CAMEO™ Valdez

Computer-Aided Management of Emergency Operations for the Exxon Valdez Spill

Developed for the
Federal On-Scene Coordinator, Exxon Valdez

by the

Hazardous Materials Response and Assessment Division
National Oceanic and Atmospheric Administration
Seattle, Washington

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Exxon Valdez 1989

Introduction

On March 24, 1989, the tanker *Exxon Valdez*, en route from Valdez, Alaska to Los Angeles, California, ran aground on Bligh Reef in Prince William Sound (PWS), spilling approximately 11 million gallons of Prudhoe Bay crude oil.

As mandated by the National Contingency Plan (NCP), the U.S. Coast Guard established a Federal On Scene Coordinator (FOSC) to monitor the cleanup activities of the responsible party; and, if necessary, to take over operational control of the cleanup effort. During the response to the *Exxon Valdez* incident, the USCG held a monitoring role only; Exxon maintained operational control of the cleanup.

The National Oceanic and Atmospheric Administration (NOAA) provides scientific support to the USCG FOSC in the event of major oil or hazardous materials incidents. This scientific support includes providing expertise in contaminant transport, biological resources at risk, recommended methods for protection and mitigation of impacts, the coordination of scientific input from other sources, and assessment of the effectiveness and impacts of cleanup operations. Implicit in each of these duties is the management of large volumes of information.

Table 1 on the next page shows the common phases of a spill response and gives a comparison to the Exxon Valdez response. During the first six to seven weeks of the response the major tasks were the tracking and recovery of the large volume of floating oil. During this time NOAA compiled information on oil-sightings from Federal, state and local agencies as well as from industry. This oil-sighting data was represented in computer generated maps and distributed to on-scene response groups within hours of the sightings. During the first 60 days of the spill response, more than 250 individual oil-sighting maps were prepared. In addition, special maps were created to show the locations of sensitive fisheries, bird colonies, marine mammal rookeries and haulout areas, and potentially contaminated seaweed.

The next phase of the response effort shifted in focus from tracking floating oil to assessing the oil impact on the shorelines. Due to the transient nature of the oil caused by tidal shifting and weather, it was difficult to consistently assess the status of some beaches. Oil on a shoreline could be lifted off at high tide and then be re-deposited at a previously un-oiled location. There was the potential for seemingly contradictory reports depending on the time and day of the sighting.

Shoreline oiling assessment began in April and continued through August. The shoreline assessment teams formed by Exxon were called Shoreline Cleanup Advisory Teams (SCAT). Each team was comprised of a marine biologist, an archaeologist and an oil geomorphologist. The SCATs evaluated the degree of oiling on the shorelines and documented archaeological and ecological resources. In

Table 1.-Generalized Table of Spill Response Phases

	Phase 1	Phase 2	Phase 3
Major concern	Contain the Source	Mitigate the Impacts	Remove the Contaminants
Focus	Keep it in... the ship the boom the area	Keep it out ... of this bay of this rookery of this area	Get it off ... of the beach of the rocks of the biota
Typical Activities	Pumping, corralling, burning, dispersing	Skimming, deflecting, tracking	Assessment, cleaning and removal
Typical status	Hectic, non-stop, crucial decisions, conflicting information, poor communications.	Communications in place. Daily order established with patterns of long hours and many meetings.	Weekly order established with hours becoming more normal and fewer meetings.
Information needs	Readily available data on the product spilled, the local environment, and response options. Key situation graphics.	Hourly/daily tracking and graphics and reports on specific product, location, sampling and response efforts.	Daily /Weekly Tracking and Reporting of assessment and clean-up efforts. How clean is clean?
Typical products	Wall products ... Vessel position on chart Vessel diagram	Distributed products ... Overflight maps Situation summary reports	Presentation products ... Briefing packages Assessment reports
Command Post	Contact point and rumor - control.	Central coordination and clearing house.	Corporate knowledge and presentations.
Typical timing	1 to 4 days	1 to 4 weeks	1 to 4 months
Exxon Valdez timing	7 to 10 days	9 to 10 weeks	25 to 30 months

From the Genwest Systems, Inc. Oil Spill Response Training Manual, 1991

addition to the SCATs, a Shoreline Committee comprised of experts from various federal, state and local agencies, worked independently to identify and assure consideration of special environmental protection concerns.

Due to the different levels of oiling, the environmental diversity, and the size of the impacted area, it was agreed by Exxon and the Coast Guard that the most reasonable goal for cleanup during 1989 was to assure at least "Gross Contaminant Removal" was accomplished. Because the oil, in various forms, would eventually impact over 1,100 miles of non-continuous coastline in Alaska, it was agreed by Exxon and the FOSC that areas of oiled shoreline would be divided into discrete segments for tracking and reporting purposes.

Additionally, it was determined by the FOSC that a comparison of the distance treated versus the distance oiled would be misleading as a method for judging cleanup progress. Large distances of very lightly oiled shoreline would not take as much time and energy to clean as smaller distances of heavily oiled beaches. Sandy beaches and rocky headlands would each require different methods and levels of effort in cleanup.

To more accurately monitor and depict clean-up progress, the FOSC staff developed a unit, (the Clyde) for measuring required work. (see Appendix C for Spill Treatment Work Progress Model). The Work Progress model, used information about individual shorelines (length of the beach segment, type of predominant sediment, degree of beach contamination, width of the beach, penetration of oil into the beach, percentage of beach covered, and the amount of debris

on the beach), to estimate the amount of work required to treat each shoreline.

The 1989 cleanup began in April and continued until September 26, 1989. Present with the and field personnel on the shorelines during cleanup, were the Shoreline Cleanup Oversight Teams (SCOTs), which were made up of representatives from the USCG and Exxon. The SCOTs monitored the operations of the beach cleanup crews. Once a shoreline had been treated, a USCG monitor assessed the effectiveness of the gross contamination removal efforts, and approved or disapproved demobilization.

Each of the phases of the spill response - the initial tracking of floating oil, the tracking of oiled shorelines and their cleanup, and the final assessment of cleanup - had associated data management needs. Throughout the 1989 response, NOAA maintained a nationwide electronic communications network, that served both as a means to keep NOAA headquarters and other response agencies apprised of daily spill response activities and concerns, and as a library of nearly 325 detailed daily reports. On a daily basis, briefing packages were made and distributed to Exxon, Alaska Department of Environmental Conservation (ADEC), other agencies and concerned citizens. The briefing packages contained maps of overflight observations for that day, weather forecasts and any special bulletins (such as fisheries closing information). In addition, special briefings were prepared for visiting senior government officials and the news media.

CAMEO Valdez 1989 (CV89)

By mid-May of 1989, the emphasis of the spill response effort had shifted from tracking the floating oil to the treatment of oiled shoreline. The FOSC requested the assistance of NOAA in the creation of a real time, on scene database that would compile information and display the status of the shorelines throughout the treatment phase. The CAMEO Valdez (CV89) database was designed to track the progress of Exxon's shoreline treatment operations and forecast progress based the recent performance.

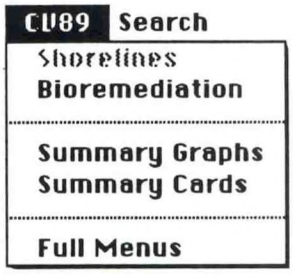
In May of 1989, CV89 was created to run on a Macintosh computer using SuperCard software, and later (1990) converted to HyperCard stacks. The original version of CV89 contained a task force tracking component, treatment information for 1108 shoreline segments, color-coded charts and pie-graphs, a list of contacts, interactive maps of Prince William Sound (PWS) and the Gulf of Alaska (GOA) and a copy of the National Contingency Plan (NCP). Several components from the original database were not included in the final version of CV89. Modules such as the task force tracking component, the NCP, and the list of contacts were operational tools, containing data that was crucial during response phases, but not needed from a historical perspective.

The CV89 database consists of two HyperCard stacks: **Static CV89** and **Static CV89 Slides**. Static CV89 includes a data card for each segment, treatment summaries by region, and links to the color graphs kept in the Static CV89 Slides stack. The Static CV89 Slides stack contains color-coded charts and pie-graphs used to show the progression of cleanup in the PWS, Seward, Homer and Kodiak sectors.

The stack consists of four sections (or backgrounds):

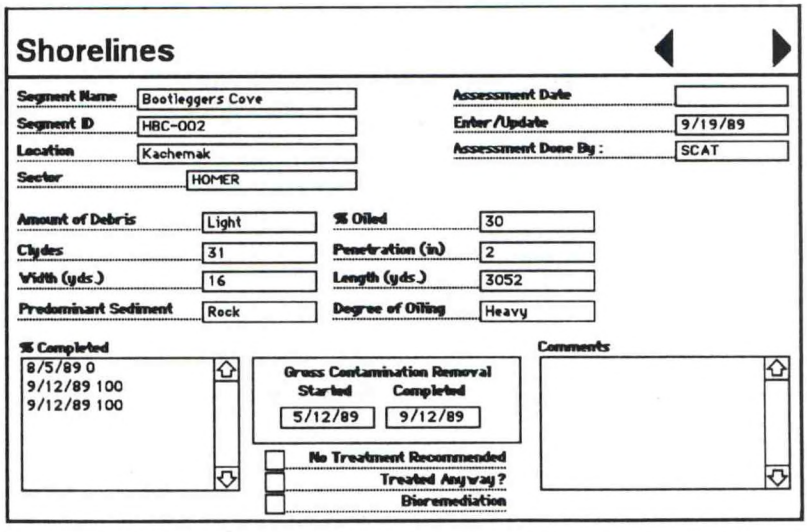
- Shorelines
- Bioremediation
- Summary Graphs
- Summary Cards

Navigation through these sections is accomplished with the **CV89 Menu**.



Shorelines

When you double-click the Static CV89 icon, the stack will open to the first Shoreline card in the stack.



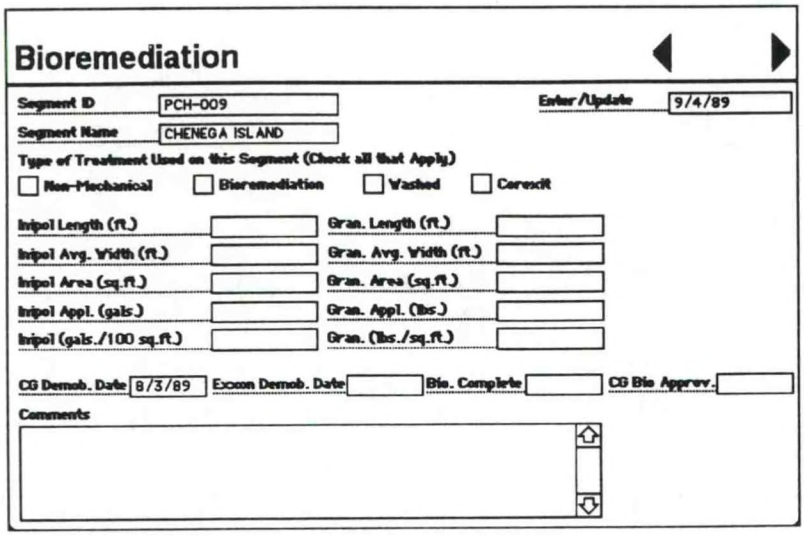
The 1,108 Shoreline cards are sorted alphabetically by Segment ID. The Shoreline cards contain the fields described below:

Segment Name	Determined by geographic location of segment
Segment ID	The first letter identifies the sector (H = Homer etc.); the next two letters identify a specific location within that sector (BC = Bootlegger's Cove); the numbers identify individual partitions within that specific location
Sector	Prince William Sound, Seward, Homer, or Kodiak
Location	Geographic name; more specific than sector
Assessment Date	Date of visit by SCAT team
Enter/Update	Date last changes for card were made
Predominant Sediment	Boulders, cobbles, sand, mud, gravel, pebbles, rock or vertical cliff. (used for Clyde calculation)
Degree of Oiling	Heavy, Medium, Light or Very Light (used for Clyde calculation); Represents worst case that exists on that segment
Amount of Debris	Heavy, Moderate, Light or None (used for Clyde calculation)
Clydes	A derived unit of work (see Appendix C)
Length (Yards)	Length of segment (used for Clyde calculation)

Width (Yards)	Width of oiled "band" on segment (used for Clyde calculation)
% Oiled	Average oil/area for segment
Penetration (in.)	Average depth of oil in inches
Gross Contamination Removal Started	Date treatment began
Gross Contamination Removal Completed	Date treatment ended
Assessment Done By	Group that did assessment (SCAT, land manager)
% Completed	Used for creation of progress chart (see Summary Graphs)
Comments	Comments
No Treatment Recommended	No treatment recommended (NTR)
Treated Anyway	Segments designated NTR that were treated
Bioremediation	Check marked if bioremediation was used

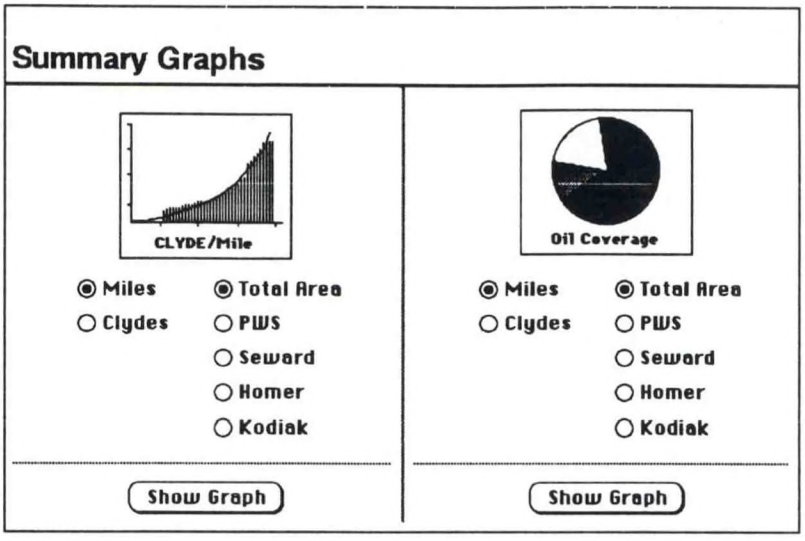
Bioremediation

The bioremediation field on the **Shoreline** card will be checkmarked if bioremediation was a treatment method used on the segment. If the bioremediation field is checked, selecting **Bioremediation** from the **CV89** menu will take you to the bioremediation card for that segment. Otherwise, selecting **Bioremediation** from the **CV89** menu will take you to the first card of the bioremediation background.



There are 117 cards in the Bioremediation background. They were originally created with the intention of tracking specific data on the amount of bioremediation agent used, the rate of application and area covered. It became obvious however, that collecting and entering the information needed to maintain this portion of the database would require more time than was available. Since the data was not crucial for response activities, it was given a lower priority. As a result, only four of the fields on these cards were maintained. They are:

Segment ID	The first letter identifies the sector (H = Homer etc.); the next two letters identify a specific location within that sector (BC = Bootlegger's Cove); the numerical characters identify individual partitions within that specific location



Segment Name	Determined by geographic location of segment
Enter/Update	Date that last changes for card were made
CG Demob. Date	Coast Guard Demobilization Date

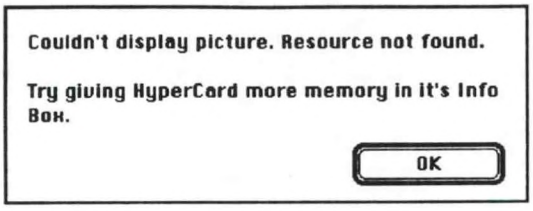
Summary Graphs

Selecting **Summary Graphs** from the **CV89** Menu brings you to the Summary Graphs card seen on the next page.

The bar graph represents the progress of cleanup over time, displayed in either miles or Clydes for the total area or any of the sectors (Prince William Sound (PWS), Seward, Homer, Kodiak). Click on either Clydes or miles and one of the area buttons and then the Show Graph button to display the graph. To close the graph window, click the close-box in the upper left hand corner.

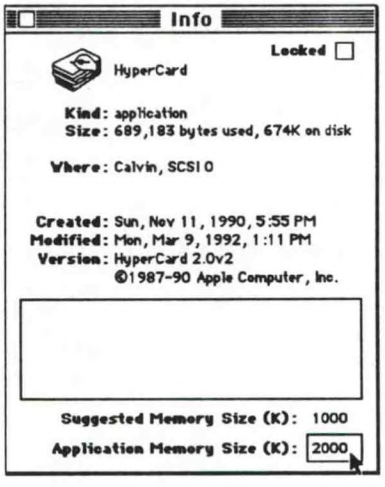
The pie graph represents oil coverage. This graph can also be displayed in either miles or Clydes for the total area, or any of the sectors. All of the graphs that accompany CV89 are color on-screen references only and cannot be printed.

If there isn't enough memory (RAM) to open the graphs, this dialog box will appear.



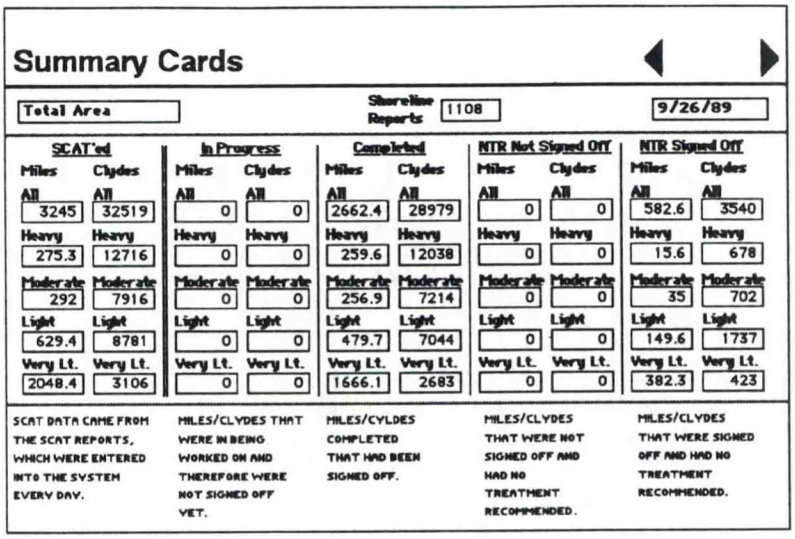
To increase memory allocation to HyperCard, quit HyperCard and then select the HyperCard icon on your desktop.

Select **Get Info** from the **File** menu, (a window similar to this will appear) and allocate more memory to HyperCard in the Application Memory Size (called Current Size in System 7) box in the lower right corner.



Summary Cards

There are five Summary Cards in the CV89 database; one for each sector (Homer, Kodiak, Prince William Sound, Seward), and one for the total area. To move through these cards, use the arrow buttons in the upper right corner of the card.



Information is broken down into miles and Clydes for four oiling categories: All (sum of the categories), Heavy, Moderate, Light, and Very Light, as follows:

SCAT'ed	Daily reports from the SCAT team
In Progress	Shorelines that had not yet been signed off by the FOSC
Completed	Shorelines signed off by the FOSC
NTR Not Signed Off	Shorelines where no treatment was recommended that were not signed off
NTR Signed Off	Shorelines where no treatment was recommended that were approved

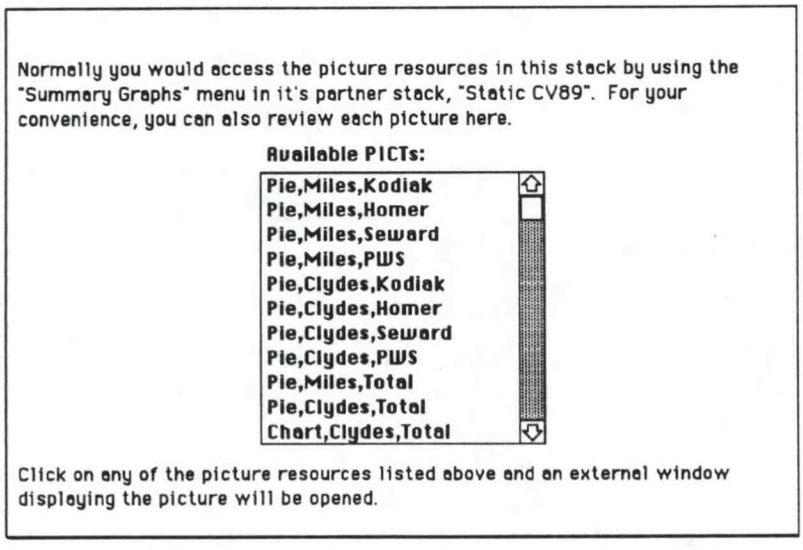
Full Menus/Short Menus

When the Full Menus option is selected from the CV89 menu, the standard HyperCard menus-Tools, Objects, Font, and Style, appear in the menu bar and the Full Menus option changes to Short Menus in the CV89 menu. Selecting Short Menus toggles the menus back to their CV89 default state.

Static CV89 Slides

The CV89 Slides stack holds all of the color graphs that are available with CV89. They can be viewed from this stack or through the link in the Summary Graphs section of the Static CV89 stack. Double-clicking on the Static CV89 Slides icon will bring you to this screen:

Click on any of the picture resources listed in the **Available PICTs** field, and a window displaying the picture will be opened. To close this window, click the close box in the upper left hand corner.



Chapter 2

Exxon Valdez 1990

Introduction

Winter surveys in 1989 indicated that it would be necessary to reassess shorelines in the spring of 1990. Assessment forms were designed over the winter and naming conventions were established so that data coming in from the field would be reported in a consistent fashion. In addition, the distribution network for data from the field to the data managers from the major response groups was outlined.

In 1989, survey and cleanup operations were based out of Valdez, AK with Incident Command Posts (ICPs) located in Homer, Seward and Kodiak. The ICPs were staffed with representatives from USCG, NOAA and Exxon (Exxon had distinct ICPs). In 1990, operations were based in Anchorage, with ICPs in Homer, Seward and Kodiak. The NOAA ICP representatives coordinated scientific meetings in their areas and visited may of the field locations to assist the USCG in making informed cleanup decisions.

The shoreline survey in the spring of 1990 (from the end of April to early May) was carried out by the Spring Shoreline Assessment Teams (SSATs or SATs) and the Anadromous stream SATs (ANAD SATs). The SAT was comprised of representatives from Exxon, USCG, NOAA, ADEC, and the land manager. The ANAD SAT was comprised of

representatives from U.S. Fish and Wildlife Service (USFWS) and Exxon. The data from the survey crews was faxed to Exxon every morning and then distributed by Exxon to USCG, NOAA, ADEC, the State Historic Preservation Officer (SHPO) and the Technical Advisory Group (TAG).

TAG was designed to provide treatment recommendations to the FOSC and the Exxon response managers and consisted of agency representatives from the State of Alaska, the Federal government, and Exxon. It was SHPO's duty to evaluate possible archaeological and cultural impacts. After TAG and SHPO reviewed and approved shoreline work plans, the plans went to the FOSC for evaluation. Once the FOSC approved work plans, they were submitted to Exxon for implementation.

After the bulk of 1990 cleanup had been completed, the August Shoreline Assessment Program teams (ASAP) re-visited the shorelines to evaluate the effectiveness of the cleanup effort. ASAP then made recommendations and submitted them to TAG. After the TAG review, the recommendations went to the FOSC for evaluation. If the FOSC assessed that further treatment was needed in 1990 on a shoreline, it was re-visited by cleanup personnel. In some cases, it was decided that the shoreline would be re-visited in 1991.

CAMEO Valdez 1990 (CV90)

The CV90 database was used to track data during the assessment, treatment and demobilization phases of cleanup in 1990. The design of CV90 was based on the CV89 model with a few modifications. In 1990, segment designations from the previous year were divided into smaller units called subdivisions. In addition, data for anadromous streams was tracked separately. The CV90 database reflected these changes.

The CV90 database consists of two HyperCard stacks: **Static CV90** and **Static CV90 Slides**. Static CV90 includes a data card for each segment, subdivision, and stream, and treatment summary cards by region, as well as links to the color graphs kept in the Static CV90 Slides stack. The CV90 Slides stack contains color-coded maps used to show the distribution of areas requiring treatment versus those requiring no treatment for the PWS and GOA areas.

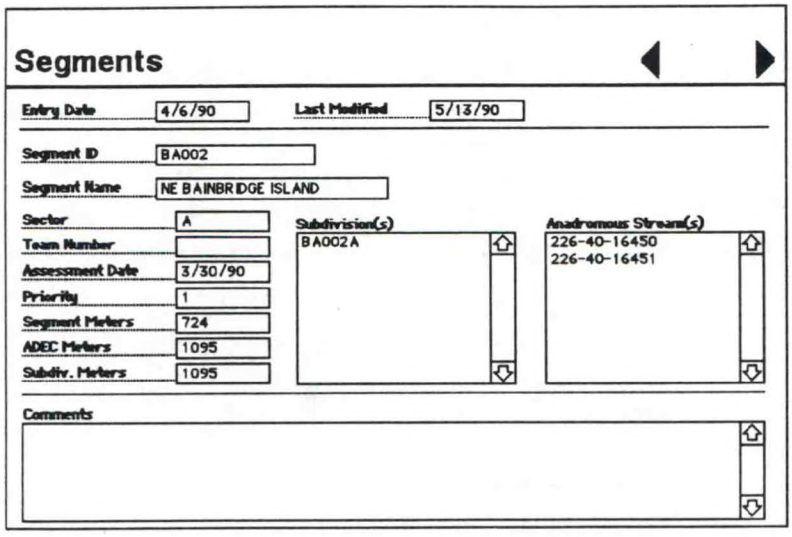
The **Static CV90** stack consists of five sections (or backgrounds):

- **Segments**
- **Subdivisions**
- **Streams**
- **Summary Graphs**
- **Summary Cards**

Navigation through these sections is accomplished with the **CV90 Menu**.

Segments

Double-clicking on the Static CV90 icon opens the stack to the Segments background:



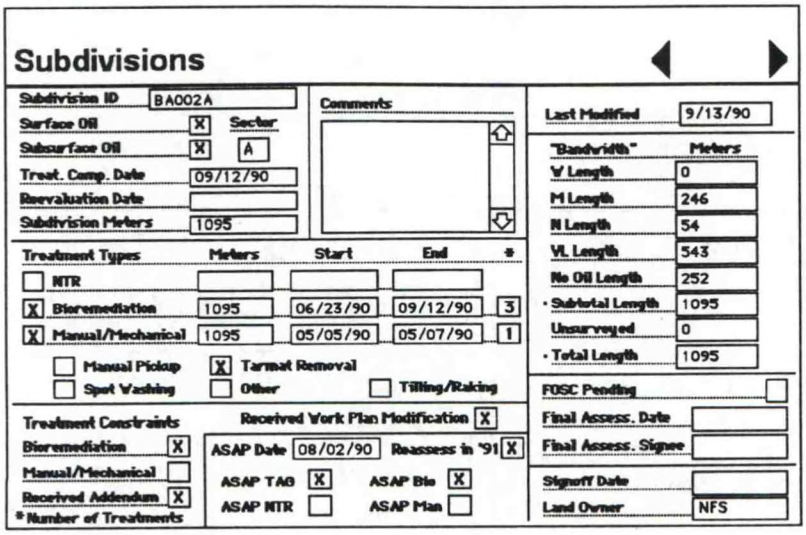
The 735 Segment cards are sorted alphabetically by Segment ID. The Segment cards contain the following fields:

Entry Date	Date that the card was originally created
Last Modified	Date that the card was last changed
Segment ID	The first two letters identify a specific location within that sector (BC = Bootlegger's Cove); the numbers identify individual partitions within that specific location (sector indicator used in 1989 naming convention was not used in 1990)
Segment Name	Determined by geographic location

Sector	Prince William Sound was designated sectors A-E; Homer/Seward was sector F; Kodiak was sector G
Team Number	Unused field (would have tracked SAT number)
Assessment Date	Date segment was assessed by SAT
Priority	Priority scale of 1 to 5 for cleanup (1 = high, 5 = low)
Segment Meters	Segment length as recorded in CV89 database
ADEC Meters	Length of segment according to ADEC database
Subdiv. Meters	Total length in meters of all subdivisions in segment
Subdivision(s)	Names of subdivisions in segment
Anadromous Stream(s)	ID numbers (from USFWS) of streams in segment
Comments	Comments

Clicking on a subdivision in the Subdivision(s) field brings the user to the corresponding subdivision card for that segment. The same is also true for the Anadromous Stream(s) field which takes you to a corresponding stream card for that segment.

Subdivisions



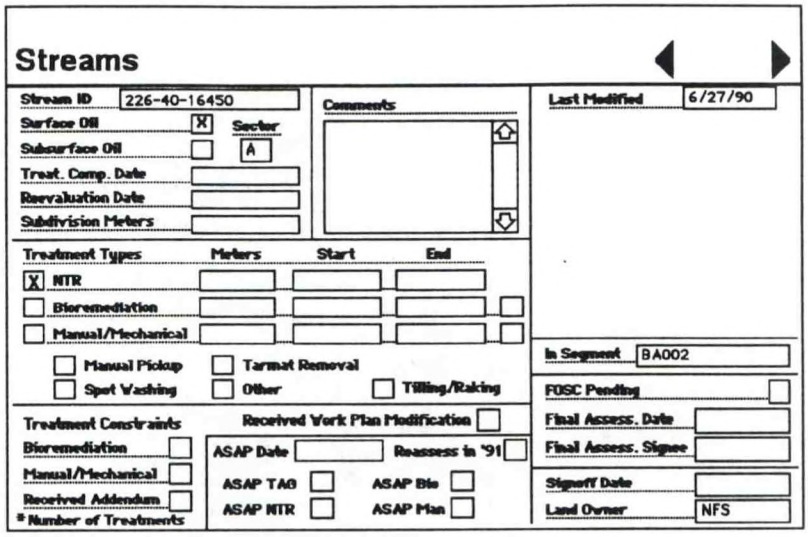
The 1035 Subdivision cards are sorted alphabetically by subdivision ID. The Subdivision cards contain the following fields:

Subdivision ID	Segment name followed by subdivision designation (A, B, etc.)
Surface Oil	Check marked if surface oil was present
Subsurface Oil	Check marked if subsurface oil was present
Treat. Comp. Date	Date 1990 treatment was completed
Reevaluation Date	Unused field
Subdivision Meters	Length in meters of subdivision
Sector	Prince William Sound was designated sectors A-E; Homer/Seward was sector F; Kodiak was sector G

Treatment Types	Treatment method used is check marked: **NTR** - No Treatment Recommended **Bioremediation** - Bioremediated **Manual Mechanical** - The following treatment types are check marked when they apply: Manual Pickup, Spot Washing, Tarmat Removal, Tilling/Raking, Other (did not fit into the other categories, e.g., hand wiping with sorbent pads
*	Number of treatments at site
Treatment Constraints	Ecological constraints (eagle nests, fisheries, marine mammals, etc.)
Bioremediation	Treatment constraint exists that is prohibitive to bioremediation
Manual/Mechanical	Treatment constraint exists that is prohibitive to manual/mechanical treatment
ASAP Date	August Shoreline Assessment Program survey date
Reassess in '91	Check marked if it was recommended by ASAP team that the subdivision be reassessed in 1991
ASAP TAG	TAG reviewed original ASAP recommendations
ASAP NTR	If check marked, ASAP recommended that the subdivision receive no treatment

ASAP Bio	If check marked, ASAP recommended bioremediation for the subdivision
ASAP Man	If check marked, ASAP recommended manual/mechanical treatment for the subdivision
Last Modified	Date that the card was last changed
Bandwidth Oiling Meters	Data from Exxon describing the bandwidth of oil on the subdivision
W Length	Meters of wide
M Length	Meters of medium
N Length	Meters if narrow
VL Length	Meters of very light
No Oil Length	Meters of no oil
Subtotal Length	Sum total of above numbers
Unsurveyed	Meters of subdivision that were unsurveyed
Total Length	Sum of subtotal and unsurveyed meters
FOSC Pending	Check marked if waiting for FOSC approval
Final Assess. Date	Not used
Final Assess. Signee	Not used
Signoff Date	Not used; see Treatment Complete Date
Land Owner	Organization owning the land

Streams



The 97 Stream cards are sorted alphabetically by the Stream ID number. The Streams cards contain the following fields:

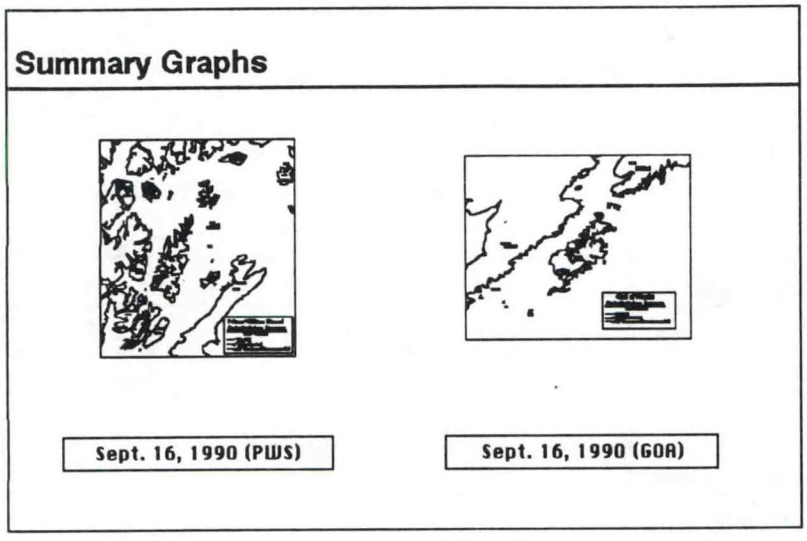
Stream ID	ID number (from USFWS) of stream
Surface Oil	Check marked if surface oil was present
Subsurface Oil	Check marked if subsurface oil was present
Treat. Comp. Date	Date 1990 treatment was completed
Reevaluation Date	Not used
Subdivision Meters	Length in meters, of the subdivision
Sector	Prince William Sound was designated sectors A-E; Homer/Seward was sector F; Kodiak was sector G

Treatment Types	Treatment method used is check-marked: **NTR** - No Treatment Recommended **Bioremediation** - Bioremediated **Manual Mechanical** - The following treatment types are check marked when they apply: Manual Pickup, Spot Washing, Tarmat Removal, Tilling/Raking, Other (did not fit into the other categories, e.g., hand wiping with sorbent pads
*	Number of treatments at site
Treatment Constraints	Ecological constraints (eagle nests, fisheries, marine mammals, etc.)
Bioremediation	Treatment constraint exists that is prohibitive to bioremediation
Manual/Mechanical	Treatment constraint exists that is prohibitive to manual/mechanical treatment
Received Addendum	Received addendum that defined work constraint
Received Work Plan Modification	Check marked if paperwork was received
ASAP Date	August Shoreline Assessment Program survey date
Reassess in '91	Check marked if it was recommended by ASAP team that the subdivision be reassessed in 1991
ASAP TAG	TAG reviewed original ASAP recommendations

ASAP NTR	If check marked, ASAP recommended that the subdivision receive no treatment
ASAP Bio	If check marked, ASAP recommended bioremediation for the subdivision
ASAP Man	If check marked, ASAP recommended manual/mechanical treatment for the subdivision
Last Modified	Date that the card was last changed
In Segment	ID of segment that stream is on
FOSC Pending	Check marked if waiting for FOSC approval
Final Assess. Date	Not used
Final Assess. Signee	Not used
Signoff Date	Not used; see Treatment Complete Date
Land Owner	Organization owning the land

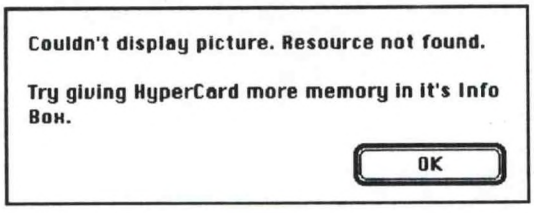
Summary Graphs

Selecting **Summary Graphs** from the **CV90 Menu** will display the following screen:



The maps were used during the response to show the distribution of treated areas (and areas needing treatment) vs. areas that were designated NTR. The final maps generated in 1990 for the Prince William Sound and Gulf of Alaska areas are included here. Click on the button (Sept. 16, 1990 (PWS), or Sept. 16, 1990 (GOA) below the picture to view the map.

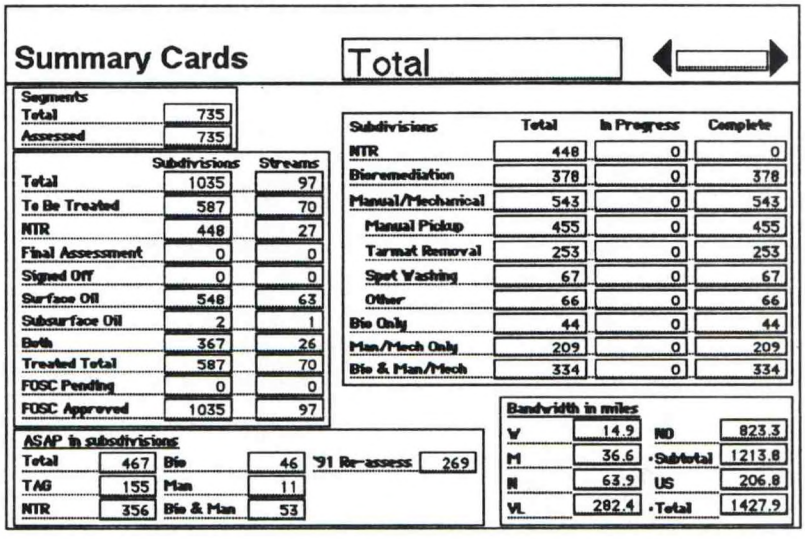
If there isn't enough memory (RAM) to open the maps, this dialog box will appear. (See the CV89 Summary Graphs for detailed information on changing memory allocation.)



The maps are color on-screen references only and cannot be printed. To close the map, click the close box in the upper left hand corner.

Summary Cards

There are four Summary Cards; one for each sector (Kodiak, Kenai, and Prince William Sound), and one for the total area. The data on the Summary cards is a compilation of information from the Segments, Subdivisions and Streams backgrounds. To navigate through the Summary cards, use the arrow buttons in the upper right hand corner of the card.

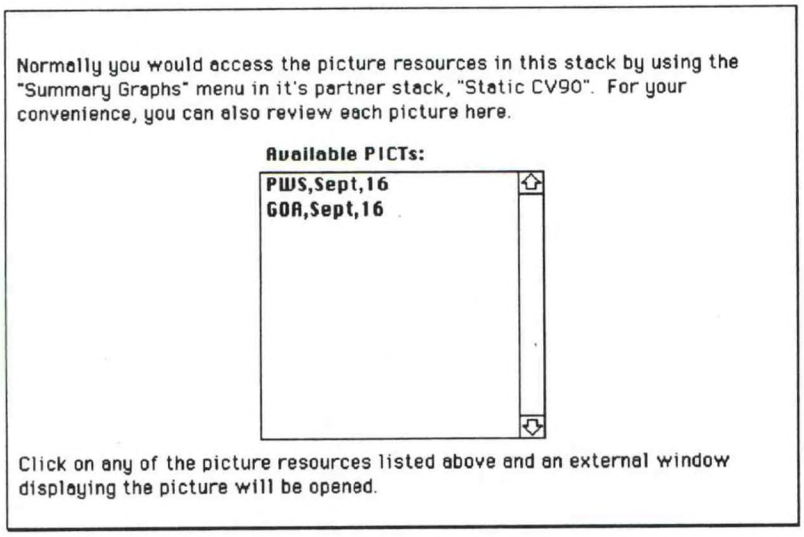


Full Menus/Short Menus

When the Full Menus option is selected, the standard HyperCard menus Tools, Objects, Font and Style appear and Short Menus now appears in the bottom of the CV90 menu. Selecting Short Menus toggles the menus back to their CV90 default state.

Static CV90 Slides

The Static CV90 Slides stack holds the color maps that are available with CV90. They can be viewed from this stack or through the link from the Summary Graphs section of Static CV90. Double-clicking on the Static CV90 Slides stack icon will bring you to this screen:



Click on any of the picture resources listed in the **Available PICTs** field and an external window displaying the picture will be opened. To close the window, click the close box in the upper left hand corner.

Chapter 3

Exxon Valdez 1991

Introduction

By 1991 the scope of the cleanup effort was greatly reduced. The total number of subdivisions surveyed was 588 (includes 3 subdivisions that were inadvertently surveyed), and of those, only 120 were recommended for treatment by the FOSC. The operational structure for 1991 was similar to that in 1990 with some reductions. No ICPs were established in 1991, and the majority of cleanup was complete by the end of July.

The initial shoreline assessment took place in three phases from April 26 - June 4 and was called MAYSAP (May Shoreline Assessment Program). The MAYSAP team consisted of representatives from USCG, NOAA, ADEC, Exxon, the land manager, local community plus an oil geomorphologist, a biologist and two contracted cleanup personnel. The survey teams conducted the assessment by walking the shoreline and recording observations. They documented surface and subsurface oiling on forms, maps, sketches and photographs. They also documented key intertidal biota, wildlife observations and sensitive resources and performed debris pickup and removal as was appropriate. At the end of each day the MAYSAP teams would send their reports to Anchorage via daily mail (helicopter or boat) and

then Exxon would distribute copies of the reports to USCG/NOAA and ADEC.

The MAYSAP documents then went to TAG for review. After TAG made their recommendations, the MAYSAP data went to SHPO. After SHPO signed the MAYSAP packet, copies went to the land manager, ADEC, NOAA and the FOSC. The FOSC then reviewed and approve a course of action (including no action if appropriate) and sent the final paperwork to Exxon for implementation.

No additional shoreline assessment or cleanup assessment surveys were conducted after the initial survey. Demobilization began on July 15, 1991, with a small work crew remaining until the end of August to re-apply bioremediation agents on selected sites.

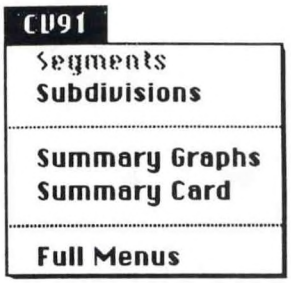
CAMEO Valdez 1991 (CV91)

The CV91 database consists of two HyperCard stacks: **Static CV91** and **Static CV91 Slides**. Static CV91 includes a data card for each segment and subdivision, and a treatment summary for the entire area. The CV91 slides stack contains color-coded maps used to show the distribution of areas requiring treatment vs. areas requiring no treatment for the Prince William Sound and Gulf of Alaska areas.

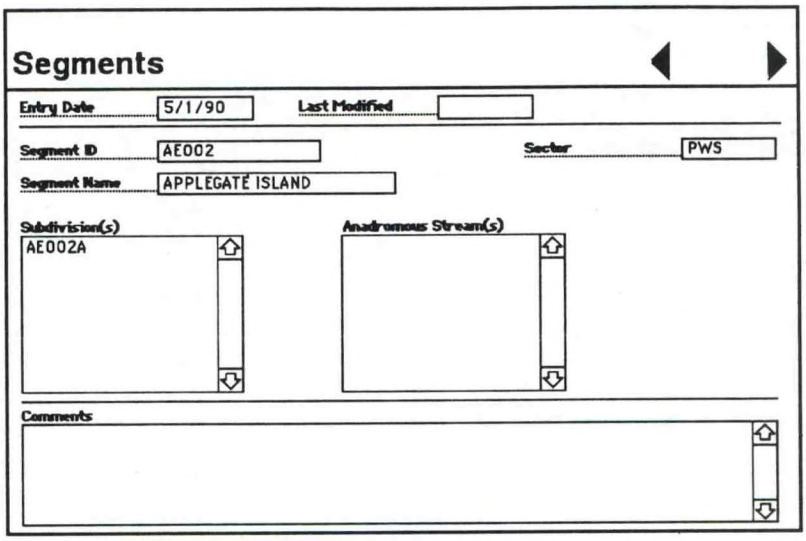
The **Static CV91** stack consists of four sections (backgrounds):

- **Segments**
- **Subdivisions**
- **Summary Graphs**
- **Summary Cards**

Navigation through these sections is accomplished with the **CV91 Menu**.



Segments

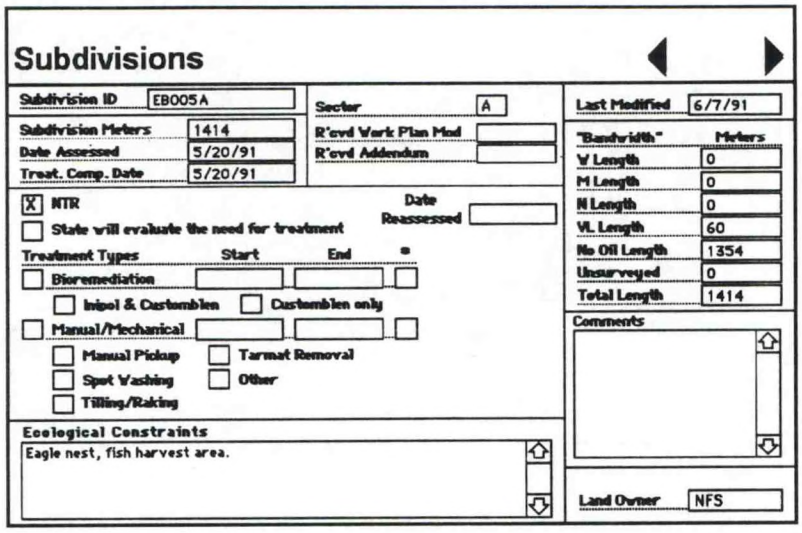


The 412 Segment cards are sorted alphabetically by Segment ID. The Segment cards contain the following fields:

Entry Date	Date that the card was created
Last Modified	Date that card was last changed
Segment ID	The first two letters identify a specific location within that sector (BC = Bootlegger's Cove); the numbers identify individual partitions within that specific location
Segment Name	Determined by geographic location

Sector	PWS or GOA
Subdivision(s)	Subdivisions (in segment) that were assessed in 1991
Anadromous Stream(s)	ID numbers (from USFWS) of streams in segment
Comments	Comments

Subdivisions



The 588 Subdivision cards are sorted alphabetically by field Subdivision ID and contain the following fields:

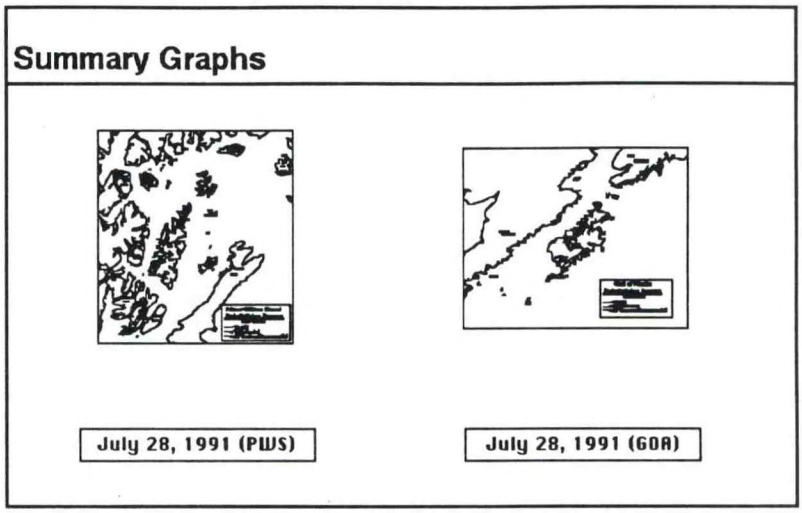
Subdivision ID	Segment name followed by subdivision designation (A, B. etc.)
Subdivision Meters	Length of subdivision in meters
Date Assessed	Date of MAYSAP assessment
Treat. Comp. Date	Date 1991 treatment was completed

Sector	Prince William Sound was designated sectors A-E; Homer/Seward was sector F; Kodiak was sector G (1990 designation)
R'cvd Work Plan Mod	Received work plan modification paperwork
R'cvd Addendum	Received addendum to initial work plan
NTR	No treatment recommended
State will evaluate the need for treatment	In some cases ADEC disagreed with TAG recommendations of NTR and independently evaluated the need for treatment
Date Reassessed	Date ADEC conducted reassessment (with Exxon cleanup personnel)
Treatment Types	Treatment method used is check marked: **NTR** - No Treatment Recommended **Bioremediation** - Bioremediated **Manual Mechanical** - The following treatment types are checkmarked when they apply: Manual Pickup, Spot Washing, Tarmat Removal, Tilling/Raking, Other (did not fit into the other categories, e.g., hand wiping with sorbent pads
Bioremediation	Received bioremediation
Inipol & Customblen	Check marked if Inipol and Customblen were bioremediation agents used

Customblen Only	Check marked if Customblen was the only bioremediation agent used
Manual/Mechanical	The following treatment types are check marked when they apply: Manual Pickup, Spot Washing, Tarmat Removal, Tilling/Raking, Other (did not fit into other categories, e.g., hand wiping with sorbent pads)
*	Number of treatments at site
Ecological Constraints	Ecological constraints present
Last Modified	Date that the card was last changed
Bandwidth Oiling Meters	Data from Exxon describing the bandwidth of oil on the subdivision
W Length	Meters of wide
M Length	Meters of medium
N Length	Meters of narrow
VL Length	Meters of very light
No Oil Length	Meters of no oil
Unsurveyed	Meters of subdivision that were unsurveyed
Total Length	Total length of subdivision in meters
Comments	Comments
Land Owner	Organization owning the land

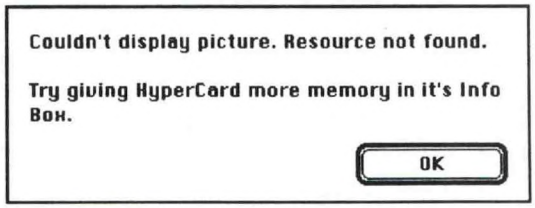
Summary Graphs

Selecting **Summary Graphs** from the **CV91 Menu** will display the following screen:



The maps were used during the response to show the distribution of treated areas (and areas needing treatment) vs. areas that were designated NTR. The final maps generated in 1991 for the Prince William Sound and the Gulf of Alaska area are included here. Click on the button (July 28, 1991 (PWS), or July 28, 1991 (GOA)) below the picture to view the map.

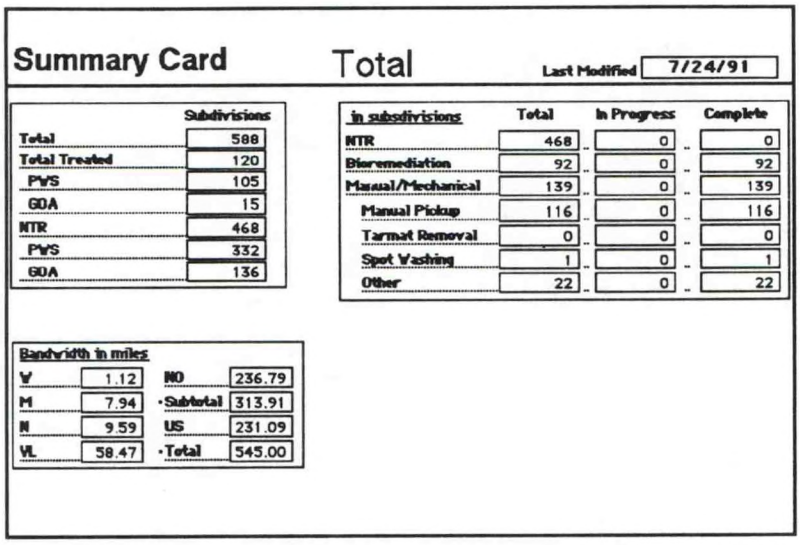
If there isn't enough memory (RAM) to open the maps, this dialog box will appear. (See CV89 Summary Graphs for detailed information on changing memory allocation.)



To close the map, click the close box in the upper left hand corner.

Summary Card

Selecting **Summary Card** from the **CV91 Menu** will bring you to the summary card:



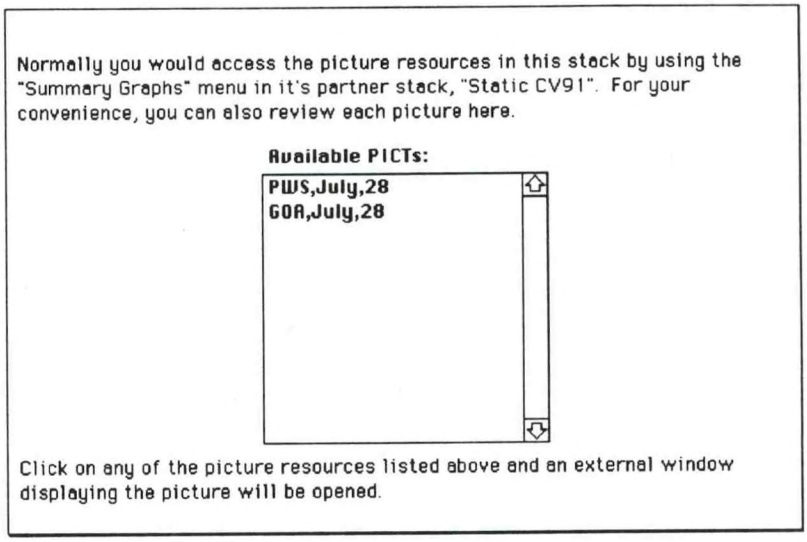
The Summary card indicates how many of the 588 subdivisions treated in 1991 received bioremediation, manual/mechanical treatment, and no treatment. Also summarized is the Exxon bandwidth oiling data.

Full Menus/Short Menus

When the Full Menus option is selected, the standard HyperCard menus, Tools, Objects, Font and Style appear in the menu bar, and Short Menus becomes the option at the bottom of the CV91 menu. Selecting Short Menus toggles the menus back to their CV91 default state.

Static CV91 Slides

The Static CV91 Slides stack holds the color maps that are available with CV91. They can be viewed from this stack or through the link from the Summary Graphs section of Static CV91. Double-clicking on the Static CV91 Slides stack icon will bring you to this screen:



Click on any of the picture resources listed in the **Available PICTs** field and an external window displaying the picture will be opened. To close the window, click the close box in the upper left hand corner.

Chapter 4

Segment Summary Database

Introduction

The Segment Summary database is a compilation of data accumulated from all three years of the *Exxon Valdez* response, with an emphasis on cleanup methods.

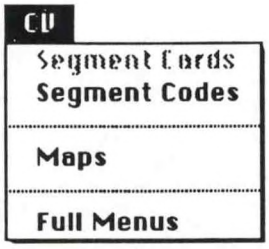
The Segment Summary database consists of two HyperCard stacks: **Segment Summary** and **Segment Summary Maps**.

The **Segment Summary** stack is organized so that the user can find information on a given area of shoreline by searching on the segment/subdivision name. The **Segment Summary Maps** stack contains 49 maps of the Prince William Sound and Gulf of Alaska area. In this stack there is one map of the entire area (PWS and GOA), 4 sector maps (Homer, Kodiak, PWS, Seward), and 44 regional maps showing approximate segment locations.

The **Segment Summary** stack consists of two sections (or backgrounds):

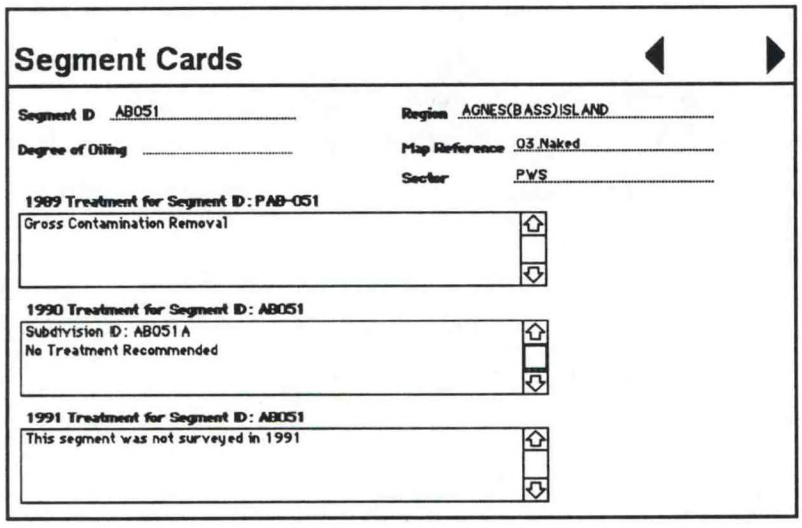
- **Segment Cards**
- **Summary Codes**

Navigation through these sections is accomplished with the **CV Menu**.



Selecting **Maps** from the **CV** menu while on a Segment card, will take you to the corresponding map for that region, and highlight the segment ID on the map. In cases where the location of a segment is unclear, selecting **Maps** from the **CV** menu will simply open the **Segment Summary Maps** stack.

Segment Cards



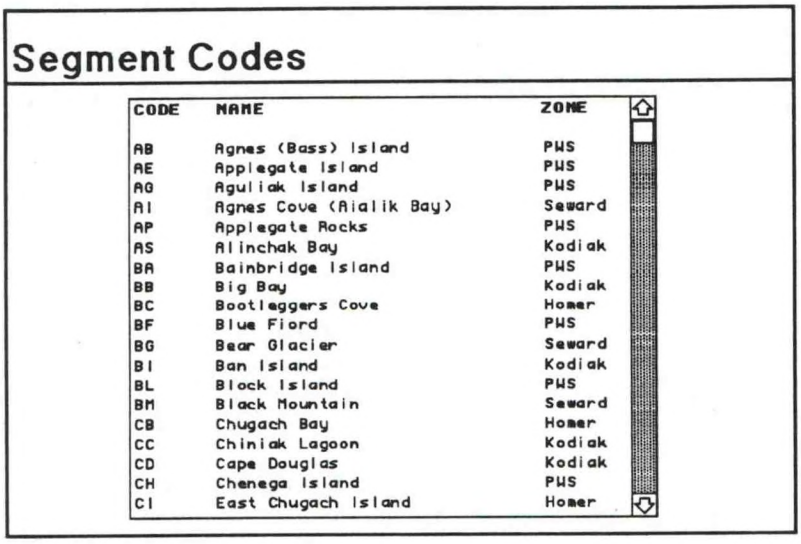
The 1148 Segment cards are sorted alphabetically by Segment ID. The Segment Cards contain the following fields:

Segment ID	The first two letters identify a specific location within that sector (BC = Bootlegger's Cove); the numbers identify individual partitions within that specific location (sector indicator used in 1989 naming convention is not used in 1990)
Region	Geographic name of area
Degree of Oiling	Degree of oiling in 1989 (if data available)
Map Reference	Map reference to Segment Summary Maps stack
Sector	Either Prince William Sound or Gulf of Alaska
1989 Treatment	The treatment techniques use on shoreline in 1989*
1990 Treatment	The treatment techniques used on this segment and its subdivisions in 1990
1991 Treatment	The treatment techniques used on this segment and its subdivisions in 1991

*Cleanup data was unavailable for some of the 1989 segments. This may be because these segments were created in 1990 or 1991 or because they were considered NTR in 1989 and not tracked. In cases where the 1989 status of the segment is unclear, "NO DATA" was entered into the 1989 Treatment field.

Segment Codes

Selecting **Segment Codes** from the **CV Menu** will bring you the following screen:

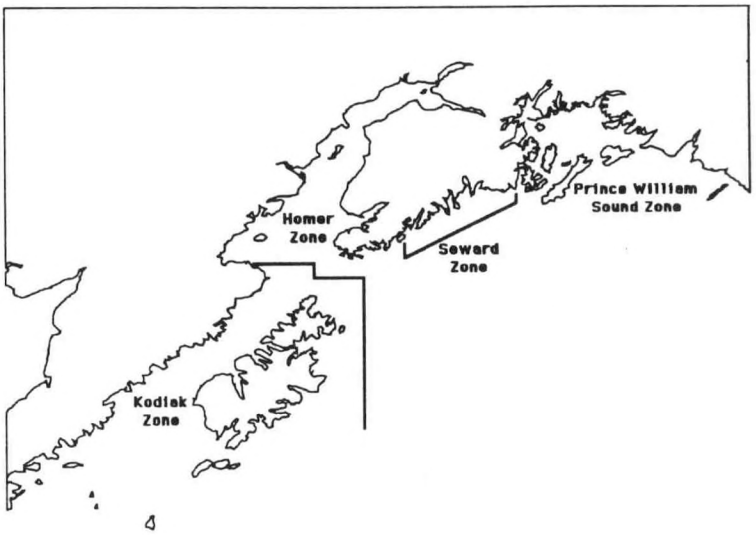


The segment codes field contains a glossary of the two character codes that make up the segment names. Clicking on a line within the segment codes field will take you to the first occurrence of that segment in the database.

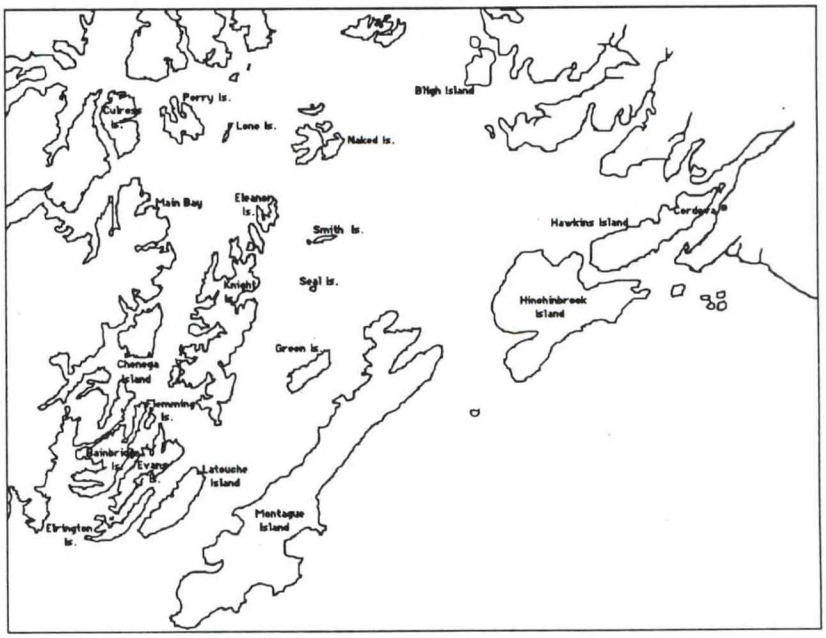
Segment Summary Maps

Double-clicking on the **Segment Summary Maps** stack icon opens the stack to the first map in the stack.

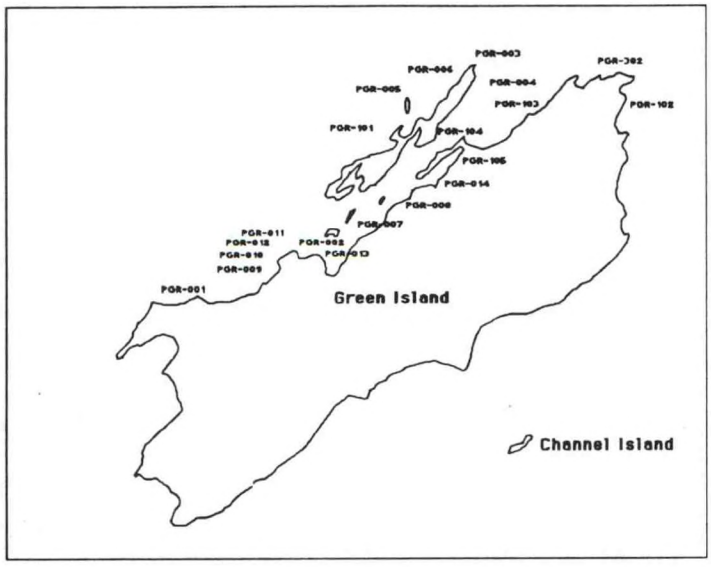
The maps in this stack are organized in a hierarchical manner. If you click on the map in an area that has a map linked to it you will be taken to the linked map. Clicking on the Prince William Sound from the map of the entire area will take you to a "zoomed in" map showing Prince William Sound.



From the map of Prince William Sound you can click on Green Island and go to a "zoomed in" map of that area.



The map of Green Island shows the approximate locations of the segments in the area. Clicking on a segment name will take you to the corresponding data card (in the Segment Summary stack) for that segment.



To return to the map of Prince William Sound or of the entire area from the map of Green Island, select the **Step Out** option from the **CV** menu. This option will bring you to the next available "zoomed out" map if there is one.

Chapter 5

Searching and Printing

Introduction

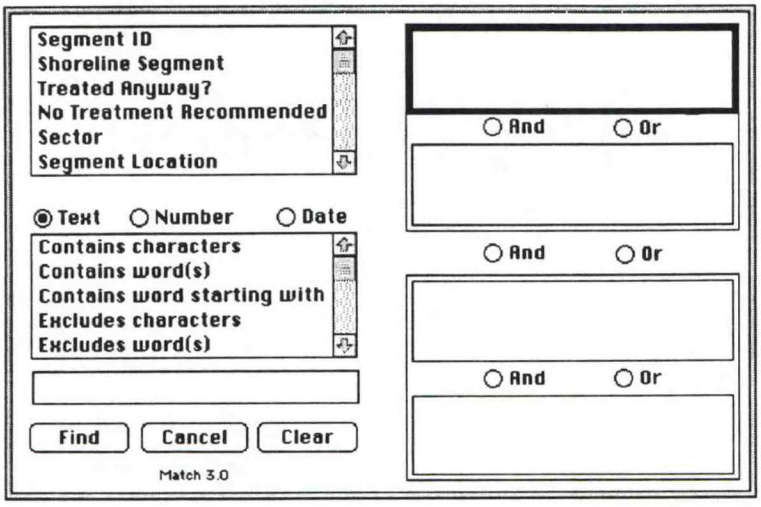
From the CAMEO Valdez databases, you can perform complex searches based on specific criteria that you set.

Using the CAMEO™ Search Menu Item

All of the stacks in the CAMEO Valdez databases that have searchable data, allow the user to perform specific queries, (you cannot search on backgrounds containing only one card such as summary cards or graphics cards):

To begin, choose **Search Cards...** from the Search menu.

No matter which of the CAMEO Valdez stacks you are in when you choose **Search Cards...**, you will see some version of the following window:



The upper left box contains all of the fields on the cards in the stack that you are searching.

The bottom left box contains all of the criteria that you can choose from to search the stack.

The four boxes on the right side of the window are actually two sets of boxes that mimic the information that you chose in the boxes on the left side of the window. For example:

- Click Segment ID in the field box; click Contains characters from the criteria box; and type in BC in the text box at the bottom of the window.

- Now, look at the first summary box on the top right of the window: everything that you selected is mimicked, or summarized, here.

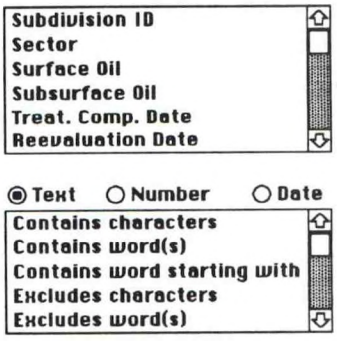
- The **And** and **Or** buttons between the four right-side boxes allow you to pair searches: You can click And to search for both sets of conditions that you enter in the pair of summary boxes, or you can click Or to search for either set of conditions.

The buttons in the upper right corner of the card allow you to page forward and backwards through the cards collected in the search; you can also use the arrow keys on your keyboard to move through these cards.

Select Clear Search from the Search menu to erase the set of cards collected in the previous search.

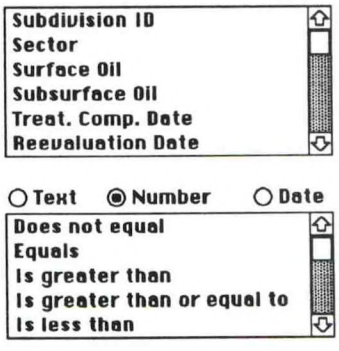
Text criteria

Clicking Text allows you to conduct searches based on word fragments, individual words, or pairs of words.



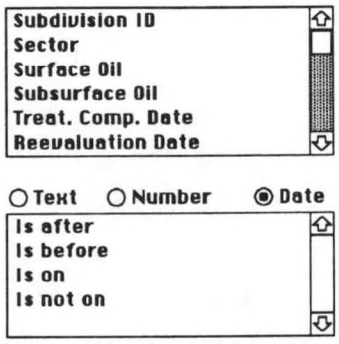
Number criteria

Clicking Number allows you to conduct searches based on number fragments, individual numbers, or pairs of numbers.



Date criteria

Clicking Date allows you to conduct searches based on the date a record was modified or entered. (Make sure that you enter the date as MM/DD/YY.)



Exercises in getting information

For the purpose of searching, a *word* is a collection of characters that...

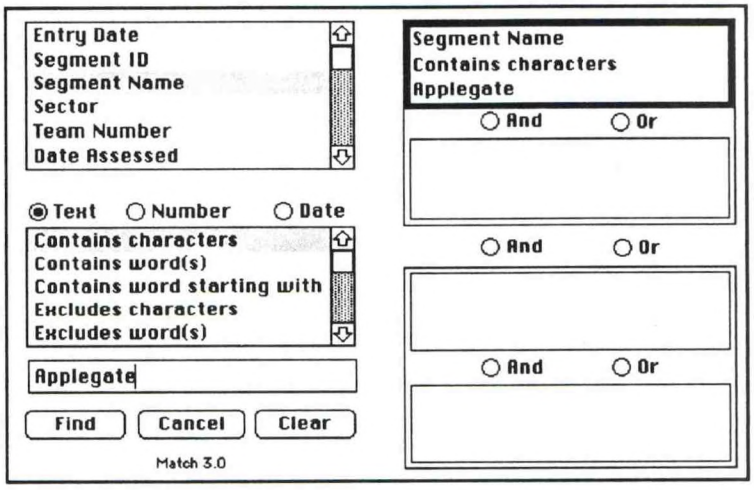
- is preceded or followed by a hyphen (for example, K0101-SI007A)
- is separated by spaces (for example, Applegate Island)
- ends with a carriage return (for example, raking<carriage return>

In the examples that follow, the CV90 stack will be used. The steps demonstrated here are basically the same for the other CAMEO™ Valdez databases, and the Segment Summary stack.

Exercise One
Searching on a field containing one or more specific words.

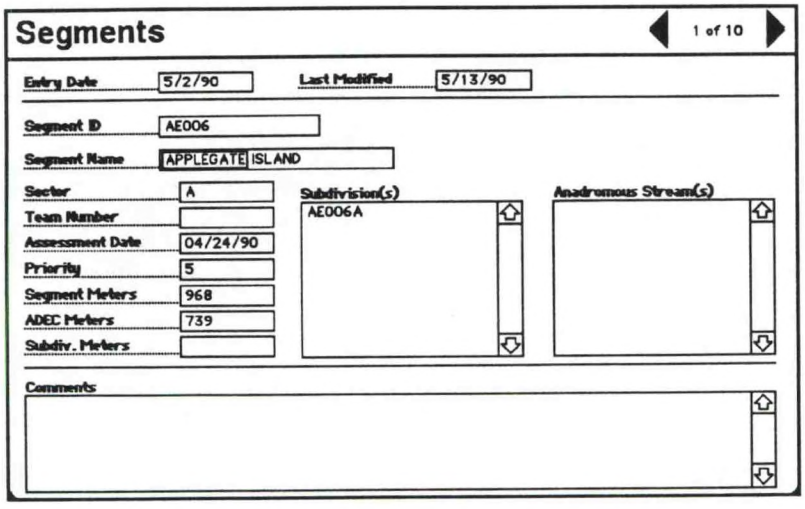
- ☐ Go to the CV90 Segments background.
- ☐ Select **Search Cards...** from the **Search** menu.
- ☐ Select **Segment Name** from the field window.
- ☐ Select **Contains characters** from the criteria window.
- ☐ Type **Applegate** in the text box.

As you select your search criteria, they appear in the upper right hand box of the search window.



- ☐ Click **Find**.

The search finds ten records that meet the search criteria.

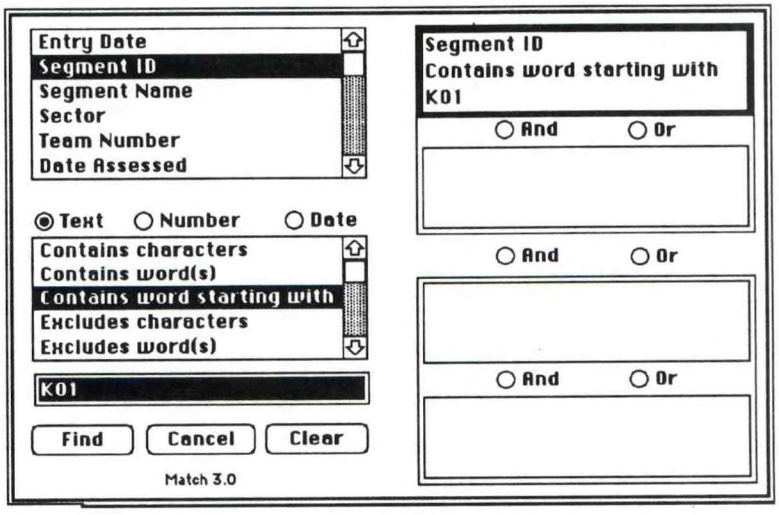


Exercise Two

Searching for a field starting with a specific word

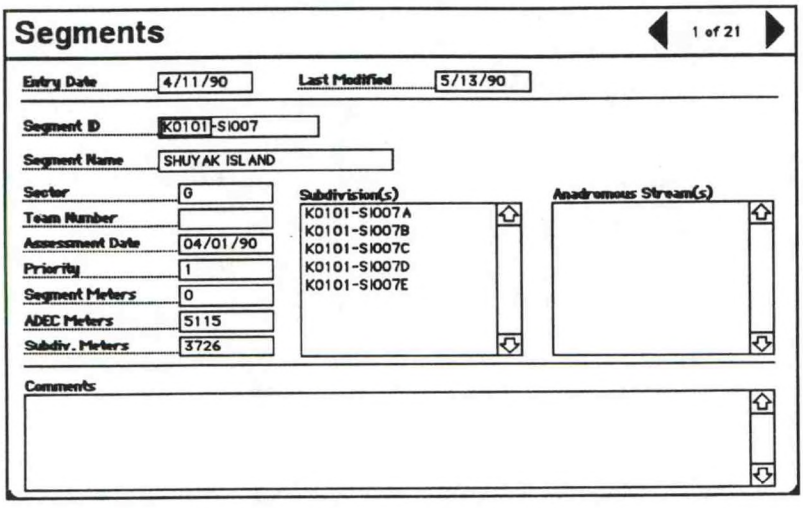
Sometimes, you may only know part of a word; you can still use the CAMEO™ search.

- ☐ Select **Search Cards...** if you are no longer in the search window.
- ☐ Select **Segment ID** from the field window.
- ☐ Select **Contains words starting with** from the criteria window.
- ☐ Type in **K01**.



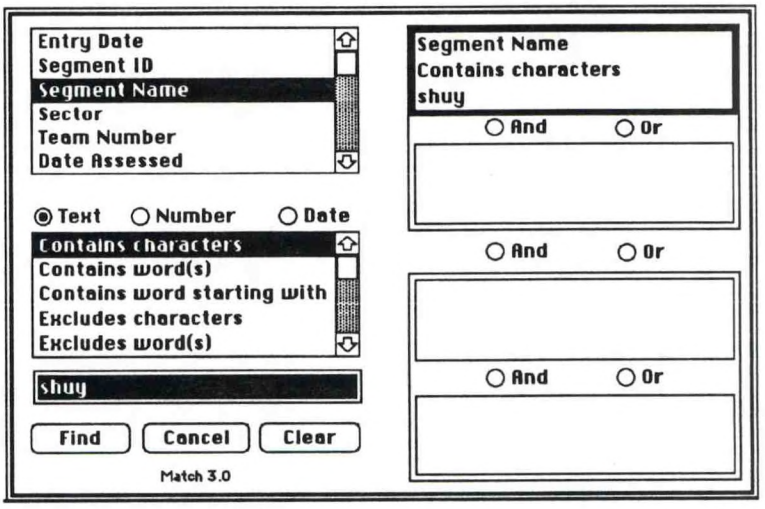
- ☐ Click **Find**.

The search finds twenty-one records that meet the search criteria.



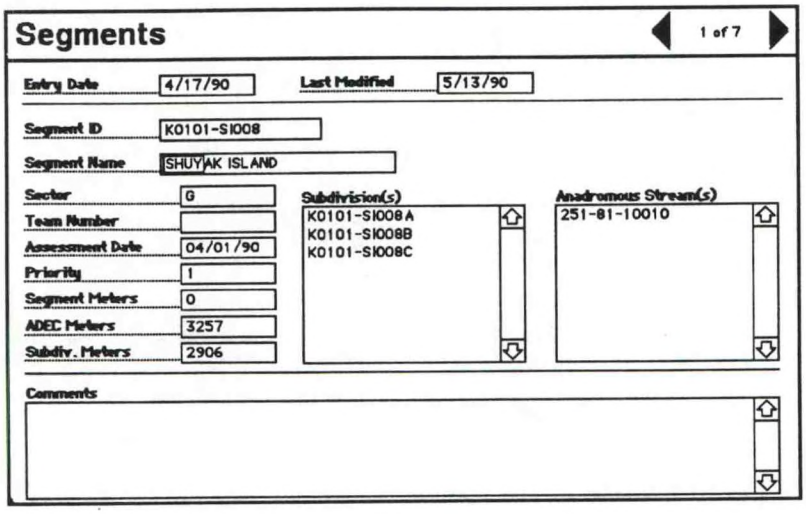
Exercise Three
Searching for a field containing specific characters

- ☐ Choose Search Cards...
- ☐ Select Segment Name from the field window.
- ☐ Select Contains characters from the criteria window.
- ☐ Type in the characters **shuy**.



- ☐ Click **Find**. The Search will find the characters **shuy** anywhere in the Segment Name field.

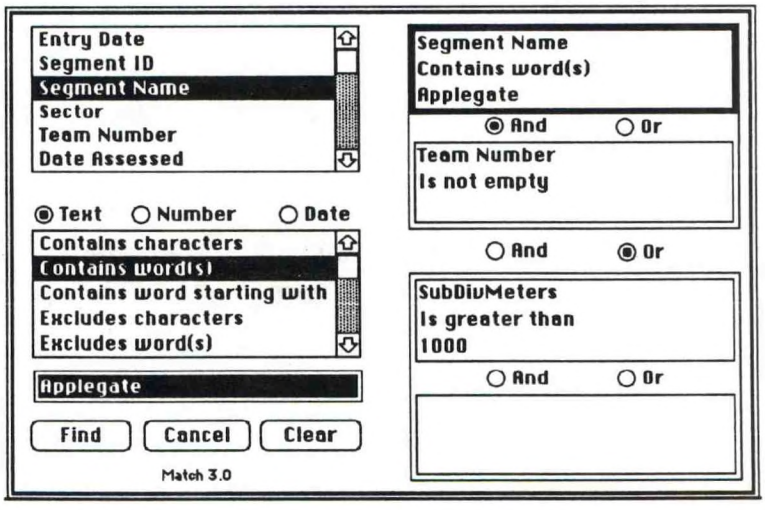
The search finds seven records that meet the search criteria.



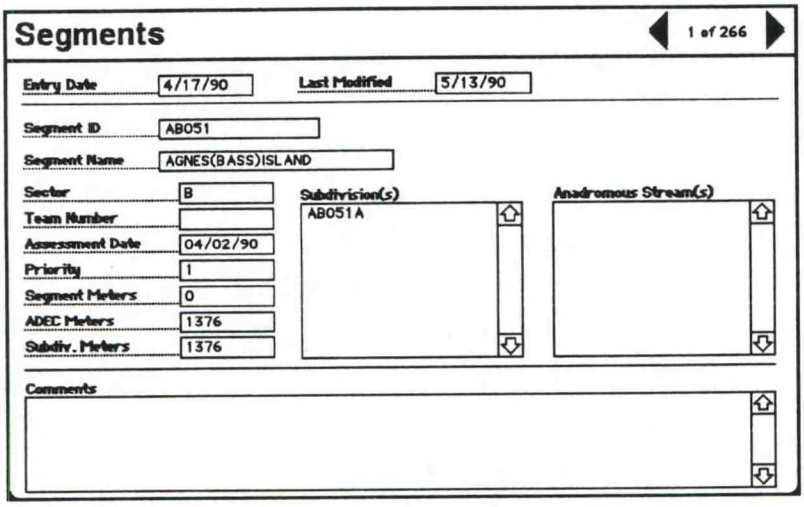
Exercise Four
Using the And/Or criteria

The **And** and **Or** options can be used to perform complex searches with up to four different criteria.

- ☐ Select Search Cards...
- ☐ Select Segment Name from the field window.
- ☐ Select Contains word(s) from the criteria window.
- ☐ Type in the word Applegate in the text box.
- ☐ Click the And button under the first display window on the right.
- ☐ Select Team Number from the field window.
- ☐ Select Is Not Empty from the criteria window.
- ☐ Click the Or button under the second display window on the right.
- ☐ Select SubDivMeters in the field window.
- ☐ Click on the Number button under the field window.
- ☐ Select Is greater than from the criteria window.
- ☐ Type 1000 in the text box.
- ☐ Click Find.



The search finds two hundred and sixty-six records that meet the search criteria.



Tips

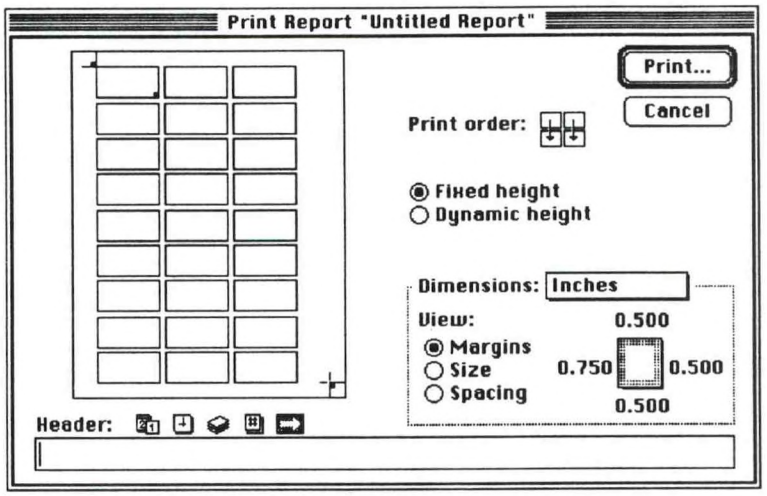
- If you're searching for two pieces of information in a field, put the more precise search in the top summary box. This will make the search faster.

- If you are running under MultiFinder, you can conduct complex searches in the background while working in another application.

- You may cancel your search at any time by pressing the command key and period simultaneously. This stops the search immediately; you are placed on the last card found before you halted the search.

Printing the results of a search

To print the information from the cards found in a search, select the **Print Collection** option from the Search menu. You will see a screen that looks similar to this:

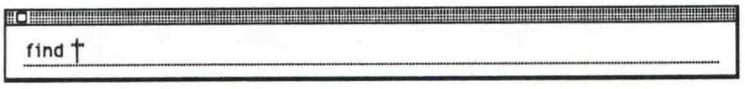


Use this layout box to customize the format of the printed report and choose the fields to be printed. For more information on how to customize the layout of your report, consult your HyperCard manual.

Using HyperCard's Find command

In addition to the CAMEO™ Search, HyperCard has a **Find** command built-in that can be used for simple searches. This is a relatively fast way to find the first occurrence of the characters that you specify.

- ❒ Select **Find** from the **Go** menu.
- ❒ When the HyperCard message box appears, the cursor is between quotes; type the string to be searched for in the space between the quotes and press the Return key.



Each time that you press the Return key, you will be taken to the next occurrence of the criteria that you have specified. See your HyperCard manual more specific instructions on the use of the HyperCard Find.

Appendix A

System Requirements

Static CV89, CV90, and CV91 and the Segment Summary databases require HyperCard version 2.0, or higher running on a 2 MB Macintosh Plus or higher.

Display of color graphics included with the CAMEO Valdez databases requires a color monitor, and may require additional memory allocation to HyperCard; the steps in changing memory allocation are described in Chapter 1 of this manual.

Appendix B

Glossary of Terms and Acronyms

ADEC	Alaska Department of Environmental Conservation.
ANAD SAT	Spring 1990 survey of anadromous streams.
Anadromous stream	A stream utilized by anadromous fish (e.g., salmon spawning).
ASAP	August Shoreline Assessment Program. Cleanup evaluation conducted in August of 1990.
CAMEO™	Computer-Aided Management of Emergency Operations.
CLYDE	A derived unit of work used to monitor the progress of Exxon's cleanup effort during the 1989 cleanup season. See Appendix C: Exxon Valdez Spill Treatment Work Progress Model.

FOSC	Federal On-Scene Coordinator; U.S. Coast Guard senior officer in charge of monitoring cleanup efforts by responsible party during an oil spill.
ICP	Incident Command Post.
MAYSAP	May Shoreline Assessment Program; The beach survey conducted in 1991.
NOAA	National Oceanic and Atmospheric Administration.
NTR	No Treatment Recommended; Generally an area is designated NTR if the cleanup would do more harm than good environmentally.
SAT (or SSAT)	Spring Shoreline Assessment Team; Conducted initial beach surveys in spring of 1990.
SCAT	Shoreline Cleanup Advisory Team; Evaluated oiling conditions on shorelines as well as ecological and archaeological constraints in spring of 1989.

SCOT	Shoreline Cleanup Oversight Team; Monitored beach cleanup in 1989.
Segment	The first letter identifies the sector (H = Homer etc.); the next two letters identify a specific location within that sector (BC = Bootlegger's Cove); the numbers identify individual partitions within that specific location.
SHPO	State Historic Preservation Officer.
Subdivision	Segment ID followed by letter (A, B, C etc.) to designate a portion of the segment.
TAG	Technical Advisory Group; TAG was developed jointly by agency representatives from the State of Alaska, the Federal government, and Exxon and provided advice and treatment recommendations to the FOSC.
USFWS	United States Fish and Wildlife Service

Appendix C

Exxon Valdez Spill Treatment Work Progress Model

Note

This appendix is a verbatim copy of the *Exxon Valdez Spill Treatment Work Progress Model* report dated 27 May 1989. The report was prepared for the Federal On-Scene Coordinator, Vice Admiral Clyde Robbins, USCG, by LCDR Peter C. Olsen, USCGR, P.E. and LCDR Wayne R. Hamilton, USCG.

Introduction

This is a preliminary report of the Coast Guard's EXXON VALDEZ Operations Analysis Team. The report outlines the development of the Team's Spill Treatment Work Progress Model and describes the current version.

Purpose of the Model

The purpose of the EXXON VALDEZ Spill Treatment Work Progress Model is to allow the Federal On-Scene Coordinator (FOSC) to accurately track progress toward the goal of completing appropriate initial treatment of all oil-contaminated beaches by 15 September, 1989, where the "appropriate initial treatment" for each beach segment

depends upon the conditions of the segment. The model uses information about the degree of beach contamination, the composition of the beach, the width of the beach, oil penetration into the beach, oil coverage of the beach, and the amount of wrack on the beach to provide a factor which can be used to estimate the work required to treat any beach segment in terms of that required to treat a "standard equivalent" segment of identical length. This conversion of workload into "standard equivalent" terms provides the FOSC with a means of aggregating the progress made in treatment of different beaches, under different conditions, and measuring overall progress toward the 15 September goal.

General Policy Assumptions about how the treatment will be carried out

1. The objective is to complete initial treatment of each beach segment by 15 September 1989. In this plan, "initial treatment" means an operation to remove gross oil contamination and stabilize the remaining in place to eliminate the possibility of its migration to cause further contamination re-oiling. "Treatment" is not the same as "cleaning" and beach segments may require substantial further work after the completion of their initial treatment.
2. "Beach segments" as identified by Exxon and approved by the Shoreline Committee are the basic unit for managing treatment operations. The Coast Guard will inspect each segment of beach for compliance with treatment standards. A beach segment will be accepted as compliant only when the entire segment meets the standard.

3. The treatment of each beach segment will depend on its condition. Segments which are environmentally sensitive or heavily contaminated will normally be treated first.
4. There are three types of treatment that may be appropriate. Type I treatment is the removal of gross oil contamination to a level which will prevent any further migration of the remaining oil. This is the minimum standard for initial treatment. Because Type I treatment does not require the removal of all oil, standards for its attainment are set by the FOSC. Type II treatment is the removal of all surface contamination. Type III is the complete removal of all contamination. The type of treatment appropriate for each beach segment depends on several factors, including its level of contamination, and archeological, environmental sensitivity, among others. The treatment for each beach segment will be determined by the FOSC (or his representative) after considering the recommendations of the Shoreline Committee. Some beaches will receive all three Types in succession, but lightly- or moderately-oiled beaches may begin with Type II or Type III treatment, while heavily-oiled beaches may receive only Type I. Completion of Type II treatment implies the completion of Type I and completion of Type III treatment implies the completion of both Types I and II. Because treatment itself poses a risk of environmental damage, some beaches which are very-lightly contaminated, particularly sensitive, or exposed to the action of high-energy surf may not be treated at all. This Model measures progress toward completing the initial treatment of all beach

segments, without regard to whether it is Type I, Type II, or Type III.

Technical Assumptions about factors which influence the amount of work required to complete the treatment

1. "Beach segments" are small enough to be either roughly homogenous in composition or completely described on the Shoreline Cleanup Assessment Team (SCAT) forms.
2. The work required to treat a beach segment varies directly with the length of the segment.
3. Exxon will provide adequate approved survey data on each beach segment.

Analysis

The study was conducted by a Coast Guard Operations Analysis Team (OAT) consisting of LCDR Peter C. OLSEN, USCGR, P.E. and LCDR Wayne R. HAMILTON, USCG. The team divided the study into two parts. The first part was an analysis of the environmental factors which influence the amount of work required to complete the treatment of each beach segment. The team developed factors which can be used to compare the amount of work necessary to treat any given beach segment with the amount of work required to treat a "standard" segment one-hundred yards long - called a "Clyde." The second part was a forecast of the total amount of work required to complete all beach segments by applying the per-segment estimates to the contamination data from the preliminary surveys by the Alaska Department of Environmental Conservation (ADEC) and the Exxon Shoreline Contamination Assessment Team (SCAT) reports.

Estimation of Work Per Segment

Because accurate estimates of absolute productivity appeared to be difficult or impossible to obtain, the team decided to avoid them by adopting a system based on relative productivity. Instead of actually estimating the time required to treat particular segments, the team estimated the relative amount of time required to clean one segment in comparison to another. All of these relative times were referred to a common "standard" beach: a cobble beach, not more than 30 meters wide, completely covered with light oil, with not more than ten centimeters penetration and a light to moderate amount of contaminated debris. The amount of work required to treat 100 yards of a standard beach is "one standard equivalent beach work unit - called one "Clyde."

To develop the conversion factors necessary for comparing different types of beach, the team began with a rapid review of Exxon's treatment plans, SCAT reports of oil contamination, and reports from the treatment teams about the effectiveness of their operations on different beaches. Based on this review, the Team identified a number of factors which appeared to effect treatment productivity. The team decided to divide these factors into two broad classes. The first class consisted of factors which were related directly to the degree and type of oil contamination on the beach. These were called "contamination factors" and included:

- **length of beach**
- **width of beach**
- **depth of oil penetration into the surface**
- **porosity of the penetrated layer,**
- **density of the oil (both on and beneath the surface)**
- **amount of oil (both on and beneath the surface)**

- ☐ **beach material**
- ☐ **slope of beach**
- ☐ **thickness of the tar layer**
- ☐ **amount of drifted material on the beach**
- ☐ **beach composition**

The second class consisted of all other factors, called "productivity factors," including:

- ☐ **access by water or land**
- ☐ **distance from sector office (Valdez, Homer, Seward, or Kodiak)**
- ☐ **distance from anchorages for support vessels**
- ☐ **inshore reefs**
- ☐ **type of equipment required**
- ☐ **availability of treatment supplies and equipment**
- ☐ **archeological or cultural restrictions**
- ☐ **tidal action**
- ☐ **wildlife**

The present model is based entirely on the contamination factors and attempts to model only the level of contamination for each beach segment. The productivity factors are ignored. The Team took this approach based on two considerations. First, several of the productivity factors (like the availability of equipment and supplies and the distance from support vessel anchorages) are directly under Exxon's control (and difficult or impossible for the Coast Guard to accurately track or predict from day to day while the effects of others (like tidal action or archeological, cultural, or environmental restrictions) are difficult to estimate. Second (more importantly), the Coast Guard's primary interest is the attainment of the 15 September goal based on completed

beach segments, not the allocation of resources. Resource allocation is Exxon's problem.

To determine which of the contamination factors were significant, and the size of their effect, the Team visited several treatment sites throughout the entire spill area. At each site, the Team observed the work in progress and spoke with Coast Guard beach monitors, Exxon and contractor supervisory personnel, and beach cleaners. In speaking with each person, the Team first asked for a description of the person's job and experience in general terms and then followed-up with specific questions intended to obtain information about the relative importance of the contamination factors with which the person had first-hand experience. The team ended each interview with a free-form request for comments on any additional factors that might be of interest.

Based on these visits, the Team believes that the most significant factors for comparing the relative amounts of work between different segments are: degree of oil contamination, width of the beach, depth of oil penetration, beach composition, percentage of oil coverage, and the amount of debris on the beach. The team has attempted to quantify the relative effect of these factors. For each factor, the team has also indicated the **relative confidence** that it has in the factor.

- not surprisingly, the **degree of oil contamination** appears to have a significant influence on the amount of work required to complete initial treatment of contaminated beaches. The Team believes that this influence can be modeled by dividing the degree of contamination into four broad categories: heavy contamination, moderate

contamination, light contamination, and very-light contamination. The first three categories correspond to the Alaska Department of Environmental Conservation standards. The last represents the minimum detectable level of contamination. Relative weights assigned are:

- **heavy contamination - 2**
- **moderate contamination - 1.5**
- **light contamination - 1**
- **very-light contamination - 0.1**

The Team has **moderate to high confidence** in these estimates.

- the **width of the contaminated beach** appears to effect the amount of work required to treat a beach segment both because wider beaches have more contaminated area and because (given a limited range of tides) wider beaches usually have gentler slopes. Slope is important because gently sloping beaches tend to have slower runoff of deluge water, more frequent "ponding" of deluge water on the lower beach above the current tide line, and greater chance of rocks on the lower beach "breaking water" below the current tide line. All of these factors slow the rate of deluge treatment, increase the chance of re-oiling, and increase the likelihood that manual absorption will be required.
Relative weights assigned are:

- **width up to 30 meters - 1**
- **width between 30 and 45 meters - 1.5**
- **width more than 45 meters - 2**

The team has **moderate confidence** in these estimates

- the **depth of oil penetration** appears to be significant because deeper penetration means both more oil has been absorbed and that more work "per gallon of oil removed" will be required to remove a given amount of oil from a deeper level. Relative weights assigned are:

- ☐ **depth of 10 cm or less - 1**
- ☐ **depth from 10 cm to 20 cm - 2**
- ☐ **depth of more than 20 cm - 3**

The Team has **moderate to little confidence** in the deeper factors.

- the **composition of the beach** appears to be significant because some compositions are much easier to treat than others. Large cobble beaches can be treated quickly because they have large spaces through which high volumes of deluge water can flow without washing the cobbles away. Pebble or gravel beaches appear to be more difficult to treat because the oil is more tightly bound in smaller spaces and high volume washing cannot be used because it washes the beach away. It appears that rock beaches can be either harder or easier to treat, depending on the porosity of the rock and the slope of its face; flat shale beaches with large numbers of vertical cracks may be very difficult to treat while smooth vertical rock faces are likely to be very easy. Sand or mud beaches can usually be cleaned mechanically with no more effort than that required to wash large cobbles. Relative weights assigned are:

- ☐ **cobble, boulder, mud, or sand beaches - 1**
- ☐ **gravel or pebble beaches - 2**
- ☐ **rock beaches (not vertical rock faces) - 1**

- ❑ **vertical rock faces - 0.5**

The Team has **moderate to high confidence** in these factors.

- the amount of work appears to vary with the **percent of beach covered**. Relative weights assigned are:

- ❑ **at least 67% of beach covered - 1**
- ❑ **between 34% and 66% of beach covered - 0.8**
- ❑ **less than 34% of beach covered - 0.5**

The Team has **moderate confidence** in these factors.

- finally, the amount of beach debris appears to have a significant effect on beach treatment. Contaminated debris must be collected and removed by hand. Beaches with lots of contaminated debris require more work to collect it than beaches with little or no debris. Relative weights assigned are:

- ❑ **"heavy" strand line - 1.2**
- ❑ **"moderate," "light", or no strand line - 1**

(The amount of beach debris is not explicitly determined by either the ADEC or SCAT surveys and must be estimated from other information on the SCAT sheet. A strand line is assumed to be "heavy" if it is described as heavy or extensive in narrative comments or if it contains all three "algae/debris/logs") The team has **low confidence** in these estimates.

Model Equation:

Based on these factors, the model equation for estimating the standardized beach work is:

$SEBWU = (L/100)*E_f*W_f*P_f*T_f*C_f*D_f$

SEBWU is "Standardized Equivalent Beach Work Units" (measured in CLYDES)

L = segment length in either yards or meters. (Given the precision of the remainder of the model, either unit may be used interchangeably with the other.)

E_f =	1	for light oil
	1.5	for moderate oil
	2	for heavy oil
	0.1	for very-light oil
W_f =	1	for widths not more than 30 m
	1.5	for width of 30 to 45 m
	2	for widths more than 45 m
P_f =	1	for penetrations of not more than 10 cm
	2	for penetrations of between 10 cm and 20 cm
	3	for penetrations of more than 20 cm
T_f =	1	for boulders, cobbles, sand, or mud
	2	for gravel or pebbles
	1	for rock segments, not vertical rock faces
	0.5	for vertical rock faces
C_f =	1	for segments with coverage of 67% or more
	0.8	for segments with coverage from 34% to 67%
	0.5	for segments with coverage of 33% or less

D_f = 1.2 for segments with heavy debris

1 for segments with less than heavy debris

Estimating Total Work Required for Complete Initial Treatment

To develop a method of forecasting whether or not the goal of completing initial treatment by 15 September 1989, the Team had to first develop a method for estimating the total number of standard equivalent beach work units ("Clydes") required. The Team did this by using a combination of detailed data provided by the SCAT reports and general data provided by the ADEC surveys. All SCAT data was first entered into a NOAA database which incorporated the model equation. This data was used to estimate the amount of work required to treat the beaches it covered. This estimate, which included a mixture of beach types, was then used to calculate an "average" measure of work-per-unit-length ("Clydes per mile") for beaches with heavy, moderate, light, and very light contamination. These average figures were then applied to the total length of each level of contamination identified in the ADEC surveys, after the lengths of the SCATed segments had been subtracted.