

W. B. Hill
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**WESTWARD SEAFOODS, INC.
DUTCH HARBOR, ALASKA**

**BAILEYS LEDGE
SEAFLOOR INSPECTION
CAPTAINS BAY, ALASKA**

**FINAL REPORT
1993 SURVEY**

**SUBMITTED BY:
WATSON COMPANY
ANCHORAGE, ALASKA**

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FINAL REPORT
WESTWARD SEAFOODS, INC. -- CAPTAINS BAY, ALASKA
SIDE SCAN SONAR AND BATHYMETRY INVESTIGATION
REPORT No. WC93A06.1

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ACKNOWLEDGEMENTS

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1.0 Introduction

The primary objectives of this study were to provide topographic information around the seafood processing waste outfall in the vicinity of Baileys Ledge and to determine the area of seafood processing waste accumulation. Baileys Ledge is located in Captains Bay, near Dutch Harbor, Alaska. The survey was conducted between September 30, and October 6, 1993.

The region surveyed is characterized by very steep relief of highly reflective acoustic materials. Baileys Ledge (figure 1) is a marine geologic outcrop characteristic of the Aleutian Chain Islands. This prominent geologic outcrop has complex surface topography. The seafood outfall is suspended over the north side of Baileys Ledge at an approximate heading of 334 degrees.

2.0 Field Data Acquisition

The following sections of this report present a discussion of the systems and methodology utilized for the acquisition of digital side scan sonar, bathymetric seafloor depth data, and precision navigation. The data was acquired aboard the vessel "Rocky Point."

2.1 Digital Side Scan Sonar

Imagery of the seafloor was obtained using the E.G.&G. Model 260 Image Correcting Digital Side Scan Sonar with the Model 272-TD Towfish. This system operates at 100 or 390 KHz, and transmits two simultaneous "fan-shaped" beams oriented at right angles to the towfish major axis. As the transmitted signals insonify the seafloor, the energy is reflected from the features present. The reflected signals are received by the transducers and amplified and filtered, to yield a display analogous to a photograph of the seafloor.

The higher the amplitude of the return signal the harder or more dense the seafloor feature is. A high amplitude signal is reflected from materials such as steel or rock, while a low amplitude signal would come from mud or some other soft unconsolidated material.

An advantage to digitizing side scan data is that the image can be corrected in the axis perpendicular to the direction of travel. The E.G.&G. Model 260 has a third channel that displays the depth of water under the towfish. This information is used to calculate the horizontal distance to seafloor features from points directly under the towfish.

The post survey processing of the sonar data necessitated the utilization of a sophisticated image processing system in order to determine small changes in seafloor material types.

The WSMS Image Processing System (Appendix A) uses "state of the art" technology to provide advanced processing capabilities. In addition, many signal processing techniques are employed to take into account the geophysical conditions of the seafloor. This is of particular importance in a complex geologic formation like Baileys Ledge where seafloor modeling gives the end user a more complete understanding of seafloor conditions.

2.2 Digital Bathymetric Mapping

Baileys Ledge is a complex and intricate geologic structure. For this reason it was necessary to collect precision depth data. Bathymetry of the seafloor was acquired using the Ross Model 6800/4400 Digital Precision depth sounder. A narrow beam transducer was utilized in order to keep acoustic side lobes to a minimum. The bathymetric data was corrected to MLLW using tide data collected by NOAA in Dutch Harbor. In addition, tide data was collected at the site using a CL insitu tide gauge that was installed at the Westward Seafoods Dock.

The Ross depth sounder has a paper recorder that displays the water depth in meters. The depth sounder transducer is corrected for draft and for the speed of sound in water. The Ross numerically displays the depth on the front panel and outputs the information to the navigation logging device.

2.3 Precision Navigation

In order to properly map the seafloor in the vicinity of Baileys Ledge a precision navigation system was employed. A Motorola Mini-Ranger system with an operating frequency of 5 GHz, and a system accuracy of +/- 5 meters was utilized.

The Mini Ranger shore network was configured in Captains Bay to optimize the available geometry for three transponder locations. The transponder locations that were utilized were the same as those employed during the 1992 Westward Seafoods survey.

On board the vessel "Rocky Point", a Receiver/Transmitter was mounted to receive signals from the three shore transponders. The Mini-Ranger console displays the individual ranges and then outputs them to a navigation computer for trackline display and recording. In addition to logging the navigation information the computer simultaneously recorded the digital depth information from the Ross depth sounder.

The navigation computer displays such information as distance off line, distance to end of line, northing and easting, depth as well as many other parameters. A display with this information is what the captain uses to steer the vessel on line. In order to correlate the sonar and depth information the computer outputs a signal at a periodic distance to allow the precise correlation of the side scan sonar, depth and navigation information.

3.0 Data Reduction and Presentation

The following sections of this report detail the methodology utilized for the reduction and analysis of the survey data acquired during Westward Seafoods Baileys Ledge Outfall Seafloor Analysis. Seafloor data and information can be observed in figures 2 through 8.

3.1 Bathymetric Data Reduction

A bathymetric contour map was created in part to correlate the imagery from the side scan sonar with the depth data. This map (figure 2) has contours every 2 meters and labeled contours at 10 meter intervals. As can be observed during review, the ledge extends further to the North on the eastern side of Baileys Ledge. Figure 3 is a bathymetric 3-dimensional projection of the area of investigation. From this figure it can be seen that the outfall site is a steep and complex geologic structure. Figure 3 is tilted at a 30 degree angle for a more complete perspective of the seafloor topography.

The outlet of the diffuser is in approximately 17 meters of water, as can be seen in figure 2 and 3. The water depth at the base of Baileys Ledge ranges from 45 to 57 meters. During the data reduction for the 1992 survey the diffuser end was assumed to be up slope, at the beginning of the "light bulb" shaped area. During the reduction of the 1993 data it was observed that the diffuser end is apparently midway into the "light bulb" area. The data reduction is referenced from this point, and an offset of the 1992 coordinates is noted. The below coordinates are the approximate location of the outlet of the diffuser end and the Day Marker for Baileys Ledge.

	<u>ASP ZONE 10</u>	<u>LAT/LON</u>
Point 1	1619352 E 359019 N	53 51 37.9 LAT 166 33 34.5 LON
Baileys Ledge DM	1619379 E 358957 N	53 51 35.8 LAT 166 33 33.5 LON

Please Note: Coordinates in Alaska State Plane Zone 10
Distances in Meters.

In figures 2 and 3 the colors represent discrete depths of water. The following is a list of those depths:

<u>Color</u>	<u>Depth</u>
Red	-12 meters (less than)
Green	-22
Purple	-34
Blue	-44
Black	-60

3.2 Side Scan Sonar Data

The geologic structure of Baileys Ledge is a rock outcrop (figure 4) that has a very high density. These hard reflectors yield high density returns. Utilizing the WSMS Image Processor the side scan sonar imagery in figure 4 highlights the rock outcrops of Baileys Ledge. The predominant geologic angle of repose of the ledge average from 20 to 40 degrees. The steepness and shape of the ledge dictate, to a large degree, the flow of the seafood processing waste away from the outfall.

As can be observed in figure 5, Westward Seafood's Outfall Pipe traverses the shallows on the south side of Baileys Ledge and bends to the Northwest where it terminates. The shadows are caused by the steep rock outcrops, that block the path of the acoustic energy. The abandoned outfall location was to the Northeast of the present diffuser location at a distance of approximately 25 meters.

3.3 Seafloor Analysis

The seafloor analysis criteria employed for the 1993 Westward Seafoods side scan sonar survey was modified from the criteria utilized in 1992. The criteria implemented for the 1993 survey is to quantify the total area that contains apparent seafood processing waste as verified using the noted methods. Seafood processing waste thickness is not estimated for the 1993 survey results. The analysis performed consisted of classifying seafloor regions where the amplitude

of the sonar signal return is anomalous to indigenous seafloor materials and is designated as apparent seafood processing waste.

The seafloor materials located with the side scan sonar in the immediate proximity of the diffuser and immediately down slope of the diffuser, was found to be of a different density than what was found in the surrounding region (figures 4, 6 and 7). The "light

bulb" shaped region is classified as the "Diffuser Outlet Region". Apparent seafood processing waste is contained within this region. A zoomed segment of the sonar image of the diffuser outlet region is displayed in figure 5. Due to surface floats it was not possible to transit completely across the waste pile as was done during the 1992 survey. For this reason it is not possible to estimate the depth of the apparent seafood processing waste pile based on the predominant angle of repose.

In composing the seafloor analysis drawing (figure 8), sonar imagery was delineated according to the density of seafloor materials. The diffuser outlet region is surrounded by seafloor materials having a higher density signal return than this area, but less than the geologic structure of Baileys Ledge in approximately nine meters of water. This material is also delineated as apparent seafood processing waste in figure 8.

A region that was not investigated during the 1992 outfall survey but has been included in the 1993 study is the area where an abandoned outfall, May 1991, was located. This region is southeast of what has previously been delineated as Baileys Ledge. This region has a similar acoustic impedance to other locations designated as apparent seafood processing waste area and is delineated as the same.

The apparent processing waste area is approximately 6200 square meters. This area is the accumulation of apparent seafood processing waste overlying consolidated and unconsolidated materials. In figure 8 this region is classified as "Apparent Seafood Processing Waste Area." This finding requires verification using a grab sampler.

Watson Company has developed an image processing technique that enables the warping of sonar imagery over a 3-dimensional bathymetric grid. This ability facilitates the untrained observer to visualize the area of investigation. Figure 6 and 7 display the composite of the bathymetry and imagery into a seafloor model (scale 1:1) that effectively illustrates the seafloor conditions. The resulting model is not an exact 3-D seafloor representation, however; it is representative of the general seafloor relief and features of the study area. In figures 6 and 7 the sonar imagery displays the apparent seafood processing waste, light blue material, flowing down slope as would be expected of a fluid material. In figures 6 and 7, it can be observed that the seafood processing waste is constrained by the geologic structure of Baileys Ledge.

3.4 Data Analysis

The following represent the findings from the 1993 seafloor investigation at the Westward Seafoods Baileys Ledge Outfall. No physical samples were taken during the side scan sonar survey and therefore the results are listed as "apparent." In calculating the area of waste distribution the angle of repose of the geologic structure is taken into consideration.

Apparent Accumulation of Seafood Processing Waste - 6200 Square Meters

The calculated density differences representing apparent seafood processing waste areas are within 80% certainty based on the overall accuracy of the program.

The 1992 Westward Seafoods, Final Report (Baileys Ledge Seafloor Waste Inspection, Watson Company, 1992) classified the apparent seafood processing waste accumulations as "medium" and "heavy", and were quantified within the report. Where sonar data indicated areas of discontinuous seafood processing waste the classification was "light", the aerial extent was not quantified. The 1993 report quantifies all areas indicating seafood processing waste within the extent of coverage.

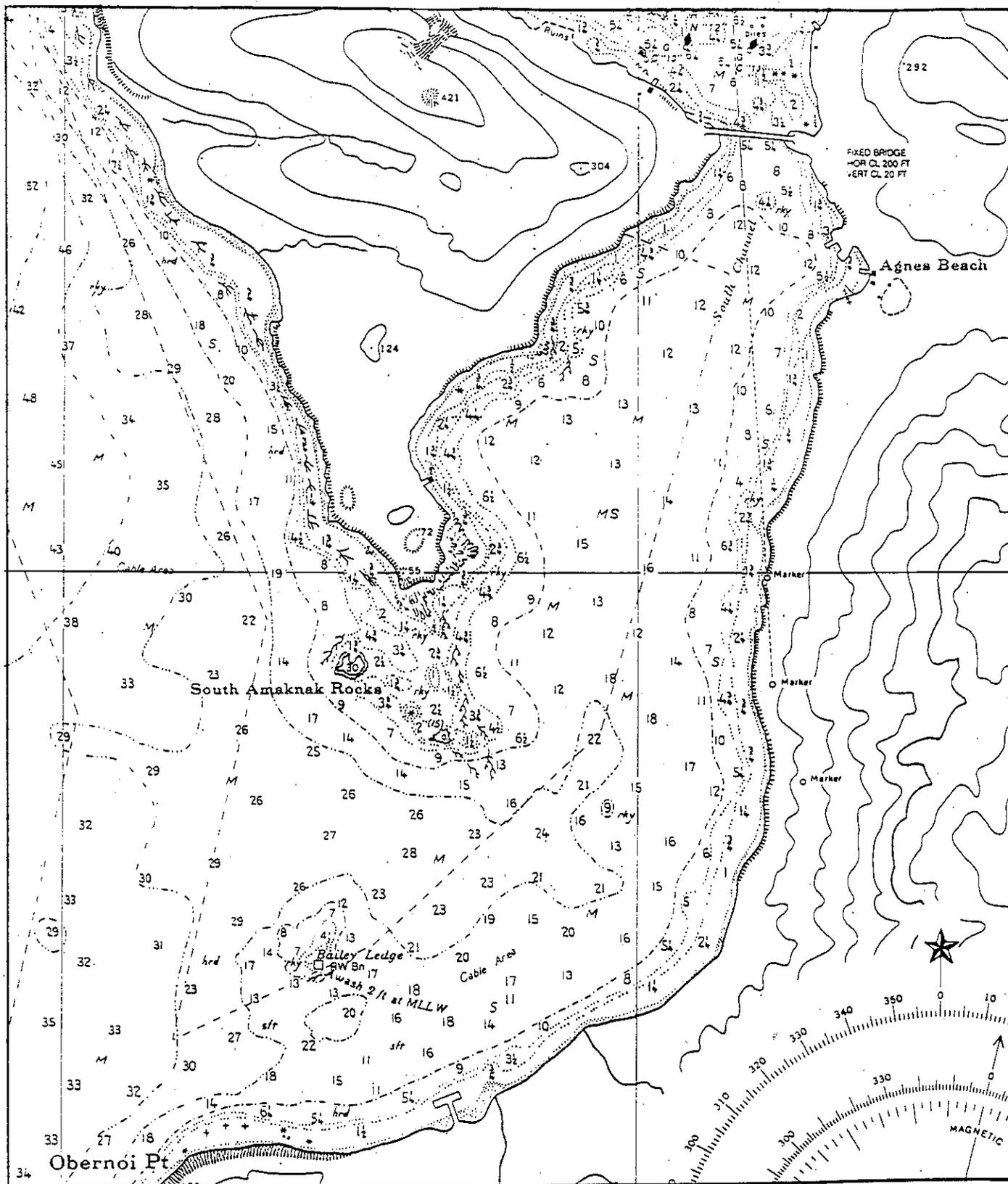
In comparison with the 1992 survey results, inclusive of the area indicating "light" seafood processing waste, the 1993 outfall survey demonstrates a reduction in seafood processing waste. In particular, the apparent seafood processing waste area has receded markedly on the west side of Baileys Ledge, and increased slightly on the east side of the area of investigation, from the observed seafloor conditions in 1992.

Overall, the 1993 survey results demonstrate a reduction in apparent seafood processing waste aerial accumulation from the 1992 seafloor condition. This reduction may indicate a general trend and should be investigated in subsequent side scan sonar surveys.

4.0 Conclusions and Recommendations

The Westward Seafood's Outfall Site Survey using Digital Side Scan Sonar, Bathymetry, Precision Navigation and the WSMS Image Processing System demonstrated itself to be very successful for compiling a map of the seafood processing waste distribution in the vicinity of Baileys Ledge. It should be noted

that because of the extreme relief and complexity of the area it is recommended that on the succeeding survey efforts, additional bathymetry data be gathered particularly in areas of high relief. It is further recommended that grab samples be taken to verify survey results.



WATSON COMPANY
ANCHORAGE, ALASKA

Prepared For:

WESTWARD SEAFOODS INC.

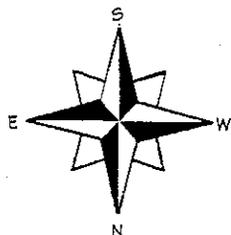
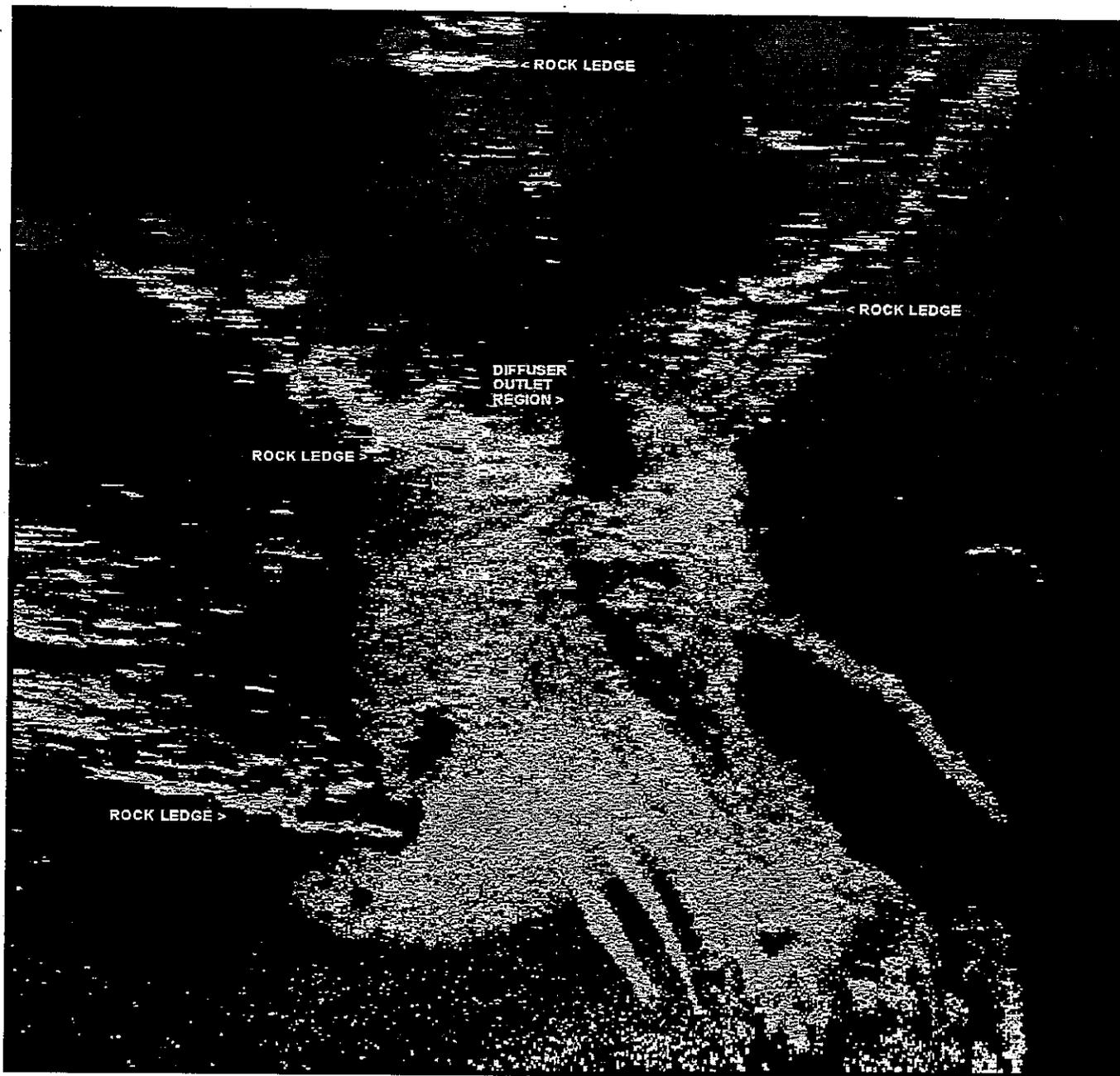
Survey Dates:

Sept 30 - Oct 6, 1993

Location:

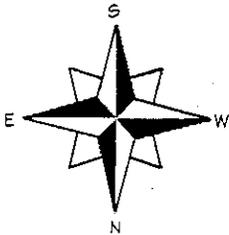
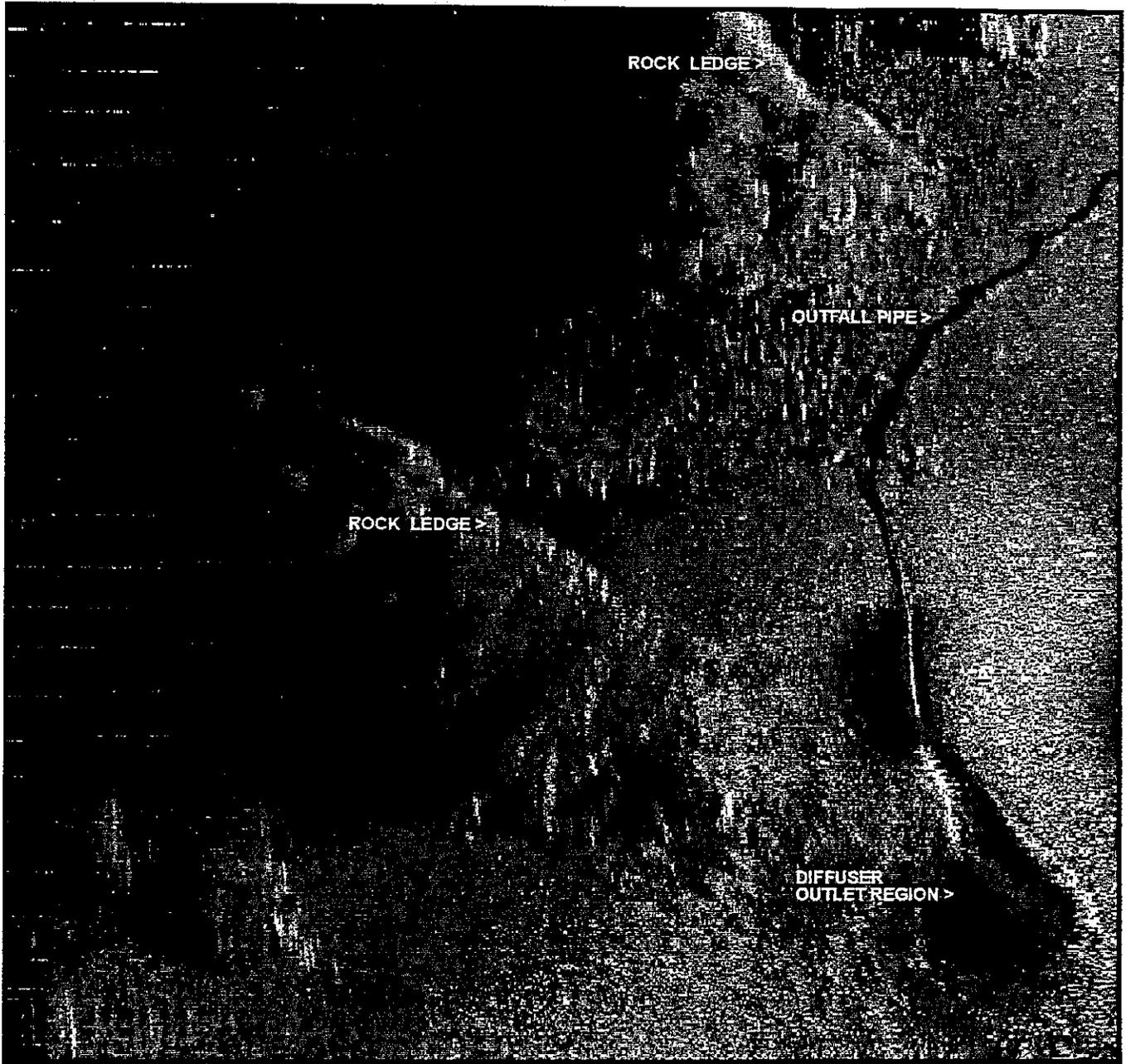
CAPTAINS BAY, ALASKA
NOAA CHART #16530

FIGURE 1



BAILEYS LEDGE SEAFLOOR SONAR IMAGE
 2 Dimensional View
 Image Size 150 x 150 Meters (approx.)

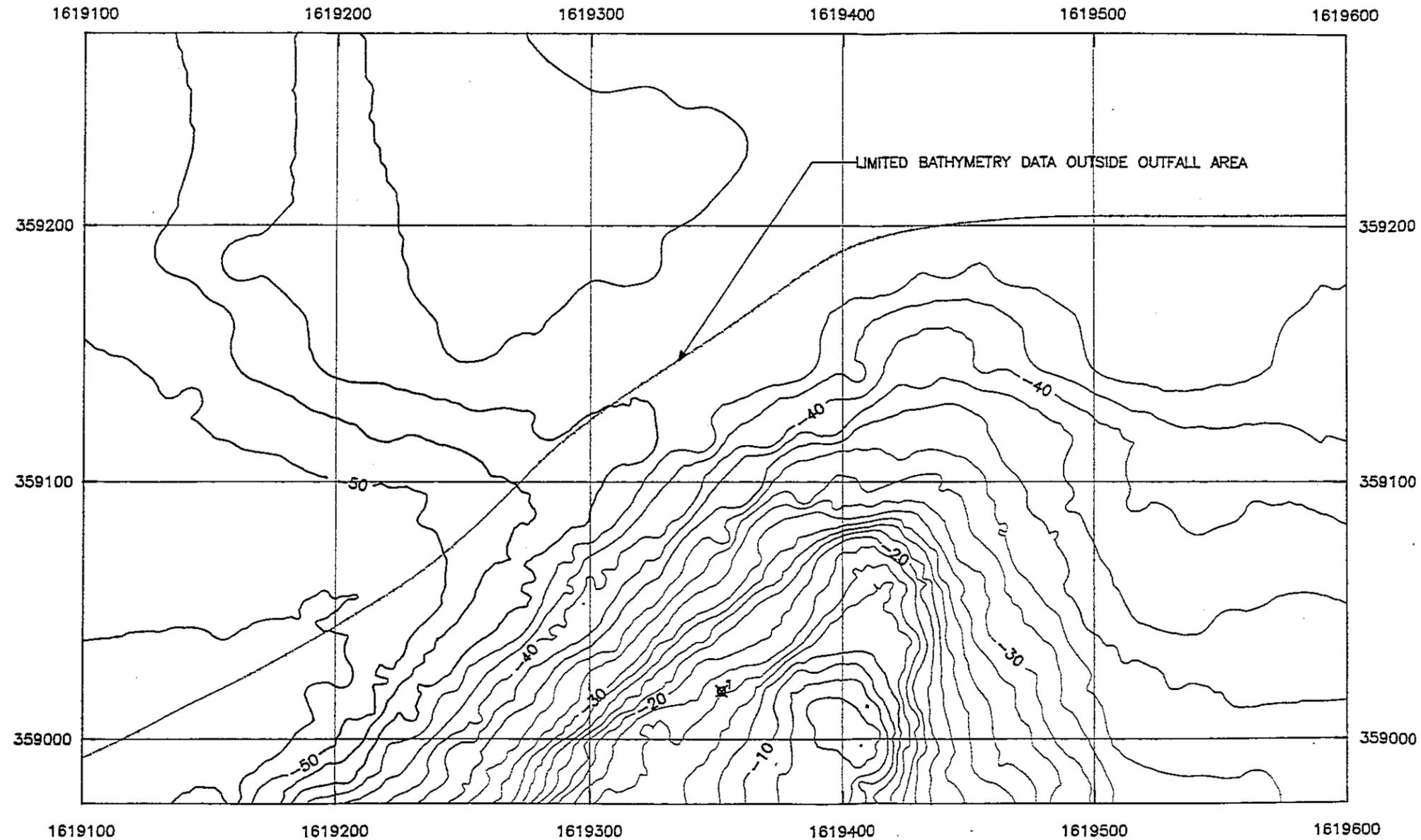
WATSON COMPANY ANCHORAGE, ALASKA	Prepared For: WESTWARD SEAFOODS INC.	Survey Dates: Sept 30 - Oct 6, 1993
	Location: CAPTAINS BAY, ALASKA	FIGURE 4



BAILEYS LEDGE SEAFLOOR SONAR IMAGE
 2 Dimensional View
 Westward Seafoods Outfall Pipe & Diffuser Outlet Region
 Shadows On Left Due To Rock Outcrops

WATSON COMPANY ANCHORAGE, ALASKA	Prepared For: WESTWARD SEAFOODS INC.	Survey Dates: Sept 30 - Oct 6, 1993
	Location: CAPTAINS BAY, ALASKA	FIGURE 5

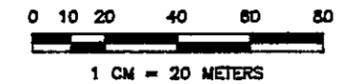
WESTWARD SEAFOODS -- BAILEYS LEDGE OUTFALL SURVEY -- OCTOBER 1993
 State Plane Zone 10 (Meters)



LEGEND

 CONTOUR LINE
 CONTOUR INTERVAL 2 METERS

 DIFFUSER END



ALASKA STATE PLANE
 ZONE 10 (METERS)

WATSON CO.
 Anchorage, Alaska

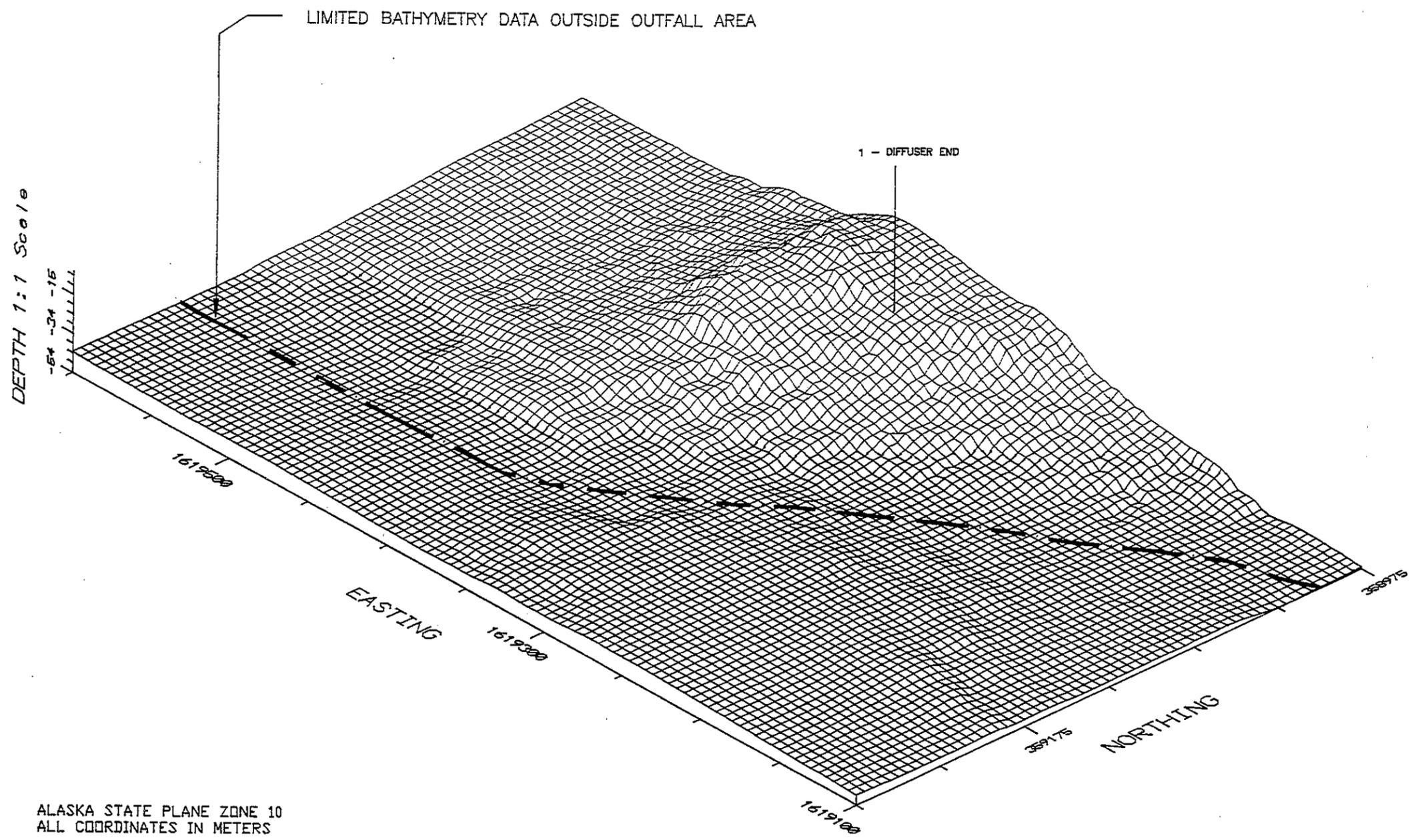
Prepared for:
WESTWARD SEAFOODS, INC.

**BAILEYS LEDGE OUTFALL SURVEY
 SEAFLOOR BATHYMETRY**

LOCATION: CAPTAINS BAY, ALASKA

PRINCIPAL INVESTIGATOR:	SURVEY DATES:
W.D. WATSON	SEPT 30 - OCT 6, 1993

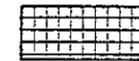
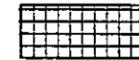
FIGURE 2	SCALE: 1:2000	DRAWN: GA
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ALASKA STATE PLANE ZONE 10
ALL COORDINATES IN METERS



LEGEND

-  DEPTH LESS THAN 12 METERS
-  DEPTH LESS THAN 22 METERS
-  DEPTH LESS THAN 34 METERS
-  DEPTH LESS THAN 44 METERS
-  DEPTH LESS THAN 60 METERS

WATSON CO. Anchorage, Alaska	
Prepared for: WESTWARD SEAFOODS, INC.	
BAILEYS LEDGE OUTFALL SURVEY 3-D BATHYMETRY PLOT	
LOCATION: CAPTAINS BAY, ALASKA	
PRINCIPAL INVESTIGATOR: W.D. WATSON	SURVEY DATES: SEPT 30 - OCT 6, 1993
FIGURE 3	SCALE: N/A
	ORANGE: GA



BAILEY'S LEDGE SEAFLOOR MODEL
3 Dimensional View
Image Tilted At Aprox. 20

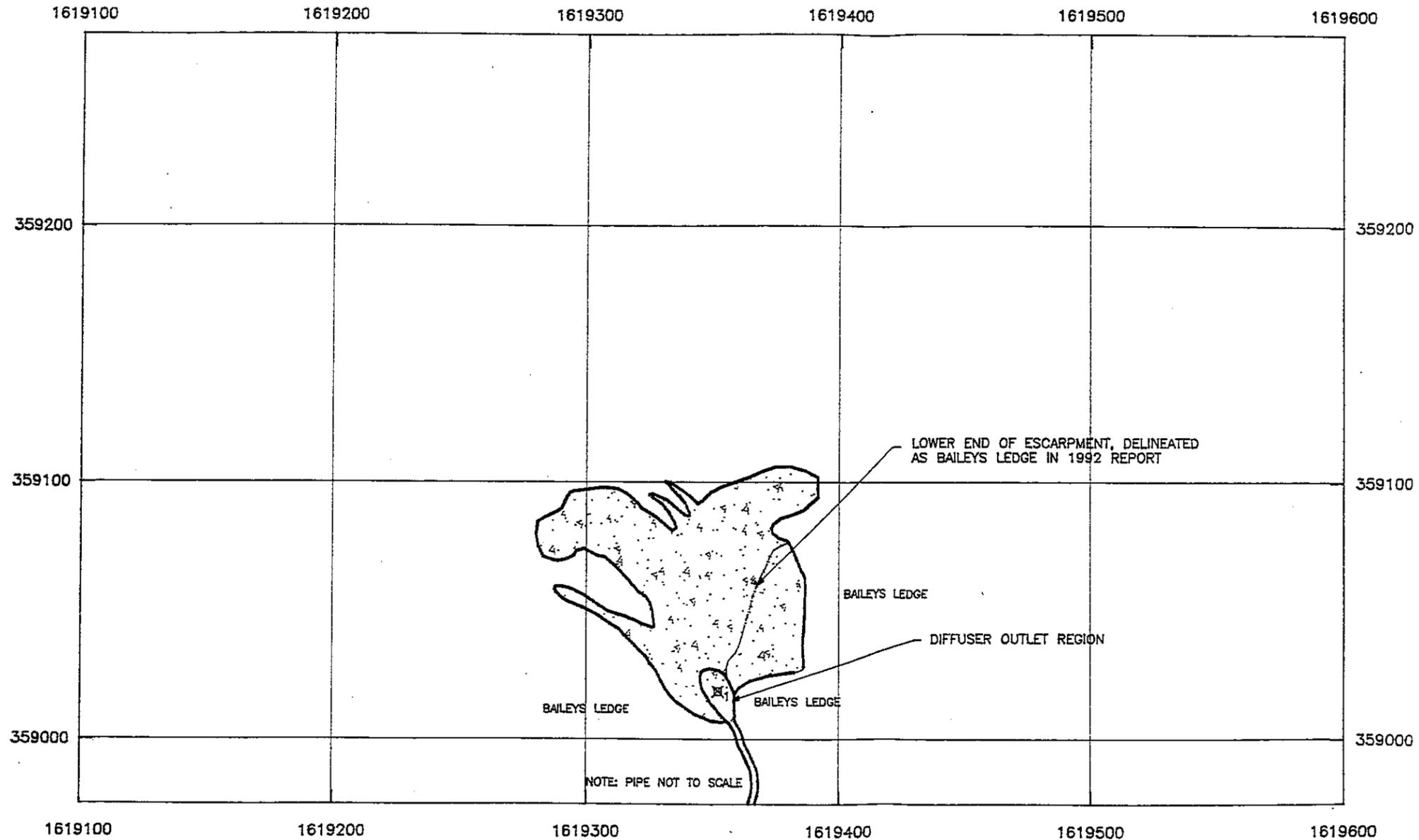
WATSON COMPANY ANCHORAGE, ALASKA	Prepared For:	WESTWARD SEAFOODS INC.	Survey Dates:	Sept 30 - Oct 6, 1993
	Location:	CAPTAINS BAY, ALASKA		FIGURE 6



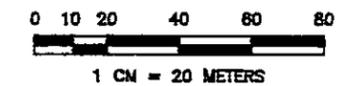
BAILEY'S LEDGE SEAFLOOR MODEL
 3 Dimensional View
 Image Rotated 90 And Tilted At Approx. 20

WATSON COMPANY ANCHORAGE, ALASKA	Prepared For: WESTWARD SEAFOODS INC.	Survey Dates: Sept 30 - Oct 6, 1993
	Location: CAPTAINS BAY, ALASKA	FIGURE 7

WESTWARD SEAFOODS -- BAILEYS LEDGE OUTFALL SURVEY -- OCTOBER 1993
 State Plane Zone 10 (Meters)



SEAFLOOR LEGEND



ALASKA STATE PLANE
 ZONE 10 (METERS)

WATSON CO.
 Anchorage, Alaska

Prepared for
 WESTWARD SEAFOODS, INC.

BAILEYS LEDGE OUTFALL SURVEY
 SEAFLOOR ANALYSIS

LOCATION: CAPTAINS BAY, ALASKA

PRINCIPAL INVESTIGATOR:	SURVEY DATES:
W.D. WATSON	SEPT 30 - OCT 6, 1993

FIGURE 8	SCALE: 1:2000	DRAWN: GA
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