APPENDIX D
ADAK ISLAND MARINE ROV AND CORING INVESTIGATION

THE GLOSTEN ASSOCIATES
Consulting Engineers Serving the Marine Community

PROJECT MEMORANDUM

Results of the Adak Marine Geophysical Investigation

TO: Rich Formisano
Cc: Bob Traister, Tom Diggs, Bob Dees
DATE: 24 November 2004
FILE No.: 02100 Document No.: T27L-018 Rev. -
FROM: Ken FitzGerald

The attached report "Results of the Adak Marine ROV and Coring Investigation" contains the results of geotechnical sampling and bottom video survey carried out in September 2004 and reported on by Golder Associates.

Results of this work provided anchor size criteria for the final mooring design and debris quantity, description and location estimates.

Vibrocore sediment samples were collected for analysis of soil strength. ROV survey provided location and description of debris along mooring leg routes and near anchor locations.

Charts of debris locations with photographs of the observed debris are provided. Sediment samples were analyzed and reported on in the Glosten report "Sediment Characterization of Kuluk Bay, Document No. T27L-015."

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Prepared for

The Glosten Associates Inc.

Results of the Adak Island Marine ROV and Coring Investigation

November 23, 2004

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REPORT ON

RESULTS OF THE ADAK ISLAND MARINE ROV AND CORING INVESTIGATION

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EXECUTIVE SUMMARY

Adak Island, located near the western end of the Aleutian Islands was selected by the Department of Defense as the site for the Sea-Based X-Band radar which will be part of the U.S. missile defense system. This island has been used previously as a military installation during WWII and during the cold war from 1960 to 1995.

The radar will be installed on a semi-submersible vessel, anchored in Kuluk Bay which is located on the north side of Adak Island. The bay is approximately 3 nautical miles square, 60 to 300 feet deep and connected with the island through Sweeper Cove.

A marine geophysical investigation was conducted earlier to obtain information for assisting in the design and planning of the anchor system by The Glosten Associates. The geophysical data were used to map the bathymetry, characterize the nature and map the thickness of the seafloor sediment, and locate bedrock outcrops, cables and debris on the seafloor.

Based on the information and recommendations presented in the geophysical investigation a subsequent investigation using Vibrocore and remote operating vehicle with video was conducted. The objectives of this study were to:

- To obtain sediment samples for evaluating the engineering properties of the seafloor and
- To obtain video images of selected objects identified on the sidescan sonar data and video images of the seafloor areas identified by the client as possible anchor locations.

The Vibrocore was able to obtain sediment samples to a depth of 5 to 7 feet below the seafloor. These core samples were analyzed by others and the results of the analysis are presented in a separate report.

The ROV-video system, using DGPS, scanning sonar and ultra-short baseline acoustic navigation for positioning, scanned several that were selected based on sidescan sonar data. The ROV-video system obtained images of 15 targets in small areas within a debris zone that is approximately 800 feet in width and 6,000 feet in length and contains several hundred objects. The objects viewed on the video images ranged from miscellaneous unidentifiable debris to anchors, buoys and submarine nets.

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1.0 PROJECT BACKGROUND

1.1 Project Objective

Adak Island, located near the western end of the Aleutian Islands (1,200 miles west of Anchorage, AK), was selected as a site for the Sea-Based X-Band radar which is part of the United States missile defense system. The Department of Defense (DOD) has contracted the Boeing Company to oversee the project which includes installation of the radar system on a semi submersible drilling platform, moving the platform to Adak Island and securing the platform in Kuluk Bay (Figure 1). In preparation for installation of the semi submersible platform a detailed geophysical investigation was conducted to map the seafloor and subsurface geology. This investigation was followed by an underwater video study and coring program to obtain additional detailed information on the seafloor sediment and objects located on the seabed.

1.2 Geology and Geomorphology

Adak Island was formed by extreme geologic events, including tectonic collision of the Pacific and North America Plates along the Aleutian Trench, resulting in uplift and volcanic eruptions. The resulting rock sequences consist primarily of volcanic rocks with some sedimentary rock. On land only a relatively thin layer of unconsolidated material, generally less than 10 feet thick, covers the entire island. Offshore the thickness of unconsolidated sediment ranges from less than 1 foot to over 50 feet in thickness with several localized areas of bedrock outcrops.

Advancing and receding glaciers, extensive rainfall and high winds have shaped Adak Island into a dramatic landscape of hills, valleys, cliffs and floodplains. Glacial events may have modified the seafloor during periods of lower sea level and may have possibly provided sediment to the marine environment during glacial retract.

Kuluk Bay, located on the eastern side of Adak Island, opens to the east, is somewhat exposed to the Bering Sea on the north and entirely sheltered on the south by the island (Figure 2). The bay is approximately 3 nm by 3 nm in dimensions and connects with the island through Sweeper Cove. The water depth at the proposed site ranges from 180 to 350 feet.

1.3 Island History

During WW II, Adak Island became the site of a military base operated by the Army Air Corp for defensive action against Japanese forces occupying Attu and Kiska Island also located on the Aleutian Chain. In 1944 there were 32,000 military personnel on the island. This number decreased substantially following the end of the war. By 1953, after the facility had been turned over to the U.S. Navy only 200 personnel were located at this station. In 1966 the facility, Naval Air Station Adak, began to grow and by 1990 over 3,000 personnel were on station. Following the end of the cold war the facility was listed under Base Realignment and Closure and the military mission was ended in 1997 (Figure 2)

2.0 PROJECT OBJECTIVE AND SCOPE OF WORK (SOW)

A marine investigation was conducted for the purpose of:

- Obtaining video images of selected targets identified with sidescan sonar during the geophysical investigation.
- Obtaining sediment samples to assist in characterizing the sediment and their engineering properties.

The results from this investigation will be used to provide additional information on seafloor objects and aid in the design of the seafloor anchoring system

The primary tasks associated with the ROV and sampling program were:

- Mobilization and installation and preliminary testing of instrumentation on the survey vessel in Dutch Harbor, Alaska.
- Testing and calibration of the navigation, coring and ROV systems at Adak.
- Sediment sampling at selected locations.
- ROV video inspection of selected targets on the seafloor.
- Demobilization of instruments in Dutch Harbor.
- Data analysis and preparation of draft report.
- Preparation and submittal of final report.

3.0 INSTRUMENTATION AND OPERATIONS

This section provides a brief discussion of the instrumentation and field operations. Table 1, located at the end of the discussion, is a list of the instruments and some of their specifications.

3.1 Survey Vessel

The vessel used for this project was the 96 foot, *M/V Erin Lynn*. This vessel had excellent electrical and hydraulic power for running the instrumentation and handling the over-the-side equipment (Vibrocore, sediment sampler, ROV). The navigation and instruments were installed on this vessel in Dutch Harbor Alaska, and tested and calibrated prior to moving the vessel to Adak, a distance of approximately 800 miles.

3.2 Navigation

A differential global positioning system (DGPS) was used to determine the vessel's location in real-time, and to plot the vessel's position along the ROV tracklines**.** Position information was acquired at the rate of 1 update/second. All position information was collected in NAD-83, Alaska State Plane Zone 10, and US survey feet. The location of the coring sites and the ROV were displayed on a video monitor located on the bridge for use by the vessel operator. A second navigation monitor was located in the instrumentation van located on the deck. The navigation computer recorded the vessels position and the position of the ROV relative to the vessels. This information was logged with the video and scanning sonar data acquisition systems.

An ultra short baseline (USBL) acoustic navigation system was used to track the ROV. This system was integrated with the shipboard GPS system so that the position of the ROV could be observed relative to the vessel and to the project grid.

Correctors for the navigation data were obtained in real-time from the US Coast Guard beacon located at Cold Bay, Alaska. Calibration of the system was done at a tidal bench mark located on the pier in Sweeper Cove (Tidal Bench Mark 18, US 7919). The position error at this benchmark was approximately 9 feet north and 6 feet east.

3.3 Coverage

The Vibrocore samples (8 cores) were obtained at locations, identified by Glosten Associates, that corresponding with the proposed anchor locations (Map 1).

The ROV-video investigation looked at several specific targets identified on the sidescan sonar data obtained in the previous geophysical investigation and in areas identified by Glosten Associates as being proposed anchor locations.

3.4 Vibrocore

Sediment samples of the seafloor were obtained with an electric Vibrocore using 4 inch diameter core barrels that were 10 feet in length. A plastic liner was inserted in the aluminum barrels to retain the sediment sample (Figure 3). The vibrocore was lowered to the seafloor where it rested on a base plate with the motor housing and barrel held vertical by a floatation package. Vibration continued until there appeared to be no advancing of the barrel; usually 2 to 3 minutes.

After retrieval of a sample, plastic caps were taped on both ends of the core tube with the liner still inserted. The aluminum barrel was marked with core number, orientation (top and bottom), length of sample and then placed in the shipboard freezer.

3.5 ROV-Video

The ROV operations consisted of positioning the survey vessel in an area of interest and then lowering the ROV to the seafloor using a large clump weight (Figure 4). The ROV was piloted to the target location using the USBL. A scanning a sonar, mounted on the front of the ROV, was used to locate targets to a distance of 150 feet from the vehicle. The sonar image, location of the ROV relative the vessel and video images were all monitored on LCD monitors in the instrumentation van. Using the scanning sonar image the ROV was driven in the direction of a target for closer viewing with the video system. The video system obtained images continually as the ROV moved towards a selected target.

Following the ROV-video and sonar search of an area the ROV was retrieved and the survey vessel moved to the next selected location.

The table below provides general information and specifications on the instrumentation.

Table 1: Instrumentation and Specifications

System	Manufacturer	Parameters
Differential GPS	CSI Model MAX	L1 C/A code, 12 channel
Precision Echosounder	Odem Hydrotrack	200 KHz, 5 degrees
Vibrocore	NWGS Model VC-1	3 h.p, 220v, 3phase electric
ROV	DOE HD Model 2+2	265lbs, 1 lux camera, 4 thrusters, 1,000 ft cable
USBL	LinkQuest 1500MA	40kHz, 1 degree, 1500m range
Scanning Sonar	Imagenex 851	675 kHz, 2.5 X 22 degree

4.0 DATA PROCESSING AND ANALYSIS

Preliminary review of the video data, recorded on two acquisition systems, was conducted at the end of each survey day. In addition, the navigation data from the GPS and USBL were downloaded to CDs.

4.1 Navigation Data

The navigation data were edited for anomalous or extreme values. The edited information, core sampling locations and ROV tracklines were then plotted on a site map (Map 2). The navigation information for the ROV-video data are shown on the video images as well as being archived with the ROV navigation data.

4.2 Vibrocore Samples

The sediment samples were air shipped to Redmond and delivered to a local soils laboratory for a series of analysis. The results of the sediment core analysis are provided in a separate report prepared by Glosten Associates Inc.

4.3 ROV-Video

A list of ROV targets, and their description was compiled (Appendix A) and short MPEG clips of the targets were downloaded to a CD. In addition, still photographs were made of the targets shown on the CD video clips.

5.0 RESULTS

The following summarizes results of Vibrocore and ROV-video data. The location of the core samples and ROV tracklines are presented on Maps 1 and 2. A list of target and video stills is presented in Appendix A.

5.1 Vibrocore Samples

The Vibrocore samples consisted of fine-grained sand and are described in detail in the Glosten Sediment Characterization Report (File 02100). The following table provides general information on the samples and their locations are shown on Map 1.

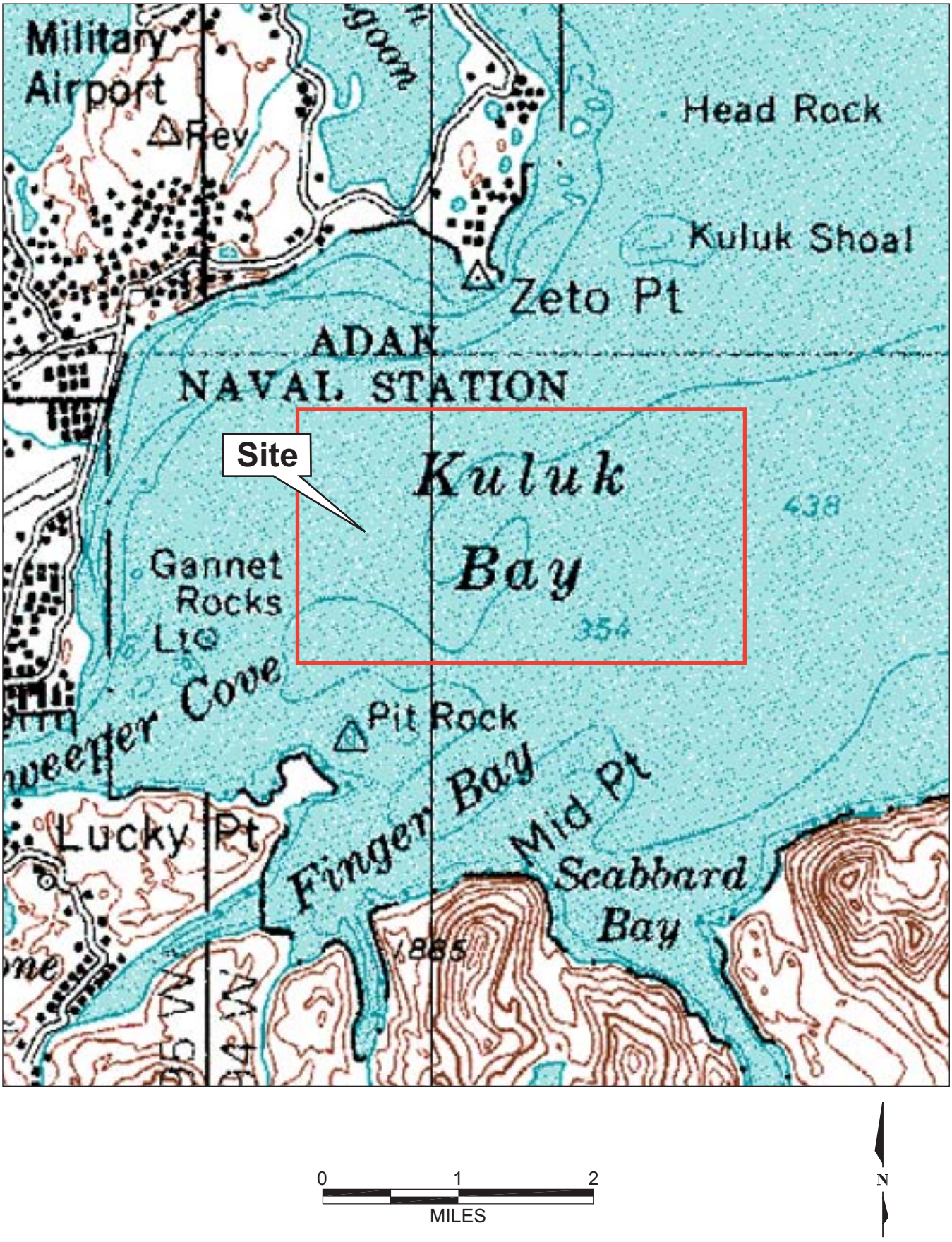
Table 2: Vibrocore Samples (see Map 2 for location)

Number	Length (In.)	Easting	Northing	Latitude	Longitude	Date	Time	Vibrate Time (Min)
N1_Core	68	3152676	325048.6	51.88899	-176.567	7-Sep	1845	2.5
S2_Core	58,5	3152761	321970.6	51.88056	-176.567	8-Sep	1052	3
W2_Core	59.5	3151844	323693.7	51.88526	-176.571	8-Sep	1236	3
E1_Core	56	3155455	323627.6	51.88516	-176.555	8-Sep	1323	3.5
S1_Core	48	3154582	321981.3	51.88063	-176.559	8-Sep	1515	3
E2_Core	66	3155427	323357.6	51.88442	-176.555	8-Sep	1626	3.5
W1_Core	54	3151853	323433.8	51.88455	-176.571	8-Sep	1820	3
N2_Core	72	3154546	325022.8	51.88896	-176.559	14-Sep	1900	3

5.2 ROV-Video Data

Only a limited number of the targets, detected with sidescan sonar during the earlier geophysical investigation (600 wide, 6,000 feet long debris corridor), were investigated during this study. These targets tended to be in the areas of the proposed anchor locations. The targets ranged from unidentifiable miscellaneous debris to anchors, buoys and submarine nets (Figure 4, Appendix A). The targets are also plotted on Map 1.

FIGURES



Source: USGS 1:250,000 Topographic Quadrangle Map, Adak, Alaska (1983)

FIGURE **1**

SITE LOCATION MAP

GLOSTEN/ADAK ISLAND GEOPHYSICS/AK

DRAWING NO. 0431163001400fg05.fh11 DATE 11/17/04 DRAWN BY EL

Golder Associates

View from center of site looking south.

Photograph of abandoned military facility on Adak.

FIGURE **2**
SITE PHOTOGRAPHS
GLOSTEN/ADAK ISLAND GEOPHYSICS/AK

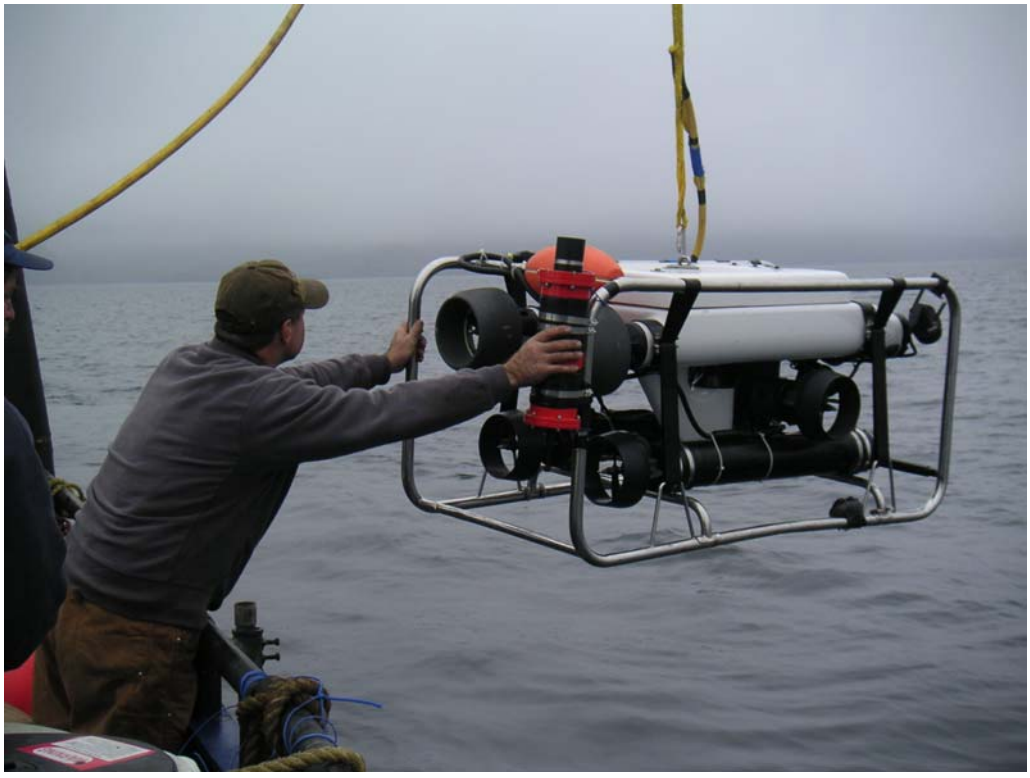
DRAWING NO. 0431163100400fg04.fh11 DATE 11/16/04 DRAWN BY EL

Golder Associates

Preparing vibrocore sampling barrel.

Deploying vibrocore.

FIGURE **3**
SITE PHOTOGRAPHS
GLOSTEN/ADAK ISLAND GEOPHYSICS/AK

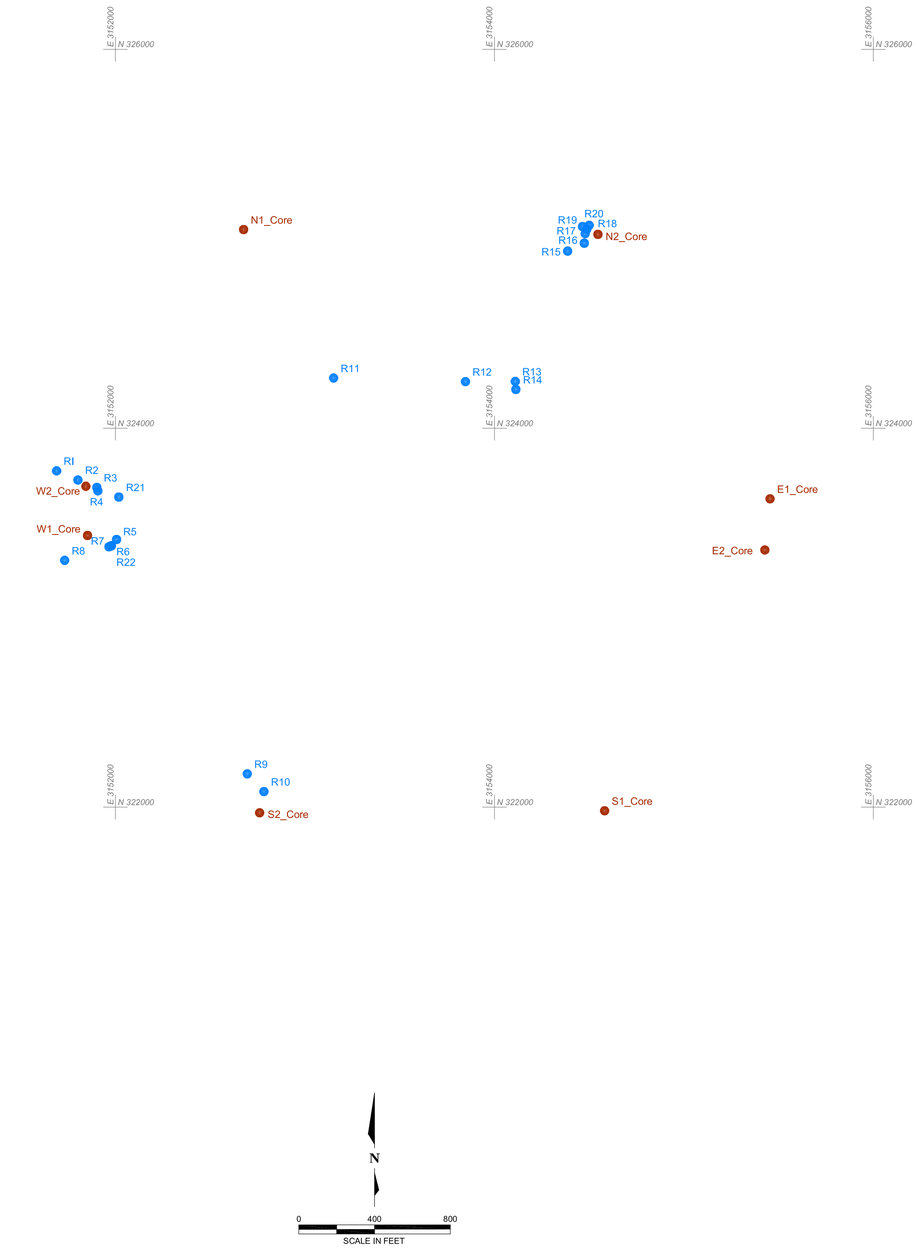


Deployment of remote operating vehicle (ROV).

Ship's anchor entangled with WWII submarine net.

FIGURE **4**
SITE PHOTOGRAPHS
GLOSTEN/ADAK ISLAND GEOPHYSICS/AK

MAPS



KEY MAP

LEGEND

LOCATION OF SELECTED TARGETS VIEWED WITH ROV

RI — ROV VIDEO IMAGE

E1_Core — LOCATION OF VIBRACORES

INSTRUMENTATION

ROV:	DOE HD 2+2
NAVIGATION:	CSI DGPS MAX
SOFTWARE:	COASTAL HYPACK
ACOUSTIC NAV:	LINKQUEST 1500 USBL
SCANNING SONAR:	IMAGENEX 850
VIBRACORE:	NWGS; 220, 3PH, 3HP

GEODETIC PARAMETERS

DATUM: NAD 83
PROJECTION: ALASKA STATE PLANE, ZONE 10
US SURVEY FEET

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SUBMITTED TO:

THE GLOSTEN ASSOCIATES
Consulting Engineers Serving the Marine Community

PROJECT:

GLOSTEN/ADAK ISLAND GEOPHYSICS/AK

TITLE:

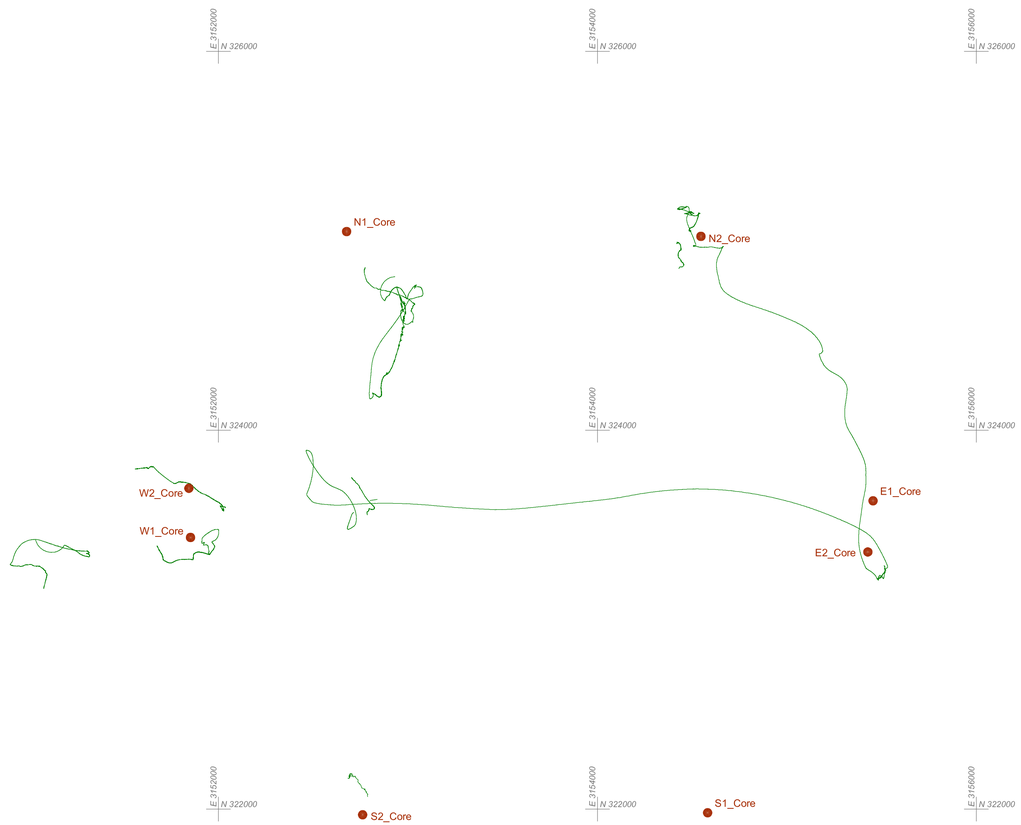
ANCHOR AREA ROV TARGET LOCATIONS

REV	DATE	REVISION DESCRIPTION	SIGNED
–	–	–	–

PROJECT No.		043–1163.001
FILE No.		0431163001C01.dwg
REV. 0	SCALE	AS SHOWN
DESIGN	–	–
CADD	SMB	11/05/04
CHECK	–	–
REVIEW	–	–

MAP 1

0431163001C01.dwg 11/24/2004, 10:07 Layout: MAP1



KEY MAP

LEGEND

ROV TRACKLINES

E1_Core
LOCATION OF VIBRACORES

INSTRUMENTATION

ROV:	DOE HD 2+2
NAVIGATION:	CSI DGPS MAX
SOFTWARE:	COASTAL HYPACK
ACOUSTIC NAV:	LINKQUEST 1500 USBL
SCANNING SONAR:	IMAGENEX 850
VIBRACORE:	NWGS; 220, 3PH, 3HP

GEODETIC PARAMETERS

DATUM: NAD 83
PROJECTION: ALASKA STATE PLANE, ZONE 10
US SURVEY FEET

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SUBMITTED TO:

THE GLOSTEN ASSOCIATES
Consulting Engineers Serving the Marine Community

PROJECT:

GLOSTEN/ADAK ISLAND GEOPHYSICS/AK

TITLE:

ANCHOR AREA ROV TRACKLINES

REV	DATE	REVISION DESCRIPTION	SIGNED
–	–	–	–

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FILE No.	0431163001C01.dwg
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DESIGN	– / –
CADD	SMB / 11/05/04
CHECK	– / –
REVIEW	– / –

MAP 2

0431163001C01.dwg 11/29/2004 08:30 Layout: MAP2

APPENDIX A

TARGET NUM	LAT	LONG	DESCRIPTION
R01	51 53.12875	176 34.30274	Submarine Net
R02	51 53.12092	176 34.27271	Large Buoy
R03	51 53.114664	176 34.246170	Large Buoy
R04	51 53.11161	176 34.24475	Large Buoy
R05	51 53.069664	176 34.218000	General Debris Pile
R06	51 53.06420	176 34.22525	General Debris Pile/Submarine Net
R07	51 53.06323	176 34.22850	Large Buoy
R08	51 53.05115	176 34.29043	General Debris Pile
R09	51 52.86724	176 34.03218	General Debris
R10	51 52.852002	176 34.008510	Anchor
R11	51 53.211168	176 33.915504	Possible Culvert Pipe
R12	51 53.208966	176 33.730632	Block Mass
R13	51 53.209464	176 33.660780	Submarine Net
R14	51 53.20255	176 33.65984	Anchor
R15	51 53.32285	176 33.58869	General Debris
R16	51 53.329830	176 33.565500	Submarine Net
R17	51 53.338164	176 33.564336	Large Buoy
R18	51 53.34202	176 33.56211	Large Buoy
R19	51 53.34417	176 33.56815	General Debris
R20	51 53.34538	176 33.55880	Large Buoy
R21	51 53.106498	176 34.215168	Large Buoy
R22	51 53.06418	176 34.22544	Submarine Net

TABLE OF ROV TARGETS
GLOSTEN/ADAK ISLAND GEOPHYSICS/AK

DRAWING NO. 0431163300fg18.fh11 DATE 11/23/04 DRAWN BY EL

R1 - Submarine Net.

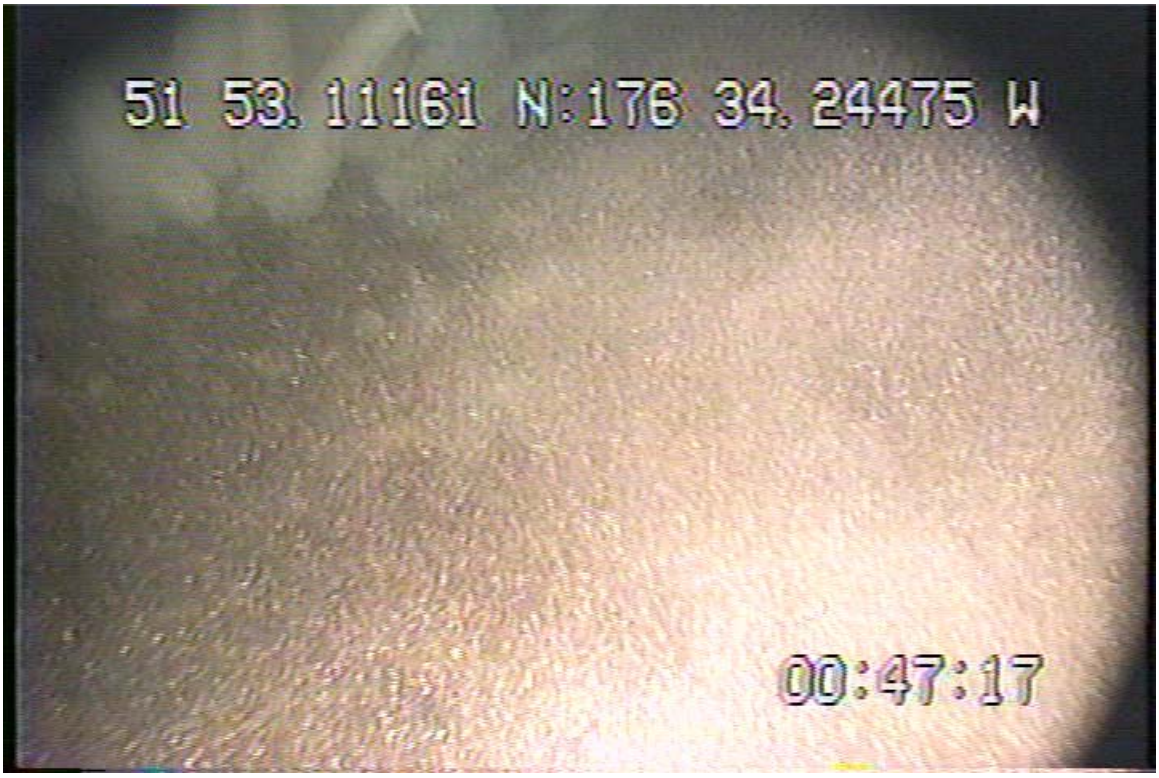
R2 - Large Buoy.

VIDEO STILLS
GLOSTEN/ADAK ISLAND GEOPHYSICS/AK

DRAWING NO. 0431163300fg13.fh11 DATE 11/05/04 DRAWN BY EL

Golder Associates

R3 - Large Buoy.



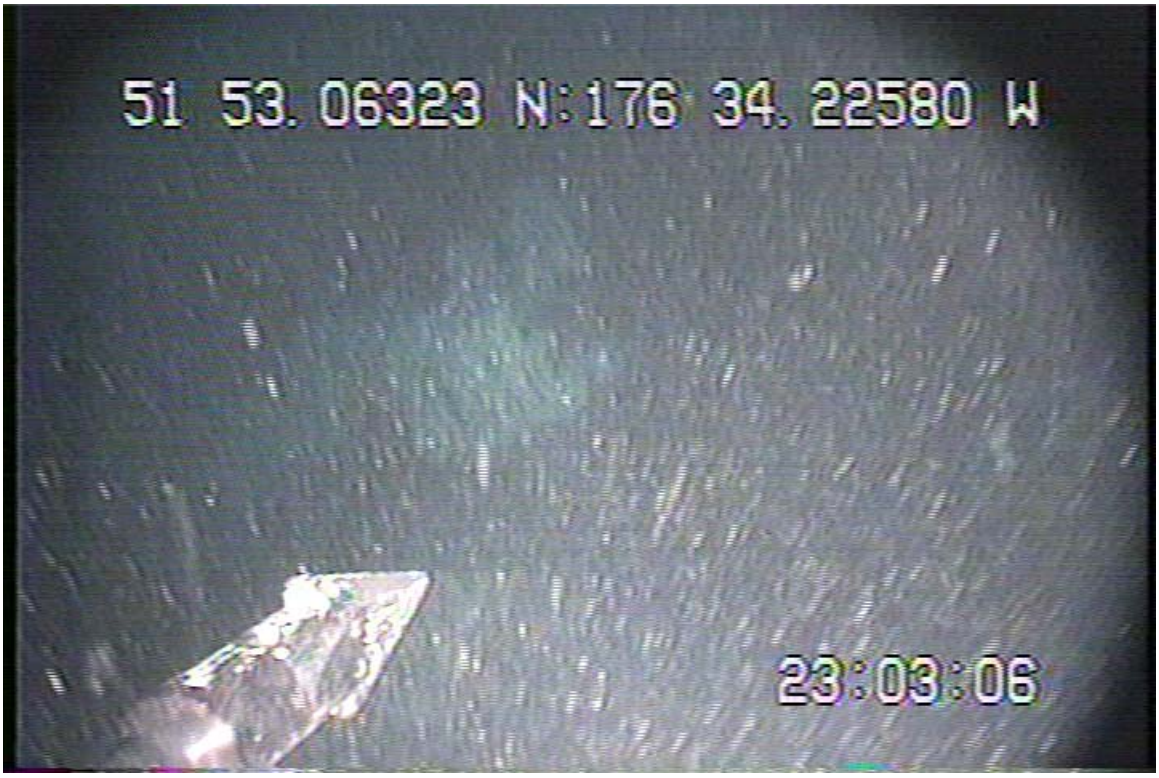
R4 - Large Buoy.

VIDEO STILLS
GLOSTEN/ADAK ISLAND GEOPHYSICS/AK

R5 - General Debris Pile.

R6 - General Debris Pile/Submarine Net.

VIDEO STILLS
GLOSTEN/ADAK ISLAND GEOPHYSICS/AK



R7 - Large Buoy.

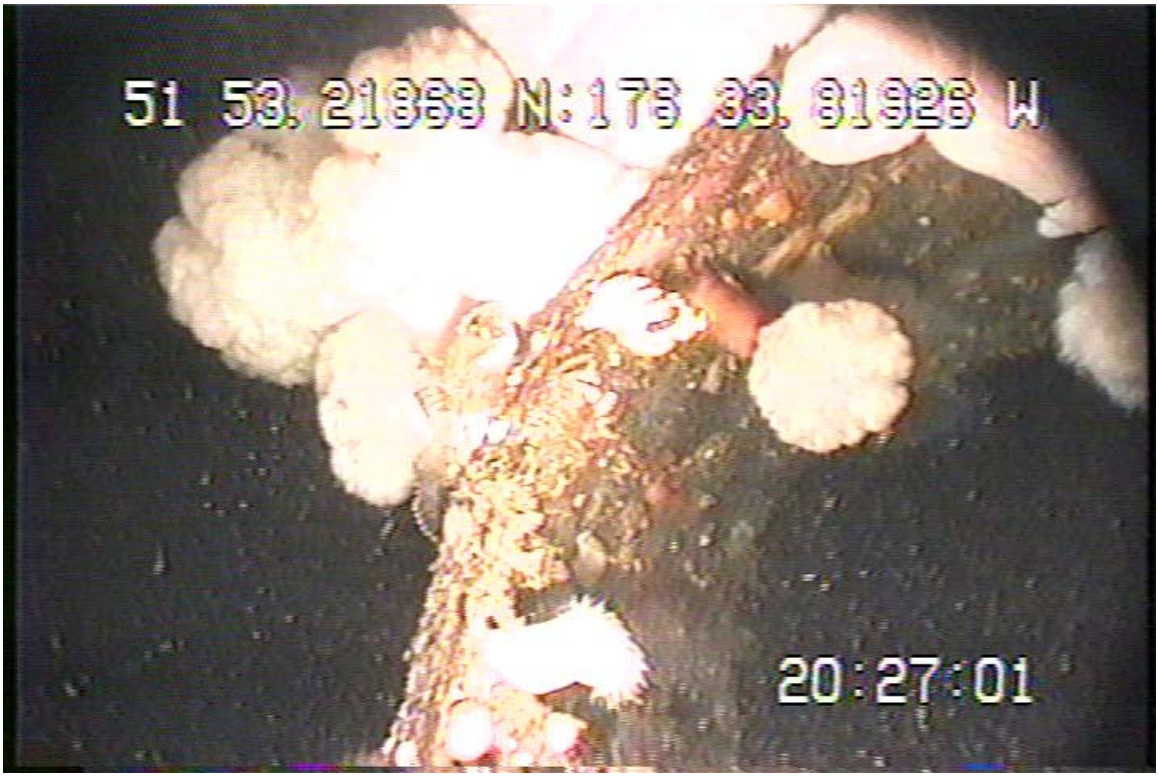
R8 - General Debris Pile.

VIDEO STILLS
GLOSTEN/ADAK ISLAND GEOPHYSICS/AK

R9 - General Debris.

R10 - Anchor.

VIDEO STILLS
GLOSTEN/ADAK ISLAND GEOPHYSICS/AK



R11 - Possible Culvert Pipe.

R12 - Block Mass.

VIDEO STILLS
GLOSTEN/ADAK ISLAND GEOPHYSICS/AK

R13 - Submarine Net.

R14 - Anchor.

VIDEO STILLS
GLOSTEN/ADAK ISLAND GEOPHYSICS/AK

R15 - General Debris.

R16 - Submarine Net.

VIDEO STILLS
GLOSTEN/ADAK ISLAND GEOPHYSICS/AK

DRAWING NO. 0431163300fg21.fh11 DATE 11/05/04 DRAWN BY EL

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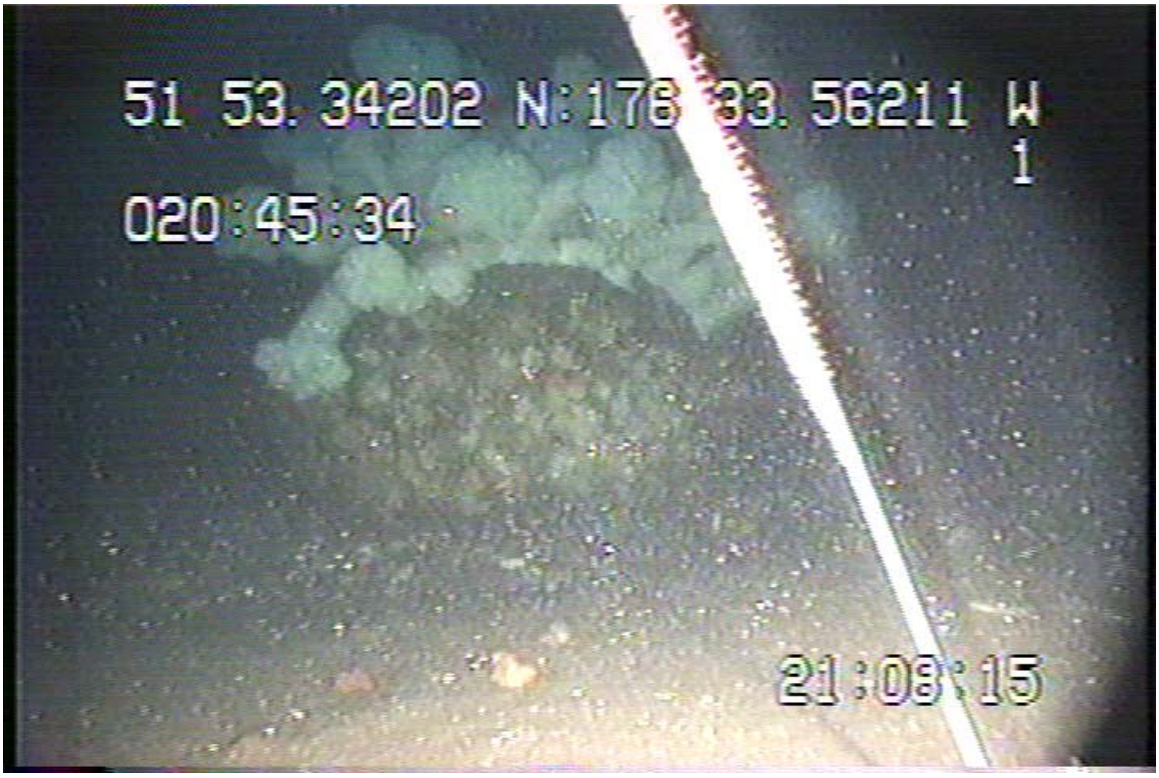
R17 - Large Buoy.



R18 - Large Buoy.

VIDEO STILLS
GLOSTEN/ADAK ISLAND GEOPHYSICS/AK

DRAWING NO. 0431163300fg22.fh11 DATE 11/05/04 DRAWN BY EL

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R19 - General Debris.

R20 - Large Buoy.

VIDEO STILLS
GLOSTEN/ADAK ISLAND GEOPHYSICS/AK

DRAWING NO. 0431163300fg23.fh11 DATE 11/05/04 DRAWN BY EL

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R21 - Large Buoy.

R22 - Submarine Net.

VIDEO STILLS
GLOSTEN/ADAK ISLAND GEOPHYSICS/AK