

SIDE SCAN SONAR OPERATIONS
1974

BY: R.J.C. ROBITAILLE

SIDE SCAN SONAR OPERATIONS

1974

BY: R.J.C. ROBITAILLE

CONTENTS

INTRODUCTION	PAGE 1
SUMMARY	PAGE 2
PHOTOGRAPH OF SIDE SCAN SONAR	PAGE 3
NARRATIVE	PAGE 4
INITIAL PROBLEMS	PAGE 4
FIGURE 1 - BREAK-AWAY TAIL FIN	PAGE 6
FIELD SEASON OPERATIONS	PAGE 7
a) FRENCHMAN BAY	PAGE 7
b) LOWER ST. LAWRENCE	PAGE 7
FIGURE 2 - BOTTOM MATERIAL ZONES OF BEAUJEA CHANNEL	PAGE 8
c) LAKE HURON HARBOUR	PAGE 9
d) NIPIGON RIVER	PAGE 10
FIGURE 3 - THE SEARCH AREAS	PAGE 11
e) LAKE WINNIPEG HARBOURS	PAGE 12
f) BURLINGTON	PAGE 13
g) CHESTERFIELD INLET	PAGE 14
CONCLUSIONS AND RECOMMENDATIONS	PAGE 16

INTRODUCTION

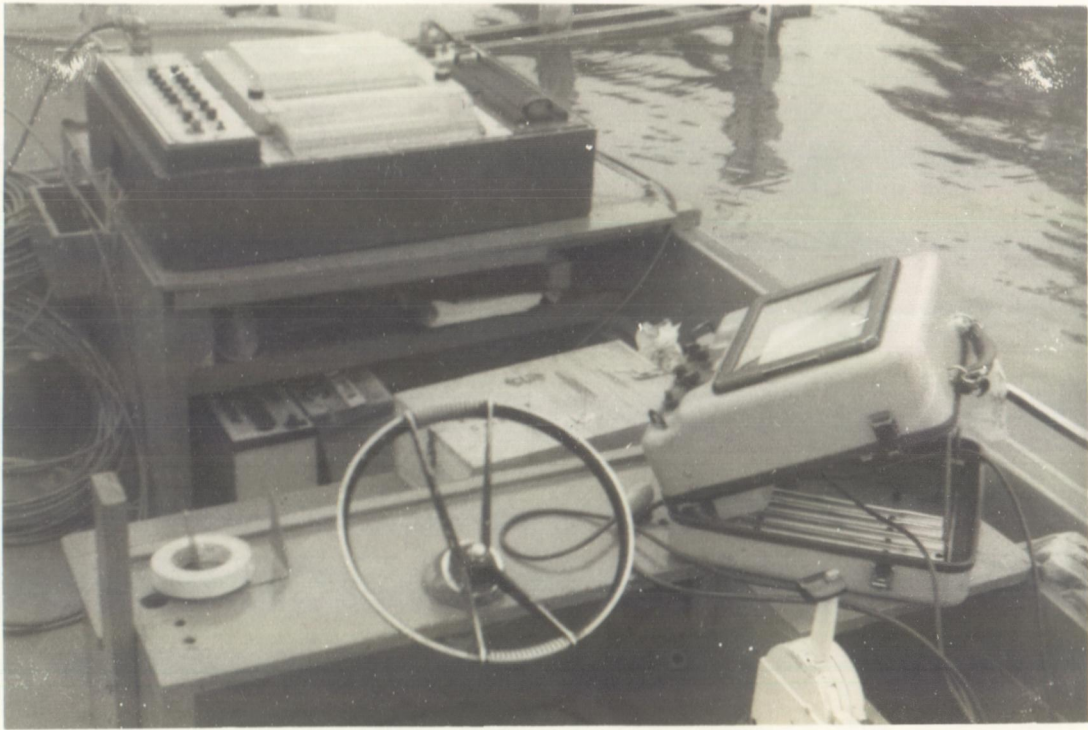
Early in 1973, Central Region bought a Klein Model 400 Side Scan Sonar, hereafter called the sonar, to determine the instrument's usefulness to Hydrography.

This report deals with the progress made with the instrument in its second year of use by the Region. To avoid duplication of material, the reader is referred to last year's report on the sonar entitled "Side Scan Sonar Operations, May 14 to September 28, 1973", by J.H. Weller. The section entitled 'Description of Sonar Equipment' is particularly relevant.

Traditionally, hydrographers are never content with merely finding and surveying new sea passages. They are continually looking for better ways to gather and present their data. Soon, chart users will no longer be satisfied with discontinuous depth information. They will want to see a true representation of the bottom topography realistically portrayed on a chart. The sonar or a similar device can help make this possible. Therefore, it is the hydrographer's responsibility to see that charting becomes more compatible to these devices. Moreover, any other meaningful data made available by the use of these devices must be incorporated on a chart.

SUMMARY

Electronic problems plagued the sonar most of the year. The sonar did not prove to be more capable of finding shoals than our conventional sounding techniques. However, submerged artificial structures are more readily found with the aid of the sonar. The sonar, with proper overlap, could be used to replace sweeping. In depths less than 30 metres, the sonar has a dramatic capability to map areas into bottom type zones. This aspect can revolutionize our bottom bottom sampling techniques. More development must be done to the instrument to make it more rugged and to give it a dependable range of at least 200 metres. Then the sonar may become a useful reconnaissance tool.



Side Scan Sonar Recorder

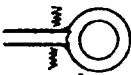


Transducer Fish

NARRATIVE

Initial Problems

The spring experimental program for the sonar had to be cancelled because of electronic malfunctions. In November of 1973, the original sonar fish (transducer) was sent to Klein for repairs and an additional fish was purchased to be used as a spare. As of February 1, 1975, the original fish had not been returned. However, the spare fish did arrive on April 4, 1974 and was tested the next day. The test results were poor. Mr. R.S. Bryant, Acting Head of Hydrographic Development for Central Region, participated in the testing and recommended that the sonar be bench tested. At the time, the priority of the electronic shop was to prepare launches for field operations. Thus, the sonar was not made serviceable until May 17th. A loose circuit board in the fish was the major problem. The sonar ran well for several trial runs, just long enough for me to become familiar with the instrument. The endless loop electrode drive motor which had been broken and repaired the previous fall and in the spring now became unserviceable. I ordered a replacement motor and it arrived on May 31st. Our Customs Agent was very helpful in speeding up delivery of the motor. I installed the motor that day and it has worked well since.

During the trial period, the tail fin design caused some problems. First the tail fin retaining cone, made of gray plastic, fractured. Klein replaced this cone with one made of polypropylene. It is indestructible. The tail fin retaining line also presented problems. The original line was composed of a stretchable cord, Bungie Wire, with attachment ends made of copper electrical terminals shaped as drawn.  These connectors are too brittle and break after a few bends. Thus, the tail fin, valued at \$200, is lost soon after the tail fin breaks away. It is interesting to note that a gas engineer on one of our field parties made a replacement for this tail fin out of scrap aluminum in less than two hours. I tried to make a more serviceable retaining line using 3/8" diameter, high tension steel cable welded to larger, more durable terminals. This design was proved unsuccessful. So, a short, small diameter rope was added as an additional recovery line, but no collisions with the bottom have occurred since to test this design.

The break away tail fin design should be discarded. This should be done not merely because of the less than 50% recovery rate of the tail fin but because the complete detachment of the tail fin allows the fish to fluctuate erratically. This fluctuation can take the fish to depths 2 to 3 metres below the normal towing depth. Under these conditions, collisions with the bottom may occur on the sides of the fish where the instrument is more susceptible to damage.

Figure 1 illustrates this problem. Perhaps a plastic or fiber glass tail fin with a low horizontal shear strength could be used.

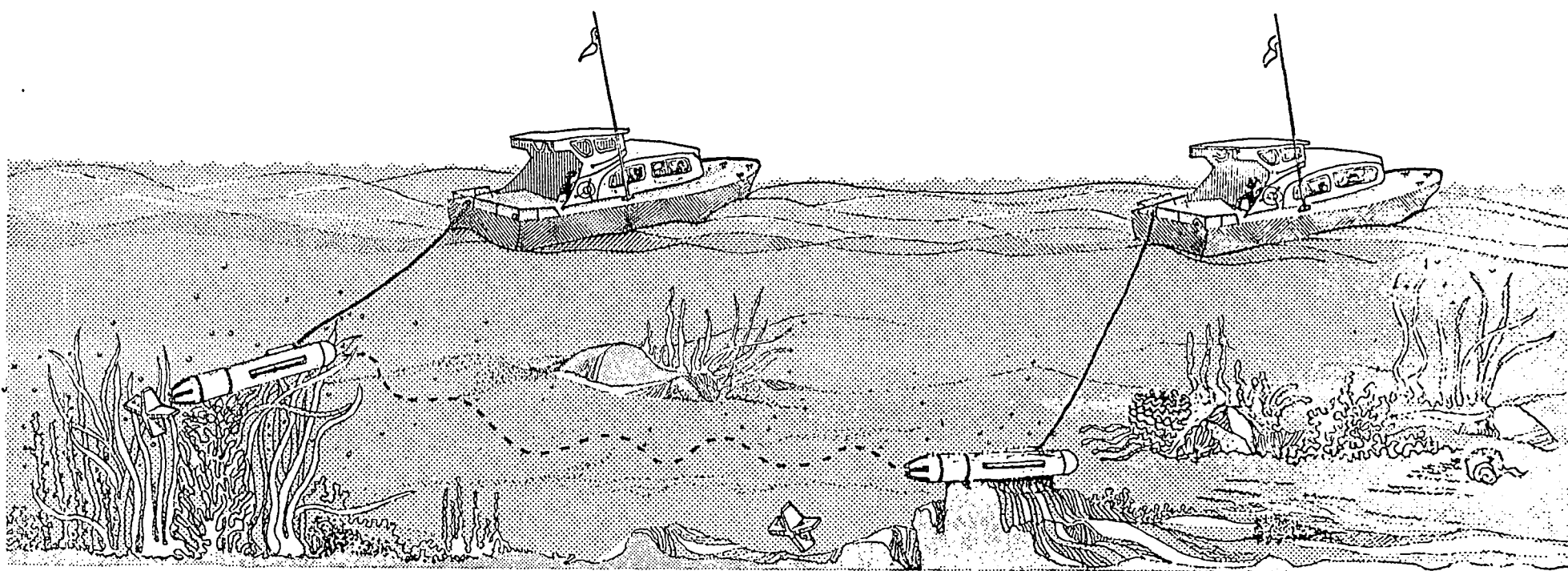


Fig. 1 The Break-away Tail Fin

FIELD SEASON OPERATIONS

a) Frenchman Bay, Lake Ontario

This local survey was to be a primer for the more remote field locations. Frenchman Bay, however, was so shallow and weed clogged that the sonar was ineffective. Later we took the sonar further offshore into Lake Ontario using the launch HERON. This launch had an unusually high electronic noise level which affected the efficiency of the instrument. The problem did not recur on other vessels used during the past season. No positive results were obtained from the first field excursion, namely, the Frenchman Bay Project.

b) The Lower St. Lawrence

Use of the sonar on the St. Lawrence River project was more successful. Working with the survey party at St. Jean-Port Joli, 80% of the south ship channel, on Field Sheet Number 3690, was covered at least once. In this area, 50% of the work done was overlapped.

High winds made field work with the sonar impossible three quarters of the time. When the sonar was used in moderate to heavy seas, breaks in the graph were caused by the pitching of the fish. The pitching occurred in unison with the launch falling in to the wave trough.

Few shoals were found in the channel, those picked up by the sonar had been previously examined. Inside the 200 metre sweep the sonar did not miss any shoals found by sounding. Moreover, details such as boulders, small shale ridges, mud gullies, mud ridges and waves of various materials were evident. These details, when analyzed, will enable us to make a general statement on the bottom topography.

Very satisfactory graphs were also obtained while working with the St. Lawrence, Montmagny Survey Party. The south channel was smothered with sonar tracks from Algernon Rock south past Pointe aux Pins on Ile aux Grues. Again the sonar tracks did not reveal any new shoals. The sonar did reveal complex bottom topography, to the extent that this part of the channel has

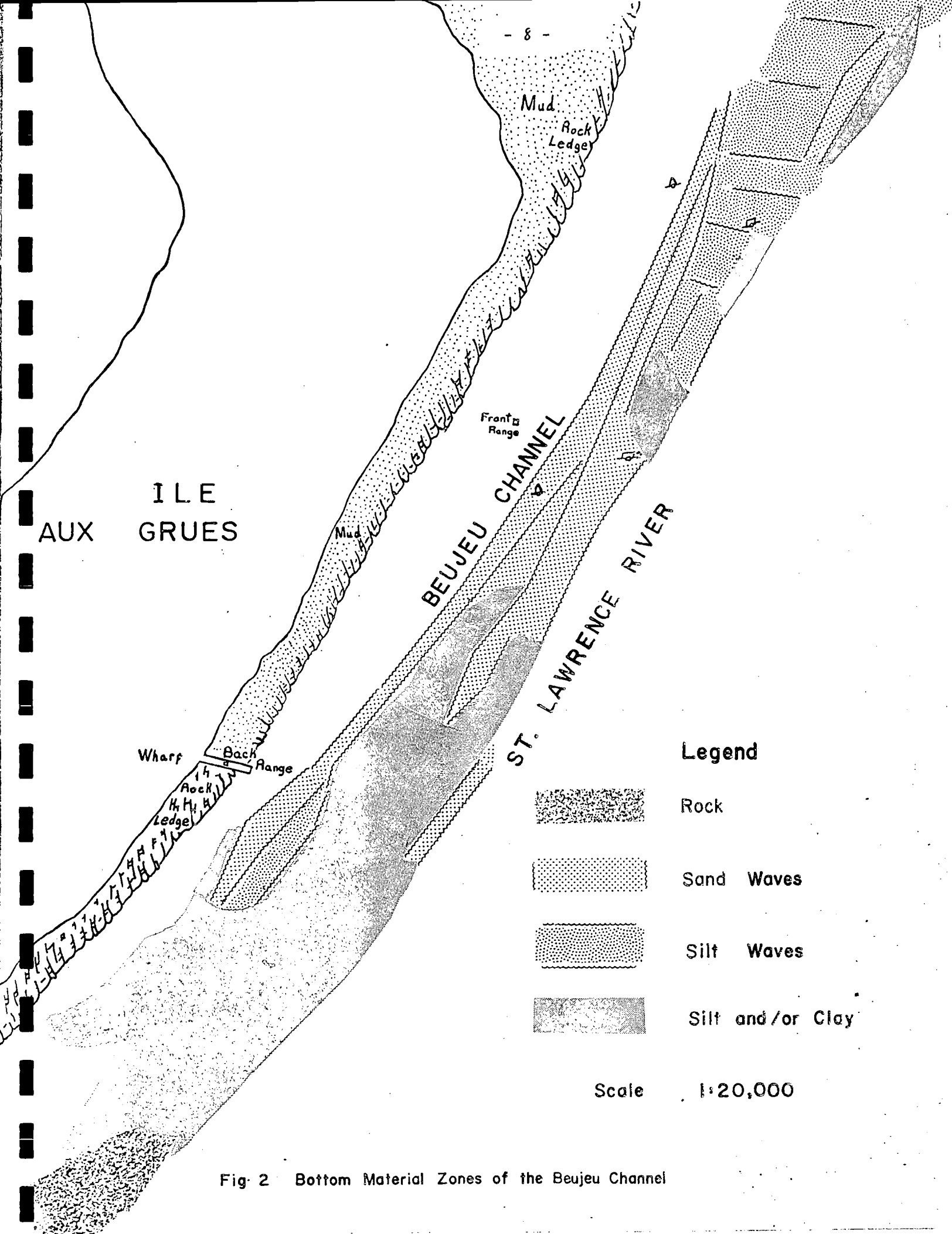


Fig. 2 Bottom Material Zones of the Beujeu Channel

been divided into bottom type zones. Figure 2 illustrates these bottom type zones at the most complex portion of the channel. From this it can be seen that the sonar can improve our bottom sampling technique. The entire area could be mapped into bottom type zones. Conventional bottom samples could then be taken in each of the various zones to confirm and fully describe the material in that zone. Once interpretational expertise has been developed, the need for conventional bottom sampling would be reduced or even eliminated.

Sonar graphs of this area are very dramatic, but none are included as part of the report because their quality is drastically reduced by the photo copying process. Instead, the reader is referred to a magnificently illustrated text entitled "Sonar Graphs of the Sea Floor" by Belderson, Kenyon, Stride and Stubbs.

Only one minor electronic problem was had with the sonar during the month with the St. Lawrence Survey parties. A capacitor shook loose and caused a loss of focus on the port channel. The photographs in the maintenance manual were extremely useful. They not only enabled us to quickly locate where the capacitor had dropped from but also indicated how it should be reconnected.

The weight of the recorder, 120 pounds, posed a problem on these and subsequent surveys. It is just too heavy and awkward. Two persons are needed to lift and carry the recorder. Often it has to be moved over and around wet and slippery boats and docks. These conditions add up to a potentially dangerous situation. One slip may result in a personal injury and a damaged recorder. The sonar recorder should either be permanently installed in one vessel or be broken down into two more manageable components. Furthermore, air transport of this equipment is often delayed by the excessive weight of this unit. Two projects were cancelled because of delayed air transportation.

c) Lake Huron Harbours and Range Lines

One of the most practical uses of the sonar is to sweep narrow channels and harbour basins. In these areas, the presence of man-made hazards to navigation are more likely to occur. The sonar is remarkably capable in detecting such

objects. In most cases these areas can be swept quickly from a small boat such as a 17 ft. Boston Whaler. As an example, the harbour basin at Goderich was swept in about 30 minutes. Similarly, the range lines at Goderich, Grand Bend and Kincardine and a natural range in Bayfield were each swept in less than 30 minutes per area. There were no obstructions on any of these ranges in Goderich Harbour. The most difficult part of the operation was transporting the small boat from one location to the next.

d) The Nipigon River, Ontario

The year's best practical use of the sonar was a search for pilings in the Nipigon River. Most of the work here was in shallow and sheltered water with one area in particular being less than three metres deep. To safely conduct a search in this area, we towed the fish from the bow. In this way, a tow depth of $3/4$ of a metre was achieved. Normally, the fish is towed from the stern at 6-8 knots and the tow depth is two metres. Towing from the stern, a minimum speed of three knots is required to keep the fish planing, however, the tow depth is increased to three metres. Thus, towing from the bow also gives added mobility; stopping, very slow speeds and sharp turns can be executed without endangering the fish. The one major drawback to this procedure is that any vertical movement of the bow affects the fish. With a small fiber glass boat this means that a .2 metre wave causes the bow to fluctuate enough to reduce the range at which a pile or similar object can be detected from 50 metres to 25 metres. The maximum range for the detection of a half metre diameter pile was found to be 50 metres whether the fish was towed from the bow or from the stern. When the fish is towed from the bow, and with an increase in fluctuation, the range at which small objects can be detectable decreases. Moreover, the quality of the graph decreases. The fish must ride smoothly in the water for good resolution and detection of small objects.

We searched for the piles in a very methodical manner. First the visible piles were used as a target to determine the maximum range for their detection. The range then became the distance between our search lines. This gave us a large safety factor because it reduced the maximum possible distance from any unknown pile to one-half the maximum range. In addition, the area

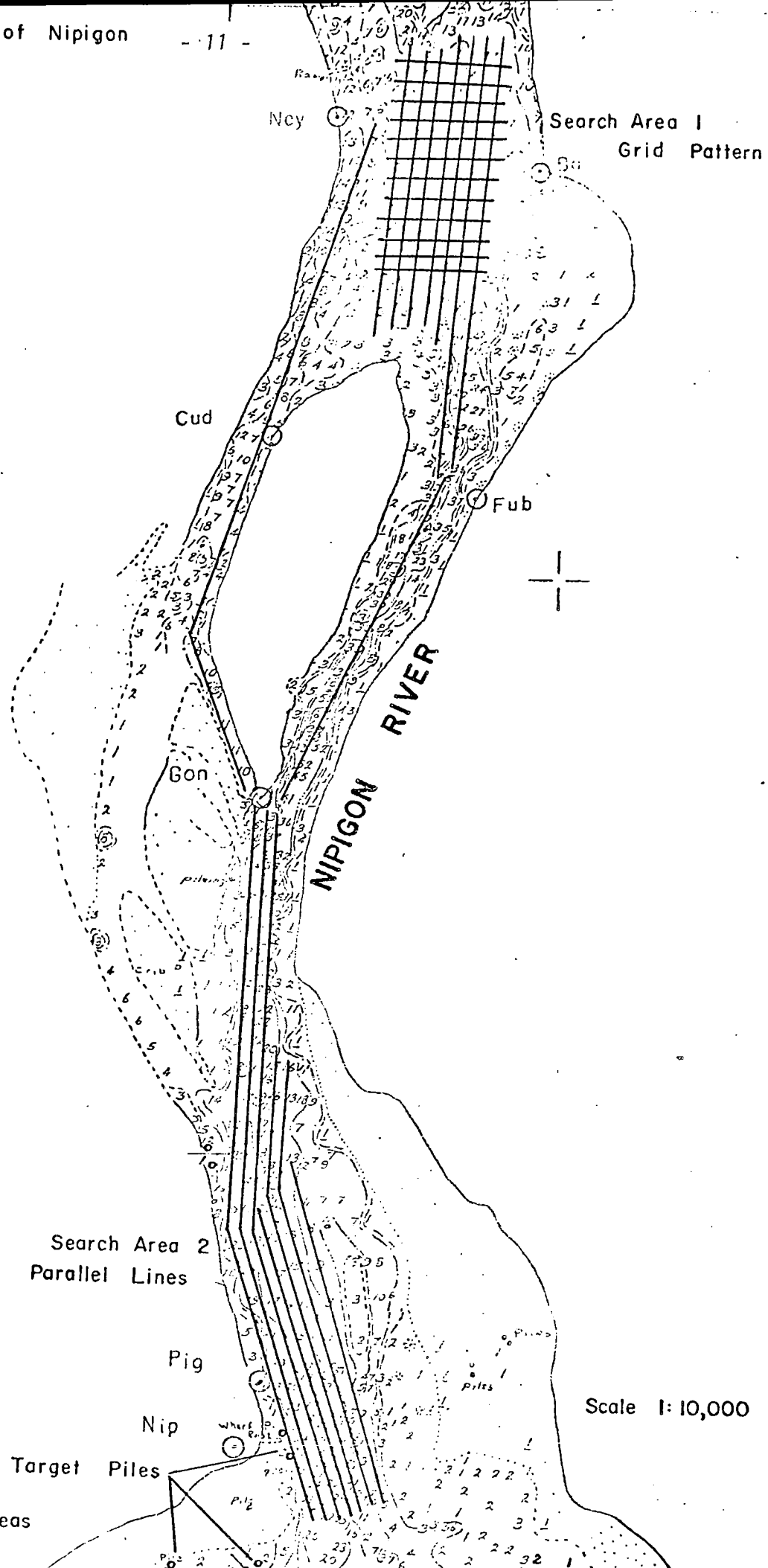


Fig. 3 The Search Areas

near the town of Nipigon was surveyed on a grid, that is, an additional search pattern of parallel lines were run normal to the original search pattern of parallel lines. Figure 3 illustrates the working area, the target piles, and the search patterns used. Finally at the end of each search operation, to ensure that the sonar was still operating properly, the visible piles were again used as targets. On every occasion, the sonar worked equally well after the search operation.

Our search proved that the log boom piles shown on the 1952 aerial photographs had been completely removed. The sonar revealed that many areas of the bottom of the lower section of the Nipigon River are strewn with logs. This, coupled with the sighting of many dead heads in the area, leads to the conclusion that the report of piles in the area were in fact dead heads.

All went well on this survey until Sunday, July 28th. At this, little or no trace was obtained from the starboard channel. All the circuit board pairs in the recorder were switched, but the problem remained unchanged. The fish circuitry board became suspect. At this particular time, I did not have the ability to change the boards, consequently, we completed our search for the piles with the port channel. A hydrographer who intends to use the sonar independently should be well-versed in the repair or replacement of as many of the components as possible.

e) Lake Winnipeg Harbour Surveys

I elected to proceed to Lake Winnipeg regardless of the unserviceability of the starboard channel. I felt confident that the problem with the sonar was caused by the fish circuit board, and that the technician attached to the survey party in Lake Winnipeg could effect repairs. I arrived at Gull Harbour late in the afternoon of July 30th. That evening, I discovered that the technician had experienced and solved the same malfunction the year previous.

The next morning, we completed the exchange of the fish circuit boards and tested the sonar alongside the dock when Mr. A.J. Kerr, our Regional Hydrographer, called and requested that the sonar be seconded to Mr. Marshall on the St. Lawrence River to assist in locating a misplaced current meter. We complied. The old fish circuit board was repaired and

both circuit boards were field tested within the harbour limits. At the same time, the sonar was demonstrated to several people in the party. Sonographs with good detail were obtained.

The sonar was airlifted to Québec City.

The equipment was of no use in helping to locate the missing current meter. The port channel was virtually inoperative while the maximum range on the starboard channel was 75 metres. However, the sonar was capable of spotting an array of current meters whose location was marked. By August 7th, the sonar was back in Gull Harbour, Lake Winnipeg.

Repairs were carried out on the following day - firstly the Silicon Controlled Rectifier (S.C.R.) component on the port channel board was repaired. It was also necessary to repair the Time Variable Gain (T.V.G.) board. After these repairs, the sonar seemed to be working satisfactorily, but the detail of the trace on the sonographs was not as good as the detail obtained earlier. On August 9th, we used the sonar in an attempt to find some reported pilings at the mouth of the Manigotagen River. The search failed. During the preliminary range testing, the quality of the sonar graphs deteriorated rapidly. In less than half an hour, the sonograph of a small island turned from a good crisp return to a dark and undefined blob. In retrospect, this deterioration of the graph had begun at the end of the testing the day previous. I resorted to the procedure of switching circuit boards to try and isolate the problem. I only compounded the problem because while the print amplifier board was being exchanged, a piece of metal lodged between the pins and went unnoticed. This caused the starboard channel to be completely blank. We spent the next two weeks trying to get the sonar up to the standards necessary to detect piles. Our efforts were in vain. On August 23rd, I left the area with the sonar and returned to Regional Headquarters.

6) Burlington

The last week in August was spent in Burlington extensively bench testing the sonar. The testing did not reveal any major problems and no major repairs were made. We field tested the sonar at the end of the week; to my

amazement the sonar was now capable of giving good detail, particularly on the port channel. What caused the improvement in the sonar still remains a mystery.

Preparations were made to join the Chesterfield Inlet party.

g) Chesterfield Inlet

The sonar was in fact quite useable at a range of 100 metres in depths of 5 to 40 metres. However, in Chesterfield Inlet it was found that any attempt to use the sonar in depths greater than 50 metres was futile. At this depth, the starboard channel had difficulty producing a direct bottom return and some vague outlines of the major features. The port channel was in better condition and in some exceptional instances clear returns from 200 metres were obtained. However, this was in a rocky area with a launch speed of 4 knots. The bottom type and the launch speed are both ideal for sonar. Normally, the returns from the port channel began to fade out at 100 metres. I do not recommend the 200 metre range selection because the increase in range is accompanied by the obvious compaction of features and a lack of contrast and blending. This makes the records more difficult to interpret.

A ten mile wide strip of the narrowest part of Chesterfield Inlet near Baker Lake was swept. Again no new shoals were discovered. The bottom topography was ninety-five per cent (95%) boulder strewn bed rock. Much of the remaining area was sand. Only one small patch of mud was seen on the twenty mile circuit. As an experiment, a line was run 250 metres away from the major shoal in this area - Ice Hunter Rock. Using the 100 metre range, there was no indication of the shoal. The return from the up slope of the shoal was not different from the return from the channel edges. A similar line run 150 metres from the rock showed the shoal well.

Two ranges near the entrance to Baker Lake were swept. These ranges were in such shallow waters that an echo sounder would have been a more practical instrument to use. Four ranges were run further down stream. Conversely, most of these ranges were in depths greater than 50 metres. Thus, with the starboard channel barely able to penetrate to the bottom and the port

channel only effective to a range of 100 metres, the sonar in fact only swept a path 35 metres wide -- not much better than an echo sounder. With the present launch speed restrictions and limitations due to range and depth, the sonar has little use for reconnaissance.

CONCLUSIONS AND RECOMMENDATIONS

The sonar must be repaired by Klein, the manufacturer. Our technicians have already exhausted every means available to them in an attempt to fix the instrument. In proper working condition, the sonar can exceed the performance stated in my report. In good working condition the sonar could be a useful reconnaissance tool.

Two physical design modifications could improve the sonar. First, split the recorder into two more manageable components. Carrying the present heavy, awkward recorder over slippery boats and docks is dangerous. Second, the break-away tail fin design should be discarded. The complete detachment of the tail fin can jeopardize the fish. In addition to these physical design modifications, our technicians have suggested that the fish circuit boards be modified. More protection should be given to the S.C.R. component.

The sonar proved to be an excellent tool for finding relatively small man-made submerged objects. For this reason, I recommend that the sonar be used on a Revisory Survey. They could sweep the many harbours and narrow channels they frequent. Three other advantages of assigning the sonar to a revisory survey are: the sonar could have a permanent installation, transporting a small boat from harbour to harbour by road to accommodate the sonar would be avoided, and expensive and time consuming air transport of the sonar could be avoided.

Late in the field season, the sonar should be taken to another survey party. Once there, the bottom sampling and check lines for one field sheet should be obtained using the sonar in conjunction with an echo sounder and conventional bottom sampling techniques. Additional lines should be run so that the sonar sweeps cover about 50% of the open areas of the field sheet. The amount of additional coverage needed would depend upon the complexity of the bottom topography. Hopefully, there would be adequate coverage to allow the field sheet to be divided into bottom type zones. Conventional bottom samples could then be taken in each of the various zones to confirm and fully describe the material in that zone. For this added information to be of any use, a means of portraying the various bottom types on a chart must be investigated and incorporated on a chart. Perhaps symbols similar to those used on topographical maps could be used.