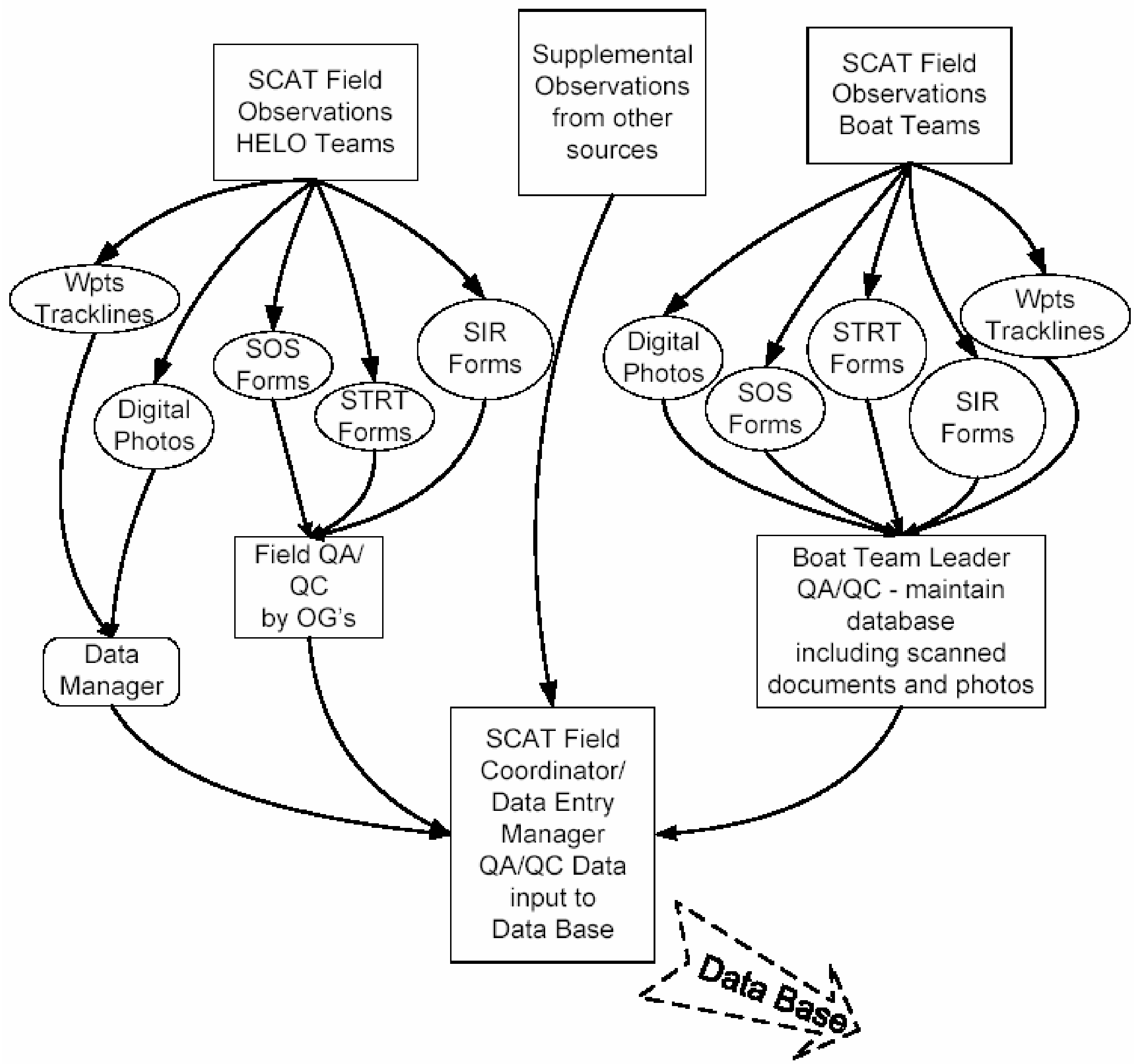

Figure 7 Information Inputs to the Database

During the break between winter and spring operations, the RP Archaeologist continued to carefully review status reports and summaries of on-going work. Both the RP Archaeologist and the HPS provided input into permitting issues and spring plans, including a plan for historic resource work. Agency personnel and landowner representatives were consulted for comments on the proposed plan. The HPS developed a fuller GIS project that incorporated the expanded spring operations area and the new sites located over the winter. This information was worked up in several different formats that would be useable by the spring historic resource team in varying field situations.

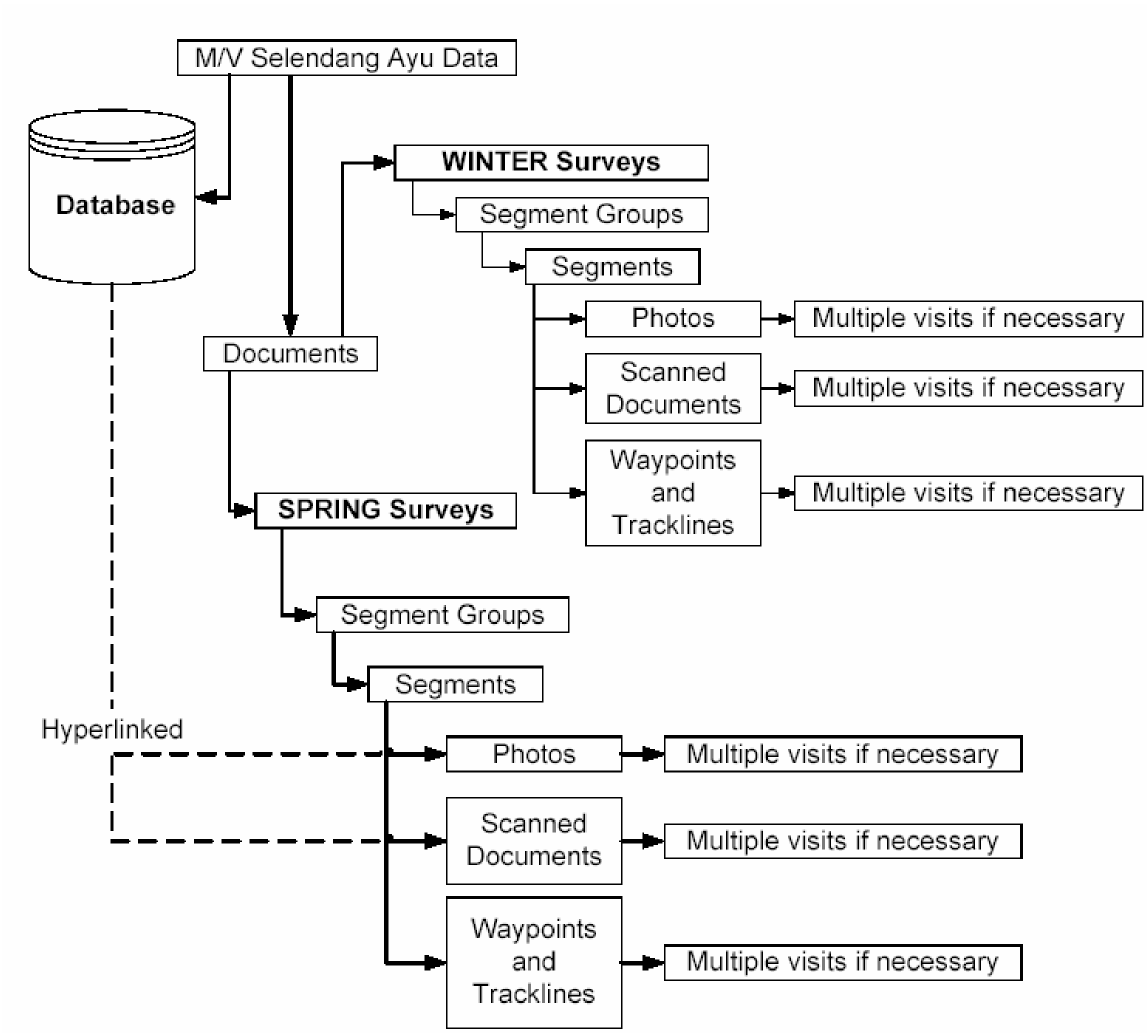

Figure 8 System Characteristics of the Database

7. Discussion

Inasmuch as every spill response is unique, one feature of this response was the separation of the activities into two distinct time periods. The winter survey and surveillance program followed the emergency phase and supported a winter cleanup program that made use of available operations personnel who had been originally deployed to control possible releases from the grounded vessel.

During the two-month hiatus after the winter program, the Spring/Summer SCAT program was designed around four interagency teams: two helicopter-based teams to survey the “core” area, in which the winter survey indicated that most of the oil was concentrated, and two boat-based teams that worked farther afield in areas where oiling was expected to be light or absent. Operations personnel accompanied the two boat-based teams surveying outside of the “core” area to remove any small amounts of oil encountered. This was, in effect, a “*clean as you go*” and a “*sign off as you go*” strategy designed to obviate the need to follow the lengthy process of returning forms to the Command Post for review, routing cleanup recommendations through Planning and Operations, deploying cleanup crews, and then sign-off teams returning to inspect segments in this remote area.

Two forms were created to assist the UC decision process: a Shoreline Treatment Recommendation Transmittal Form that enabled field observations and recommendations to be quickly transmitted to the Command Post; and a Shoreline Inspection Report form that provided a formal mechanism for the field teams to recommend sign off to the UC.

One technique that has been used before on smaller spills that was applied to a much greater degree was to link GPS track lines to the times when digital photographs when taken. This synchronization provides a rapid, accurate, and efficient method to georeference the images, including the creation of links to each segment.

One of the benefits of the two month lead-time in preparing for the Spring/Summer SCAT survey was the ability to review and upgrade the database. The key lesson learned from the winter database is that it is critical to design the architecture based on segments rather than zones. The upgraded database included links between digital photographs, video images, scanned SCAT forms, and the GIS to provide rapid and easy access to the information generated by the different surveys. These data management activities have created a single SCAT database that is flexible and can be used for future responses.

Another key benefit of the two-month lead time was the ability to integrate the numerous concerns and issues of all affected agencies and stakeholders. Through regular dialogue and review of all field survey methods, treatment techniques, and permitting and other requirements, a comprehensive shoreline survey program was developed. A strong interagency network of key players was established so that any concerns or issues that arose could be resolved while the field survey was in progress.

A common question regarding SCAT programs relates to the appropriate number of teams that are required for a survey. Initially four teams were deployed, two of which concentrated their efforts on priority segments in the “core” area while the other two teams began a boat-based systematic survey. One helicopter team was demobilized after three weeks, as scheduled, after the priority segments in the “core” area had been surveyed. Additional teams could have been deployed outside of the “core” area, with a commensurate increase in the logistic support. However, these were not considered necessary as there were no critical or urgent issues by the time the spring program began, four months after the spill. So, in effect, the majority of the 800 km of shoreline was surveyed by three teams

The program combined the typical field components of SCAT: an initial visual aerial reconnaissance to scale the affected area and identify key issues; an aerial videotape survey to map the distribution of stranded oil; and detailed, systematic ground surveys (one winter and a second in the spring) to provide information for the decision and planning processes and to support Operations. The program also went beyond the typical field component in developing a robust database, refining the sign-off process for remote lightly or unoiled areas, and ensuring a balanced approach based on agency and stakeholder concerns.