

ENVIRONMENT
CANADA

ENVIRONMENTAL
PROTECTION
SERVICE

1973 SHELLFISH GROWING WATER SANITARY SURVEY

of

SALTAIR (DAVIS LAGOON), B.C.

by

T. J. TEVENDALE, P. ENG.
PROJECT ENGINEER
SHELLFISH WATER QUALITY PROGRAM
PACIFIC REGION

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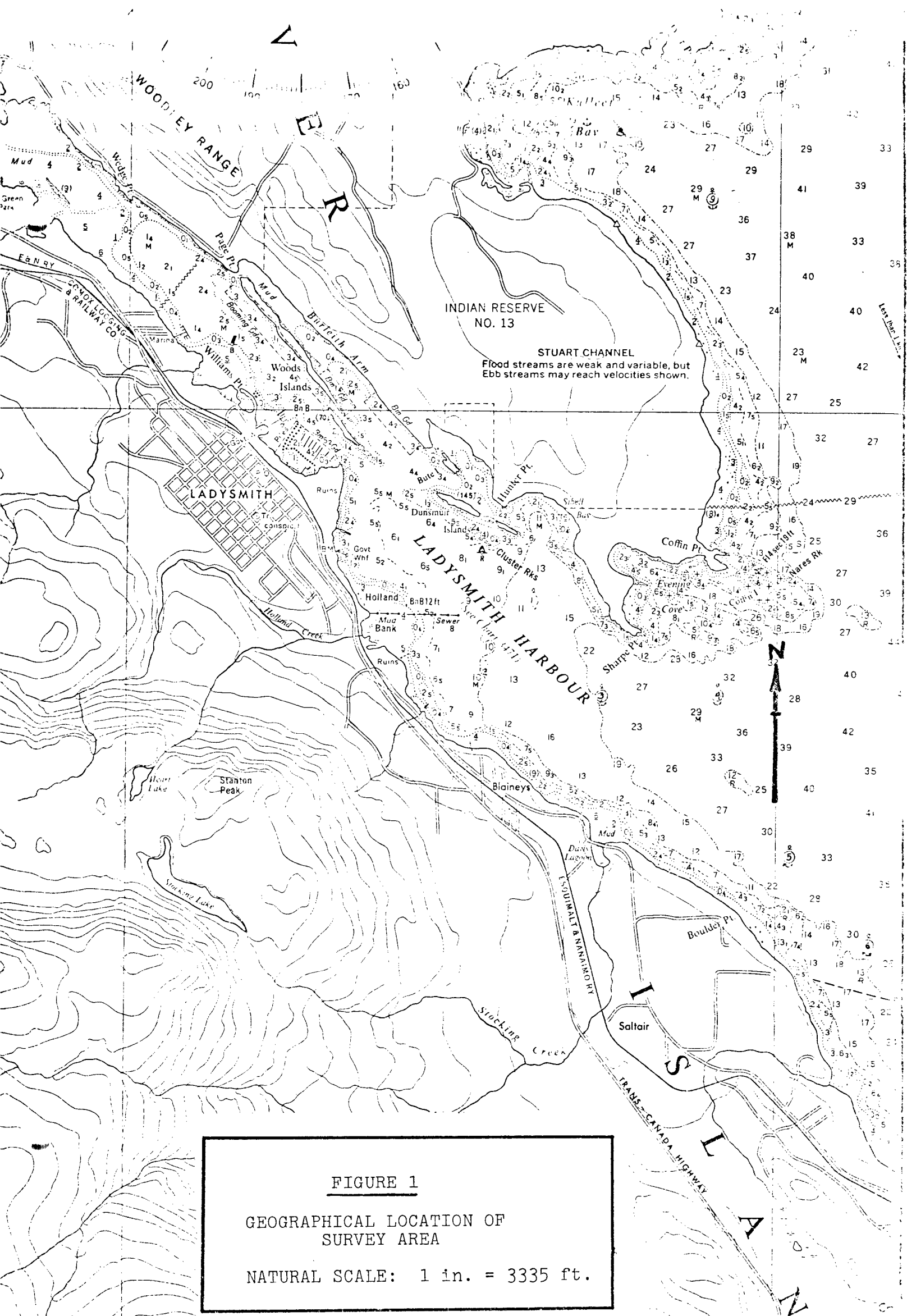
SURVEILLANCE REPORT
MARCH, 1973

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SHELLFISH WATER QUALITY PROGRAM

Sanitary Survey of Saltair (Davis Lagoon) Shellfish Growing Area

INTRODUCTION:

A sanitary survey of the commercial oyster lease at the mouth of Davis Lagoon, 2½ miles southeast of the Town of Ladysmith, on Vancouver Island, was conducted by Public Health Engineering, Department of National Health & Welfare in November-December, 1964. The survey report recommended that "these leases should be allowed to remain open only if an immediate surveillance program is instituted and the results of the sampling show that both growing waters and shellstock bacterial levels are within the standards. If immediate action of this nature is not possible, then the Davis Lagoon leases should be classified as restricted".

An outright recommendation for restriction was not made since low growing water bacterial levels were obtained during the first seven days of an eleven-day survey. Unacceptably high coliform counts on the last three days of the survey were obtained coincident with rainfall following a preceding four weeks' dry spell. The higher counts following rain were attributed to seepage of sewage from on-site disposal systems serving homes on the waterfront and in the Davis Lagoon Watershed area.

Since the 1964 study, there has been a considerable increase in the number of homes established along the adjacent waterfront and in the drainage area, all serviced by septic tank and disposal field sewerage. Also, in 1965 the Town of Ladysmith constructed under permit, an Imhoff type primary treatment plant at Holland Bank with an outfall extending 2875 feet into the outer harbour at a depth of 62.5 feet. The end of the outfall is approximately 8,000 feet from Davis Lagoon.

An overflow of raw sewage from a shoreline sewer manhole can occur due to lift station failure at a distance of approximately

5,000 feet from Davis Lagoon.

Following transfer of the sanitary control of shellfish fisheries in British Columbia from provincial to federal jurisdiction in October 1972, a sanitary survey of the Saltair area was given a high priority and the survey carried out during the period January 9th to 26th, 1973.

The geographical location of the study area is shown in Figure 1.

FIELD PROCEDURES AND METHODS:

Sampling stations were selected and a bacteriological, chemical and physical water testing program developed to assess the shellfish growing water quality and the source of pollutants.

(a) Bacteriological Sampling and Analyses:

At each marine station, samples were taken from a boat in a sterile 6 ounce wide-mouth bottle attached to the end of a 5 foot sampling rod. The samples were collected $\frac{1}{2}$ to 1 foot below the surface at a depth of 3 feet and stored in coolers until processed. At each fresh water station, samples were taken on foot in a sterile 6 ounce wide-mouth bottle attached to the end of a 5 foot sampling rod. Stream station samples were collected 1 to 6 inches below the surface and ditch station samples directly from culvert outpourings. Analyses were carried out in the Environmental Protection Service Mobile field laboratory located in Ladysmith and were performed within 5 hours (average $2\frac{1}{2}$ hours) after collection. The total confirmed coliform MPN was obtained using the multitube fermentation technique as described in the 13th Edition of Standard Methods for the Examination of Water and Wastewater, Part 407A, page 664.

(b) Chemical and Physical Sampling and Analyses:

Temperature and salinity measurements at marine sample stations were determined $\frac{1}{2}$ to 1 foot below the surface using test equipment carried in the boat. Temperature

was taken by the thermistor component of a Precision Scientific Company oxygen analyzer. Salinity was measured with a Beckman Model RB83-349 Solubridge Electrolytic Conductivity Meter. Temperature was taken with a thermometer at fresh water sample stations.

(c) Float Studies:

Float studies were conducted during the period January 16 to 25, 1973, in the vicinity of Saltair (Davis Lagoon) to determine the velocity and direction of tidal currents. The floats were of the metal vane type riding at a depth of 4 feet below the water surface and buoyed by a plastic bottle filled with sufficient water to allow only 2 inches of the bottle to protrude.

(d) Flow Measurements:

Flow measurements at significant fresh water sample stations were carried out during the period January 15 to 25, 1973. Near each station a culvert or suitable portion of stream was located. The lengths and diameters of the culverts and the lengths and widths of the stream portions were measured. A plastic bottle was used as a float to determine the surface velocities while a surveyor's rule was used to measure the depths. These measurements were taken on a daily basis and the flows computed.

DISCUSSION OF RESULTS:

The 16 salt water sample station locations are plotted in Figures 2(A) and 2(B) and the 15 fresh water sample stations are plotted in Figures 2(C) and 2(D). Sample station descriptions and photographs are shown in Appendix 1.

The total confirmed and fecal coliform MPN results obtained from the salt water and fresh water sampling stations have been summarized in Tables 2(A) and 2(B) respectively.

Individual station results are shown on Tables 3, 4 and 5 in Appendix 2.

Salt water sample stations 5, 6, 7A, 7B, 8, 9 and 10 were located on an existing active commercial oyster lease. Clams are also taken from this lease and clams and oysters are taken by residents and recreationalists along the intertidal zone of the surveyed area. An examination of the sea water bacteriological data summarized in Table 2(A) shows that the approved shellfish growing water standard of total coliform median MPN not greater than 70 per 100 ml with not more than 10% of samples exceeding 230 per 100 ml, is exceeded at all sample stations located in the intertidal zone (Stations 5 to 14 inclusive). The fecal coliform results for these same sample stations show that the contamination is of public health significance.

The principal source of contamination, based on the conclusions of the 1964 survey and the high total and fecal coliform results of fresh water discharges to the shellfish growing areas shown in Table 2(B), would appear to be septic tank ground disposal seepage to ditches draining the populated coastal strip and hinterland. A description of the fresh water sources, and visual observations on the appearance of the waters are given in Appendix 3. Rainfall data for the month of January and flow volumes for fresh water streams D1, D2, D3, D5 and 16 are shown in Table 9. Visual or olfactory signs of domestic discharges were reported at sample stations D1, D2 and 02. Enquiries were also made at eight foreshore residences respecting their sewage disposal systems, and whilst evidence of sewage seepage to the beach was found at only one residence, the location of septic tanks at four others was unknown. Limited time and manpower did not permit inspection of hinterland residential on-site sewage disposal systems, but since the soil is relatively impervious in the Ladysmith area and periodic emptying of septic tanks is not mandatory in British Columbia, the existence of other ineffective tile field absorption systems can be anticipated. Fresh water sample station 16 located on Stocking Creek, shows coliform data

representing run-off from uninhabited watershed. Sample station 15 downstream on Stocking Creek will be subject to minimal contamination from residential development.

Salt water sample stations 17, 18 and 19 are located in Stuart Channel at least 4,000 feet out from the Saltair area shoreline and the bacteriological data summarized in Table 2(A) shows insignificant contamination. The high coliform levels confirm the results obtained during the 1970 Ladysmith Harbour Survey at a sample point located approximately 1200 feet south of Station 17. Disinfection of the Town of Ladysmith sewage treatment effluent during the 1971 survey reduced the high bacterial levels to practically zero. Sample station 20 located outside the sphere of influence of the tidal flow from Ladysmith Harbour gave extremely low coliform levels.

An oceanographic study of Ladysmith Harbour conducted by the F.R.B. Station, Nanaimo, during 1967-68 established that the tidal flow into and out of the Harbour takes place in an anti-clockwise direction. Float studies conducted during the present survey are presented in Figures 3(A) to 3(F) inclusive. The results indicate that landwash to the sea will tend to travel along the shoreline on outgoing tides.

Elemental conditions during the survey, sea water temperature and salinity data, and fresh water temperature data are presented in Tables 6, 7 and 8 in Appendix 4.

CONCLUSIONS:

The results of the sanitary survey of that portion of the east coast of Vancouver Island south of Ladysmith extending from Blainey's to Boulder Point show that the shellfish growing waters did not meet the approved bacteriological standard.

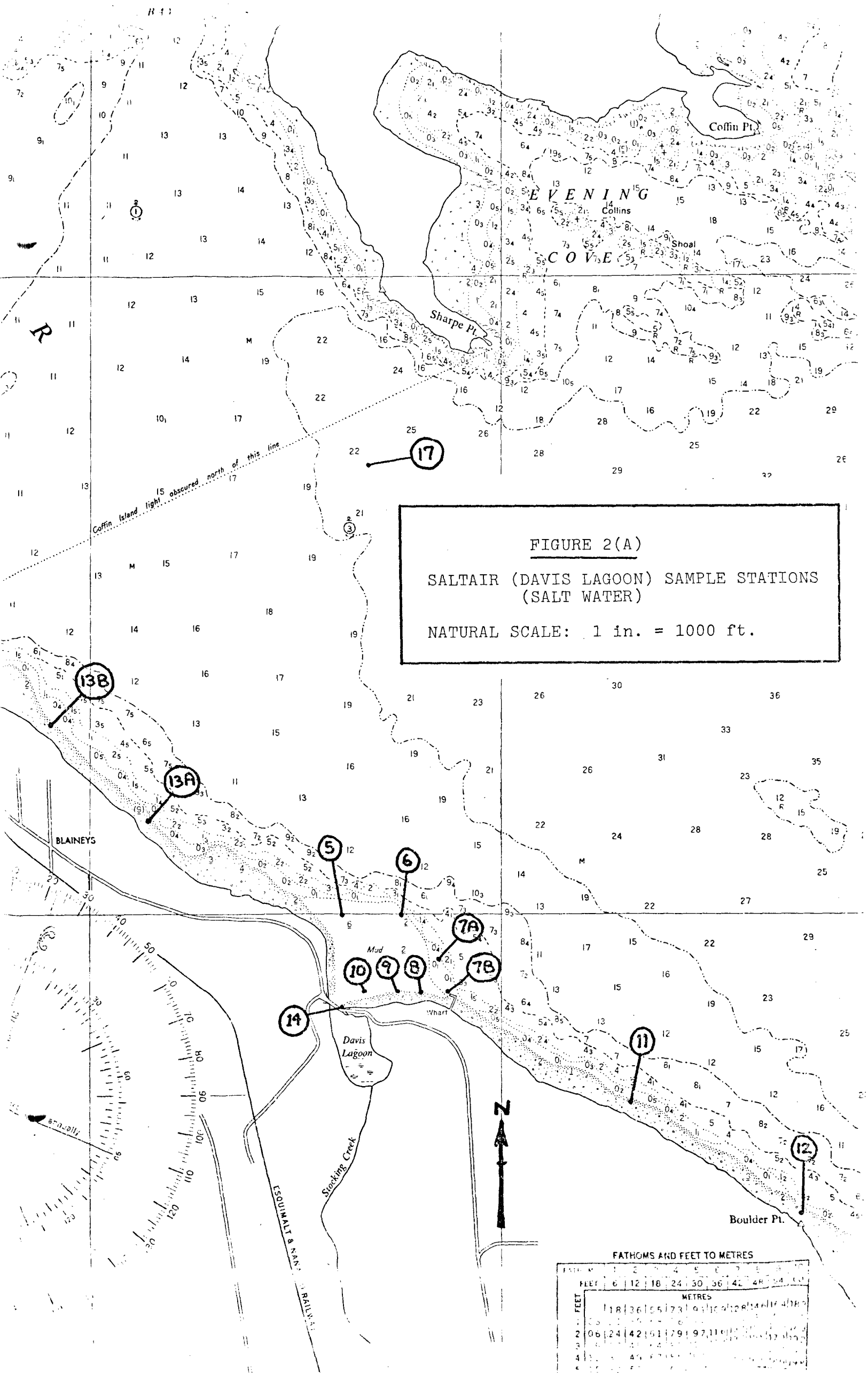
The waters are subject to fecal pollution from landwash during rainy periods and possibly also to sewage effluent from the Town

of Ladysmith primary treatment plant outfall and/or raw sewage from a sewer overflow in the Arcady area during a sewage lift pump failure.

RECOMMENDATION:

It is recommend that Schedule J contaminated area 17-1 (No. 15) be amended to read:

"That portion of Ladysmith Harbour, Area 17, lying inside a straight line drawn from Sharpe Point on the north side of Ladysmith Harbour to Boulder Pt. on the south side of that harbour."



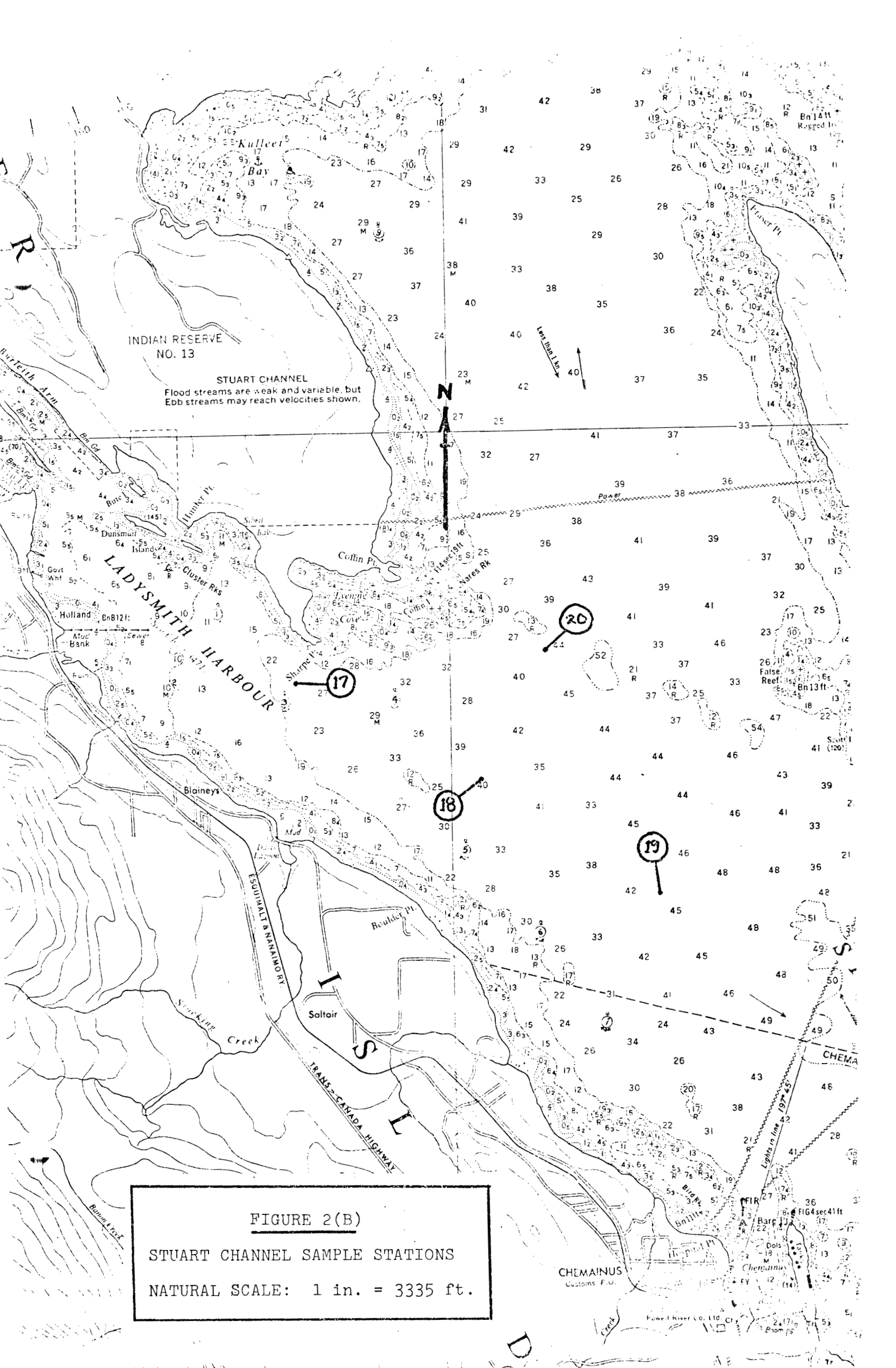


FIGURE 2(B)

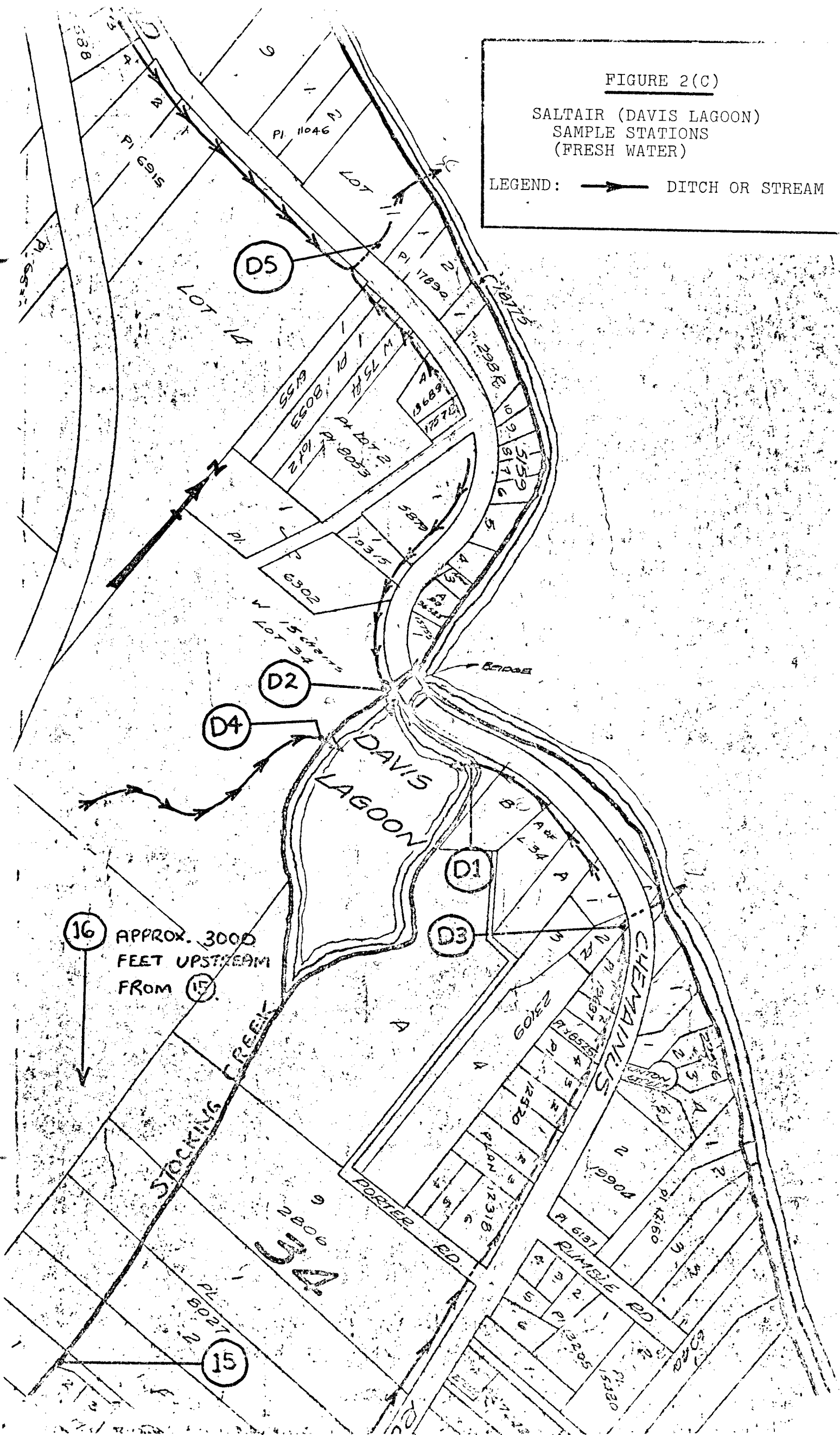
STUART CHANNEL SAMPLE STATIONS

NATURAL SCALE: 1 in. = 3335 ft.

FIGURE 2(C)

SALTAIR (DAVIS LAGOON)
SAMPLE STATIONS
(FRESH WATER)

LEGEND: ———> DITCH OR STREAM



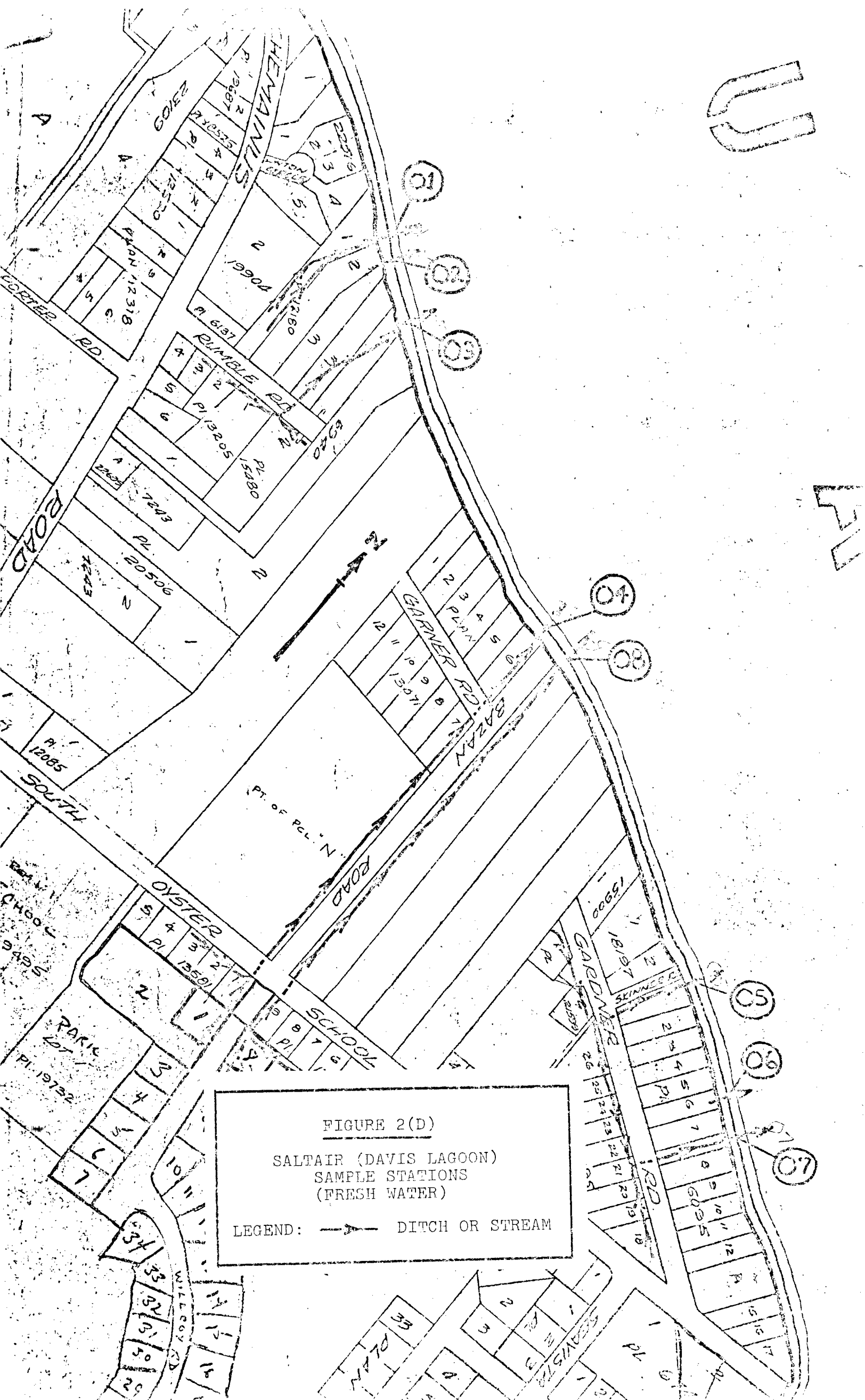


TABLE 2(A)

SUMMARY OF BACTERIOLOGICAL DATA FOR
SEA WATER SAMPLES

STANDARD TOTAL CONFIRMED COLIFORM MPN PER 100 ml														
SAMPLE STATIONS	5	6	7 ¹	8	9	10	11	12	13 ²	14	17	18	19	20
NO. OF SAMPLES	16	15	16	22	21	23	16	20	20	11	14	10	10	4
MEDIAN	150	110	180	170	220	79	175	109	130	220	130	41	120	3
RANGE	33-1600	13-1600	11-2400	13-2200	22-1600	4.5-1600	23-920	17-1600	11-1700	6.8-920	33-1600	4.5-240	<1.8-920	<1.8-14
% OVER 230	44	46	44	41	43	41	44	36	45	45	36	10	20	0
FECAL COLIFORM MPN PER 100 ml														
SAMPLE STATIONS	5	6	7	8	9	10	11	12	13	14	17	18		
NO. OF SAMPLES	2	2	4	5	6	6	5	4	4	3	3	2		
MEDIAN	120	525	45.5	23	18.7	29	23	15	186	4.5	130	8		
RANGE	110-130	130-920	11-170	6.8-1600	4.5-70	2.0-540	1.8-130	4.5-130	<1.8-350	4.0-23	79-130	2.0-14		

NOTES:

- (1) Samples were collected at two different locations during survey. The first six were taken at station 7A and the remainder at station 7B. The last two samples for fecal test were also taken at station 7B.
- (2) Samples were collected at two different locations during survey. The first eight were taken at station 13A and the remainder at station 13B. The last two samples for fecal test were also taken at station 13B.

TABLE 2(B)

SUMMARY OF BACTERIOLOGICAL DATA FOR
FRESH WATER SAMPLES

STANDARD TOTAL CONFIRMED COLIFORM MPN PER 100 mL															
SAMPLE STATIONS	15	16	D1	D2	D3	D4	D5	01	02	03	04	05	06	07	08
NO. OF SAMPLES	13	12	5	5	6	5	7	6	6	5	5	5	1	5	5
MEDIAN	49	10.4	540	1300	≈11000	23	540	245	>1600	540	140	700	>1600	540	
RANGE	<1.8 920	<1.8 130	33- 1700	1.8- >1600	3300 ⁴ 33x10 ⁴	4.5- 1300	350 1100	2.0- 540	>1600 >16000	350- 1700	110- 540	240- 920	1600	>1600 9200	140- 920
FECAL COLIFORM MPN PER 100 mL															
SAMPLE STATIONS	15	16	D1	D2	D3	D4	D5	02	03	04	05	06	07	08	
NO. OF SAMPLES	3	1	1	1	1	1	1	2	2	2	3	1	3		
MEDIAN											13		350		
RANGE	1.8- 22	2.0	23	7.8	830	4.5	350	130 >16000	23- 79	23- 49	13- 18	350	350- 920		

TABLE 9
PRECIPITATION AND FRESH WATER FLOW DATA

DATE JAN.	TOTAL PRECIPITATION (in.)	FLOW (ft ³ /min.) SAMPLE STATION				
		D1	D2	D3	D5	16
1	0.28					
2	0.04					
3	0.33					
4	0.01					
5	0.05					
6	0.00					
7	0.00					
8	0.00					
9	0.00					
10	0.00					
11	0.50					
12	0.66					
13	0.46					
14	1.41					
15	1.01	23.8	6.0	276	250	13,200
16	0.24	14.2	2.4	114	126	9,760
17	0.08	6.0	2.2	57.5	68.8	4,680
18	0.02	4.8	2.0	45.0	55.5	2,100
19	0.31	3.6	3.6	27.6	52.0	2,310
20	0.65					
21	0.01					
22	0.01	3.8	4.8	37.5	65.6	2,540
23	0.12	7.2	4.2	32.4	68.2	2,940
24	0.41	10.0	4.5	44.0	85.4	3,750
25	0.33	5.5	3.0	30.6	70.2	3,060

NOTE:

- (1) Total precipitation data was that recorded by the weather station at Naniamo Airport.

Example Flow Calculation: Sample Station D1
January 17

Water depth = 2 in. x 1 ft./12 in. = 0.167 ft.

Culvert I.D. = 7 in. x 1 ft./12 in. = 0.584 ft.

Cross-sectional area = 0.064 ft.²

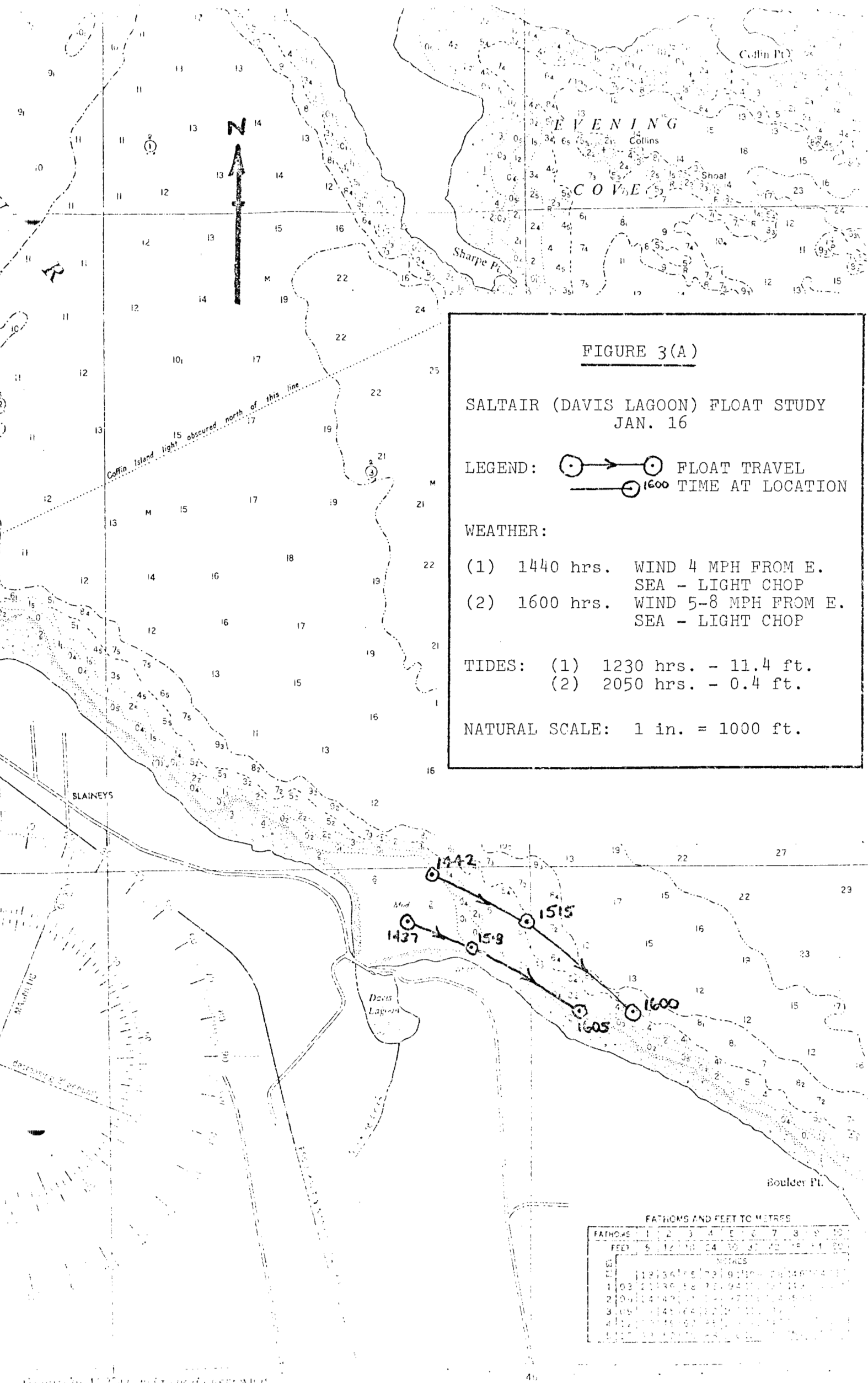
Culvert length = 60 ft.

Volume = 60 ft. x 0.064 ft.² = 3.84 ft.³

Surface Velocity = 40 sec./60 ft.

Flow = 3.84 ft.³/40 sec. ≈ 0.10 ft.³/sec.

Flow ≈ 0.10 ft.³/sec. x 60 sec/1 min. ≈ 6.0 ft.³/min.



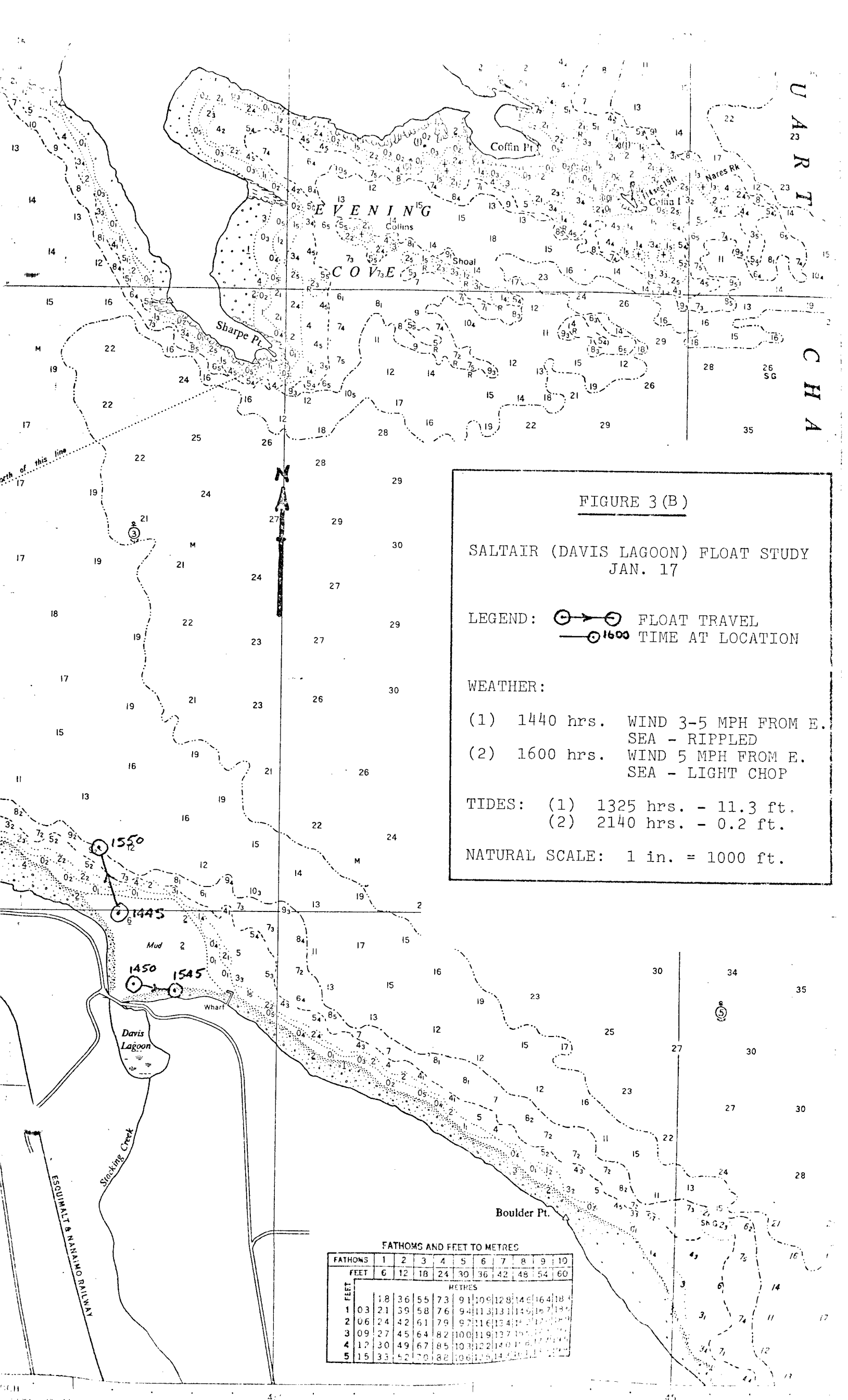


FIGURE 3 (B)

SALTAIR (DAVIS LAGOON) FLOAT STUDY
JAN. 17

LEGEND:  FLOAT TRAVEL
 TIME AT LOCATION

WEATHER:

- (1) 1440 hrs. WIND 3-5 MPH FROM E.
SEA - RIPPLED
(2) 1600 hrs. WIND 5 MPH FROM E.
SEA - LIGHT CHOP

TIDES: (1) 1325 hrs. - 11.3 ft.
(2) 2140 hrs. - 0.2 ft.

NATURAL SCALE: 1 in. = 1000 ft.

FATHOMS AND FEET TO METRES

FATHOMS	1	2	3	4	5	6	7	8	9	10
FEET	6	12	18	24	30	36	42	48	54	60
METRES	1.1	2.3	3.4	4.6	5.8	6.9	8.1	9.3	10.4	11.6
FEET	18	36	55	73	91	109	128	146	164	182
1	0.3	2.1	3.9	5.8	7.6	9.4	11.3	13.1	15.0	16.8
2	0.6	2.4	4.2	6.1	7.9	9.7	11.6	13.4	15.2	17.0
3	0.9	2.7	4.5	6.4	8.2	10.0	11.9	13.7	15.5	17.3
4	1.2	3.0	4.9	6.7	8.5	10.3	12.2	14.0	15.8	17.6
5	1.5	3.3	5.2	7.0	8.8	10.6	12.5	14.3	16.1	17.9

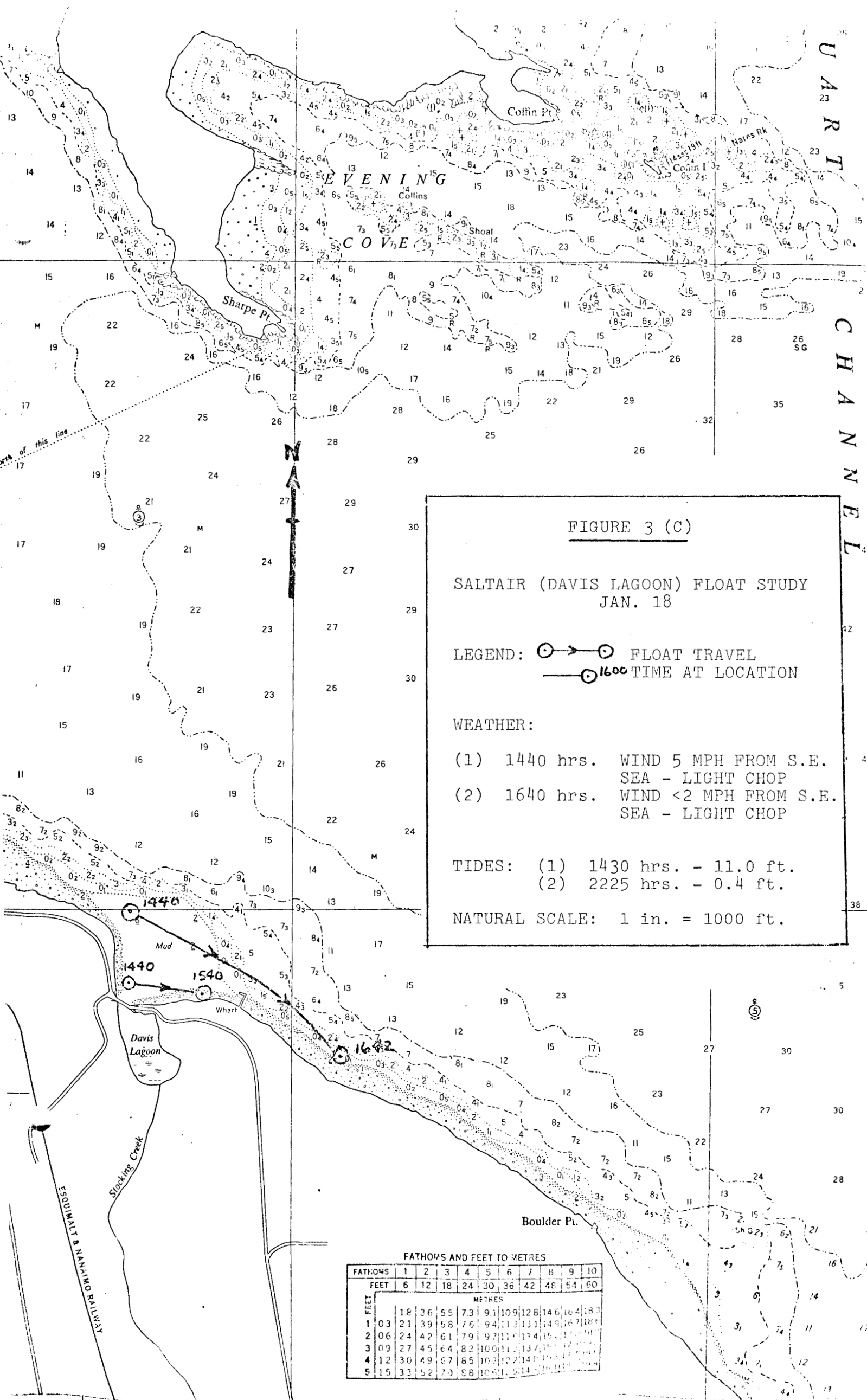


FIGURE 3 (C)

SALT AIR (DAVIS LAGOON) FLOAT STUDY
JAN. 18

LEGEND: FLOAT TRAVEL
 1600 TIME AT LOCATION

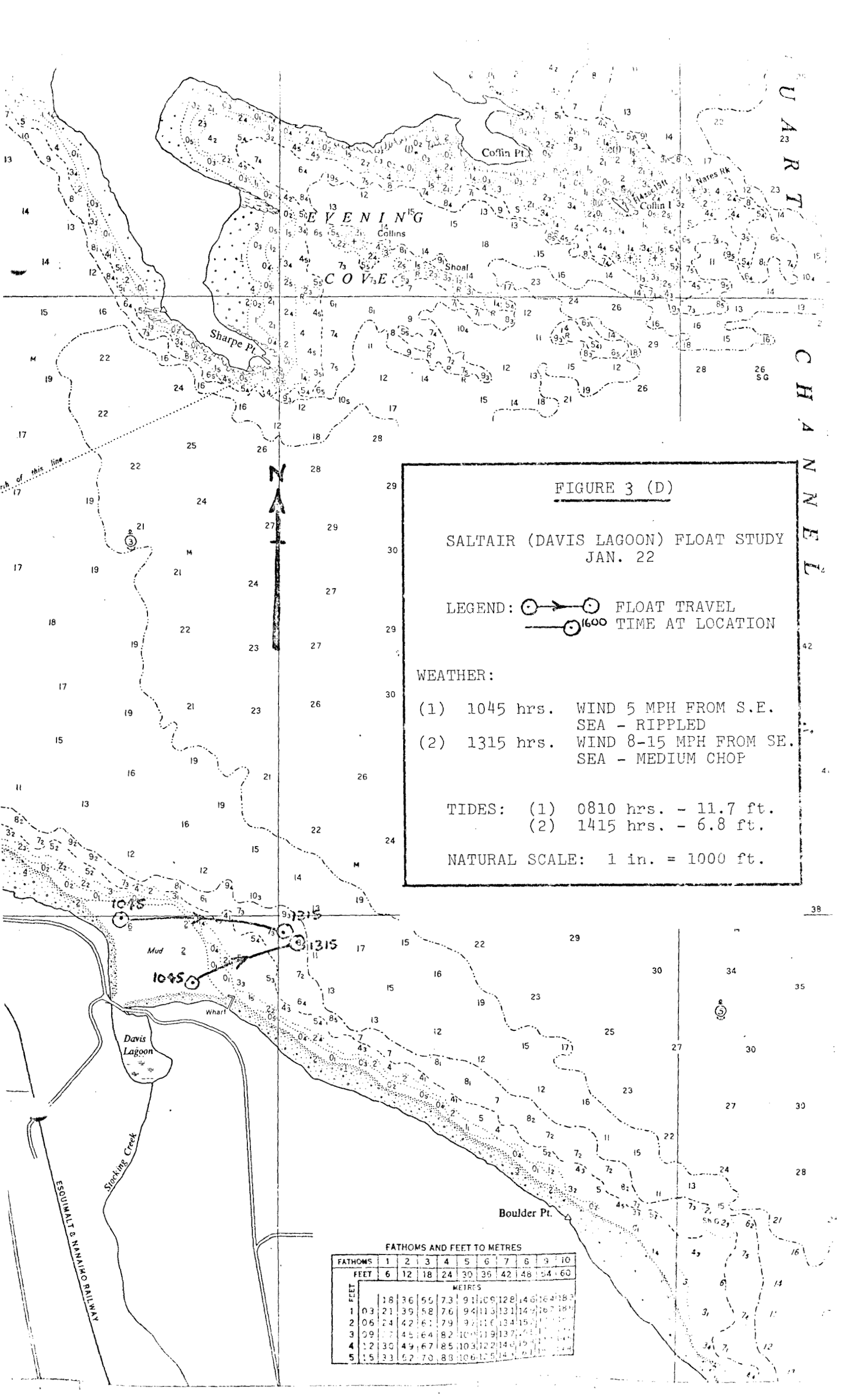
WEATHER:

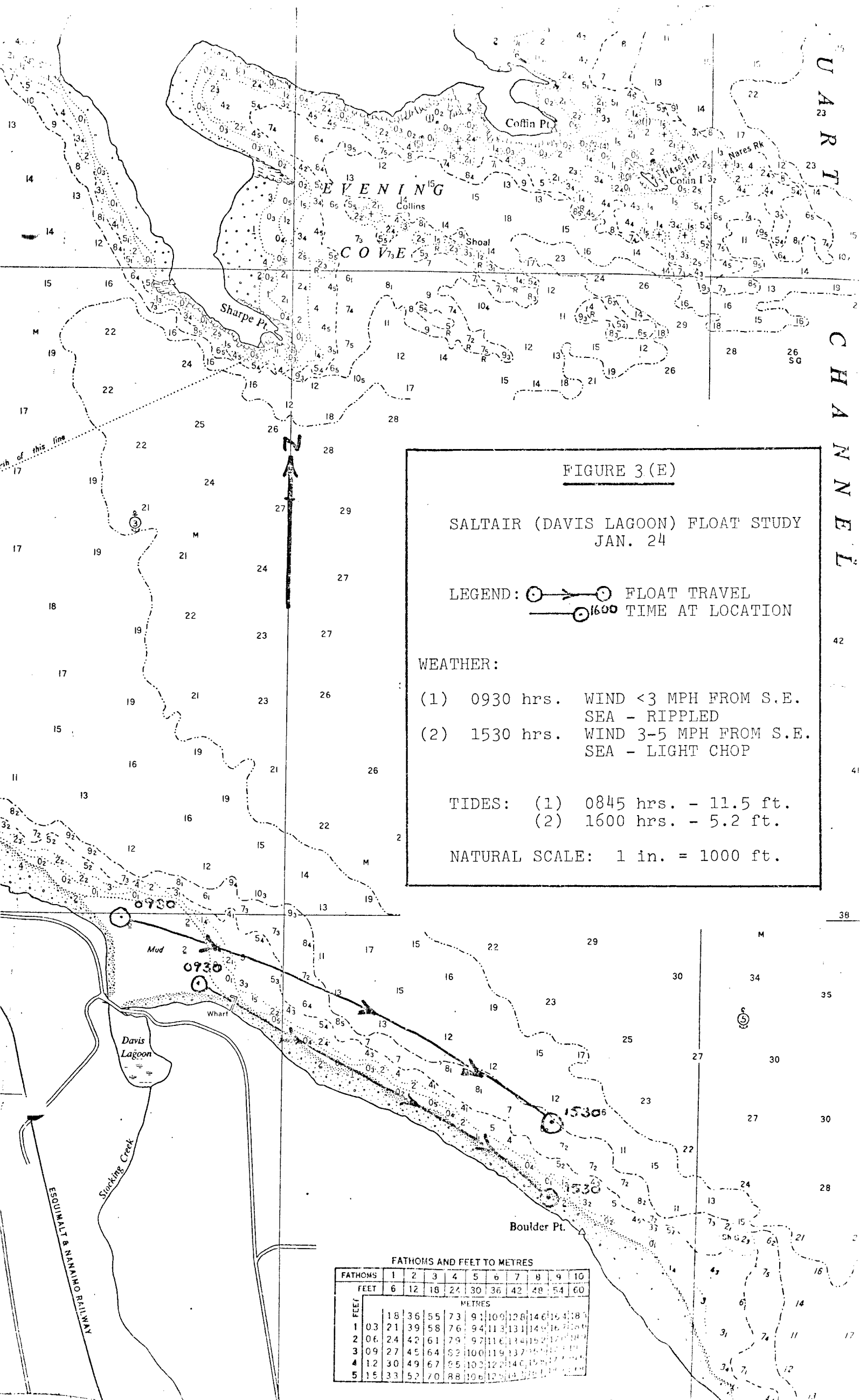
- (1) 1440 hrs. WIND 5 MPH FROM S.E.
SEA - LIGHT CHOP
- (2) 1640 hrs. WIND <2 MPH FROM S.E.
SEA - LIGHT CHOP

TIDES: (1) 1430 hrs. - 11.0 ft.
(2) 2225 hrs. - 0.4 ft.

NATURAL SCALE: 1 in. = 1000 ft.

FATHOMS AND FEET TO METRES										
FATHOMS	1	2	3	4	5	6	7	8	9	10
FEET	6	12	18	24	30	36	42	48	54	60
METRES	1.1	2.2	3.3	4.4	5.5	6.6	7.7	8.8	9.9	11.0
FEET	103	21	39	58	76	94	113	131	149	167
METRES	18.8	3.6	6.5	9.3	12.1	15.0	17.8	20.6	23.4	26.2
FEET	2	6	12	18	24	30	36	42	48	54
METRES	0.3	1.1	2.2	3.3	4.4	5.5	6.6	7.7	8.8	9.9
FEET	3	9	15	21	27	33	39	45	51	57
METRES	0.5	1.7	2.8	3.9	4.9	6.0	7.1	8.2	9.3	10.4
FEET	4	12	20	28	36	44	52	60	68	76
METRES	0.7	2.1	3.7	5.1	6.6	8.1	9.6	11.0	12.5	13.9
FEET	5	15	25	35	45	55	65	75	85	95
METRES	0.9	2.7	4.6	6.4	8.2	10.1	11.9	13.7	15.5	17.3





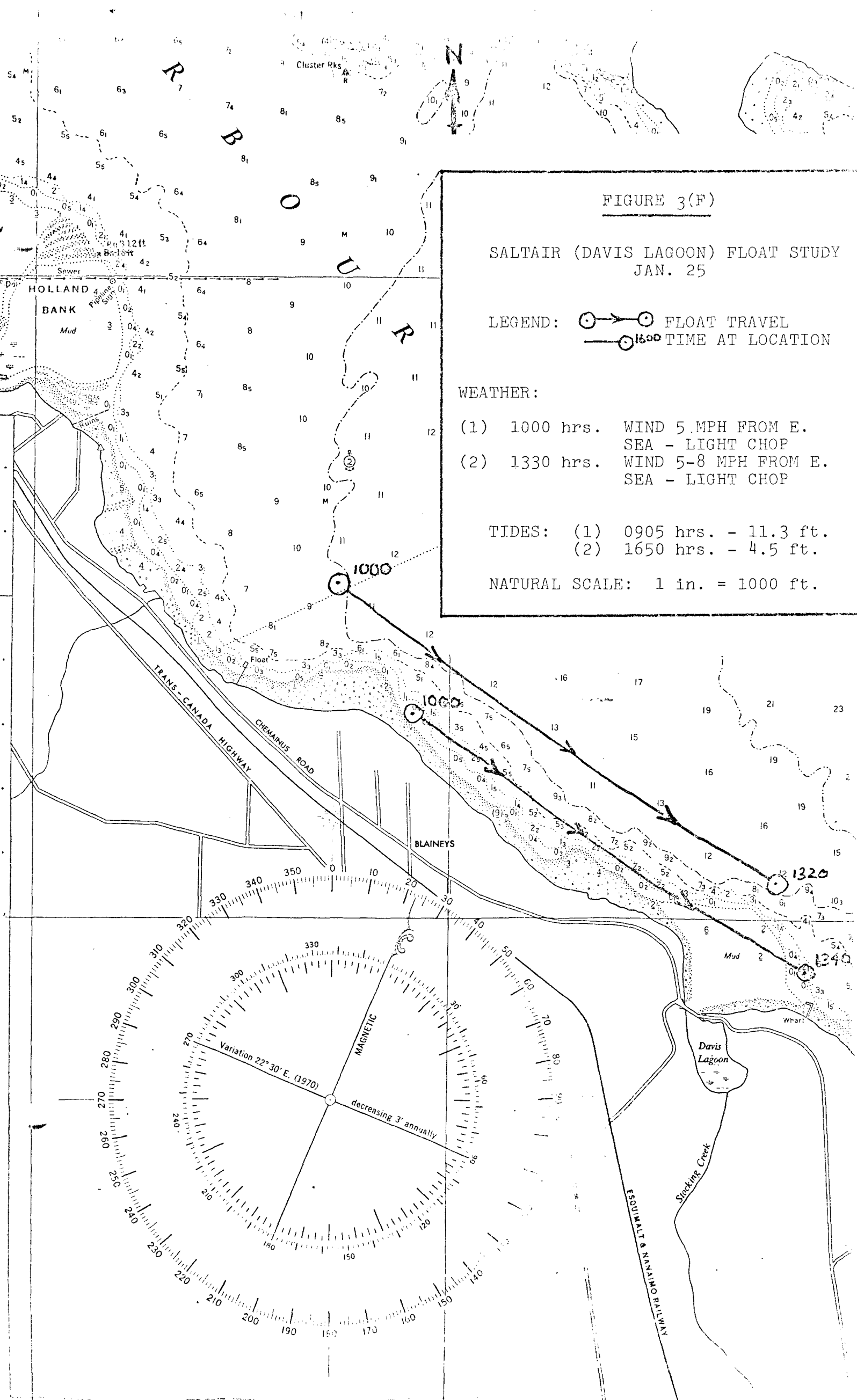


FIGURE 3(F)

SALT AIR (DAVIS LAGOON) FLOAT STUDY
JAN. 25

LEGEND: (circle with dot) -> (circle with dot) FLOAT TRAVEL
(circle with dot) - 1500 TIME AT LOCATION

WEATHER:

- (1) 1000 hrs. WIND 5 MPH FROM E.
SEA - LIGHT CHOP
(2) 1330 hrs. WIND 5-8 MPH FROM E.
SEA - LIGHT CHOP

TIDES: (1) 0905 hrs. - 11.3 ft.
(2) 1650 hrs. - 4.5 ft.

NATURAL SCALE: 1 in. = 1000 ft.

A P P E N D I X 1.

SAMPLE STATION LOCATION DESCRIPTIONS
AND PHOTOGRAPHS.

TABLE 1. Description of Sample Station Locations.

Pages 1 - 9 Photographs of Sample Station Locations.

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DESCRIPTION OF SAMPLE STATION LOCATIONS

STATION NO.	DESCRIPTION
5.	Lease marker approximately 900 feet north ¹ of east end of Davis Lagoon road bridge.
6.	Lease marker approximately 600 feet east of sample station 5.
7A.	Lease marker approximately 600 feet south-east of sample station 6.
7B.	North-west end of Seaview Motel wharf.
8.	Lease marker approximately 600 feet south of sample station 6.
9.	Lease marker approximately 400 feet north-east of east end of Davis Lagoon road bridge.
10.	Lease marker approximately 200 feet west of sample station 9.
11.	Opposite ² log boat shed approximately 1900 feet south-east of Seaview Motel wharf.
12.	Opposite large boulder marking location of Boulder Point.
13A.	Opposite yellow and green house approximately 1900 feet north-west of sample station 5.
13B.	Opposite white house on line with Blainey's Road ³ approximately 1500 feet north-west of sample station 13.
14.	Lagoon mouth at east end of Davis Lagoon road bridge.
15.	Stocking Creek at west end of Knudson Road.
16.	Stocking Creek at south-west end of culvert under Trans-Canada Highway.
17.	On line midway between Coffin Point and sample station 13B, approximately 4300 feet from sample station 13B.
18.	Intersection of bearing lines, Boulder Point to Fraser Point (Thetis Island) and Davis Lagoon road bridge to False Reef beacon, approximately 4500 feet from Boulder Point.
19.	Intersection of bearing lines, Boulder Point to south-east tip of Hudson Island and extension of bearing line sample station 17 to sample station 18, approximately 8,000 feet from Boulder Point.
20.	Intersection of bearing lines, Coffin Point to south end of Hudson Island and Boulder Point to Fraser Point (Thetis Island), approximately 9,300 feet from Boulder Point.
D1.	Ditch on south side of Chemainus Road at culvert opposite north-east corner of Davis Lagoon ⁴ .
D2.	Ditch on south side of Chemainus Road at culvert opposite north-west corner of Davis Lagoon.
D3.	Ditch on south-west side of Chemainus Road at culvert near north end of LOT 2 of PLAN 23109. ⁵

STATION NO.	DESCRIPTION
D4.	Mouth of stream about 40 feet south of boathouse on north-west side of Davis Lagoon.
D5.	Ditch on south side of Chemainus Road at culvert near south-east end of LOT 11.
01.	Outfall at north-east end of LOT 1 of PLAN 12180 north of Rumble Road.
02.	Outfall at north-east end of LOT 2 of PLAN 12180 north of Rumble Road.
03.	Stream at north-east end of LOT 2 of PLAN 15480 north of Rumble Road.
04.	Ditch on west side of Bazan Road at beach near north-east corner of LOT 6 of PLAN 13071.
05.	Ditch on vacant lot north-west of LOT 2 of PLAN 6095 at beach.
06.	Outfall from drain pipe above beach at LOT 6 of PLAN 6095.
07.	Ditch at north-east end of vacant lot between LOTS 7 and 8 of PLAN 6095.
08.	Ditch on east side of Bazan Road at beach opposite north-east corner of LOT 6 of PLAN 13071.

NOTES:

- (1) All compass bearings are true bearings.
- (2) The distances from shore reference points varied with the tide as offshore samples were taken where the water depths were approximately 3 feet.
- (3) Blaineys Road meaning the most easterly road running seaward at Blaineys.
- (4) Refer to Appendix No. 2 for detailed description of freshwater inputs.
- (5) All sample station locations which include lot and plan numbers refer to Figures 2(C) and 2(D).

APPENDIX I

Photographs of Sample Station Locations

Photo 1

Facing sample station 1 (arrow) from southwest¹ end of Kuleet Bay.



Photo 2

Facing, from left to right in picture, sample stations 2 and D7 (arrows) from west end of Kuleet Bay.



Photo 3

Facing sample station 3 (arrow) from northeast end of Kuleet Bay.



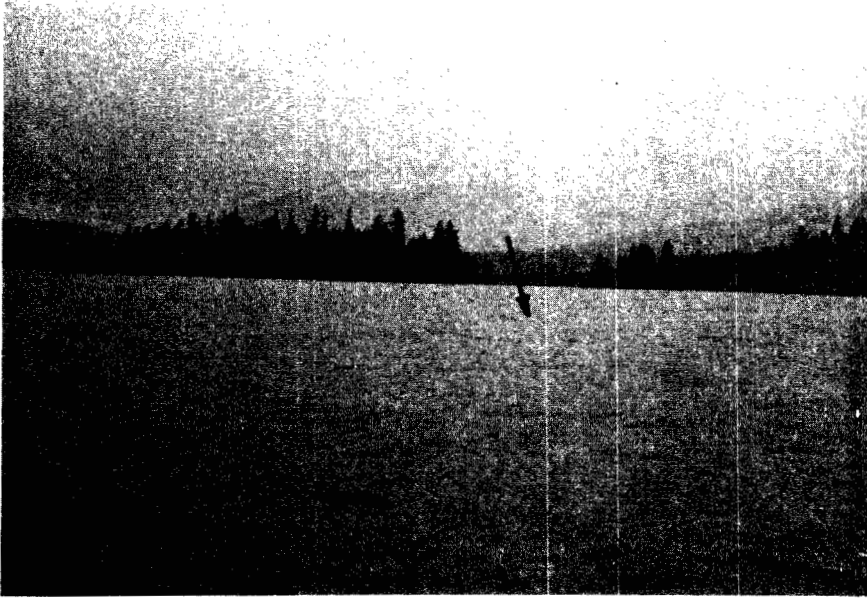


Photo 4

Facing sample station
4' (arrow) from
second bay north-east
of Coffin Point.

Photo 5

Facing sample station
5 (arrow) from a point
north of lease² marker.
Bridge in background³ is
Davis Lagoon bridge³.
House on shore (right
of arrow) is oyster
shucking plant.



Photo 6

Facing sample station
6 (arrow) from a point
north-east of lease
marker.



Photo 7

Facing sample station
7' (arrow) from a
point north-east of
Seaview Motel wharf.



Photo 8

Facing from left to
right in picture,
sample stations 8, 9
and 10 (arrows) from
a point north-west of
Seaview Motel wharf.



Photo 9

Facing sample station
11 (arrow) from a point
north-east of boat shed.

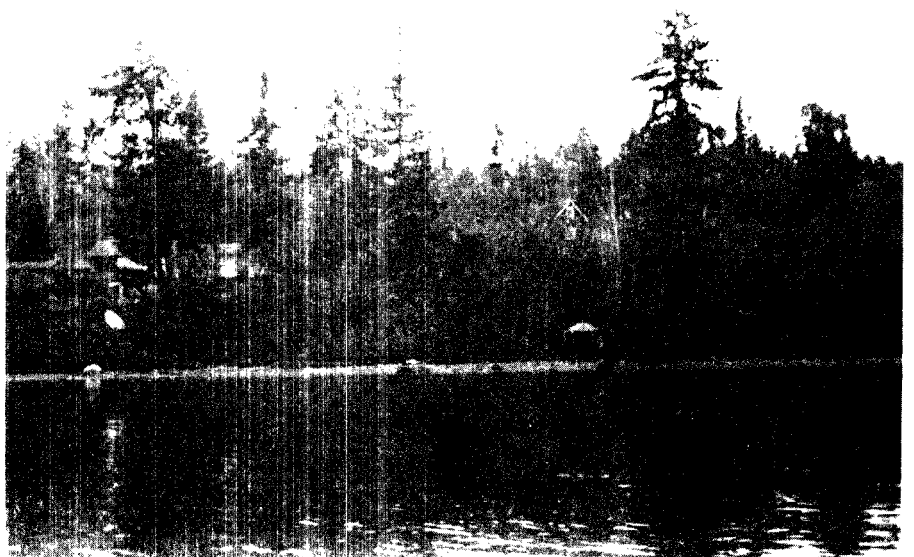


Photo 10

Facing sample station
12 (arrow) from a
point north of Boulder
Point.



Photo 11

Facing sample station
13' (arrow) from a
point north of Blaineys.

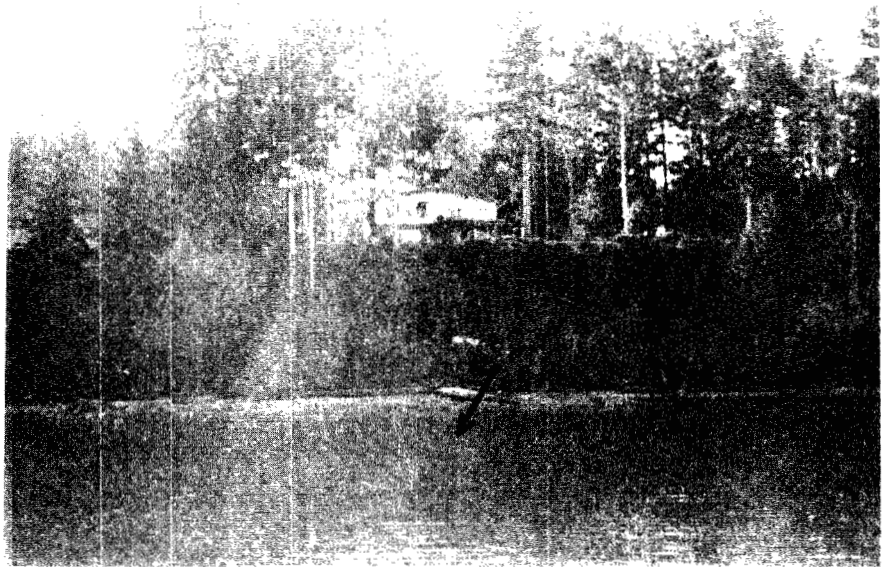


Photo 12

Facing sample station
14 (arrow) from the
lagoon side of Davis
Lagoon bridge.



Photo 13

Facing sample station 15
(arrow) from Stocking
Creek.



Photo 14

Facing sample station
16 (arrow) from below
Trans-Canada Highway.

Photo 15

Facing sample station D1
(arrow) from north-west
end of Davis Lagoon.





Photo 16

Facing sample station D2 (arrow) from above north-west corner of Davis Lagoon.

Photo 17

Facing sample station D3 (arrow) from north-west corner of LOT 2 of PLAN 23109. Seaview Motel entrance is in background.



Photo 18

Facing sample station D4 (arrow) from north-east corner of Davis Lagoon. Boat-house is shed at right of arrow.



Photo 19

Looking at stream D5
north of sample station
(not shown) from
Chemainus Road.

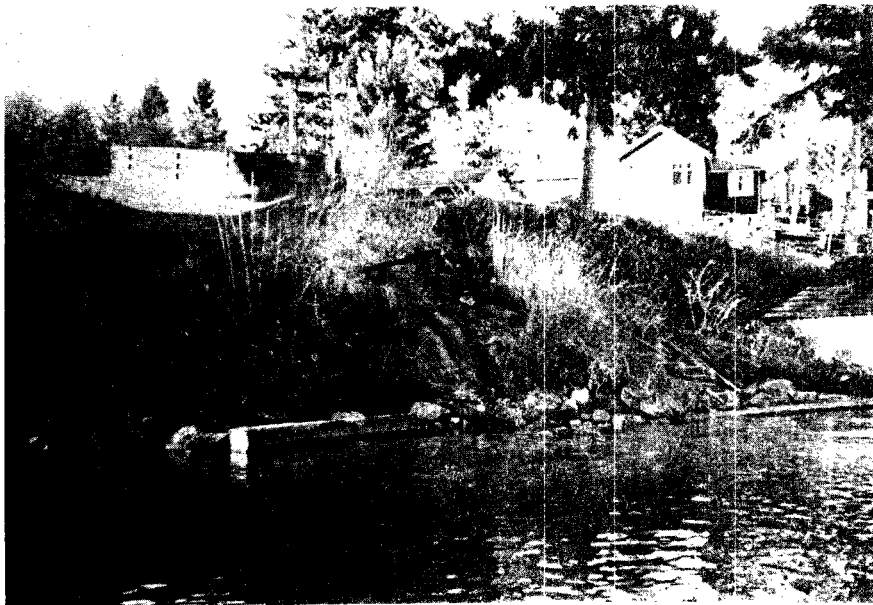


Photo 20

Facing sample station
01 (arrow) from off-
shore location.

Photo 21

Facing sample station
02 (arrow) from offshore
location. Culvert is
hidden by bush.





Photo 22

Facing sample station
03 (arrow) from
offshore location.
Stream is hidden by
bush.

Photo 23

Facing from left to
right in picture,
sample stations 08 and
04 (arrows) from
offshore location.
Both streams are
hidden by bush.



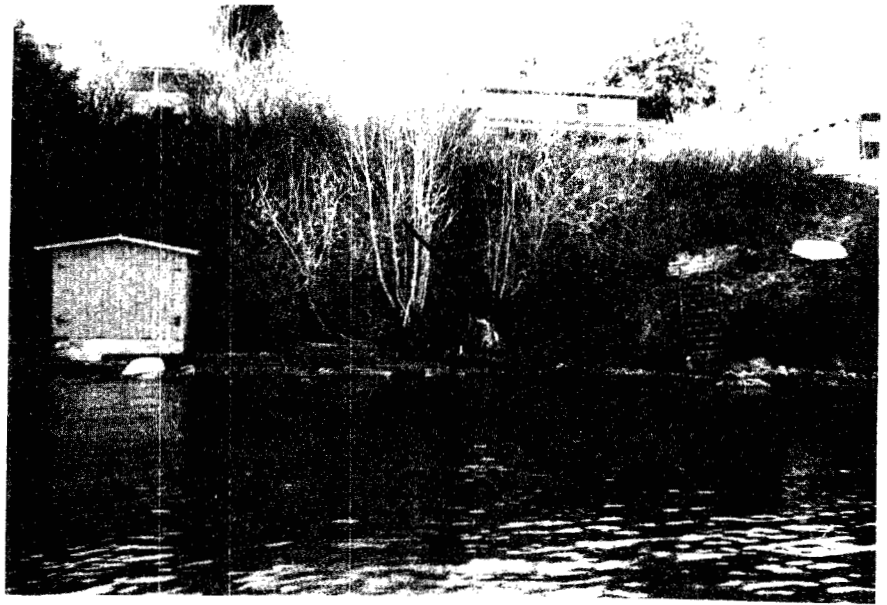
Photo 24

Facing sample station
05 (arrow) from off-
shore location.



Photo 25

Facing sample station
07 (arrow) from off-
shore location.



NOTES:

- (1) All compass bearings are true bearings.
- (2) Lease meaning the area included by a registered oyster lease.
- (3) Davis Lagoon bridge meaning the bridge by which Chemainus Road crosses Davis Lagoon.

A P P E N D I X 2.

BACTERIOLOGICAL RESULTS FOR SEA
AND FRESH WATER SAMPLES.

TABLE 3. Standard Total Confirmed Coliform MPN per
100 ml for Sea Water Samples.

TABLE 4 Fecal Coliform MPN per 100 ml for Sea Water
Samples.

TABLE 5 Bacteriological Results for Fresh Water
Samples.

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TABLE 3

STANDARD TOTAL CONFIRMED COLIFORM MPN PER 100 ml
FOR SEA WATER SAMPLES

DATE	RUN	SAMPLE STATION															
JAN.	NO.	5	6	7A	7B	8	9	10	11	12	13A	13B	14	17	18	19	20
9	1	33	49	79		13	22	49	79	49	49		33				
9	2	49	13	11		31	23	4.5	49	10	11						
10	3	33	49	27		33	49	79	23	17	33		6.8				
10	4	79	24	130		49	49	22	46	33	23						
11	5	110	110	33		49	32	49	46	79	240						
11	6	70	49	49		33	49	49	110	49	46		40				
12	7	920	920		1600	350	>1600	1600	350	920	350		350				
12	8	240	70		70	170	220	79	350	240	79						
15	9	920	350		920	170	350	350	540	920		920	540	350			

TABLE 3 (Cont'd)

STANDARD TOTAL CONFIRMED COLIFORM MPN PER 100 ml
FOR SEA WATER SAMPLES

DATE JAN.	RUN NO.	SAMPLE STATION											17	18	19	20	
		7A	7B	8	9	10	11	12	13A	13B	14						
15	10		540	>1600	220	240	220	140		130							
16	11	1100	1300	2400	2200	790	270	790	430	1300	220	170					
16	12	1300		230	950	330	790	790	230	1700							
17	13	170	540	240	>1600	540	350	920	920	350	540	540					
17	14	540	1600	920	>1600	220	95	130	33	350							
18	15	1600	920	350	1600	920	350	240	240	130	49	130					
18	16	130	79	130	79	49	79	49	7.8	110							
19	17				170	540	240		920	1600	920	1600	49	540			
19	18				170	170	79		170	79							

TABLE 3 (Cont'd)

STANDARD TOTAL CONFIRMED COLIFORM MPN PER 100 ml
FOR SEA WATER SAMPLES

DATE JAN.	RUN NO.	SAMPLE STATION														19	20
		5	6	7A	7B	8	9	10	11	12	13A	13B	14	17	18		
22	19					240	41	170		33		350	79	13	17		
22	20					79	540	240		49			350	17	7.8		
23	21					540	240	79				7.8	33	79	130		
23	22					46		49		79	130		79	4.5	170		
24	23							54		>1600	540		79	49	920		
24	24												540	130	140	1	
25	25												130	33	110	2	
25	26												49	7.8	<1.8	4	
25	27												130	240	32	<1.	

TABLE 4

FECAL COLIFORM MPN PER 100 ml
FOR SEA WATER SAMPLES

DATE	RUN	SAMPLE STATION													
JAN.	NO.	5	6	7A	7B	8	9	10	11	12	13A	13B	14	17	18
9	1						4.5	2.0	23				4.5		
9	2					23	7.8	2.0	1.8	13					
10	3			11		7.8	49	49	23	17	<1.8		23		
11	5			21		6.8	7.8	9.3	6.8	4.5	23		4.0		
15	9	130	130		70	46	70	540	130	130		350		79	14
17	13	110	920									350		170	
18	15				170	1600									
22	19														2.0
22	20						33	49						130	

TABLE 5
BACTERIOLOGICAL RESULTS
FOR FRESH WATER SAMPLES

STANDARD TOTAL CONFIRMED COLIFORM MPN PER 100 ml								
DATE JAN.	RUN NO.	15	16	SAMPLE STATION		D3	D4	D5
				D1	D2			
9	1	33	1.8					
10	3	<1.8	<1.8					
12	6	350	13					
12	7	540						
15	9	920	79	1700	1300	>1600	1300	950
16	11	170	31					
17	13	140	33	>1600	1300	33x10 ⁴	23	1100
18	15	17	4.5	540	>1600		70	350
19	17	4.0	14	27	240	33x10 ⁴	18	540
22	19	110	130					
22	20							
23	21	33	7.8	33	1.8	7900	4.5	350
23	22							
24	23	49	4.5			3300		1600
24	24							
25	25	23	2.0			13000		350

FECAL COLIFORM MPN PER 100 ml							
DATE JAN.	RUN NO.	15	16	SAMPLE STATION		D3	D4
				D1	D2		
17	13	2.0	2.0				
18	15				7.8		
23	21	1.8		23		830	4.5
23	22	22					

TABLE 5 (Cont'd)

BACTERIOLOGICAL RESULTS
FOR FRESH WATER SAMPLES

STANDARD TOTAL CONFIRMED COLIFORM MPN PER 100 ml									
DATE	RUN	SAMPLE STATION							
JAN.	NO.	01	02	03	04	05	06	07	08
19	17	350							
22	19								
22	20	540							
23	21	2.0							
23	22	49	>1600						
24	23	350	>1600	350	170	350	1600	>1600	140
24	24		>1600	1600	110	920		>1600	920
25	25	140	>1600	540	540	240		>1600	540
25	26		>1600	540	140	920		>1600	540
26	27		>16000	1700	140	700		9200	240

FECAL COLIFORM MPN PER 100 ml									
DATE	RUN	SAMPLE STATION							
JAN.	NO.	02	03	04	05	06	07	08	
17	13								
18	15								
23	21								
23	22	130							
24	23		49		13	350	350		
25	25			49	13		920		
26	27	>16000	79	23	18		330		

A P P E N D I X 3.

DESCRIPTION OF SOURCE AND CONDITIONS
OF FRESH WATER INPUTS TO STUDY AREA.

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APPENDIX 3

FRESH WATER SAMPLE STATIONS

DESCRIPTION OF SOURCE AND CONDITIONS OF FRESH WATER INPUTS TO STUDY AREA

D1	Ditch along south ¹ side of Chemainus Road from LOT 1 of PLAN 23109 ² to north-east corner of Davis Lagoon. Water appeared greyish and sudsy on numerous occasions although there was no indication of septic tank effluent infiltration along its route.
D2	Ditch along south side of Chemainus Road from LOT 1 of PLAN 5879 to north-west corner of Davis Lagoon. Water appeared greyish on several occasions although there was no indication of septic tank effluent infiltration along its route.
D3	Ditch along west side of Chemainus Road about 0.6 miles in length from south of Knudson Road to the beach north of LOT 2 of PLAN 23109. Water appeared generally clear throughout the sampling period.
D4	Stream flowing through steep hilly bush area of LOT 34 from south of railroad tracks to northwest side of Davis Lagoon approximately 40 feet south of boathouse. Water appeared clear through the sampling period. Approximate flow ³ range was 50 to 100 c.f.m.
D5	Ditch along south side of Chemainus Road from beyond LOT 1 of PLAN 13588 east and from LOT 2 of PLAN 8053 west to the beach at the north-east corner of LOT 11. Water appeared generally clear throughout the sampling period.
01	Run-off from hilly area on both sides of LOT 1 of PLAN 12180, flows about 90 yards to north-east end of property and out through a culvert 15 feet above beach. Appeared clear and odourless throughout the sampling period. Approximate flow range was 2 to 4 c.f.m.
02	Discharge through 12" I.D. culvert in bank at north-east end of LOT 2 of PLAN 12180. Water appeared clear but had septic odour on several occasions. Approximate flow range was 0.5 to 2 c.f.m.
03	Ditch from south side of Rumble Road to beach at north-east end of LOT 2 of PLAN 15480. Water appeared clear and odourless throughout the sampling period. Approximate flow range was 15 to 30 c.f.m.
04	Ditch along west side of Bazan Road about 0.2 miles in length from unbuilt area south of South Oyster School Road to beach at north-west end of Bazan Road. Water appeared clear and odourless throughout the sampling period. Approximate flow range was 25 to 60 c.f.m.

FRESH WATER
SAMPLE STATIONS

DESCRIPTION OF SOURCE AND CONDITIONS OF
FRESH WATER INPUTS TO STUDY AREA

05	Ditch along south side of Gardner Road from beyond LOT 1 of PLAN 21599 south-east and from LOT 25 of PLAN 6095 north-west to the beach near the north-east end of Skinner Road. Water appeared generally clear during sampling period. Approximate flow range was 10 to 20 c.f.m.
06	Discharge through 5" I.D. cast iron pipe to beach.
07	Ditch along south side of Gardner Road from LOT 25 of PLAN 6095 south-east and from LOT 18 of PLAN 6095 north-west to beach at vacant lot between LOTS 7 and 8 of PLAN 6095. Water appeared generally clear during sampling period. Approximate flow range was 15 to 30 c.f.m.
08	Ditch parallel to ditch 04 but on east side of Bazan Road. Water appeared clear and odourless throughout the sampling period. Approximate flow range was 20 to 40 c.f.m.

NOTES:

- (1) All compass bearings are true bearings.
- (2) All notes which include mention of LOT and PLAN numbers refer to the corresponding locations on Figures 2(C) and 2(D).
- (3) Approximate flow data was determined by visual comparison to actual flow data compiled in Table 9.

A P P E N D I X 4.

ELEMENTAL AND PHYSICAL DATA

TABLE 6 Elemental Conditions During Survey.

TABLE 7 Temperature and Salinity Data for
 Sea Water Samples.

TABLE 8 Temperature Date for Fresh Water
 Samples.

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TABLE 6
ELEMENTAL CONDITIONS DURING SURVEY

DATE JAN.	RUN NO.	SAMPLING TIME (HRS.)	DAILY AIR TEMPERATURE RANGE (°F)	DAILY TOTAL PRECIPITATION (IN.)	TIDE CONDITION (TIME - HEIGHT)	WIND SPEED (MPH) AND DIRECTION	LOCAL SEA CONDITION	LOCAL SKY CONDITION
9	1	1110-1140	9 - 34	0.00	0055 - 3.5' 0840 - 11.9'	N.W.@5	Light Chop	Clear
9	2	1525-1555	"	"	1520 - 7.2' 1920 - 8.1'	W@<5	Rippled	Clear
10	3	0940-1005	8 - 34	0.00	0125 - 4.6' 0910 - 11.8'	E@<5	Rippled	9/10 Cloud
10	4	1417-1445	"	"	1600 - 6.1' 2115 - 7.7'	S@<5	Rippled	Overcast
11	5	0955-1008	29 - 38	0.50	0200 - 6.0' 0915 - 11.8'	E@4	Medium Chop	Overcast
11	6	1450-1510	"	"	1650 - 4.8' 2310 - 7.8'	S@<5	Rippled	Overcast & Rain
12	7	0912-0937	31 - 45	0.66	0235 - 7.3' 0940 - 11.7'	E@<2	Calm	Overcast & Rain
12	8	1240-1258	"	"	1735 - 3.6'	S@5-10	Rippled	Overcast & Rain
15	9	1038-1105	46 - 51	1.01	0415 - 10.7'	S@<3	Light Swell	Overcast & Rain
15	10	1541-1600	"	"	1130 - 11.5' 2000 - 0.9'	E@5-10	Medium Swell	Overcast & Rain

TABLE 6 (Cont'd)
ELEMENTAL CONDITIONS DURING SURVEY

DATE JAN.	RUN NO.	SAMPLING TIME (HRS.)	DAILY AIR TEMPERATURE RANGE (°F)	DAILY TOTAL PRECIPITATION (IN.)	TIDE CONDITION (TIME - HEIGHT)	WIND SPEED (MPH) AND DIRECTION	LOCAL SEA CONDITION	LOCAL SKY CONDITION
16	11	1032-1055	38 - 48	0.24	0455 - 11.4' 0830 - 10.6'	E@<3	Light Swell	9/10 Cloud
16	12	1450-1525	38 - 48	0.24	1230 - 11.4' 2050 - 0.4'	E@5-10	Light Chop	Overcast & R
17	13	1028-1054	28 - 48	0.08	0535 - 11.7' 0945 - 10.4'	SE@7-10	Light Chop	2/10 Cloud
17	14	1456-1547	"	"	1325 - 11.3' 2140 - 0.2'	SE@<5	Rippled	Overcast
18	15	0948-1013	29 - 44	0.02	0605 - 11.8' 1035 - 10.0'	SE@<4	Rippled	Overcast
18	16	1410-1540	"	"	1430 - 11.0' 2225 - 0.4'	SE@5	Light Swell	Overcast
19	17	0835-0916	31 - 45	0.31	0640 - 11.9' 1130 - 9.4'	0	Rippled	8/10 Cloud
19	18	1225-1328	"	"	1540 - 10.7' 2310 - 0.9'	0	Calm	5/10 Cloud
22	19	0910-1036	37 - 44	0.01	0025 - 3.0' 0810 - 11.7'	SE@6-10	Medium Chop	Overcast
22	20	1515-1545	"	"	1415 - 6.8' 1915 - 8.7'	SE@5-8	Light Chop	Overcast

TABLE 6 (Cont'd)
ELEMENTAL CONDITIONS DURING SURVEY

DATE JAN.	RUN NO.	SAMPLING TIME (HRS.)	DAILY AIR TEMPERATURE RANGE (°F)	DAILY TOTAL PRECIPITATION (IN.)	TIDE CONDITION (TIME - HEIGHT)	WIND SPEED (MPH) AND DIRECTION	LOCAL SEA CONDITION	LOCAL SKY CONDITION
23	21	0850-0918	33 - 49	0.12	0105 - 4.3' 0820 - 11.6'	SE@20-30	Heavy Chop Swells Whitecaps	Overcast
23	22	1453-1534	"	"	1510 - 5.9' 2020 - 8.1'	0	Medium Swells	Overcast
24	23	0830-0926	34 - 47	0.41	0135 - 5.7' 0845 - 11.5'	0	Rippled	9/10 Cloud
24	24	1400-1415	"	"	1600 - 5.2' 2215 - 7.9'	SE<5	Light Chop	9/10 Cloud
25	25	0838-0855	27 - 43	0.33	0205 - 7.0' 0905 - 11.3'	0	Rippled	Clear
25	26	1355-1354	"	"	1650 - 4.5' 2350 - 8.3'	W@10-15	Medium Chop	Clear
26	27	0847-0950			0310 - 8.3' 0925 - 11.0'	SE @ 3-5	Light Chop	Overcast

NOTES:

- (1) Ambient air temperature and total precipitation data were received from the weather station at Naniamo Airport.
- (2) Tide datum are for Fulford Harbour reference port.
- (3) All compass bearings are magnetic bearings.

TABLE 7
TEMPERATURE (°C) AND SALINITY (°/∞) DATA
FOR SEA WATER SAMPLES

DATE JAN.	RUN NO.	SAMPLE STATION													
		5		6		7 ¹		8		9		10		11	
		°C	°/∞	°C	°/∞	°C	°/∞	°C	°/∞	°C	°/∞	°C	°/∞	°C	°/∞
9	1	5.4	18.0	4.8	14.2	5.2	21.0	4.8	20.5	4.9	19.0	4.5	18.0	5.0	20.5
10	3	4.9	19.5	4.6	14.8	5.5	21.0	5.3	20.8	4.8	19.2	4.6	19.2	5.0	30.8
11	5	6.0	22.5	4.5	15.5	6.0	22.2	6.0	22.5	6.0	22.5	5.5	20.5	6.0	26.0
12	7	4.2	17.2	4.2	14.0	5.0	21.5	5.0	21.5	4.5	19.5	3.8	15.2	5.0	21.5
15	9	5.0	18.8	5.0	14.2	6.0	20.6	6.0	21.0	5.0	20.0	4.6	16.0	6.0	20.5
16	11	5.3	17.6	4.8	15.2	5.5	21.2	5.2	21.8	5.2	19.0	5.0	16.4	5.5	22.0
17	13	4.5		4.2		4.0		4.0		4.0		3.6		3.5	
18	15	5.0		5.2		6.0		5.4		5.0		4.5		5.0	
19	17							4.5		4.5		5.0		4.5	
22	19							4.8		5.0		5.1			
23	21							6.0		6.0		6.0			
24	23														

NOTES:

- (1) Measurements were taken at two different locations during survey. Measurements up to and on Run No. 5 were taken at Station 7A and the remainder at Station 7B.

TABLE 7 (Cont'd)

TEMPERATURE (°C) AND SALINITY (°/oo) DATA
FOR SEA WATER SAMPLES

DATE JAN.	RUN NO.	SAMPLE STATION									
		12		13 ²		14		17		18	19
		°C	°/oo	°C	°/oo	°C	°/oo	°C	°/oo	°C	°/oo
9	1	5.2	23.0	5.2	21.2	4.4					
10	3	5.0	22.5	4.8	22.0	4.6					
11	5	6.8	25.0	6.0	22.0	4.2					
12	7	5.2	22.0	5.0	21.5	4.5					
15	9	6.0	21.0	5.8	17.6	4.4		5.8			
16	11	5.8	22.0	5.0	22.8	4.2		5.8			
17	13	3.6		3.5		4.5		4.5			
18	15	5.4		5.6		4.2		5.0			
19	17	4.0		4.2		4.1		4.2	4.2	4.0	
22	19	4.6				4.8		6.0	5.8	5.8	
23	21	6.5		6.2				6.0	6.2	6.1	
24								5.8	6.0	6.0	

NOTES:

(2) Measurements were taken at two different locations during survey. Measurements up to and on Run No. 7 were taken at Station 13A and the remainder at Station 13B.

TABLE 8
TEMPERATURE ($^{\circ}\text{C}$) DATA
FOR FRESH WATER SAMPLES

DATE JAN.	RUN NO.	SAMPLE STATION						
		15	16	D1	D2	D3	D4	D5
9	1	4.0	4.0					
10	3	4.2	4.1					
11	5	4.0	3.8					
12	7	4.2	3.9					
15	9	4.1	4.0	6.0	7.5	5.6	4.0	4.9
16	11	3.8	3.8					
17	13	4.2	3.8	6.5	7.0	5.0	3.8	4.8
18	15	4.5	4.0	6.2	6.5	5.2	4.4	3.8
19	17	5.0	4.1	5.8	6.4	5.2	4.0	5.4
22	19	4.6	4.4					
23	21							
24	23	4.4	4.0					