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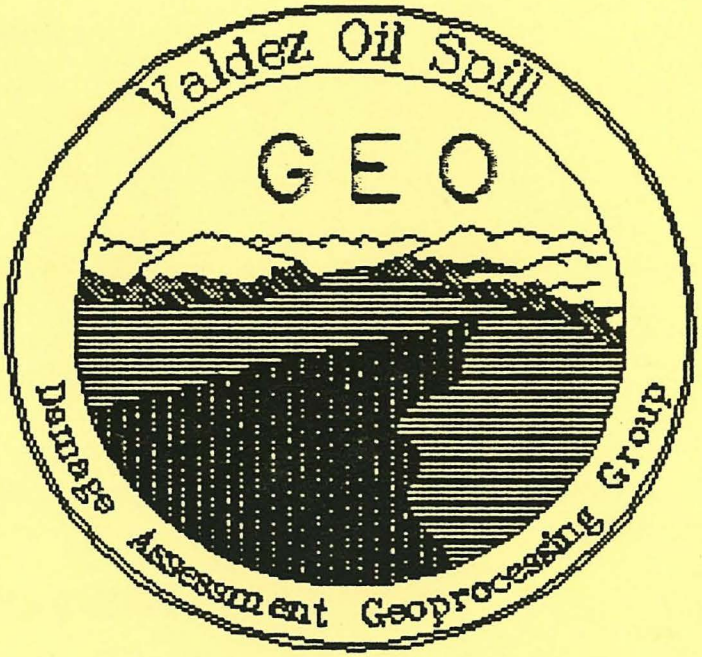
EXXON VALDEZ OIL SPILL

CERCLA DETAILED STUDY PLAN



Technical Services Study Number 3

GIS Technical Group

Mapping of Damage Assessment Data and Information

September 25, 1989

Technical Services Study Number 3

Mapping of Damage Assessment Data Information

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Natural Resource Damage Assessment and Restoration Strategy for the Exxon Valdez Oil Spill

Detailed Study Plan
September 25, 1989

Technical Services Study Number 3

Title: Mapping of Damage Assessment Data and Information

ADNR

Deanne M Hughes / Richard A McGee — Co-Lead

Deanne M Hughes — Management Official

USF&WS

Roger Slothower — Co-Lead

_____ Management Official

OSIAR

_____ OSIAR Program Manager

_____ OSIAR Director

Technical Services Study Number 3
Mapping of Damage Assessment Data and Information

II. INTRODUCTION

As stated in the justification of this study group:

"A geographic information system (GIS) will be selected and implemented to facilitate the management and presentation of all information." p.183

The GIS technical group has implemented production facilities at ADNR and is currently implementing co-lead production through USF&WS. Both sites are designed to handle the mapping and data management workload created by the damage assessment and restoration studies. Cooperating agencies on this project include ADEC, USFS, and NOAA.

This GIS technical group provides the capability to map and model resource inventory data and related injury statistics. The database structure allows for modeling statistical questions such as: "How many miles of tidelands were oiled, plot the animal and plant kill statistics sampled over these lands, and determine an injury amount by extrapolating these field conclusions over all tidelands that could not be specifically sampled due to cost constraints and the remote nature of the affected coastline miles." Specifically this project provides the following services:

1) Capture and manage the base resource inventory data needed to conduct damage assessment work, which includes uplands land status (ownership), ecological shoreline classifications, and the degree of oil impact over the extent of the spill (Air/Water Study number 1). Integrate this data to a common coastline model.

2) Upon this common resource inventory base, combine the following damage statistics:

   a. The locations and values of chemical point samples collected by researchers at both NOAA and ADEC.

   b. The locations and values of ecosystem impacts collected by the Coastal Habitat Study group headed by USFS and ADF&G.

   c. The locations and values of injury statistics compiled by the Fish/Shellfish, Marine Mammals, and Birds study groups.

d. The locations and values of any additional resources of economic value such as shore fishery leases, recreational usage sites, anadromous streams, etc.

3) Provide the study groups maps and statistical reporting which represent unique combinations of the data relevant to their study conclusions of total injury assessed.

4) Provide rigorous data repository and archival services of GIS data to the CERCLA litigation teams. Insure documentation of all data standards and procedures, and project audit trails to meet standards of data admissibility.

5) Provide map products and statistical reports to the CERCLA decision makers on a requested basis.

6) Work cooperatively to service the needs of CERCLA related studies.

The geographic information mapping system will support the generation of information products from most of the resource-oriented studies through the entire course of activities under the Damage Assessment Plan.

III. OBJECTIVES

The GIS Technical Services Study group is charged with providing geographic information management services related to the Exxon Valdez oil spill. Five general categories of work will be required to meet the long term objectives for this group:

Foundation Work - Collect, process, integrate, manage, and report on those data considered to be the 'primary' data sources. Examples are coastal morphology and land status. (Service/Product #1 in Introduction)

Thematic Work - Collect, process, integrate, manage, and report on those data considered to be 'secondary' data sources. Examples are chemical point samples and animal/plant impact statistics. (Service/Product #2 and #3 in Introduction)

Primary Services - Plot maps and print statistical reports, and distribute products to users. Provide technical information and support to users. Distribute high quality digital information, such as coastline data, to assure data capture integrity in field offices such as ADEC and UAF. (Service/Product #5 and #6 in Introduction)

Administrative Services - Assure data documentation, data procedures, data quality, and data admissibility within litigation requirements. Assure rigorous database architecture, disaster recovery, documentation, and appropriate distribution. Assure coordination between multi-agencies on data sharing. Assure high priority personnel, fiscal, and operations management to meet overall project needs. Assure adequate audit trails. (Service/Product #4 in Introduction)

Quality Control - The utility of base data is partly a function of their overall reliability. The GIS group will concentrate on achieving a high level of data accuracy, both with respect to reflection of source documents as well as consistency with ancillary field data. Capture methods will provide for high standards of verifying with source documents. A review process which incorporates standards for updates and changes to the data will target accuracy gains from experienced staff with extensive field experience.

The dynamic nature of the themes being mapped presents a difficult problem with respect to the perceived accuracy: ownerships change hands, beach texture and composition changes with winter storm patterns, and the duration of oil on the tidelands is partly a function of wave energy, rain intensity

and 'type' of oil deposited, i.e. mousse versus thick crude versus tar balls. Even the location of the coastline is subject to change from erosional processes and major events like the 1964 earthquake. Thus, a snapshot view of this landscape can be difficult to field verify due to the timing differences of field visits and data collection.

A second source of accuracy problems is introduced with subjective classifications as found in both shoreline types and degree of oil impact. The subjectivity is a function of describing what is a continuum in nature as discreet classes in the database. Borderline errors occur when different people hold slightly different views of a given classification. For example, a mixed sand and gravel beach, a gravel beach and a sheltered rocky shore might all describe one area fairly well leading different people to make different interpretations, particularly when their observations will have the spread of several years between them; i.e. a 1983 source map and a 1989 field season.

IV. METHODOLOGY

There are six major steps in the development of a mature damage assessment and restoration database:

1) Determine geographical limits of the project.
2) Identify database layers.
3) Identify source material for each layer.
4) Develop capture standards and methodology.
5) Capture data layers, verify with source documents.
6) Prepare database design for security, layer integration, update procedures, archive rules, documentation, and technical aspects of data handling.

Geographic Limits of the Project

The project area includes all lands which have been or may be effected by the Exxon Valdez oil spill. This includes all coastal lands west of the 146th meridian, east of the 160th meridian, and south of 61 degrees, 30 minutes north latitude.

If this limit proves to be inadequate, the extent of the database can be expanded.

Within this limit, all efforts will be made to maintain a reasonable continuity of resolution and local dependability for any given data layer.

Identify Database Layers

Foundation Work

The foundation data layers have been specified by the CERCLA Management Team from the inception of the GIS mapping group. These include:

1. A standard digital coastline relevant to field applications;

2. Degree and location of all coastal lands contaminated by crude oil from the TV Exxon Valdez;

3. Shoreline type as described by coastal morphology; and

4. Land ownership, at a resolution of one section.

In addition to these primary layers, the mapping group has included the following layers based on their collective experience on the use of maps.

5. Basemap annotation, including settlements, water bodies, peninsulas, major islands and capes;

6. Hydrography - lakes, rivers and streams, for those areas where digital information currently exists;

7. Geographic referencing including UTM tic marks and the protracted township grid.

These layers will be combined to create a standard basemap which can be distributed to all parties involved in the damage assessment and restoration process. Most study groups collect field data with locational attributes which will permit the placement of data and various summary results on basemaps.

Other foundation layers which are likely to be incorporated into the database, and in some cases have received preliminary work, include:

8. Bathymetry data, particularly for those submerged lands near the intertidal zone; and

9. Critical and important wildlife habitats including marine birds, marine mammals, anadromous fish, and bald eagles;

Thematic Work

Thematic data includes that information which is collected by the respective study groups which can be spatially referenced and therefore used in conjunction with all or some of the foundation layers. Most of these data are based upon a sampling process and therefore represent either point samples, as in the case of chemistry data, or line samples, as in the case of beach transects, or areal samples, as in the case of a trawl area for fish samples.

The technical mapping group is continuing to work with the various contacts and principal investigators with the intention of first, describing the composition and possible uses of the foundation layers, and second, to investigate possible avenues for GIS applications which would assist the study groups in the review and presentation of their findings. To date, the primary contacts have been with the coastal habitat group, the air/water group, marine mammals group, and the birds group. We have had only phone contact with the fish/shellfish group. Further, we realize we have not contacted all responsible study group leaders within these major studies.

Examples of thematic data include toxicity point samples by sample type, e.g. water, sediment, tissue, etc., mortality statistics for

species sampled by the various groups, changes in ecosystem productivity as measured by health and fecundity of key species across different habitat types, impacts on aesthetic values, changes in recreational use patterns, constraints to land use permits for aquaculture, and so on until the relevant themes have been exhausted.

Work with the field groups is continuing at this time with the principle goals of communicating the capabilities of and appropriate role of a geographic information system on the damage assessment project.

Source Material, Capture Standards and Database Design

The following discussion covers methodology steps three (3) through six (6) for the major data layers identified at this point in time.

Layer 1

Coastline:

1:250,000 Primary sources of ADNR, the North Slope Borough, and NOAA have worked on this public domain dataset. This data covers the entire State geographic area, with those data clipped out that cover the spill extent. Source documents have been the most current USGS 1:250,000 quads, with quality control to assure that all data plots overlay each respective source quads. Database structure includes differentiations between coastline, major river, major lakes, and islands. This data has been totally captured and is already incorporated into the database.

1:63360 Primary source of USFS for the PWS area, using USGS quads with some partial photo rectification. Primary source of ComRim Company for all other inch to the mile quads covering CIK, KAP, and all additional quads for which there was accompanying ESI (coastal morphology) data. Source documents have been the most current USGS 1:63360 quads, with quality control to assure that all data plots overlay each respective source quad. This dataset is captured to a very fine level of resolution and much attention to detail is evident. This dataset includes only the coastline data, and is structured into the database only as such. This data has been totally captured and is already incorporated into the database.

Layer 2

Oil Impacts: Primary Source: Alaska Department of Environmental Conservation, CERCLA Air/Water Study number 1, titled "Geographic Extent, Temporal Persistence and Mapping of Floating and Beached Oil from the TV Exxon Valdez Oil Spill."

Alaska DEC has utilized two main sources of data to record the location and degree of oil on the shoreline:

1) response data consisting primarily of mapped information based on aerial observation,

2) field observations from personnel who have walked miles of shoreline in an effort to document the location and degree of oiling not attainable through aerial observation.

Data from non-DEC sources may also be considered in the compilation of this data layer.

Response Data

Response data was based on information provided by DEC staff who are present are in Valdez, Seward, Homer, and Kodiak. Daily reports filed by these teams represent a large volume of DEC source material. During the early response period, DEC compiled oil location data, both in the water and on the shoreline, primarily from aerial reconnaissance with supplementary field observations. In June, these daily flights were limited to weekly overview flights because the shoreline cleanup assessment teams (SCAT) began to collect field data on a large number of beaches.

The response data was transferred to the DEC computer mapping system in a summary fashion which expedited the immediate use of the data at the expense of providing mirror images of the source documents.

The summary response data set was transferred by digital file to the GIS technical group for use in map production. This group in turn transferred copies of the detailed coastline (1:63,360) to DEC for purposes of establishing a common digital base.

The summary response data is the only digital oil

location data available at this time on either computer system.

Field Observations

As the cleanup deadline approached, DEC launched its own shoreline assessment teams whose primary task is to document the condition of the shorelines at the end of the season, particularly those which received significant treatment efforts. These crews are now working in the field and will continue to work until poor weather and lack of daylight make the efforts less than fruitful. Both DEC and Exxon winter plans specify that a beach monitoring system will be undertaken with the intent of recording changes to the oiled shoreline over the course of the winter.

The GIS technical group intends to work closely with the principal investigator of the AIR/WATER study number 1 to facilitate the incorporation of these data sources to a professional digital database which serves the needs of the related studies.

Additional Oil Impact Data:
Shoreline Cleanup Assessment Teams (SCAT Data)

The SCAT data was used to set beach cleanup schedules. It provided for a fairly standard method of ranking the degree of oil on the shoreline based on first hand observations from a team of trained staff who were paid by Exxon. Many agency field personnel used the SCAT reports in the course of their response work during the summer.

The SCAT teams divided the landscape into a series of beach segments which contained alpha-numeric codes for easy identification and information tracking. The segments were further subdivided as detailed oil location information was generated. For example, one segment may be 500 meters long and contain three classes of oil impact and four types of coastline. NOAA has requested these digital data sets from Exxon. Whether these data are appropriate for use by the CERCLA process, particularly with respect to the ADEC Air/Water study number 1, is not known at this time.

The general beach segments have been captured on the standard 1:63,360 coastline by DEC for the Prince

William Sound and Kenai Peninsula areas. (Detailed SCAT segments for PWS has also been digitally captured by mapping staff working for Exxon: source NOAA) The segment database would change as daily field reports were filed.

Further work is being done by ADEC to capture segments for the Kodiak and Alaska Peninsula areas. Early work by Kodiak ADEC through the Kodiak Borough which automated the beach segments could not be used because of a non-standard coordinate system used by the Borough.

A database was developed for each beach segment which reported on a wide variety of attributes for each segment. A sample of this database is shown in figure 1. The database was used to scale the workload, record progress and provide for agency sign-off on treatment. The database viewed by members of the technical mapping group contained data for the general segments, which were used to manage the project, and not the sub-segments which have the more exacting oil location data.

Layer 3

Shoreline Type: Primary source are the NOAA/MMS ESI Books, 1979-1984. Supplemental source is Eric Gundlach, ADEC Valdez. These data were captured in digital format under contract with ESRI, using GIS Technical Group monies through USFWS. Source documents are USGS 1:63360 quads, reduced to roughly 1:80,000, which delineate shore types in color codes.

Members of the GIS technical group have compared plots of the digital data with the source documents to assure accuracy. The maps are also currently being reviewed for accuracy by Eric Gundlach. As of this writing Eric has reviewed and submitted corrections for all PWS quads, and those CIK quads showing oiling. Still requiring Eric's review are the KAP quads showing oiling, and the CIK and KAP quads not currently showing any oiling.

Two versions of these data are maintained: the source documents as received by ESRI, and the modified versions following Eric Gundlach's review.

Please refer to the literature cited section of this

FIGURE 1 - EXAMPLE OF SCAT DATA

NOAA — KODIAK - Shoreline Cleanup Tracking — 8/9/89

UNIT ID	SHORELINE DESCRIPTION	LINE MILES	CURRENT SURVEY AGENCY	CURRENT SURVEY DATE	SCAT AVAIL	DEGREE IMPACT	SUB SURF	MILES OILED	PRI	COMMENTS	NO CLNUP	WORK ORDER DATE	WORK ORDER NUMBER	START DATE	END DATE	COMMENTS	MILES TREATED	% TREATED	DEMOB DATE	COMMENTS
K01		285						0									0			
01	E.SHUYAK I.	20.5	ADF&G	7/26/89	Y	H-VL			X			6/18/89	A020	8/1/89				70		DNR
02	BIG FORT I.	5.5	ADEC	6/27/89	Y	VL						8/1/89	A085	8/1/89				80		
03	S.SHUYAK I.	10	DEC	6/4/89	Y	VL			X			8/4/89	A092		7/24/89	A016				DNR
04	NEKETA BAY	9.5	DEC	5/24/89		VL														
05	BIG BAY	19.5	SCAT	5/21/89	Y	L					X									
06	WONDER BAY	11	DEC	5/20/89		VL														
07	DARK IS.	3	ADF&G	7/26/89		L														
08	LATAX ROCKS	2.5																		
09	CARRY IN.	17	ADF&G	5/2/89		L			X			8/5/89	A118							DNR
10	SHANGIN	11.5	SCAT	5/23/89	Y	H														
11	PEREVALNIE	9.5	ADF&G	7/26/89	Y	H			X			7/14/89	B017	7/15/89		A015/022		49		DNR
12	SHUYAK ST.	10.5	ADEC	6/27/89	Y	VL						8/3/89	A104							
13	WATERFALL	14.5	DEC	6/4/89		VL														
14	DELPHIN B.	8.5	DEC	6/4/89		VL														
15	DISCOVER B.	11	ADF&G	5/24/89		VL														
16	PAUL'S B.	8.5			Y				X											USFWS
17	PHOENIX B.	17.5	ADF&G	6/12/89		VL														
18	DUCK CAPE	4.5										8/5/89	A119							
19	SEAL B.	19																		
20	TOLSTOI	10.5			Y															
21	W.TONKI B.	11	DEC	5/30/89	Y	N														
22	E. TONKI B.	9	ADF&G	5/23/89	Y	L														
23	CHUGACH	11	DEC	5/30/89	Y	N						7/30/89	A088							
24	KING COVE	9.5			Y															
25	W MARMOT I	11	DEC	5/30/89	Y	N														
26	E MARMOT I	9.5			Y							8/2/89	A093							
K02		192						0									0			
01	BLUE FOX B	23	ADEC	6/27/89		VL														
02	GRASSY I.	8	ADF&G	6/30/89		VL														
03	DEVIL'S B.	14.5	ADF&G	6/30/89		VL														
04	FOUL B.	18.5	SCAT	5/18/89	Y	L			X			8/1/89	A081							USFWS
05	FOUL B. SOUTH	7.9			Y															
06	S BAN IS.	7.5	ADEC	6/27/89	Y	L						8/4/89	A094	8/4/89				50		
07	PARAMANOF	8.5			Y															
08	PARAMANOFB	17.5	ADEC	6/27/89	Y	N						7/28/89	A040							
09	TANAAK C.	4	ADF&G	6/30/89	Y	L						7/30/89	A087							
10	N MALINA B	12	SCAT	5/19/89	Y	L			X			7/15/89	A031	8/4/89		A115/095/083				ADFG
11	S MALINA B	16.5	ADF&G	6/30/89	Y	VL						8/4/89	A116	8/4/89	8/4/89	A077				ADFG
12	STEEP C.	3.5	SCAT	5/19/89	Y	L						7/7/89	A013	7/7/89	7/24/89			100	7/30/89	
13	C. NUNILIAK	4.5	ADF&G	6/1/89		VL						8/1/89	A074	8/1/89	8/3/89			100	8/3/89	
14	MUSKOMEE	6	ADF&G	6/1/89		N						8/1/89	A074	8/1/89	8/3/89			100	8/3/89	
15	YUKUK B.	14	ADF&G	6/1/89		L						8/1/89	A074	8/1/89	8/3/89			100	8/3/89	
16	SELIEF B.	13	ADF&G	5/11/89		M						8/1/89	A074	8/1/89	8/3/89			100	8/3/89	
17	BEAR CR.	9										8/1/89	A074	8/1/89	8/3/89			100	8/3/89	
18	VABM	4																		
K03		102						0									0			
01	PILLAR C.	7.5	ADF&G	7/18/89	Y	N						7/24/89	A034	7/24/89	7/30/89			100	7/30/89	
02	IZHUT B.	24	ADF&G	7/18/89	Y	N			X			7/15/89	A014	7/15/89	7/18/89			100	7/27/89	ADFG
03	KITOI B.	16.5	ADF&G	7/18/89	Y	L						7/24/89	A033	7/26/89	7/31/89			100	7/31/89	
04	PERL C.	4	ADF&G	6/5/89	Y	N														
05	SELEZEN PT.	5	ADF&G	7/18/89	Y	VL														
06	MARY A BAY	11.5	ADF&G	7/18/89	Y	N						8/3/89	A105							
07	KAZAROF BAY	16.1	ADF&G	7/18/89	Y	N														
08	MARKA B.	7	ADEC	7/18/89		N														

report for a list ESI books and total number of quads involved.

Layer 4

Land Status: Primary sources of ADNR and USFS for PWS, ADNR and USFWS for CIK and KAP. Source materials include State status plats, State Land Administration System, and equivalent ownership documentation from USFS, USFWS, and NPS. The resolution is one section, or 640 acres. Where there is concurrent ownership in any given section by more than one agency, the indicated owner was decided by a general determination of which agency owned the 'larger' portion. All of this data has been captured at this time and is undergoing final agency review. This land status data has been incorporated into the database. However, it has not been fully integrated as yet. Full data integration will create database 'knowledge' as to which agency is the uplands owner of any coastline segment. This work is ongoing at this time.

It is important to note that this data layer does not address the issue of tidelands or submerged lands ownership. Only uplands owners are currently indicated. It is also important to note that there are many valid ownership boundaries that are of such a detail that they cannot be indicated at the current product scale of 1:63360. These issues must be addressed in the future.

Layer 5

Annotation: Primary source USGS 1:63360 quads. This work is currently under way using project staff, who are performing data entry, quality control, and database integration.

Layer 6

Hydrography: Primary source is BLM photo revised USGS quads already in digital format via the ADNR ADS Project, PWS and CIK areas. This data is being translated to the GIS database. For those areas (KAP) not already covered by ADNR digital data, existing sources will be sought out, and/or the group will provide this data input themselves, using the most current 1:63360 USGS quads. Quality control to assure that all data plots overlay each respective source quad has been assured by the ADS Project on

existing digital file. This work is ongoing at this point in time.

Layer 7

Geographic Referencing

Standard maps at the scale of 1:63,360 will be produced in the Universal Transverse Mercator Projection which can be co-registered with USGS quadrangle maps of the same scale. A UTM tic grid will be placed on each map and the appropriate UTM zone will be referenced. The UTM coordinates of any point can be scaled from the map with this grid.

A lat/long grid will not be used on these maps.

A township grid will be superimposed which will facilitate references made by land administrators who frequently maintain records by township and range. The township grid is based on the most recently released protraction files provided by the Bureau of Land Management. A section overlay will be provided with each atlas which will allow easy identification of any specific section.

Layer 8

Bathymetry

The marine mammals group has requested bathymetry data to assist with the description of otter habitat. However, these data have not been requested by the management team. USGS EROS has obtained a portion of NOAA bathymetry data. Example maps could be produced which might clarify their utility.

Layer 9

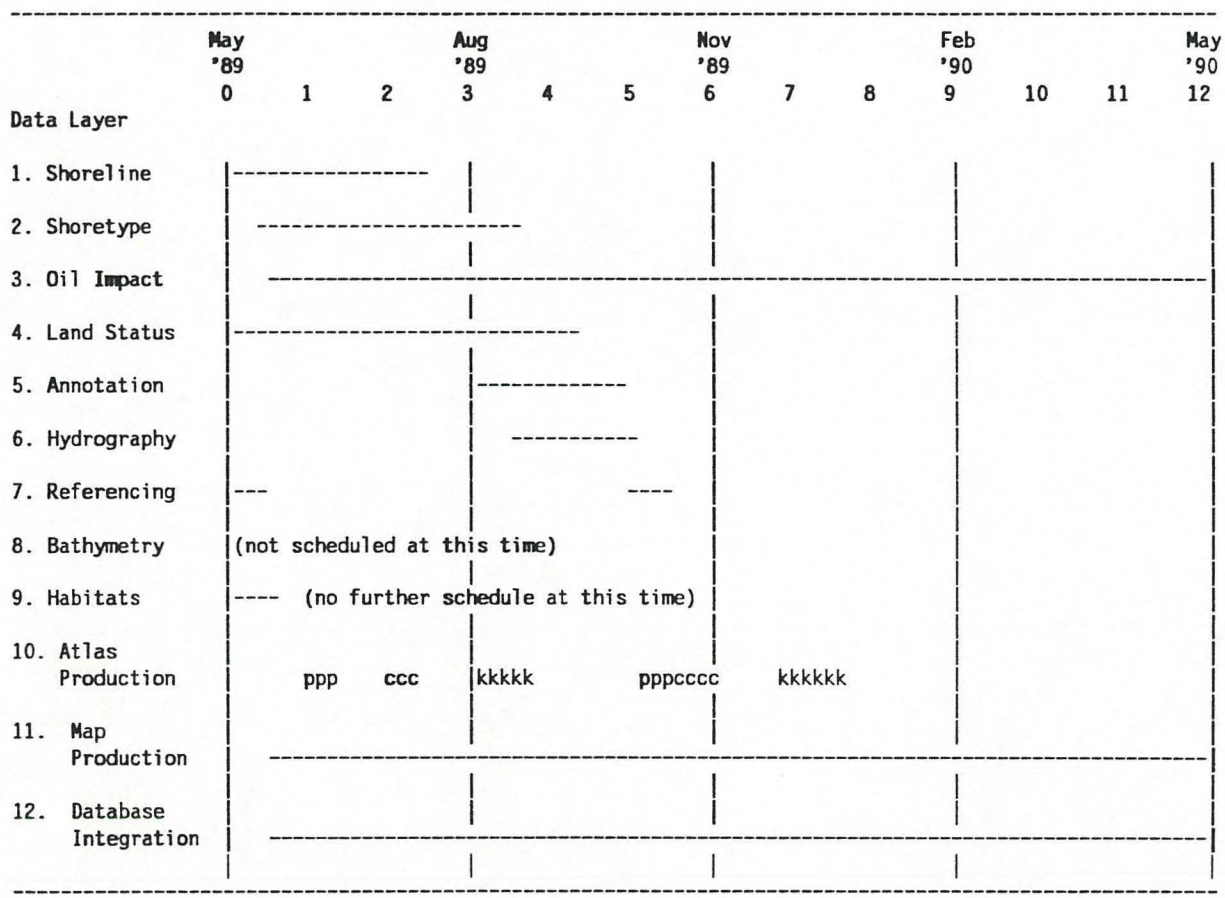
Habitats

Various public documents have recorded the location of important habitats such as bird rookeries, seal haul-outs, waterfowl nesting areas and so forth. Discussions with several different field biologists indicate that most documents are not current. No sustained effort has been made to capture these data at this time. Some of the point data from the ESI books on habitat is in the GIS database.

Mapping of Damage Assessment Data and Information

Schedule of Activity

Baseline Information



Notes:

1. Shoreline types are complete for PWS and CIK, final review by E. Gundlach is required for KAP region.

2. Oil impact data is based on air/water study number 1 in the CERCLA document. The database is updated through periodic monitoring. See Air/Water study #1 detailed plan for schedule of complete end of summer oil database.

3. Under **atlas production**, p refers to Prince William Sound, c refers to Cook Inlet, Kenai Peninsula; and k refers to the Kodiak, Alaska Peninsula area.

VI. BUDGET/PERSONNEL

1. Job Costing

2. What Study Plan Budget Bought

   A. U.S. Fish and Wildlife Service - USFWS

   B. Alaska Department of Natural Resources - ADNR

3. Costs To Date

   A. Overall Summary

   B. Personnel Costs Detail

   C. Cost Detail

      Travel, Contractual, Commodities, Equipment

4. Cooperative Resource Allocations

1. JOB COSTING

According to guidelines established by the CERCLA Management Team, the following budget / job costing procedures will be implemented for the GIS technical group.

The existing GIS technical group budget is to be used for the following purposes:

1. Work related to capturing, controlling, documenting, and integrating, etc. those data related to the foundation layers.

2. Primary service work associated with the foundation layers.

3. Administrative work associated with the foundation layers.

The ADNR $488.0 and USFWS $66.0 are dedicated through February 28, 1990 for this purpose.

The GIS technical group will create job costing procedures for the following categories of work:

1) Work related to capturing, controlling, documenting, and integrating those data related to thematic layers.

2) Primary service work associated with thematic layers.

3) Administrative work associated with thematic layers.

Generally these job costing procedures will work as follows:

1) GIS personnel resources will be calculated at an hourly cost to include benefits. Personnel will include direct service individuals, and administrative individuals required to facilitate the requisite work.

2) Supplies will be calculated at cost plus documented handling.

3) Equipment costs are currently covered under the existing GIS technical group budget and through agency cooperation.

4) Environmental costs such as space, lighting, etc. are currently covered under the existing GIS Group budget, and/or existing agency budgets.

5) Logistical handling such as mail, shipping, phone calls, will be tracked where feasible and calculated at cost.

As the GIS technical group works with a user/study group on jobs, the following steps will occur:

1) Based on information gathered from the user, the GIS technical group will give a 'best guess' estimate of time and materials.

2) Services will actually be contracted for on a time and materials basis.

3) The GIS technical group will report accumulated costs with associated backup to the user/study groups at monthly intervals.

4) The user/study group is responsible for tracking and paying these costs. The GIS technical group is responsible for assuring that all costs bought the maximum return on labor, supplies, etc.

5) The user/study group is responsible for implementing the financial mechanism required to make this money available for the GIS technical group to use, (as in State RSA).

2) **WHAT STUDY PLAN BUDGET BOUGHT**

A. USFWS and USFS

$50.0 USFS	Contract work at USGS/EROS to help produce initial atlas drafts and plot maps. This money has been totally consumed. Outstanding deliverable from EROS is database transfer to ADNR with associated database documentation.
$5.5 USF&WS	Monies used to purchase from ComRim Systems, Inc. 1:63360 coastline digital data over CIK and KAP quads. This product has been delivered.
$61.5 USF&WS	Monies used to purchase ESI data in digital format from ESRI company. This product has been delivered.
$66.0 USF&WS	These monies will be used in conjunction with ADNR to provide services/goods

through 2/90.

Budget	YTD Costs	Balance
$183.0	$117.0	$66.0

B. ADNR

The ADNR GIS Project, located within the Land Records Information Section, is charged as co-lead for the Technical Services Study Number 3, Mapping of Damage Assessment Data and Information.

Based upon projected workload analysis, ADNR requested a $488.0 budget prorated for the field season 7/1/89 through 2/28/90. The Study Plan budget is:

Salaries	$134.0
Travel	11.5
Contracts	58.0
Supplies	45.0
Equipment	239.5
	$488.0

This budget plan calls for 100% dedication of the following resources:

Personnel - Three full time positions to handle 1)Programming, 2) Data Modeling, 3) Data administration. Additionally these monies will provide overtime pay for existing staff.

Travel - Connecting with Management (Juneau) and field offices in Kodiak and Valdez.

Contractual - Equipment maintenance, training, etc.

Supplies - High volumes of paper, chemicals, graphic supplies, etc. will be consumed.

Equipment - ADNR has implemented an oil spill subsystem as listed below:

Plotter - High volume color map output

Two Workstations - Speed and storage to handle large graphic database

Ethernet - Connect the subsystem through the existing ADNR computer to access existing equipment (other terminals, plotter, disk drives, tape unit, etc.)

High Density Tape Backup - Provide high density media to archive database

Software - Licenses for plotter, workstation and Ethernet software

3. COSTS TO DATE 4/16/89 - 8/15/89

ADNR

A. OVERALL SUMMARY

Personnel

	Exxon/CERCLA/HB154	ADNR General Fund
Costs	$52,100	$53,475
Labor Hours	1,514.0	1,778.5

As one can see, the CERCLA/HB154 needs are currently being highly supplemented at this point in time via reprioritized ADNR General Fund resources. This is expected to diminish as the third of three HB154 positions become filled, and also hopefully as the schedule demands diminish.

Travel

Travel is costing less than expected so far through the utilization of the DEC Charter Flight system between Anchorage, Valdez, and Kodiak. It is not known if this will continue through the winter.

Contractual - Monies to date are for equipment maintenance.

Supplies - Monies to date are for supplies.

Equipment

To date, the CERCLA GIS work has used an average of 62.5% of ADNR's existing computer equipment (CPU & peripherals) capacity since April, 1989. This resource has not been charged for. Because ADNR could not take this oil spill workload without impacting existing work, ADNR requested to implement an oil spill computer subsystem through this study plan budget.

As of September 10, all major oil spill subsystem equipment was installed. Staff are now finalizing operating procedures

for this complex equipment.

All oil spill work will be moved to the subsystem, allowing ADNR to recoup the computer capacity funded by State General Funding that has been allocated since 4/15/89 to facilitate quick response to CERCLA mapping/information needs.

B. PERSONNEL COSTS/DETAIL Period 4/15/89 - 8/16/89

ADNR

	Labor Hours	Cost
Cooperatively Funded ADNR General Fund	1,778.5	$53,475
Exxon FY89/CERCLA/HB154	1,514.0	52,100
TOTAL	3292.5 hrs.	$95,575

COST DETAIL
(200 Travel, 300 Contractual, 400 Supplies, 500 Equipment)

State Fiscal Year 89 4/15 - 6/30/89

In addition to $36.6 to be charged through the State to Exxon for incremental labor, the project forwarded approximately $8,000 to Exxon for travel, supplies, misc. This was against an FY 89 supplemental budget amount of $8,100 for 200, 300, 400 categories.

State Fiscal Year 90/Field Year 7/1/89 - 2/28/90
(Costs as of 8/15/89)

	Budget	YTD Costs	Balance
200 Travel	11.5	$ 1,703	$ 9,797
300 Contractual	58.0	41,177	16,823
400 Supplies	45.0	17,301	27,699
500 Equipment	239.5	226,924	12,576
	354.0	287,105	66,895

3. **Cooperative Resource Allocations**

The selection of the ADNR Land Records Information Section, GIS Project as the production site (co-lead) for the CERCLA related mapping and statistical reporting needs was particularly attractive due to the existing Department expertise with large land appraisal exercises. Thus the

CERCLA process is benefiting from the Section infrastructure for administrative and managerial support, the existing four GIS positions, and the Department's mini computer equipment.

As of 8/15/89, the State has allocated more ADNR General Fund labor hours by a factor of 117%:

1,778.5 (General Fund hrs.)/1,514.0 (HB154 hrs.) = 117%

ADNR has also cooperatively shared an average of 62.5% of its GIS computing resources, in addition to the strong administrative support required for fast response to project implementation.

VII. Literature Cited

1. Environmental Sensitivity Index Maps
source: NOAA and MMS, pre-spill inventory from 1979 to 1984

ESI Book Name	Number of ESI Maps	Year
Prince William Sound	37	1983
Cook Inlet Kenai Peninsula	57	
Southern Alaska Peninsula	61	
Shelikof Straits	40	1983
Kodiak	45	
Total	240	

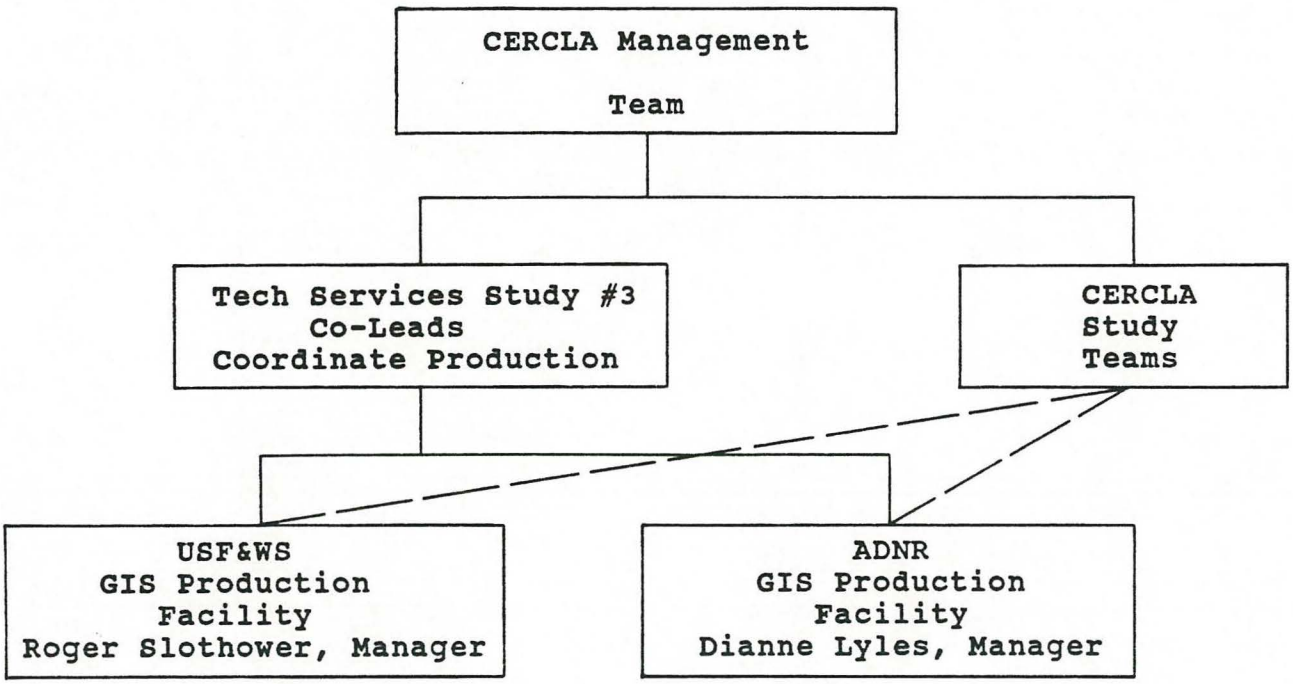
2. Please refer to citations from Pollution Abstracts at the end of this report for supplemental reference.

VIII. Additional Information

ORGANIZATIONAL CHART

Technical Services Study Number 3

Mapping of Damage Assessment Data and Information



VIII. Additional Information

PERSONNEL COSTING BACKUP
ADNR

Position	Name	Man Months
Section Chief	Dianne M. Lyles	hrs. to be determined and allocated cooperatively
GIS Manager	Richard McMahon	" "
Senior Modeler	Jean Tam	" "
Senior Analyst	Jim Jurgens	" "
GIS Programmer	Hal Brackett	" "
Admin. Assistant	Lex McKenzie	" "
GIS Technician oil spill	Marilu Koschak	8 months 7/89 - 2/90
Oil Spill Programmer	Kathryn Engle	8 months 7/89 - 2/90
Oil Spill Data Administrator	Vacant, soon to be filled	8 months 7/89 - 2/90
USFWS		
GIS Manager	Roger Slothower	hrs. to be determined and allocated cooperatively
GIS Production	Mark Kildow	" "
GIS Technician	Barbara Boyle	" "
GIS Technician oil spill	vacant	8 months 7/89 - 2/90
GIS Technician oil spill	vacant	8 months 7/89 - 2/90
USFS		
GIS Analyst	Zane Cornett	hrs. to be determined and allocated cooperatively
GIS Analyst	Bruce Williams	" "

PERSONNEL COSTING BACKUP[1]

ADNR/State General Fund Costs - April 15, 1989 to August 16, 1989

Position	Hrly Rate	# Hrs	Benefit Rate	$ Amount	% Reg. Time On Oil Spill
Section Chief (OT)[2]	29.90	73.5	1.19	2,615	
Section Chief (regular time)	29.90	356.0	1.34	14,263	55%
GIS Mgr. (4/15-7/15)	19.85	305.5	1.34	8,125	
GIS Mgr. (7/16-8/15)	21.93	147.0	1.34	4,319	70%
Senior Modeler (4/15-7/15)	18.49	282.5	1.34	6,999	
Senior Modeler (7/16-8/15)	19.85	98.5	1.34	2,620	59%
Senior Analyst	23.46	334.0	1.34	10,499	51%
GIS Programmer	17.26	138.0	1.34	3,191	21%
Admin Assistant	14.48	43.5	1.34	844	7%
		1,778.5		$53,475	

Assumes:
- 19% benefits for OT
- 34% benefits for regular time
- no consideration for other Section personnel with spill related support activities (estimated at $3000 - $5000)

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[1] All staff listed on this page are existing ADNR staff cooperatively allocated to this project.

[2] not compensated - no cash flow.

ADNR Personnel Costing Backup
Exxon/CERCLA/HB154 Costs

$36,600 FY 89 OT Charges for Exxon reimbursement

15,500 7/1 - 8/15/89 Oil Spill Payroll

$52,100 TOTAL

	# Reg Hrs	# OT Hrs	$ Amount
Section Chief		259.0	
GIS Manager		295.5	
Senior Modeler		199.5	
Senior Analyst		370.5	
GIS Programmer		130.5	
Admin Assistant		61.0	
Oil Spill Modeler (HB154 position)	75.0	6.5	
Oil Spill Analyst (HB154 position)	92.0	24.5	
	167.0 hrs.	1,347.0 hrs.	$52,100

Vacancy

Oil Spill Data Administrator (vacant, soon to be filled)
(HB154 position)

BIBLIOGRAPHIC REFERENCES FROM POLLUTION ABSTRACTS

5/L/1
88-03260
Fate and persistence of crude oil stranded on a sheltered beach
Owens, E.H.; Harper, J.R.; Robson, W.; Boehm, P.D.
Woodward-Clyde Consult., 7330 Westview Dr., Houston, TX 77055, USA
ARCTIC VOL. 40, NO. suppl. 1, pp. 109-123, Publ.Yr: 1987
SUMMARY LANGUAGE - ENGLISH, FRENCH; Special issue: Baffin Island Oil Spill (BIOS) Project.
Languages: ENGLISH
Journal Announcement: V19N3
Details observations, mapping and sampling were conducted following an experimentally spill of 15 m super(3) of crude oil adjacent to the coast at Cape Hatt, Baffin Island, N.W.T. The beach could not retain all of the oil that reached the shoreline, and as a result, one-third of the spilled oil was recovered in cleanup activities on the water, approximately one-third was lost to the atmosphere and to the ocean and one-third remained stranded on the intertidal zone. The stranded oil was subjected to natural cleaning during approximately 6 months of open-water periods from 1981 to 1983. Over this period the surface area of oil cover was reduced by approximately half, whereas estimates indicate that 80% of the oil initially stranded (5.3 m super(3)) was removed. The primary conclusion from the investigations undertaken to date is that oil is removed substantial quantities from the intertidal zone even in such a sheltered, low-energy arctic environment. Similar changes should also be expected from comparable environments in lower latitudes.
Descriptors: oil spills; marine pollution; beaches; Baffin I., Cape Hatt; research programs
Identifiers: BIOS

5/L/2
87-06366
Estimating and quantifying oil contamination on the shoreline
Owens, E.H.
Geosci. Serv. Ltd., 340 Stoneywood Rd., Dyce, Aberdeen AB2 9JX, UK
MAR. POLLUT. BULL VOL. 18, NO. 3, pp. 110-118, Publ.Yr: 1987
SUMMARY LANGUAGE - ENGLISH
Languages: ENGLISH
Journal Announcement: V18N5
A wide range of parameters can be used to describe the degree of oil contamination on the shoreline following a spill. This study compares five parameters, obtained by visual estimates and systematic ground mapping on a gravel beach at an experimental spill site. For shoreline cleanup decisions the most relevant parameters involves the measurement of the area of surface oil cover and calculation of the volume of contaminated sediments. Accurate estimates of the volume of oil on the shore require sampling and measurements of the concentrations of oil in the sediments. The reliability of aerial or ground estimates of the oil distribution on a gravel beach decreases with time as the colour of the surface oil changes to blend with the local sediments.
Descriptors: oil spills; contamination; marine pollution; sediments; monitoring measurements

5/L/4
87-04757
Measuring oil at sea by means of airborne microwave radiometry in the range 5-34 GHz

Gillot, R.A.; Toselli, F. (eds.); Skou, N.
Electromag. Inst., Tech. Univ. Denmark, Lyngby, Denmark
THE ARCHIMEDES 1 EXPERIMENT pp. 83-104, Publ.Yr: 1985
COMM. EUROPEAN COMMUNITIES, LUXEMBOURG (LUXEMBOURG)
ENVIRON. QUAL. LIFE SER., , ,
Languages: ENGLISH
The Technical University of Denmark (TUD) participated in the Archimedes oil spill remote sensing experiments with its airborne multifrequency imaging radiometer system - originally developed for sea ice investigations in the arctic region. Side-looking radars and multispectral scanners offer great potential for detection and mapping of oil spills on the sea, but the microwave radiometer offers, a unique potential for the determination of oil slick thickness, hence eventually total oil volume within the slick. So, there is at present within Europe a great interest in turning the microwave radiometer from a research instrument into an operational oil mapping and quantifying instrument.
Descriptors: oil spills; marine pollution; microwaves; pollutant detection
Identifiers: Archimedes 1

5/L/5
87-04754
Detecting oil at sea by means of a HH polarized side looking airborne radar
Gillot, R.A.; Toselli, F. (eds.); Madsen, S.
Electromag. Inst., Tech. Univ. Denmark, Lyngby, Denmark
THE ARCHIMEDES 1 EXPERIMENT pp. 51-64, Publ.Yr: 1985
COMM. EUROPEAN COMMUNITIES, LUXEMBOURG (LUXEMBOURG)
ENVIRON. QUAL. LIFE SER., , ,
Languages: ENGLISH
The Technical University of Denmark (TUD) participated in the Archimedes oil spill remote sensing experiments with its SideLooking Airborne Radar (SLAR) and its multifrequency imaging radiometer system. The purpose of the SLAR measurements was first of all to provide large scale mapping of oil spills, indicating spill position and extent.
Descriptors: oil spills; remote sensing; pollutant detection; marine environments

5/L/6
85-04808
A review of the impacts and recovery of intertidal habitats and communities following accidental oil spills
Martin, L.C.
ESL Environ. Sci. Ltd., Vancouver, B.C., Canada
11. Annual Aquatic Toxicity Workshop Richmond, B.C. (Canada) 13-15 Nov 1984
ABSTRACTS OF PAPERS PRESENTED AT 11th ANNUAL AQUATIC TOXICITY WORKSHOP, RICHMOND, B.C., NOVEMBER 13-15, 1984 (np),
SUMMARY LANGUAGE - ENGLISH; Summary only.
Languages: ENGLISH
A recent review of worldwide oilspill case histories and followup studies has indicated that intertidal habitats and organisms are frequently the resources which have been most visibly affected following oil spills. The impacts and recovery of intertidal communities following these events has varied widely depending on the circumstances surrounding the spill and the characteristics of the intertidal habitat and community affected. This paper examines the contribution of some of these factors to the impact and recovery of intertidal habitats and communities.
Descriptors: oil spills; marine pollution; ecosystems

5/L/8

85-00182
Simulation of spilled oil behavior in bays and coastal waters
Hess, K.W.
NOAA TECH. MEMO Publ.Yr: 1983
NWS/TDL, SILVER SPRING, MD (USA)
SUMMARY LANGUAGE - ENGLISH; NTIS Order No.: PB84-122597; NOAA-TM-NWS-TDL-CP-83-2.
Languages: ENGLISH
OILSPILL is a computer program designed to forecast the behavior of floating oil in the coastal zone. The program, written in FORTRAN IV, runs on the AFOS (Automation of Field Operations and Services). Data General Eclipse S/230 computer. It can be stored on floppy disk and retrieved when it is to be run. The program, which is run at the Alphanumeric Display Module (ADM), requires input such as oil spill location, map parameters, and wind and water current forecasts.
Descriptors: simulation; oil spills; pollutant dispersion; bays; coastal water; computer programs; marine pollution

5/L/9
84-05601
Calculations of seabird population recovery from potential oilspills in the mid-Atlantic region of the United States
Samuels, W.B.; Ladino, A.
U.S. Miner. Manage. Serv., Mailstop 644, Reston, VA 22092, USA
ECOL. MODEL VOL. 21, NO. 1-2, pp. 63-84, Publ.Yr: 1984
SUMMARY LANGUAGE - ENGLISH
Languages: ENGLISH
Calculations were made of herring gull (Larus argentatus) and common tern (Sterna hirundo) population recovery from potential oilspill damage in the U.S. mid-Atlantic Outer Continental Shelf (OCS) oil leasing area. Population recovery was examined using a density-dependent age-specific life history table for each species. Both a deterministic and a stochastic approach were used in the calculations. In the deterministic approach, it was assumed that an oilspill contact to a seabird colony had occurred. Using the density-dependent model, population recovery was calculated for several different mortality scenarios. Assuming that all age classes suffer 95% mortality from an oilspill contact, a worst case scenario, it was estimated that the herring gull and common tern populations could recover to their pre-spill levels in approximately 45 years and more than 100 years, respectively.
Descriptors: oil spills; Larus argentatus; Sterna hirundo; mathematical models; population dynamics; wildlife

5/L/11
79-06455
NOAA surface mapping radar: Theory and application.
Evans, M.
NOAA, Wave Propagation Lab., R45x5, 325 S. Broadway, Boulder, CO 80302
Energy/environment '78: A symposium on energy development impacts Los Angeles, CA Aug. 22-24, 1978
Energy/environment '78: A symposium on energy development impacts: Proceedings. Edited by J. Siva-Lindstedt Publ.Yr: (1978?) pp. 259-270
(n.p.)
illus. refs.
Abs.
Languages: ENGLISH
Doc Type: CONFERENCE PAPER
The NOAA has developed a remote sensing instrument for the measurement of surface currents over large areas of oceans. This system utilizes the backscatter of a surface current-induced Doppler shifted signal from 6-m ocean waves. A single map, containing 800 surface current vectors and

covering 2,000 km2 of ocean, can be produced in J8 min. The CODAR (Coastal Ocean Dynamics Radar) system was successfully tested in Florida, Alaska, California, Georgia, and Washington over the previous 2 yr. Some areas for potential use for this system include real time oil spill trajectory monitoring, environmental impact studies, beach erosion studies, coastal zone management, and nuclear power plant thermal plume trajectory analysis. (AM, FT)

Descriptors: Measuring instruments; Currents; Oceans; Monitoring systems; Oil spills; Beaches; Erosion; Coastal zones; Resource management; Thermal discharges; Nuclear power plants; Remote sensing

Identifiers: CODAR; radar

5/L/12
79-05225

Oilspill has minimal effect on environment.

Koons, C. B.; Wheeler, R. B.

NORTHERN OFFSHORE 7(5), 24-25, Publ.Yr: May 1978 Coden: NROFA9

illus. no refs.

Sum.

Languages: ENGLISH

Doc Type: JOURNAL PAPER

About 400,000 T/yr of petroleum enters the North Sea and northeastern Atlantic, 95% of which comes from industrial wastes, transportation operations, and river and urban runoff. The estimated standing crop of dispersed hydrocarbons in the North Sea is 1.6 million t. The estimated standing crop of particulate petroleum floating on the surface is j180 t. The Ekofisk Bravo blowout which spilled 12,000-20,000 t appears rather insignificant when compared with the total standing crop of dispersed hydrocarbons. Physical, chemical, and biological factors which act on petroleum following an oil spill to lessen the possible effects on human and animal life are evaporation, biodegradation, drifting, and spreading. Studies in warm and cold marine waters confirm that although fish and other marine animals take up hydrocarbons, they are able to metabolize them. Priority should be given to protection of bays, estuaries, and marshes, areas most biologically productive; once these environments are contaminated, oil tends to persist longer. Short and long-term effects on birds were slight. (SS, FT)

Descriptors: Oil spills; Oil pollution; Environmental impact; Hydrocarbons; North Sea; Petroleum; Marine environments; Industrial wastes; Runoff; Toxicity; Marine organisms

Identifiers: Ekofisk Bravo blowout

5/L/13
79-03900

Risk forecasting for the Argo Merchant spill.

Wyant, T.; Smith, R. A.

USGS, National Center, Reston, VA 22090

In the wake of the Argo Merchant Kingston, R. I. Jan. 11-13, 1978

In the wake of the Argo Merchant: Proceedings of a symposium Publ.Yr: Aug. 1978 pp. 28-33

Publ: Kingston, R. I. University of Rhode Island, Center for Ocean Management Studies

illus. refs.

Abs.

Languages: ENGLISH

Doc Type: CONFERENCE PAPER

An oilspill trajectory model, originally developed to assess environmental risks of Outer Continental Shelf oil production, was used during the Argo Merchant spill to forecast the risk to various shoreline and marine resources. The model indicated a low risk to these resources given the location and season of the spill and the particular wind

conditions under which the spill occurred. Oil from the Argo Merchant, in fact, contacted few of these resources. Had a spill at this location occurred under other typical wind conditions for the season or at a different time of year, the risk would have been much higher. Quantitative estimates of risks were constructed assuming different initial conditions, seasons, and durations of spillage. (AM)
Descriptors: Oil spills; Pollutant dispersal; Massachusetts Coast; Pollution forecasting; Mathematical models
Identifiers: Argo Merchant

5/L/14
79-02745
The effects of Bunker C oil and an oil dispersant: Pt. 2-effects on the accumulation of chlorine-labelled Bunker C oil in various fish tissues.
McKeown, B. A.; March, G. L.
Simon Fraser Univ., Dept. of Biological Sciences, Burnaby, B.C. V5A 1S6, Can.
MARINE ENVIRONMENTAL RESEARCH 1(2), 119-123, Publ.Yr: Oct. 1978
illus. refs.
PA Citation No. 79-00268 Abs.
Languages: ENGLISH
Doc Type: JOURNAL PAPER
Fish were exposed to 150 ppm concentrations of Bunker C and Oilsperse 43 for 24 hr prior to killing and tissue removal. There is an increased movement of the emulsified oil across the gill structure although accumulation by this tissue is similar for both test conditions. The liver and kidney showed significantly higher levels of the oil/dispersant mixture whereas muscle accumulations were less dramatic. The amounts of Bunker C found in the gills, liver and kidney were considerably higher than that found in the muscle. Consideration was given to the varying capability of the blood to carry polar, compared with non-polar, compounds. (AM)
Descriptors: Fuel oils; Fish; Tissues; Toxicity; Hydrocarbons; Oil removers
Identifiers: Bunker C oil; Oilsperse 43

7/M/2
86-04708
Oil concentrations in seawater following dispersion with and without the use of chemical dispersants: A review of published data
Chapman, P.
Sea Fish. Res. Inst., Private Bag X2, Rogge Bay 8012, Cape Town, South Africa
SPEC. REP. SEA FISH. RES. INST. S. AFR./SPES. VERS. NAVORSINST. SEEVIS. S.-AFR NO. 2, Publ.Yr: 1985
?TYPE S7/M/3-25^H^H51

7/M/4
85-04860
Laboratory evaluation of chemical dispersants for use on oil spills at sea
Anderson, J.W.; McQuerry, D.L.; Kiesser, S.L.
Battelle, Mar. Res. Lab., Sequim, WA 98382, USA
ENVIRON. SCI. TECHNOL VOL. 19, NO. 5, pp. 454-457, Publ.Yr: 1985
SUMMARY LANGUAGE - ENGLISH

7/M/5
85-03421
Toxicity testing of oil spill dispersants in South Africa
Moldan, A.G.S.; Chapman, P.

Address not stated
S. AFR. J. MAR. SCI./S.-AFR. TYDSKR. SEEWET NO. 1, pp. 145-152, Publ.Yr: 1983
SUMMARY LANGUAGE - AFRIKAANS, ENGLISH

7/M/12
81-07906
Industry's Role in Preparation of ASTM Spill Control Consensus Standards
Leek, W.R.
Chevron USA, Inc.
Int. Oil Pollut. Prevent. Conf.(IOPPEC) Hamburg, W. Ger. 1980
IN "INT. OIL POLLUT. PREVENT. CONF. Publ.Yr: 1980
HAMBURG MESSE & CONGRESS GMBH, W. GER.

7/M/13
81-06696
Oil Spill Contingency Plans and Policies in Norway and the United Kingdom
O'Neill, T.
Sch. Forestry and Environ. Studies, Yale Univ., Hartford, CT
COASTAL ZONE MGMT. J VOL. 8, NO. 4, pp. 289-317, Publ.Yr: 1980

7/M/14
81-05247
Oil Spill Contingency Plans and Policies in Norway and the United Kingdom
O'Neill, T.
Sch. Forestry and Environ. Studies, Yale Univ.
COAST. ZONE MGMT. J VOL. 8, NO. 4, pp. 289-319, Publ.Yr: 1980

7/M/15
81-01174
Improved identification of spilled oils by infrared spectroscopy.
Bentz, A. P.; Anderson, C. P.; Killeen, T. J.; Taft, J. B.
USCG, Research and Development Center, Groton, CT 06340
E S & T 14(10), 1230-1234, Publ.Yr: Oct 1980 Coden: ESTHAG
illus. 16 refs.
Abs.

7/M/17
80-07326
The plankton.
Hirota, J.
Univ. of Hawaii, Hawaii Inst. of Marine Biology, P.O. Box 1346, Kaneohe, HI 96744
Oil spill studies: Strategies and techniques workshop
National Oceanic and Atmospheric Administration; Bureau of Land Management; American Petroleum Institute
JOURNAL OF ENVIRONMENTAL PATHOLOGY AND TOXICOLOGY 3(1-2), 63-89, Publ.Yr: Dec 1979 Coden: JEPTDQ
illus. no refs.
Sum.

7/M/18
80-07306
Oily water discharges from offshore North Sea installations: A perspective.
Read, A. D.; Blackman, R. A. A.
UK Dept. of Energy, Thames House S., Petroleum Eng. Div., Millbank, London SWIP 4QJ, England
MARINE POLLUTION BULLETIN 11(2), 44-47, Publ.Yr: Feb 1980 Coden: MPNBAZ

illus. refs.
Sum.

7/M/19
80-07021
Developments in policy and law.
Malanczuk, P.
Univ. of Exeter, Faculty of Law, Stocker Rd., Exeter, England
ENVIRONMENTAL POLICY AND LAW 5(4), 179-185, Publ.Yr: Oct 1979
Coden: EPLAD5
refs.
No abs.

7/M/22
80-03467
They mop up after hazardous material spills.
Anonymous
CHEMICAL WEEK 126(4), 42, Publ.Yr: Jan 23, 1980 Coden: CHWKA9
no refs.
No abs.

7/M/25
80-00062
Emissions from in situ burning of crude oil in the Arctic.
MacKay, D.; Day, T.; Nadeau, S.; Thurier, R.
Univ. of Toronto, Dept. of Chemical Eng. and Applied Chemistry, Toronto, Ontario M5S 1A4, Canada
WATER, AIR, AND SOIL POLLUTION 11(2), 139-152, Publ.Yr: Feb 1979
Coden: WAPLAC
illus. refs.
ISSN: 0049-6979
Abs.

7/M/26
79-05313
Instrument quickly detects hydrocarbon spills in 0-10 ppm range: Provides early warning for fast correction.
Anonymous.
CHEMICAL PROCESSING. CHICAGO 41(13), 110, Publ.Yr: Mid-Nov. 1978
Coden: CHPCAI
illus. no refs.
No abs.

7/M/27
79-04965
Parliamentary action on the Amoco Cadiz.
Nagel, S.
Inst. for European Environmental Policy
ENVIRONMENTAL POLICY AND LAW 4(4), 167-169, Publ.Yr: Dec. 1978
Coden: EPLAD5
illus. refs. (1 in Fr.)
No abs.

7/M/28
79-02774
Setting standards for chronic oil discharges in the North Sea.
Fischer, D. W.; von Winterfeldt, D.
International Inst. for Applied Systems Analysis, Laxenburg, Austria
JOURNAL OF ENVIRONMENTAL MANAGEMENT 7(2), 177-199, Publ.Yr: Sept. 1978 Coden: JEVMAW

illus. refs.
Abs.

7/M/29
79-02747
Experiments with Littorina species to determine the relevancy of oil spill data from southern California to the Gulf of Alaska.
Straughan, D.; Hadley, D.
Univ. of Southern California, Inst. of Marine and Coastal Studies, Los Angeles, CA 90007
MARINE ENVIRONMENTAL RESEARCH 1(2), 135-163, Publ.Yr: Oct. 1978
illus. refs.
Abs.

7/M/30
79-02723
Who spilled the oil?
Bentz, A. P.
USCG, R & D Center, Avery Pt., Groton, CT 06340
ANALYTICAL CHEMISTRY 50(7), 655A-658A, Publ.Yr: June 1978 Coden: ANCHAM
illus. refs.
Sum.

7/M/31
79-02420
Legal control of pollution from North Sea petroleum development.
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