# 6 Field Methods for Oil-Spill Response

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# Chapter 6.
# Field Methods for Oil-Spill Response

## Introduction

Oil spills, by their very nature, create a sense of urgency and chaos with respect to the collection of meaningful field data. To do so requires discipline and a systematic approach. In this chapter, we present a number of methods that have proved useful to us in gathering data at dozens of oil spills. It is important that the methods used are relatively simple and that the same methodology is followed throughout the spill response. In this discussion, emphasis is placed on gathering data relevant to making clean-up decisions and recommendations for protection of resources at risk.

## Reconnaissance Studies of Large Areas

Hayes et al. (1973) developed a systematic sampling program for rapidly classifying large sections of coastline in Alaska. This method, called the Zonal Method, has been modified somewhat for application in the assessment of the initial extent and persistence of oiling at major oil spills.

This modified zonal method is described in detail below:

1) Collection and study of available literature, aerial photographs, maps, and charts occurs as soon as possible. Maps on the scale of 1:24,000 are available from the U.S. Geological Survey (USGS) for most sections of the United States. These are most useful for delineating oil distribution, as well as for determining coastal geomorphology. Charts of all U.S. coastal areas may be obtained from NOAA and are usually readily accessible from marinas in the impacted area. Aerial photographs are more difficult to obtain rapidly and have to be ordered through either the federal or state government.

2) An aerial overflight of the entire area is conducted during low tide to observe maximum exposure of the intertidal area. An aerial survey allows an extremely rapid assessment of the entire spill site and is especially useful in determining the relationship between regional geomorphology and oil distribution. Inflight observations are recorded both verbally on tape and photographically with a hand-held 35-mm camera (for details, see discussion on photography which follows), or a videocamera (preferably both). The flight is conducted at 500-1,500 ft. altitudes, although higher or lower altitudes

can be taken if desired and local flight regulations permit it. Either a helicopter or fixed-wing (high-wing) aircraft may be used.

3) Specific areas are selected for detailed study, based on the aerial survey, local maps, and oil distribution. The sampling interval depends on the variety of coastal types, as well as logistical and financial considerations. Areas selected are representative of the local geomorphology, habitat type, and oil distribution.

4) Two types of stations are set up: (a) visual inspections stations and (b) zonal stations.

   Visual inspection stations. - These sites are surveyed rapidly to determine coastal type, aerial extent of oil coverage, and the thickness and depth of buried oil layers as observed in small trenches dug across the beachface. The value of these studies, usually initiated to establish habitat protection and clean-up priorities, is greatly enhanced if the field team includes an experienced field ecologist. Ideally, the team should include: (a) a coastal geomorphologist; (b) a coastal ecologist; and (c) a field technician well-versed in chemical sampling techniques. Photographs are taken to document oil distribution, biological impact, and coastal morphology. Notes taken are recorded in a field notebook and verbally on tape.

   Zonal stations. - The oil distribution, sediment type, biota, and geomorphology at these stations are studied in much greater detail than at the visual inspection stations. The following tasks are performed at each station:

   a) A topographic profile is run from the back beach to seaward of the low water line, using a horizon-leveling technique which will be demonstrated in the field. Two permanent stakes are established, a back stake (BS) located well back of the normal storm wave erosion zone, and a front stake (FS) just behind the spring high-tide swash line. The profile is run within two hours of low tide in microtidal (TR = 0-2 m) or mesotidal (TR = 2-4 m) areas. In macrotidal areas (TR = >4 m), the upper intertidal zone is exposed for a greater amount of time, and profiles can be run within three hours of low tide. Examples of both blank and completed profile data sheets used for these surveys are given at the end of this chapter. At each horizontal-distance reading on oiled beaches (usually a maximum of 3 m), it is necessary to record the change in elevation, the percent oil coverage (estimated along that section of beach) and the oil thickness (as read off the profile rod). Comments noted on the profile sheet should include sediment type, geomorphic variations (berm crest, cusp horn, etc.), oil appearance, and biological information (species and abundance). The high-tide swash line and water level should be indicated. Stake heights are recorded in case erosion or deposition occurs that far up the beach between repetitive profiles.

b) Sediment samples are taken at three equidistant sites along the profile. Sampling sites are usually marked before running the profile, so they can be appropriately located on the profile sheet. If possible, an unoiled sample is taken for textural analysis; otherwise, the oil will have to be removed by a tedious chemical process. In some cases, surface oil should be scraped away. The sediment sample should consist of 100-200 g of sediment taken to a depth of 10-15 cm. If the sediment is coarse gravel, a photograph (with scale) is taken of the site and the grain size is estimated using the comparator chart given in Figure 3-14. Sediment size may also be measured from the projected image after the photograph is developed. If time and costs demand, one sediment sample taken at the mid beachface will suffice. The remaining sampling sites should be described in detail as to sediment size and sorting.

   Oiled sediment samples of both surface and subsurface oil contamination are usually collected. In gravel areas, surface samples may be individual clasts placed into the sample jars for analysis, usually for detailed characterization and analysis of weathering trends. In non-gravel areas, the surface samples come from the top 2 cm of sediment. Subsurface samples are collected from discreet intervals, frequently from the bottom of the oiled sediments in trenches dug in the beach. Other intervals are collected as appropriate. No samples are composited; the samples are usually “grab” samples. All samples are numbered sequentially, with surface samples denoted ‘A’; subsurface samples denoted ‘B’; and so on. Samples are collected with clean scoops and placed in pre-cleaned glass jars with teflon-lined caps.

c) Visible effects of the oil on biological communities are observed and recorded. The location and distribution of oiled (and clean) sessile organisms are photographed and described in order to determine temporal changes in the population. In each case, a 15-cm or 30-cm scale is placed in the picture in order to determine the area of the surface photographed (e.g., 0.8 $m^2$) for mortality counts. In most cases, more detailed biological surveys augment and expand upon the findings of the reconnaissance surveys.

d) Trenches are dug along the profile line to discern the distribution of buried oil. The thickness, depth of burial, and general consistency of the oil are described. Photographs are taken of all the trenches. On some sand beaches, it is useful to dig a trench across the entire beachface. Data concerning the extent of buried oil are necessary to accurately determine the quantity of oil incorporated within the intertidal zone. Samples are usually taken of the oiled layers within the trench to determine quantity and composition of the oil.

e) A hand-drawn sketch is made of the zone surrounding the profile line to force the geomorphologist to carefully observe all aspects of the site. Both a blank and filled-in examples of field sketch forms are given in the materials at the end of this chapter. On the sketch, the following should be noted:

1) Beach morphology
2) Profile line
3) Sample locations
4) Oil distribution
5) Trench locations
6) Depth of buried oil
7) Critical epifauna and flora
8) Cleanup operations if in progress (or effects if completed)
9) All samples taken
10) All photographs taken

5) Sand samples are analyzed for size characteristics by standard sieving techniques (Folk, 1968) or by a rapid sediment analyzer. If these instruments are not readily available or time is critical, grain size can be estimated using a grain-size comparator which illustrates premeasured size classes for direct comparison to the sample (using a hand lens).

6) The coast is categorized into its geomorphological components and oil distribution is superimposed onto base maps. Oil distribution may be categorized as follows*:

| | | |
|---|---|---|
| Very light | - | <5 percent coverage (of the intertidal zone) |
| Light coverage | - | 25 percent coverage |
| Moderate coverage | - | 25-65 percent coverage |
| Heavy coverage | - | >65 percent coverage |

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* These boundaries and terms (i.e., very light, light, moderate, heavy) are frequently in dispute at a spill. The measures need to be standardized.

7) Follow-up surveys and overflights are necessary to determine longer-term oil retention, cleanup effectiveness, and geomorphic changes.

The following equipment is required to carry out this type of reconnaissance survey:

Cameras (including video cameras)

Two profile rods (1.5 m long marked at 2 cm intervals)

Day pack, which contains: a) plastic sediment sample bags, b) photo scales, c) hand level, d) compass, e) sand grain-size comparator, f) hand lens, g) measuring tape (30 m, marked in cm), h) film, i) Write-in-the-Rain field notebook, j) orange surveyor's marking tape and orange spray paint, and (k) a tool for scraping sides of trenches (e.g., plasterer's trowel).

Plastic, box-type clip board, which contains: a) profile sheets, b) sketch sheets, c) gravel grain-size comparator, d) percentage estimate chart, e) roundness chart, f) plastic one-foot rule (marked in cm), g) extra lead pencils (plus erasers), h) magic markers, and i) sample-labeling tape.

Four-foot stakes to mark survey sites, two per site—2 x 2 wood stake for front stake and metal fence post for back stake.

Shovels and sledge hammers.

## Photography

Professional quality photographs are absolutely essential during spill response. Photographs convey ideas and information much more effectively than written words alone. In transmitting data, a photograph should assist—not confuse and irritate—the audience. Video-taping equipment is a necessity for documenting spill occurrence and distribution. Following are some helpful hints to avoid some of the common pitfalls made by scientists photographing an oil spill site.

1) Film is cheap!! Don't be afraid to take pictures. The expenses associated with a scientific oil spill response often run into hundreds of thousands of dollars.

2) Cameras. The field camera must be durable, preferably lightweight, and have a through-the-lens light meter. Many of the new 35-mm, single-lens, reflex compact cameras by Nikon, Minolta, Olympus (etc.) fulfill these requirements.

3) Lens. A 50-mm or 55-mm lens gives the viewer the most realistic picture of the object. A low F-stop (1.4-1.8) is necessary to be able to take pictures under varying light conditions. A UV filter should be used to protect the lens. The use of a polarizing filter during good light conditions eliminates much of the glare coming off the water (used primarily during overflights, unless the sun is extremely bright).

4) Beach Shots. At least three photographs should be taken of the beach: (1) up and (2) down the coast and (3) directly perpendicular to the beach. At zonal stations, additional photographs should include those of the profile line, trenches, and all aspects of oil distribution and biological effects. A person in the photograph is useful for discerning scale and depth of field.

5) A Straight Horizon. One of the most common problems for the beginner coastal photographer in taking pictures is a crooked horizon—make sure it is straight! In order to present a balanced photograph, it should be composed of approximately one-third sky (sometimes less) and two-thirds land.

6) Shutter Speed. The slower the shutter speed, the greater the depth of field. We most often use 1/125 of a second or 1/60 of a second during darker conditions.

7) Film Type. We have found that Kodachrome-64 gives us good pictures both on the beach and during overflights. It is a wide-latitude film capable of absorbing exposure errors, gives natural colors, and does not appear grainy. Good quality black-and-white prints can also be made. In addition to K-64, we also take some high-speed Ektachrome (ASA 400) in the field in case of poor light conditions. Film is constantly being upgraded. We recommend that you experiment with other types of film. But, don't use it at a critical spill until you have tried it on a beach somewhere.

8) Bracketing. Take the shots you feel are most important as your light meter reads, and then two others at ±1/2 F-stop. This will be a better guarantee of getting the correct exposure. Always check your light meter against other cameras. Change the battery regularly.

9) Shooting into the Sun. On a bright day (looking toward the sun), your camera will read at a closed aperture. This will result in an underexposure or a dark photograph of the beach. In order to get the correct exposure, take the light reading out of the sun's glare or open up the aperture 1/2 to 1 F-stop.

10) Close-Up Photographs. For determining the biological and geological impact of an oil spill, the close-up photograph is most useful. In all cases, an object of well-known size must be placed in the photograph for scale. Preferably, the scale should be marked in centimeters and placed in the lower right-hand corner of the photograph. The 15-cm scale that you will receive at the course works very well. NEVER place the scale in the center of the photograph. The camera should be held parallel to the surface to be photographed to prevent out-of-focus edges.

11) Aerial Photographs. Aerial photographs are usually down-stopped 1/2-1 F-stop. The exact setting varies greatly from camera to camera and should be tested beforehand. If you are not sure about your camera, shoot straight on. Shutter speed should be set at 1/250 or faster, if possible. Don't steady the camera by leaning against the plane (vibrations!). Photographs should be taken through an open window or door, if possible; if not, at least make sure the window is clean. Again, be careful to avoid crooked horizons. Also, beware of reflections—wear dark shirts to minimize reflection.

## Guidelines for Detailed Shoreline Contamination Surveys

At any spill of a significant size, a repetitive, detailed systematic survey of the extent and degree of shoreline contamination is needed for:

1) Assessment of the need for shoreline cleanup.
2) Documentation of spatial oil distribution over time.
3) Internally consistent historical record of stranded oil patterns for use by other scientific surveys on intertidal and nearshore subtidal impacts.

Survey teams must use uniform terminology for describing shoreline oil. If all survey teams are using the same terms and definitions, then there is a greater likelihood of consistency in oil reports. Therefore, the attached shoreline survey forms were developed for recording field observations on the extent and degree of shoreline contamination. These forms are similar to those used at the *Exxon Valdez* spill, the development of which was spearheaded by Ed Owens and other Woodward Clyde, Inc. scientists under contract with Exxon. The forms given in this manual were customized by J. Michel of RPI to the spill conditions and coastal geomorphology of the Arabian Gulf. Each geographic area impacted by a spill will require that minor modifications be made to these forms in order for them to conform to the local geomorphological, ecological, and oiling conditions.

During a shoreline survey, the entire shoreline should be systematically inventoried. If this is not possible, then selected sites representative of a larger area should be surveyed in more detail. Individual sites should be on the order of several hundred meters long. These representative sites can be monitored over time for tracking the changes in oil distribution. The temporal changes in the stranded oil will provide important information on the need and priorities for shoreline cleanup.

There are four different pages to the survey forms. The Shoreline Oil Terminology/Codes sheet lists all the terms to be used to describe the oil, sediments, and other features, on the forms and sketches. Training of the survey teams should include review of photographs and videos of each type of oil and extensive discussion of the range of types likely to be encountered in the field. The sheet should be taped to a clipboard for ready referral in the field.

The Shoreline Survey Form is used to record the observations at each site in a systematic manner. For each type of oil on the shoreline, the team would enter in check marks for the distribution and location by tidal zone. For example, the dimensions of individual asphalt pavements and tar mats would be recorded; each tar mat or pavement would be numbered and shown on the attached site sketch. Any trenches dug to observe subsurface oil would also be numbered and located on the attached sketch. For each trench, the form allows ready recording of the depth of the trench, its location in the intertidal zone, a description of the subsurface oil, the depth interval of the subsurface oil, the depth of the water table, and the nature of the subsurface sediments. With this type of information, repeat surveys can be made to measure the change in both surface and subsurface oil over time.

Two types of sketches are recommended. The site sketch should cover the entire shoreline section being surveyed, in plan view. The coastal geomorphology and oil distribution should be shown. The location and number of tar mats, asphalt pavements, trenches, etc. are delineated. The sketch is very important; it allows others to get a sense of the site and interpret the other data on the forms. Because of the scale of most sites, no photograph can capture the site, except for low-altitude aerial photography. The sketch also forces the team to make systematic and more complete observations. Attached is an example site sketch. Any symbology used on the sketch should be added to the legend. For example, different patterns can be used to show substrate types. The codes should be used as abbreviations on the sketch.

A second type of sketch form is for recording trench descriptions. These descriptions are very important in recording the nature of buried oil, which may pose longer-term problems with oil persistence and beach erosion. The Trench Description Form allows for quick recording of the sediments and oiling with depth. This information will be critical in assessment of the potential volumes of sediment removal, if needed. Trench descriptions from the 1991 *Exxon Valdez* surveys are included as examples. The presence and extent of buried oil has both operational and scientific applications.

## References

Folk, R.L. 1968. Petrology of sedimentary rocks. Austin: Hemphill's Publ. 186 pp.

Hayes, M.O., E.H. Owens, D.K. Hubbard, and R.W. Abele. 1973. Investigation of form and processes in the coastal zone: in D.R. Coates (Ed.), Proc. 3rd Annual Geomorphology Symp. Series, Binghamton, N.Y., pp. 11-41.

PROFILE ________________ LOCATION ______________________________ DATE __________________

RECORDERS ______________ PHOTOGRAPHS ___________________________ TIME __________________

TIDE STAGE ______________ WEATHER ______________ WIND SPEED ___________ DIRECTION _________

PROFILE ANGLE ___________ BREAKER HT. _________ BREAKER ANGLE _______ BREAKER TYPE _________

SEDIMENT TYPE _________________________

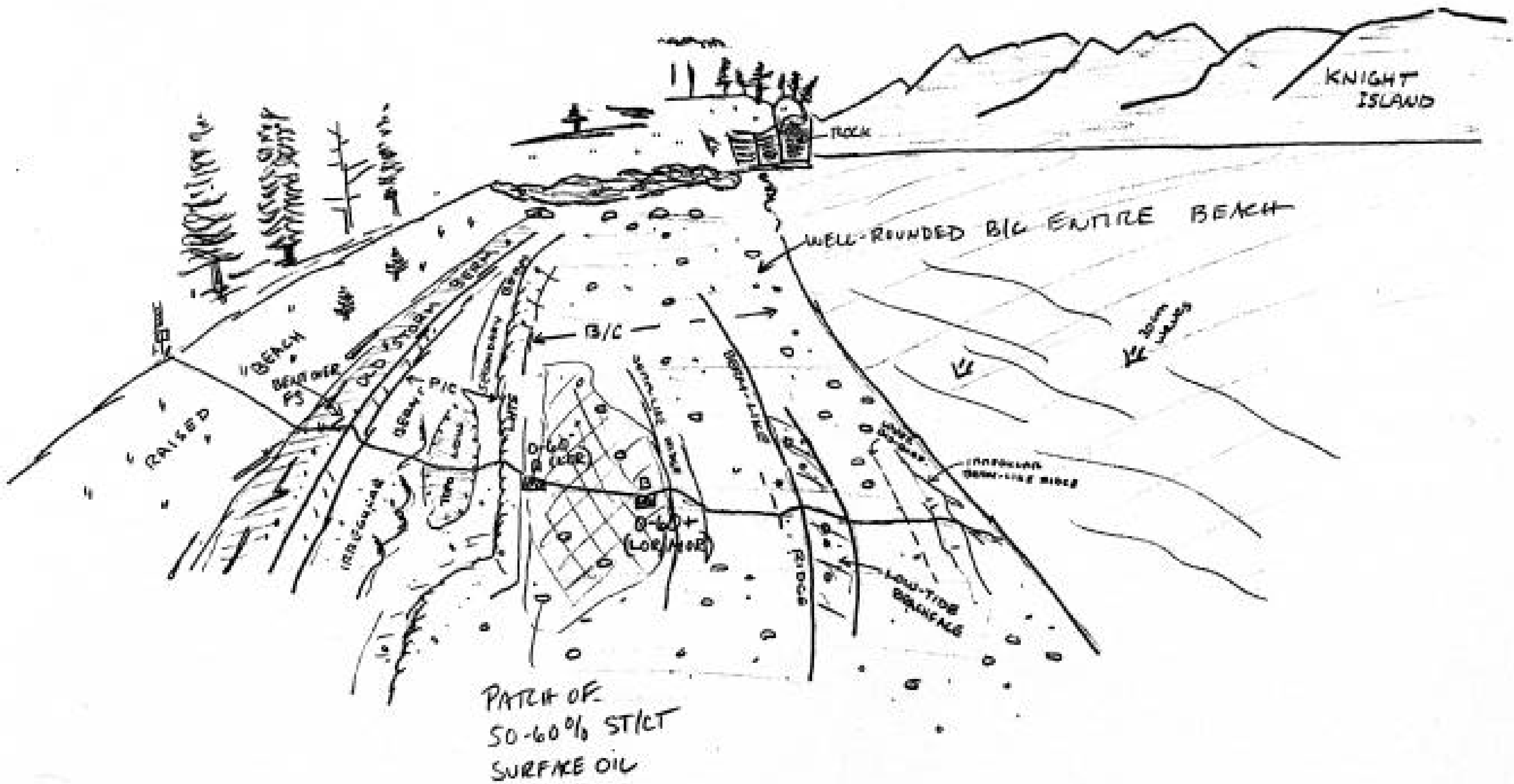
PROFILE N-15 LOCATION LATOUCHE ISLAND, PWS, AK DATE 28 AUGUST 1991

RECORDERS MDH/ JM/ DS PHOTOGRAPHS [illegible] N-15y [illegible] N-15 [illegible] N-15z [illegible] TIME 1030

TIDE STAGE LOW @ 0944 (+0.2) WEATHER mostly clear WIND SPEED 5-10 mph WIND DIRECTION NNW

PROFILE ANGLE same as before WAVE HT. 30 cm SAMPLES TAKEN: BIO ____ CHEM T-A: 10 T-B: 13B, 13B SED ____

SEDIMENT TYPE B/C/P



PROFILE LA-15 (N-15X, N-15, N-15Y)

LOCATION Latouche Island, PWS, AK

DATE 28 AUGUST 1991

RECORDERS MOH/JW/DS

PHOTOGRAPHS EVAL(47)-5(1-24) EVAL(47)-6(1-23)

TIME 1030

TIDE STAGE LOW @ 0944 (+0.2)

WEATHER mostly clear

WIND SPEED 5-10 mph

WIND DIRECTION NNE

PROFILE ANGLE

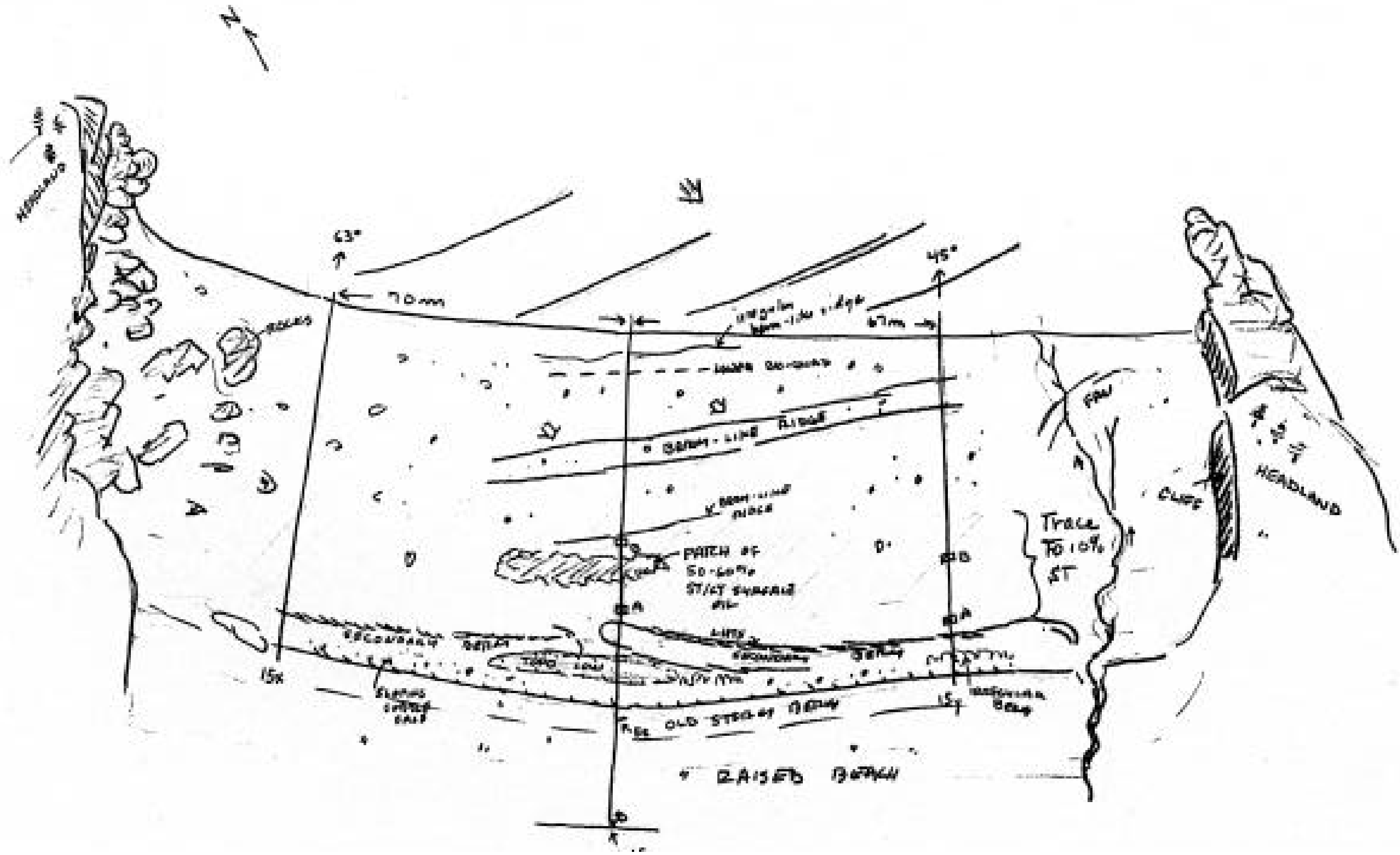
WAVE HT. 30 cm

SAMPLES TAKEN: BIO

CHEM TrA-1B TrB 2B 3D

SED

SEDIMENT TYPE B-C-P



Station No. ____________ Date________

| 1 | DIST | ELEV | GRAIN SIZE(%) | SURFACE OIL | Flag | Activity | Oil | Bio | Sample | Sample | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | | | B/ C/ P/ G/ S | %/Type/Thick | No. | | Interval | Zone | No. | Depth | |
| 3 | | | | | | | | | | | |
| 4 | | | | | | | | | | | |
| 5 | | | | | | | | | | | |
| 6 | | | | | | | | | | | |
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| 17 | | | | | | | | | | | |
| 18 | | | | | | | | | | | |
| 19 | | | | | | | | | | | |
| 20 | | | | | | | | | | | |
| 21 | | | | | | | | | | | |

(HS)
photos 15-23

Station No. N-15 Date 28 AUGUST 1991

page 1

, 0 down

| DIST | ELEV | GRAIN SIZE(%) | SURFACE OIL | Flag | Activity | Oil | Bio | Sample | Sample | BS= 131 ; FS= HWT MM ; Observers MOH/JH/DS |
|---|---|---|---|---|---|---|---|---|---|---|
| | | B/ C/ P/ G/ S | %/Type/Thick | No. | | Interval | Zone | No. | Depth | Comments BS; NOAA sign |
| 354 | -56 | grass | | | | | | | | raised beach |
| 199 | -52 | " | | | | | | | | |
| 301 | -59 | " | | | | | | | | |
| 369 | -59 | " | | | | | | | | |
| 525 | -57 | " | | | | | | | | |
| 368 | -21 | in logs | | | | | | | | base of FS; on old storm berm (?) |
| 142 | -18 | grass | | | | | | | | base of scarp |
| 167 | -53 | 0/10/90/0/0 | no oil | | | | | | | wood debris |
| 422 | -43 | 0/1/99/0/0 | ↓ | | | | | | | edge of disturbed pebble berm; scattered log debris |
| 89 | -16 | 0/60/40/0/0 | | | | | | | | LHTS |
| 249 | -31 | 0/60/40/0/0 | ↓ | | | | | | | in hole; disturbed area (irregular landward of C/B berm |
| 228 | +3 | 2/85/13/0/0 | | | | | | | | top of active HT berm |
| 197 | -4 | 2/98/0/0/0 | | | | | | | | crest of " " " |
| 176 | -32 | 2/95/3/0/0 | 2% ST | ✓ | TRENCH A | 0-60cm (LOR) | | 1B | 25-50cm | begin oiled clasts C/B platform |
| 287 | -23 | 5/90/5/0/0 | 50% ST (MOR) | | | | | | | ↓ |
| 232 | -15 | 20/80/0/0/0 | 60% ST & CT | | | | | | | |
| 147 | -20 | 20/79/1/0/0 | 50%, ST & CT | ✓ | TRENCH B | 0-60cm (LOR-MOR) | | 2B<br>3B | 35-45cm (LOR)<br>55-60cm (MOR) | |
| 262 | -8 | 25/75/0/0/0 | 30% " " | | | | | | | crest of berm-like ridge |
| 273 | -36 | 40/60/0/0/0 | 3% ST | | | | | | | |

bottom of slope

# SHORELINE OIL TERMINOLOGY/CODES Version 2/9/91

## SURFACE OIL DESCRIPTION

Discrete Oil Deposits

| | |
|---|---|
| NO | No Visible Oil |
| TB | Tarball (<10 cm diameter) |
| PT | Patty (>10 cm diameter) |
| AP | Asphalt Pavement (oil-saturated gravel >1 meter diameter) |
| TM | Tar Mat (thick, soft oil accumulation at toe of beachface) |

Continuous Oil Deposits

| | |
|---|---|
| FL | Film or Sheen on Sediment Surface |
| ST | Stain (<0.1 mm thick; cannot be scratched off) |
| MO | Mousse (emulsified oil which has not penetrated into substrate) |
| CO | Coat (dried oil on rocks or cobbles which can be scratched off) |
| CR | Crust (dried oil on sediments which has not penetrated substrate) |
| PO | Pooled Oil (> 1cm thick on beachrock or bedrock surface) |

## SURFACE OIL DISTRIBUTION

| | |
|---|---|
| /C | Continuous (90-100% coverage) |
| /B | Broken (50-90% coverage) |
| /P | Patchy (10-50% coverage) |
| /S | Sporadic or Splashes (<10% coverage) |

## SUBSURFACE OIL DESCRIPTION

Sand

| | |
|---|---|
| SL | Surface Layer (oiled sediments extending from the surface) |
| BL | Buried Layer (a layer of oiled sediments overlain by clean sediments) |
| ML | Multiple Layers (multiple layers of clean and oiled sediments) |

Gravel

| | |
|---|---|
| OP | Oil fills Pore spaces between sediments |
| OR | Residual Oil coat on sediments or in pore spaces but not saturated |
| OF | Thin Film of residual Oil on sediments |

## DEGREE OF SHORELINE CONTAMINATION

| | |
|---|---|
| H | Heavy (greater than 50% coverage of the intertidal zone with oil) |
| M | Moderate (between 25 and 50% coverage of the intertidal zone with oil) |
| L | Light (between 5 and 25% coverage of the intertidal zone with oil) |
| VL | Very Light (less than 5% coverage of the intertidal zone with oil) |

## SHORELINE ZONATION

| Beaches | | Tidal Flats | |
|---|---|---|---|
| BT | Berm Top | UF | Upper Flat |
| BF | Beachface | LF | Lower Flat |
| LT | Low-Tide Terrace | CL | Tidal Channel Levee |

## SUBSTRATE DEFINITIONS

| | | | |
|---|---|---|---|
| BR | Beachrock/Bedrock | CS | Coarse Sand (0.5-2 mm) |
| B | Boulder (>256 mm) | MS | Medium Sand (0.25-0.5 mm) |
| C | Cobble (64-256 mm) | FS | Fine Sand (0.0625-0.25 mm) |
| P | Pebble (4-64 mm) | SI | Silt (<0.0625 mm) |
| Gr | Granule (2-4 mm) | | |

## OILED DEBRIS TYPES

| | | | |
|---|---|---|---|
| W | Woody Debris | /LG | Large Amounts |
| V | Vegetation | /MD | Moderate Amounts |
| T | Trash | /SM | Small Amounts |

## VEGETATION

| | | | |
|---|---|---|---|
| HP | Halophytes | AL | Algal mats/beds |
| MG | Mangroves | SG | Seagrass Beds |

## SHORELINE SURVEY FORM 2/9/91

SITE NAME________________________ NO.______ DATE__/__/91 TIME______to______
OBSERVERS____________________________________________________________________
SITE LENGTH__________m LOW TIDE time______elevation_____
SHORELINE GEOMORPHOLOGY______________________________________________________
UPLAND DESCRIPTION___________________________________________________________
SUBSTRATE: BR___% B___% C___% P___% Gr___% CS___% MS___% FS___% SI___%
WAVE EXPOSURE:_____Low_____Med_____High
CONTAMINATION LENGTH: H_____m M_____m L_____m VL_____m NO_____m

## SURFACE OIL

| DESCRIPTION | DISTRIBUTION | | | | ZONE | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | C | B | P | S | BT | BF | LT | UF | LF | CL |
| Pooled Oil | | | | | | | | | | |
| Crust | | | | | | | | | | |
| Coat | | | | | | | | | | |
| Mousse | | | | | | | | | | |
| Stain | | | | | | | | | | |
| Film | | | | | | | | | | |
| Patties | | | | | | | | | | |
| Tarballs | | | | | | | | | | |
| No Oil | | | | | | | | | | |

| No. | LENGTH (m) | WIDTH (m) | THICK (cm) |
|---|---|---|---|
| **Asphalt Pavements** | | | |
| | | | |
| | | | |
| | | | |
| | | | |
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| | | | |
| **Tar Mats** | | | |
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| | | | |
| | | | |

OILED DEBRIS

| | AMOUNT | | |
|---|---|---|---|
| Woody | SM | MD | LG |
| Vegetation | | | |
| Trash | | | |

## SUBSURFACE OIL

| TRENCH NO. | DEPTH (cm) | ZONE | SUBSURFACE OIL DESCRIPTION SL | BL | ML | OP | OR | OF | OIL INTERVAL (cm-cm) | WATER TABLE (cm) | SUBSTRATE TYPES |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

**COMMENTS:**

# SKETCH MAP

Site Name________________
Site No.________
Date_________
Names________

## Checklist

__North Arrow
__Scale
__Oil Distribution
__High Tide Line
__Low Tide Line
__Substrate Types
__Trench Locations

## Legend

$^{1}\Delta$
Trench Number.
No Subsurface Oil
$^{2}\Delta$
Trench Number.
Subsurface Oil

# SKETCH MAP

POINT HELEN, PWS, AK

Site Name KN-405A
Site No. near NOAA's site N-1
Date 4 JUNE 1991
Names T. Kelly (EXXON) M. Cramer & B. Trimm (") M. Hayes (NOAA)

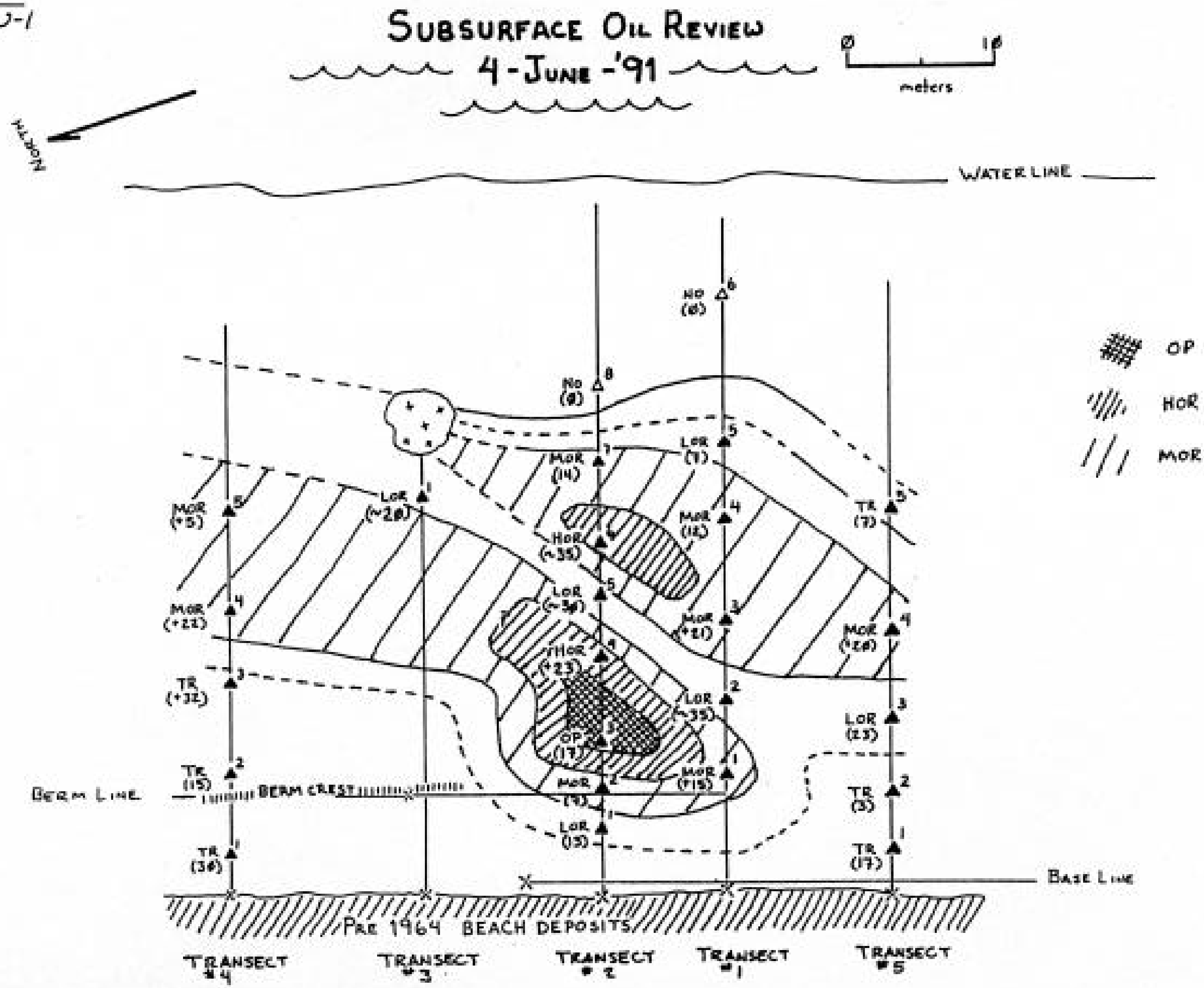
**Checklist**

✓ North Arrow
✓ Scale
✓ Oil Distribution
_ High Tide Line
_ Low Tide Line
_ Substrate Types
(on second map)
✓ Trench Locations

**Legend**

1△ Trench Number. No Subsurface Oil

2▲ Trench Number. Subsurface Oil




Map by Bryan Trimm of Woodward Clyde, Inc. (for EXXON)

# Trench Description Form

No. ___ Oil Sediments

0

Depth (cm)

Comments:

No. ___ Oil Sediments

0

Depth (cm)

Comments:

No. ___ Oil Sediments

0

Depth (cm)

Comments:

No. ___ Oil Sediments

0

Depth (cm)

Comments:

No. ___ Oil Sediments

0

Depth (cm)

Comments:

No. ___ Oil Sediments

0

Depth (cm)

Comments:

No. ___ Oil Sediments

0

Depth (cm)

Comments:

No. ___ Oil Sediments

0

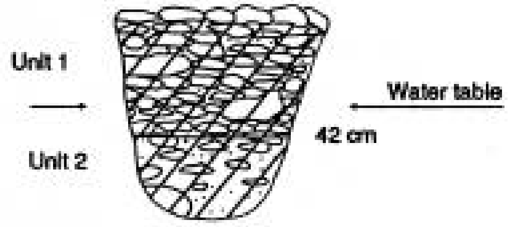
Depth (cm)

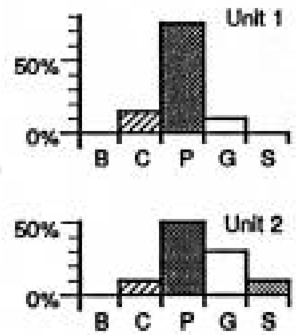
Comments:

KN405A POINT HELEN, 23 JANUARY 1991

- Oiled Zone

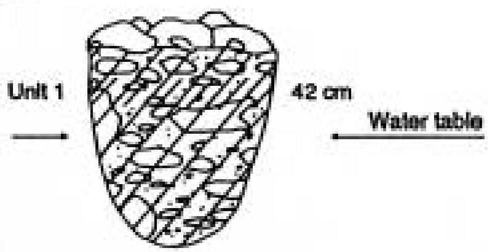
**TRENCH A**

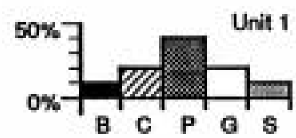



- Inversely graded
- Subangular to subrounded clasts
- Medium oil stain, heavy oil sheen on water table

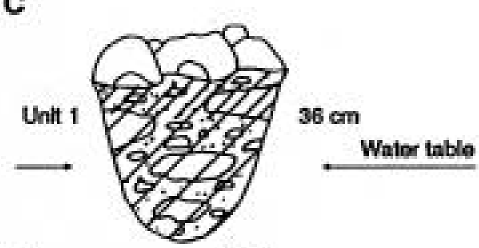
**TRENCH B**

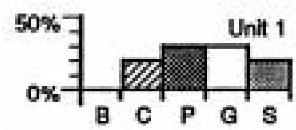



- Generally homogeneous material
- Crudely inversely graded
- Heavy oil stain throughout, with thick mousse layer floating on water table
- Boulder Armor
- Generally subrounded clasts

**TRENCH C**




- Generally homogeneous material
- Crudely inversely graded
- Medium oil stain throughout, heavy film on water surface
- Boulder Armor
- General subrounded clasts

Description of sediments in trenches dug at NOAA's station KN-405A on 23 January 1991. Note abundance of sand and granule material in subsurface sediments. See Figure 5 for location of trenches A and B. Trench C is located north of the profile a bit seaward of trench A.