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J. A. DELANEY & ASSOC.

Interim Report No.1

Sea Pollution from
Boat Harbour, N.S.

1200 ST. AMOUR STREET
ST. LAURENT, MONTREAL 384, QUE.

AREA 514 - 331-4400

J. A. Delaney & Associates
CONSULTING ENGINEERS
MUNICIPAL & INDUSTRIAL PROJECTS

July 31, 1969.

Northumberland Strait Pollution
Control Committee
RR No.1
Trenton
Black Point, N.S.

re: Interim Report No.1
Sea Pollution from
Boat Harbour N.S.

Attention: Mr. George W. Reid

Dear Mr. Reid:

We have now completed what we consider as the first part of our study, which enables us to reach a number of conclusion and a course of action which we will now enumerate for you. Please note that we included with this report, the attached data:

a) A summary of our test results on samples taken by the writer on May 26th, 1969.

b) A map of the area showing the location of the sample stations.

c) Photographs taken from a light plane on May 26th, 1969 to show the pattern of distribution of the Scott Paper effluent from Boat Harbour in the sea.

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HISTORY

A) The Scott Paper Plant

Scott Paper Co., located at Abercrombie Point N.S. started operating in the Fall of 1967 and uses a Bleached Kraft Pulping process in which the digester liquor is burned thereby permitting recovery and re-use of a large portion of the digester chemicals. However the wastes from the bleach plant are not recovered and are wasted. These wastes together with spillage from the digesters are mixed with re-use waters and are allowed to exit from the plant as plant wastes. The resultant mixture (dark brown in color) is pumped through an underwater pipe line crossing the East River, and enters the area known as Boat Harbour. This area was formerly a tidal lagoon but has since been isolated into two (2) lagoons (No.1 and No.2) by means of earthen causeways in 1967, to accept the wastes from Scott Paper Company. The flow proceeds from the effluent line that crosses the East River through Lagoon No.1 to Lagoon No.2. thence it exits to the sea.

The Mill has a nominal capacity of 500 tons of pulp per day and discharges between 20,000,000 to 25,000,000 gallons of waste water to the Boat Harbour lagoon each day. The effluent from Boat Harbour enters the sea and is progressively diluted as the wind and tides carry it out to sea in a North Easterly direction. The diluted wastes and sea water exhibits a brownish color that is clearly visible from the air as a distinct demarcation line between uncontaminated and contaminated sea water as shown in Aerial photos No.5 and No.6. During the visit of this writer one May 26/69 the mass of diluted wastes in the sea was visible to the Eastern end of Picton Island from it's exit at Boat Harbour and it extended in a fan like manner. The brownish sea water extended for about three miles east along the shore line from Boat Harbour. We were advised by local residents that this brownish sea water sometimes extends as far east as Merigomish Harbour.

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B) Local Complaints

Primarily, complaints from local residents were initiated by the obvious discoloration of the sea water along the beaches, east of Boat Harbour and Sea Ward towards Pictou Island. Progressively from the Fall of 1967 with the continued daily emission of these wastes into the sea from Boat Harbour, more and more evidence was accumulating of the detrimental effects of these wastes on the environment.

Specifically, it can now be ascertained that:

1) The effluent from Boat Harbour has deteriorated the formerly superb beaches along the shoreline from Boat Harbour east to Merigomish Harbour (8 miles) and these beaches were considered at one time, to be the finest sea beaches in Nova Scotia, because of the consistent warm temperature of the shallow water and the fine sandy shore line. We are advised by local residents that when swimmers enter the water in this specific area, their clothing, skin and hair becomes discolored with a brownish sticky film that is next to impossible to remove, by conventional means. In addition the water has a foul taste and smell consistent with the taste and smell of a paper mill effluent.

2) Because of the serious deterioration of the sea water along the stretch of coast mentioned in No.1 above, we have been advised that the property values along the beach have reduced sharply since the start of the pollution of the sea from Boat Harbour in the Fall of 1967.

3) As a matter of course, residents in the area normally carried out winter sport, fishing for smelts in the coves and inlets by fishing through the ice and we are advised that since 1967 this is no longer possible because of the absence of these fish due to the contaminated brownish sea water.

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We were also advised by the local residents that onece the brownish contaminated sea water enters a cove or inlet through the usually narrow and shallow inlet channel the action of the tides does not empty the coves at low tides and therefore traps a cumulative and increasing concentration of contaminated sea water over a period of time. The coves then become highly contaminated and act as waste treatment lagoons thus degrading the biological organisms including fish and plant life.

4) A simple inspection of the sandy stretches of beach from Boat Harbour to Merigomish Harbour indicates an accumulation of brownish deposit resembling suspended solids from a pulp mill effluent.

5) On visiting Boat Harbour, one is appalled by the utter desolation of the water, which is extremely dark brown in color and eminates a strong odor of septicity.

6) The sea coast off-shore between Boat Harbour and Merigomish Harbour has always been a productive lobster fishing area, providing a livelihood for many local residents. The catches of lobsters have reduced during the lobster fishing season of 1968 and 1969. These comparative values of lobster catches will be given in the next report.

Observations

On May 26th, 1969 the author flew aver the site of the pulp and paper mill (Scott Paper Co.) at Abercrombie Point and the surrounding area to take aerial photos numbered 1 to 7 inclusive and attached to this report:

Photo No.1

Shows a view of the area from the sea showing the Scott Mill, the East middle and West rivers, Pictou Harbour, Boat Harbour, and the outlet from Boat Harbour as it emits into the sea.

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Photo No.2

Shows a view taken fron the Scott Mill looking out to sea and showing Lagoon No.1 and Lagoon No.2.

Photo No.3

Shows a close-up view of the effluent from the Scott Mill as it enters Lagoon No.1 and a portion of Lagoon No.2.

Photo No.4

Shows a closer view of Lagoon No.1 with it's outlet to Lagoon No.2 and the existence of considerable foam.

Photo No.5

Shows the effluent from Boat Harbour into the sea, the discoloration and direction of flow of these wastes are quite evident in an easterly direction.

Photo No.6

Clearly shows a distinct color demarcation line between polluted and unpolluted sea water. This frontal demarcation was found to extend in a North-North Easterly direction.

Photo No.7

This is a view from the sea and shows a clear demarcation line between the polluted and unpolluted sea water. Please note that the frontal mass of polluted sea water extends along the shore line and beaches.

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From our laboratory tests, (copy of the results are attached) we are able to state the following:

	Entering Boat Harbour from the mill tons/day	Entering the Sea from Boat Harbour. tons/day	% Removal
Total Solids	280	185	34
Total Suspended Solids	94	4	96
Total Dissolved Solids	186	147	21
Dissolved Inorganic Solids	129	116	10
Dissolved Lignins etc	57	31	45
Biochemical Oxygen Demand	25	9	64
Chemical Oxygen Demand	125	56	55

1) In spite of the removal of 96% of the total suspended solids (in the form of pulp fines, wood chips etc) there are approximately four (4) tons per day or 1400 tons per year of this material getting into the sea. Since this material normally floats, a large portion would obviously be washed on shore because of the effect of wind and tides.

2) Lagoon No.2 contains no dissolved oxygen and is septic and highly odorous.

3) The sea water, 1 mile off shore from Otter Pond, within the mass of polluted sea water (Sample point No.4) contains 0.67% (B.K.M.E.) bleached Kraft Mill effluent. The dilution factor is about 150:1 in this area at the surface.

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The sampling stations that were chosen for purposes of comparison may be described as follows:

Sample Station No.1

The effluent from the Mill as it enters No.1 Lagoon.

Sample Station No.2

The effluent from Lagoon No.1 as it enters Lagoon No.2.

Sample Station No.3

The effluent from Lagoon No.2 as it discharges into the sea.

Sample Station No.4

Discolored sea water, 1 mile off shore at Otter Lagoon.

Sample Station No.5

Clear uncontaminated water, 1 mile off shore from Logan Point.

Sample Station No.6

Water from the Middle and West River at the Causeway.

Sample Station No.7

Pictou Harbour effluent as it discharges into the sea.

Sample Station No.8

Contaminated and discolored water at the point where Boat Harbour discharges into the sea.

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Conclusions

The effect of the continuous daily discharge of the pulp mill wastes from Boat Harbour has had the effect of virtually negating the beach areas as a recreational resource for both local residents and tourists from Boat Harbour to Merigomish Harbour, a distance of about 8 miles of beautiful sandy beach.

Land values along this stretch of sea front have been seriously reduced, to the extent of causing financial hardship for local residents.

Lobster catches have been reported as having diminished by a factor of about 30% for 1968 in comparison to 1967.

There is a belief that the effluent from Boat Harbour is having a deleterious effect on adult and lobster larvae and thereby diminishing the number of lobsters which are available to be trapped during the fishing season. The record of lobster catches for 1968 seems to indicate this phenomena. However to prove that this assumption is true or false requires a great deal of precise reseach by competent and unbiased biologists. The wastes from a Kraft Mill normally contains numerous complex and toxic chemicals that could concievably have a deleterious effect on the growth cycle of the delicate lobster larvae and in addition cause adult lobsters to migrate from this polluted area to an unpolluted area.

The philosophy encompassed in the random discharge of any wastes into the sea or any other natural body of water that fosters normal delicate biological organisms is a travesty against the human spirit in that those responsible for such action are unaware or are uninformed in regard to the ultimate damage that such a situation may engender. Such a course of action is reprehensible, more so in the case of toxic wastes. There is no doubt that a pulp mill wastes such as that from Boat Harbour will have a lethal effect on numerous species of aquatic animals in the sea. The sea is so vast that we do not notice this effect at the begining, but consider that in this case a brownish mass is being

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discharged to the sea and it ultimatly covers a given area, what would the consensus of opinion be, if the total shoreline around the whole of Nova Scotia was likewise polluted. The question arises "Is it permissible to pollute a little bit this year, then a little more each coming year or should the law be forceful enough to prevent any pollution whatsoever to our heritage and that of future generations.

The literature from the Fisheries Research Board at St.Andrews N.B. have indicated that adult lobster and lobster larvae are not affected by the discharge from Boat Harbour mainly because the concentration of Pulp Mill wastes are less than the 10% concentration which is considered lethal to larvae, but no opinions are given in regard to the possible migration of adult lobsters to unpolluted areas in order to avoid the less favorable polluted area. Also no consideration was given to the lethal aspect of the wastes on other aquatic plants and animals. For these reasons the author feels somewhat apprehensive in regard to the concern that should be forthcoming from the Fisheries Research Board of Canada with respect to their obligation to protect the fishing industry of Canada.

At this point I would like to quote from two (2) sources as follows:

1) "Public Health Report, Vol 27, No. 12 p 1059-70"

Stream Life Below Industrial Outfalls

by Dr. W.M. Ingram & W.W. Towne.

"Many industrial operations contribute settleable solids to water. Apart from the chemical activity that may be provoked in water by such particulate matter, the physical effects on aquatic life are often severe. Some industrial discharges of particulate matter are coal and other mineral products including washery by-products, glass sand, lumber, aluminum steel and other metals, pulp and paper wastes from slaughterhouses, canneries, tanneries and dairies and oil. Since such wastes in suspension limit the penetration of sunlight, they impede the growth of aquatic plants attached to the

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bottom as well as floating or weakly swimming algal forms. Being photosynthetic, these organisms depend on light for existence. Solids also floc planktonic algae and even surface animals and carry them to the bottom to die. By limiting the growth of aquatic plant meadows the wastes starve organisms which feed there. The food chains are interrupted and aquatic life in general becomes sparse".

2) "Fisheries Research Board of Canada"
New Series Circular No.17 May 19, 1964.

"A report to the fishing industry regarding the tolerance of lobsters for fluoridated water and for various woods".

by James E. Stewart & John W. Cornick.

"Tests to determine the toxicity to lobsters of various woods were performed. Black spruce, Douglas fir and Eastern fir did not appear to cause any harmful effects and should be suitable, on the basis of toxicity tests, for use in lobster tank construction. Redwood and Tennessee Cedar colored the water heavily. The redwood color stained the fringes of the lobsters shell and this stain persisted even through the boiling of the lobster. However the meat was not stained and did not taste of redwood. Because of this color, these woods should probably not be used for lobster tanks. Western Red Cedar was toxic, compared to the other woods, contributing materials to the water which killed lobsters in a very brief period. This wood definitely should be avoided when choosing materials for lobster tanks."

Both of the foregoing excerpts indicate the very delicate nature of our ecological system to subtle environmental changes. The continual discharge of large quantities of wastes into a large expanse of the sea off Boat Harbour is bound to have a deleterious effect on the normal biological balance that would otherwise exist if no pollution existed.

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It is extremely perturbing to think that the officials of the Nova Scotia Government who are directly involved in the prevention of pollution have not considered the following:

a) The deleterious effect of the solids washed up on the excellent beaches and the consequent effect on recreational aspect of swimming and tourism in the affected area.

b) The effect of the cumulative concentration of wastes in Coves and Inlets rendering these areas unsuitable and unsightly.

c) The economic hardships for the local inhabitants that have accrued as a result of the deterioration of the beaches thereby rendering these affected areas at an economic disadvantage in addition to the economic hardship rendered on the local lobster fishermen.

The next phase of this report will deal with a survey that is now being carried by Dr. Maxwell Dunbar Chairman of the Marine Sciences Department of McGill University who is now carrying our a Plankton Survey in the affected area off Boat Harbour.

We will also report on the comparative lobster catch for the year 1968 and 1969 and compare these with previous years.

We trust that the foregoing report will suffice for the present and any further data we are able to acquire will be presented in the next phase of this report.

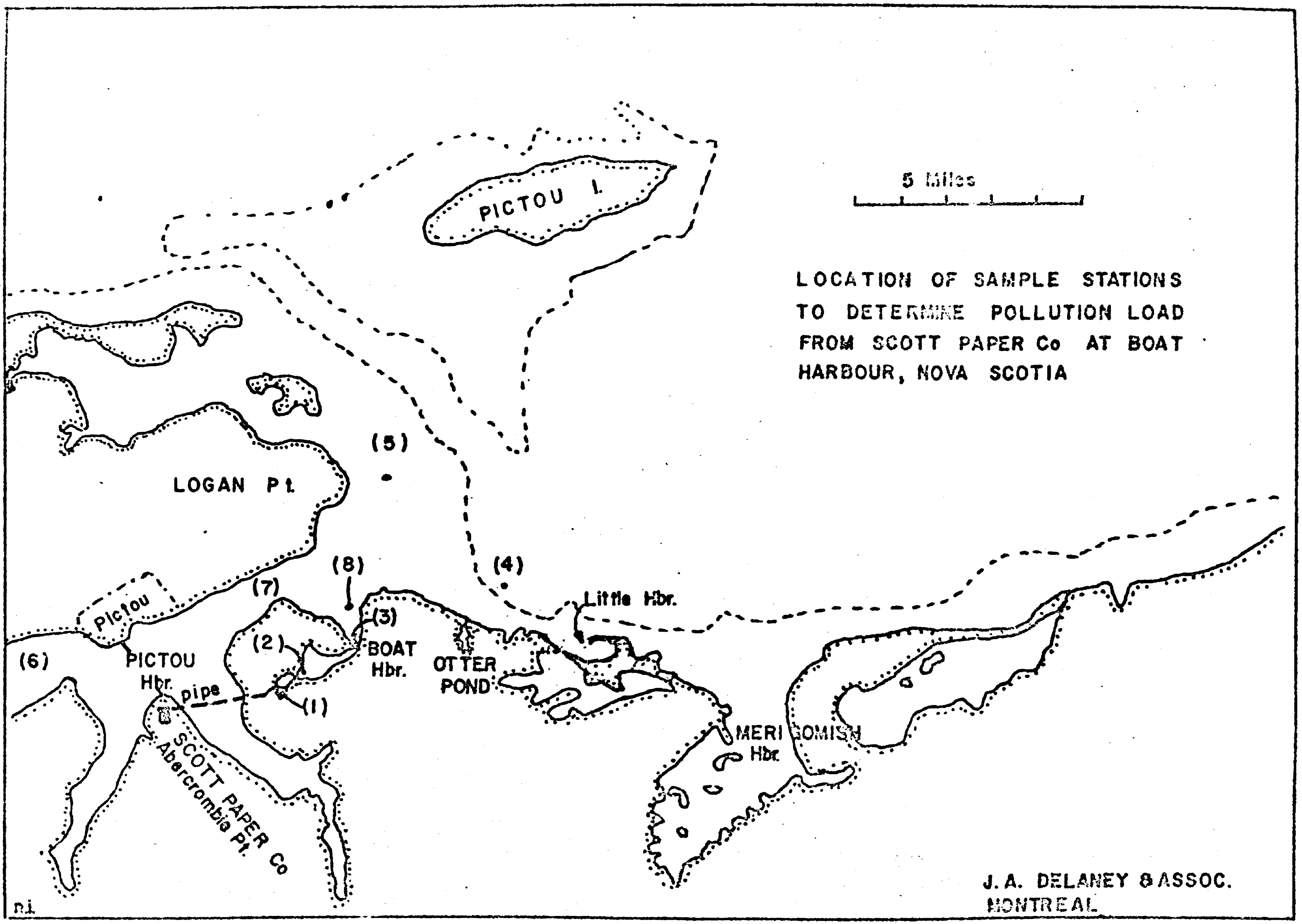
Yours truly,

J.A. Delaney & Associates

J.A. Delaney, Eng.

INGÉNIEUR · ENGINEER
J. ALLISON DELANEY
PROVINCE DE QUÉBEC

JAD/dn


PICTOU I.
5 Miles
LOCATION OF SAMPLE STATIONS
TO DETERMINE POLLUTION LOAD
FROM SCOTT PAPER Co AT BOAT
HARBOUR, NOVA SCOTIA
(5)
LOGAN Pt.
(4)
(8)
(7)
Little Hbr.
Pictou
(3)
(2)
BOAT
Hbr.
OTTER
POND
(6)
PICTOU
Hbr.
pipe
(1)
MERIGOMISH
Hbr.
SCOTT PAPER Co
Abercrombie Pt.
J.A. DELANEY & ASSOC.
MONTREAL
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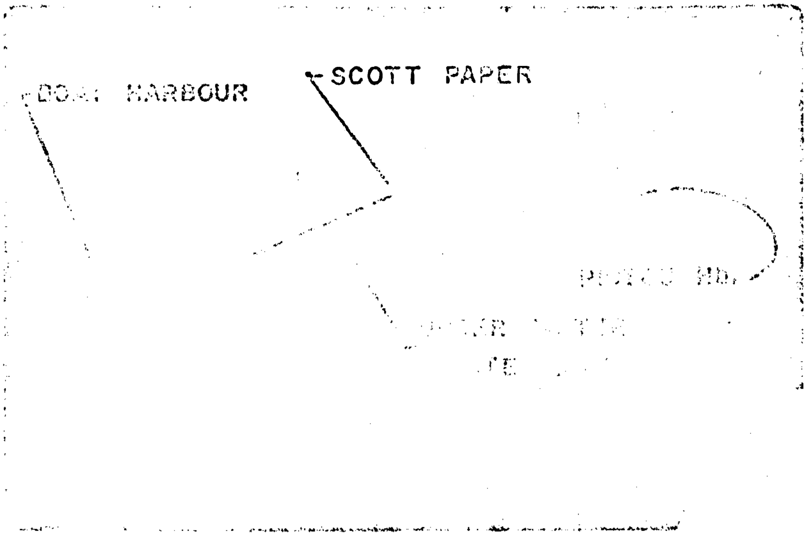

Photo No.1

View of Scott Paper Boat Harbour and Pictou Harbour from the sea.

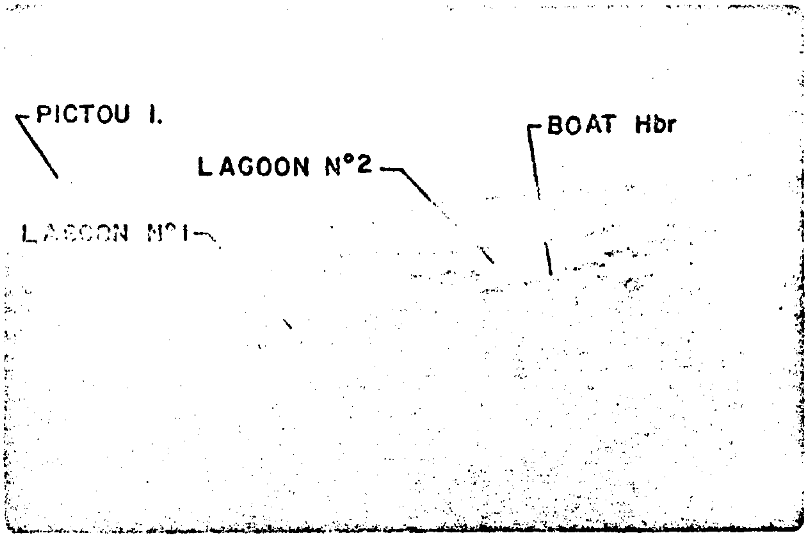

Photo No.2

View of Boat Harbour from Pictou looking towards the sea.

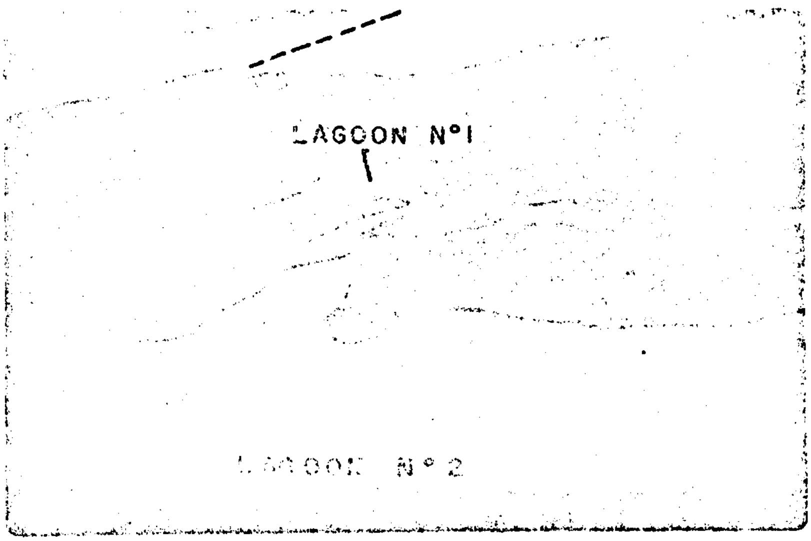

Photo No.3

View of Mill effluent to Lagoon No.1 and Lagoon No.2.

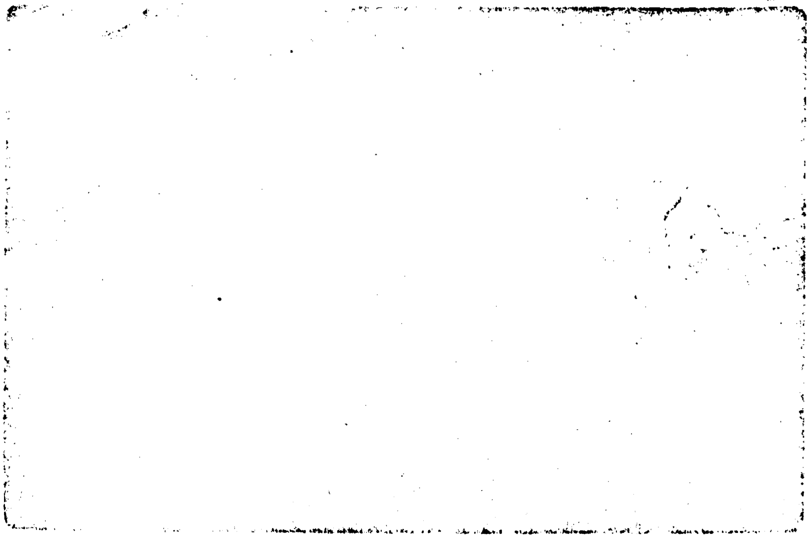

Photo No.4

A close-up view of Mill effluent to Lagoon No.1.

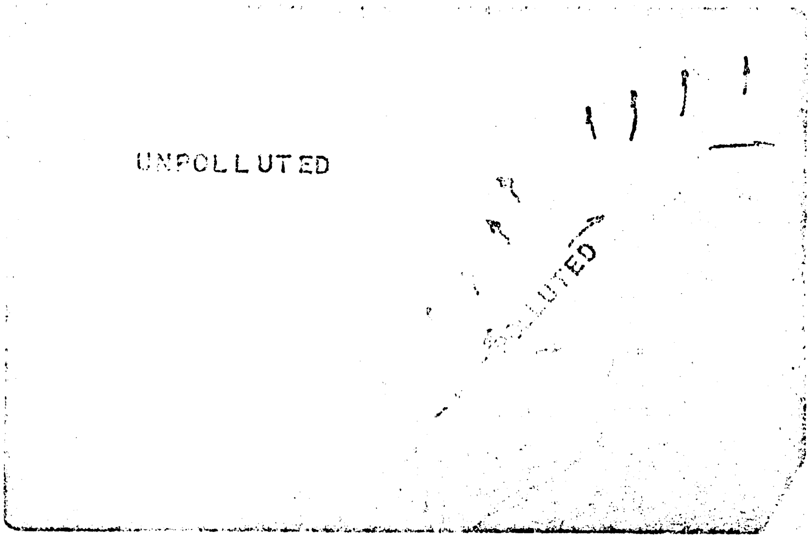

Photo No.5

Exit from Boat Harbour to the sea showing discoloration of sea.

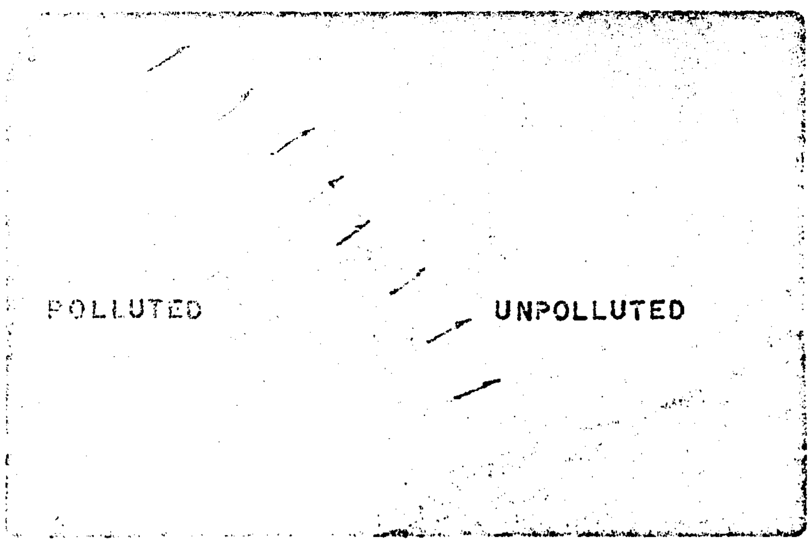

Photo No.6

Distinct discoloration along a frontal path showing a clear demarcation between polluted sea water off Otter Pond.

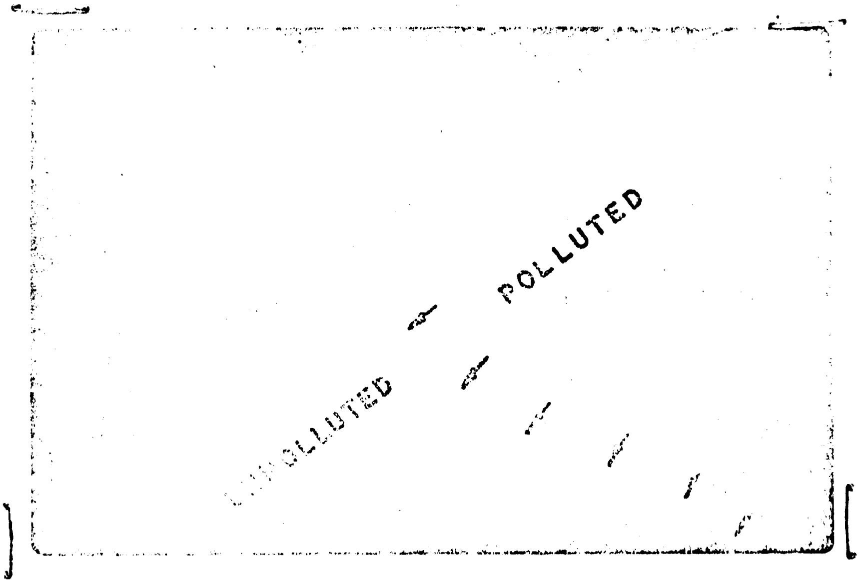

Photo No.7

Another view of the frontal mass of polluted vs unpolluted sea water at Otter Pond showing a clear demarcation. Beach areas exposed to the polluted sea water.

SCOTT PAPER

Analysis		Sample No. 1	Sample No. 2	Sample No. 3	Sample No. 4	Sample No. 5	Sample No. 6	Sample No. 7	Sample No. 8
pH	@ 20°c	6.6	6.7	7.4	7.7	7.8	7.0	7.9	7.5
Colour	A.P.H.A.	2,300	2,000	1,800	10-15	5	25	10	130
Turbidity	mg SiO_2/l	56	52	15	0.63	0.17	0.84	0.44	8.5
Setteable solids	ml/l	9.0	0.6	0.3	0.1	0.1	0.1	0.1	0.1
Total solids	mg/l	2,340	1,570	1,580	42,040	32,270	100	25,550	29,000
Total suspended solids	mg/l	750	90	30	16	8	12	8	30
Volatile " solids	mg/l	200	60	20	12	8	8	8	30
Non-volatile suspended solids	mg/l	550	30	10	4	0	4	0	0
Dissolved oxygen	mg/l	1.5	1.0	0	10.0	12.0	10.9	10.5	8.5
B.O.D.	mg/l	199	204	70	2.2	1.8	3.7	3.0	10.0
C.O.D.	mg/l	1000	647	447	173	188	27.4	200	321
Coliforms	for 100 ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Chlorides	mgCl/l	534	458	551	17,420	16,640	42.6	12,610	15,080
Lignin	mg/l	460	405	250	3.1	—	—	—	20.5
% B.K.M.E.		100%	88%	54%	0.67%	—	—	—	4.5%

Analysis results for samples on June 25th 1969
except for sample No.6 taken on June 27th 1969
(See each site on this map) enclosed.

[redacted]

1200 ST. AMOUR STREET
ST. LAURENT, MONTREAL 384, QUE.

AREA 514-331-4400

J. A. Delaney & Associates
CONSULTING ENGINEERS
MUNICIPAL & INDUSTRIAL PROJECTS

Northumberland Strait Pollution
Control Committee
RR 1
Black Harbour, N.S.

Montreal, Que
November 12th, 1969

Attention: Mr. George Reid
President.

Gentlemen:

In the following pages you will find the text of our Report No.2 which constitutes a continuation of our Interim Report No.1 dated July 31st 1969. You will recall that we were commissioned by your Committee to investigate the causes and effects of the massive quantities of polluted water eminating from Boat Harbour, which covered extensive areas of the sea as well as beach areas as far east as Chance Harbour a distance of some 4 miles.

Included, you will find discussions, observations, factual data and recommendations outlined in numerical sections as follows:

No.1 Observations

Additional photos, No.8 to No.20 inclusive, showing the extremely large masses of Kraft Mill effluent which are in constant movement along the shore line and off-shore due to the effects of tides, winds and currents.

In these photos you will note the masses of foam (Photo 13) created from the Kraft Mill effluent by wave and wind action along the shore line.

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COMPLETE LABORATORY SERVICE

WATER AND WASTE WATER ENGINEERING

No.2 Biological Studies

A report from the Marine Sciences Department of McGill University of the comparative viability of phytoplankton and zooplankton organisms found in unpolluted sea water off Nova Scotia as compared to the same organisms found in the polluted areas off Boat Harbour.

No.3 Kraft Paper Mill Waste Treatment (Comparison)

A report on a similar Kraft Paper Mill in upper Canada which uses an aerated lagoon system for treatment of their Mill wastes, with subsequent discharge into a relatively large capacity receiving stream.

No.4 Laboratory Studies

Studies, which were carried out by our laboratory to show the feasibility of preliminary treatment of the Scott Paper effluent to a level that would be amenable for further biological treatment in Boat Harbour.

No.5 Modifications at Scott Maritimes Ltd

Studies related to process changes for pre-treatment of the wastes from this Mill.

No.6 Boat Harbour Process Modification

A proposed process modification to Boat Harbour that would accomodate the entire domestic wastes from:

a) Pictou
b) Westville
c) Stellarton
d) New Glasgow
e) Trenton

together with the combined industrial wastes from:

f) Scott Paper (after preliminary treatment)
g) Michelin Tire Co.
h) Canso-Chemicals Ltd (Alkali-Chlorine)

No.7 Standards in other Provinces

A review of the effluent standards for Pulp & Paper Mills in other Canadian Provinces.

No.8 Conclusions & Recommendations

The foregoing is a concise resume of the contents of this report which we hope will be of assistance in solving a serious local dilemma, and result in the implementation of facilities that will benefit all concerned.

We take this opportunity to point out to you and to those persons who may receive this report that there exists a code of ethical conduct between professional engineers whereby original concepts in design are automatically regarded as the prior right of the designer and consequently the deliberate utilization of the design concepts contained herein, without consent, would constitute professional misconduct.

Yours truly,

J.A. Delaney & Associates

J.A. Delaney, Eng.

Report No.2

to

The Northumberland Strait

Pollution Control Committee

regarding

Sea Pollution Study

Boat Harbour N.S.

INDEX

Sea Pollution Study

Boat Harbour N.S.

This report has been divided into numerical sections for two main reasons namely:

1- In order to present relevant and related data as concisely and as completely as possible in each section.

2- To permit the reader to make rapid reference to the section of his choice.

Sea Pollution Study

Boat Harbour N.S.

Section No.1

Observations

The writer originally visited the area on May 26th 1969, and Interim Report No.1 dated July 31st 1969 resulted from this trip. The writer again re-visited the site from September 19th to 23rd 1969, during this trip samples and aerial photos were taken.

This latter series of aerial photos (No.8 to No.20 incl.) shows without any doubt whatsoever the extent of the large mass of polluted water which comes from Boat Harbour and moves about depending on tide and wind conditions. At times it extends almost to Pictou Island while at other times, the mass, remains close to shore when an "On-shore" wind is blowing. On September 23rd when these photos were taken, there was a rising tide and an "On-shore" wind of about 10 M.P.H. for these reasons the mass of polluted water was forced towards shore.

Photo No.8, 9 & 10.

These pictures show a tongue of the polluted sea-water approaching Pictou Bar Spit, one of the very beautiful beaches in the area.

Photo No.11, 12 & 13.

These pictures again show the dark mass of Kraft Mill effluent approaching a beach as well as directly washed up on the beach. Note the large masses of foam in Photo No.13 and the very dark color of the water.

Photo No.11, 12 & 13. (cont'd)

This beach would not be very inviting to tourists or local residents because of the obvious pollution and the strong odor.

Photo No.14, 15 & 16.

Photo No.14 shows a beautiful beach covered with the black mass of polluted water from Boat Harbour and the inevitable existance of foam. As the wind increases in intensity so does the quantity of foam.

Photo No.15 shows a boat circling in the mass of polluted water and stirring up a mass of foam. The close up view in Photo No.16 is a striking picture showing clearly the demarcation between the Boat Harbour effluent mass and unpolluted sea water.

Photo No.17, 18 & 19.

These photos clearly show the mass of Boat Harbour effluent distributed along the shore-line.

Photo No.20 & 21.

Photo No.20 shows the mass of polluted water washing up onto a lovely beach area.

Photo No.21 is a close-up photo of the shore-line water taken at Roy Island showing the normal clean sea-water with live organisms. This type of water is doubtless the rightful heritage of the citizens of Nova Scotia and a powerful attraction to the tourist. Needless to say, it is also more inviting as a bathing area than the beach shown in Photo No.13.

The writer walked along the beach from the Boat Harbour exit to Roaring Bull Point and found evidence of wood fibers and bark chips washed up on the beaches and shore. The heaviest concentration occurred at the Boat Harbour exit and gradually diminished as one travelled east towards Roaring Bull Point. In the beach area between Roaring Bull Point and Evans Point the quantities of wood fibers and bark chips were intermittent. On Roy Island, there was no evidence of wood fibers or bark.

The sand beaches on both sides (East and West) of the mouth of Boat Harbour for about ½ mile, showed evidence of Pulp Mill Liquor penetration of the sand to depths of 3½ to 4 inches in places and as little as ¼ inch. In this case the sand was dark brown to black in color in the top layer and light brown to sandy color under the dark layers. The lower layer extended for several feet in depth and were consistent in color. The farther one moved away from Boat Harbour exit the less noticeable was the dark coloration of the sand. This phenomena is clearly visible in Photo No.18 at the top right hand corner of this picture, just to the right of the wing strut, note a very dark area then a light area.

On flying over the area in a light plane to take aerial pictures, at 1000 feet altitude there was a very nauseating odor of septicity over Boat Harbour. This odor was much more pronounced when driving around Boat Harbour by car.

The extensive mass of brownish polluted water shown in Photo No.8 to No.20 inclusive, is a phenomena due, primarily, to the following reasons:

a) The brownish color of the water is due to the Lignins and Tannins from the Kraft process at Scott Maritimes Mill at Abercrombie Point.

b) Only 45% of these materials are removed by the existing process in Boat Harbour.

c) If 80 to 90% of the Lignins and Tannins were removed either at the Pulp Mill or at Boat Harbour then this mass of material would not be visible in the sea.

d) The water eminating from Boat Harbour is fresh water containing organic impurities. It's density is much lower than sea-water and therefore rather than mix, this material tends to float on the surface. There is some mixing at the interface of the effluent and the sea-water, but not sufficient to disperse this material.

e) We have found the layer of polluted effluent from Boat Harbour to vary in thickness from about 3 feet thick to about 1 foot depending on the area measured.

f) The intertidal area on each side of the Boat Harbour exit, East and West, for about 1 mile is repugnant and filthy, there is no evidence of normal salt water organisms, only the slimy filamentaceous growths associated with gross pollution.

The sea must be considered in it's true context by all those individuals whose role in our society is intended to protect our environment, be they elected Government Officials, Civil Servants, Directors of Control Agencies, Consulting Engineers, Biologists etc. That context is that the sea is an extremely poor repository for man-made pollution, be it, Pulp Mill, industrial or domestic wastes, since in essence the sea acts exactly like a large pond except,that the level rises and falls with a determinable frequency. The action of winds and tides tend to bring the pollutant back to shore thus contriving to deteriorate recreational beaches. The rise and fall of the tides not only do not effectively disperse the wastes but simply keep the wastes moving back and forth. One would have to contrive to find a fast moving channel in the sea that would carry away the debris, but these channels would be so far away from shore that it would be prohibitive in cost to reach them, then with time these channels would simply direct the wastes to another locale. The one and only answer to this problem is to effectively treat the wastes on shore and allow as little wastes as possible to get out to sea. Under certain conditions small quantities of organic nutrients can be safely allowed to enter the sea where they would be of beneficial merit as part of the biological food chain for sea organisms.

REPORT ON PLANKTON

COLLECTED FROM

PICTOU AND BOAT HARBOURS, N.S.

November, 1969

Mrs. D. C. MacLellan
Marine Sciences Centre
McGill University
Montreal

REPORT ON PLANKTON COLLECTED FROM PICTOU AND BOAT HARBOURS, N.S.

Examination of plankton collected in the Pictou area on 20 September of this year revealed a heavy infestation of parasites of one of the shallow water copepod species, and also considerable numbers of a ciliated protozoan of the family Tintinnidae. Since such occurrences in the plankton of other areas have been found by other workers to indicate harmful environmental influences, a further series of plankton collections was made on 7 November, paying particular attention to the Boat Harbour area (see Mr. Axelsen's report for details on collecting).

The plankton was examined immediately after collection, a Utermöhl reversed microscope (magnification x 650) having been transported from the Marine Sciences Centre for the purpose, and set up in Mr. George Reid's home at Little Harbour.

Following is a report on the planktonic plants and animals which were either dead or in an unhealthy condition just after being collected and before the collections were preserved by the addition of formalin; also noted are occurrences of any plankton organism not usually found in marine plankton communities in shallow coastal waters in the area:

1. A sample taken directly from the pipe carrying the effluent from Boat Harbour to the sea contained no living organisms, only a few skeletons of one-celled plant life.

2. Samples from the mouth of Boat Harbour, depth of water about 12 feet, contained dead or very sluggish cyclopoid copepods, Oithona and Oncaea; the diatom Planktoniella was dead, its edges curled; the dinoflagellate Ceratium longipes showed only feeble movements in contrast to its usual jerky habit of swimming; polychaete larvae were moving sluggishly.

3. Samples from outside the Sand Bar, depth about 12 feet, also showed

dead cyclopoid copepods. Numbers of the rotifer, Keratella, were present. This is a very small carnivorous animal of fresh and brackish waters, seldom found in marine plankton.

4. The samples taken between McKenzie Head and Powell Point contained dead diatoms of the genus Coscinodiscus, the protoplasm shrunken from the edges. There was not much diversity of species in this sample, although numbers of the rotifer Keratella were present.

5. Samples from the area between McKenzie Head and Otter Pond contained dead larvae of the soft-shelled clam Mya, dead Coscinodiscus, and inert cyclopoid copepods. The rotifer Keratella was also present in this sample, taken where the water is about 12 feet deep. At the 23 ft. depth off Otter Pond, the larval stages of a calanoid copepod Acartia clausii were dead, as were the diatoms Coscinodiscus, some of which contained a dark mass foreign to the species. The sample taken where the water was greater than 50 ft. in depth, also off Otter Pond, contained plankton which had a more healthy appearance. At the two latter locations, rotifers were not observed.

6. Outside Powell Point (depth 15 feet) rotifers were present in the sample.

7. Outside Chance Harbour, the sample also contained numbers of rotifers.

8. At Cole Point, the sample revealed sluggishly moving cyclopoid copepods, unhealthy looking diatoms and large numbers of the rotifer, Keratella.

9. In all the samples collected, any colour changes in the calanoid copepods were noted. Species of Acartia, Centropages and Temora, commonly found in shallow coastal waters in the area, were dulled in colour, their usual red pigment approaching a dark red-brown. Further away from shore in the vicinity of Fairway Bell, the colour change was not so marked. The calanoid copepods were feeding, as evidenced by the food visible in the guts,

the mass of food having a brighter green colour in the animals found in the Fairway samples, and in those from Roy Island.

10. Only one larval fish was found in the samples. A pipe fish about three inches long was taken from the area between McKenzie Head and Otter Pond; it died soon after being collected.

11. A sample of the top few inches of sand collected below the high tide mark at the beach just west of Boat Harbour showed no living organisms, only a few empty diatom skeletons and a number of dead Tintinnids.

Discussion

The dead or dying condition of many of the plankton organisms in the November 7th collections confirms the indications of polluted waters found in the September 20th samples (previous report to Mr. J. Delaney). The zooplankton grazes on the diatoms and dinoflagellates and can be expected to reflect any catastrophe which affects the phytoplankton. Larval fish feed on the cyclopoid copepods because of their small size and high productivity. Such species as Oithona have seven generations a year in the Atlantic Ocean. Adult pelagic fish such as herring and mackerel depend on the calanoid copepods for the bulk of their food.

The adult polychaetes live in the sediments of the sea floor and are eaten by demersal fish such as plaice and cod; effects on larval stages of polychaetes which are found in the plankton, will ultimately affect the food of some of the most important commercial fishes.

Of immediate concern to any coastal area is the damage done to the soft-shelled clams, the young stages of which were dead in samples taken between McKenzie Head and Otter Pond. Besides providing food for human consumption, the clams are important in the diet of fish and of large crustaceans.

The evidence of pollution is easily seen in the terrestrial environment of Pictou, in the dark brown effluent pouring from the pipe in countless gallons into the sea, in the frightening devastation of the trees and vegetation surrounding the lagoon, in the nauseating smell of hydrogen sulphide which pervades the countryside. All these catastrophes are being accompanied by changes in the marine environment, invisible yet to the naked eye, but clearly seen in the plankton when it is compared under a high-powered microscope with plankton from unpolluted waters.

Delphine C. MacLellan

11 November, 1969

Delphine C. MacLellan,
Lecturer, Marine Sciences Centre,
McGill University.

McGILL UNIVERSITY
MONTREAL

POLLUTION STUDY AT PICTOU, N.S.

Introduction

At the request of J. A. Delancy & Associates, the Marine Sciences Centre collected zooplankton from two areas off Pictou (see map) on 20 September, 1969. The analysis of the samples showed signs of pollution (cf. Mrs. McLellan's report). Consequently it was decided to investigate a more extensive area and to pay particular attention to the area in the vicinity of Boat Harbour.

Sampling

On 7 November 1969, sampling was done (a) in the inshore waters extending from Cole Point to Roy Island, and (b) further offshore (see accompanying map).

Sampling was carried out with a very fine standard plankton net (no. 20 mesh); 3 4-minute surface hauls were made. The "live" material was looked at immediately after collection.

Observations

The effluent from Boat Harbour was clearly visible along the whole coast-line from Logan Point to Evans Point. It was a brown smelly water, with foam on the surface, in contrast to the water outside the 5-fathom line, the so-called unpolluted water. As the water was much clearer between Evans Point and Roy Island, it is likely that the effluent takes a north-easterly course.

There was also a distinct difference between the samples taken close inshore and those taken further out. In the former, no live specimens could be seen with the naked eye, in contrast to the latter. A detailed account of the microscopic analysis is included in Mrs. McLellan's report.

Samples of sand taken on the sand bar west of Boat Harbour, below the high-water mark, showed no sign of interstitial fauna (animals found between sand grains). Only the typical smell of H_2S was present.

Boat Harbour was visited. The magnitude of pollution was unbelievable. The effluent from the mill has completely ruined what must once have been a lovely wooded area. No life at all was detectable; it looks like a waste land, black, foamy, stinking of H_2S. (Nobody seems to be able to stay there for more than 5 minutes.) The houses in the vicinity of Boat Harbour are all blackened.

The effect of the kraft mill at Pictou has been "the subject of much controversy" (ref. Dr. M. J. Dunbar: A statement on environmental pollution and destruction in Canada. September 1969.) However no one who has had the opportunity to get a closer look can consider this a subject of controversy any longer: it is a blatant example of what a disastrous effect pollution can have on the environment in a very short time. It is on record that:

Shell fish from Christie Point to Evans Point have been declared unfit for human consumption.

The deteriorating effect on fish food organisms (zooplankton) is beginning to show.

The effluent has spoilt the seashore. The beaches are deserted in summer: swimming in "pure" waste is of course inconceivable.

It must also be borne in mind that the future may see new industries grow up and likely contaminate the area still further. That will be one step further towards a total destruction of man's environment. In my opinion the state of affairs at Pictou amounts to a scandal, and action is urgently needed before it is too late.

12 November 1969

Fritz Axelsen
Marine Sciences Centre,
McGill University.

REPORT ON EXAMINATION OF PLANKTON SAMPLES FROM PICTON AREA, (N.S.) - SEPTEMBER 20th, 1969

Eight samples were taken by Mr. Fritz Axelsen of the Marine Sciences Centre, on board the "Ambrose Foot" at Stations A and B, near Picton Harbour and Stations C and D near Merigomish Harbour. Collections were made at the surface with a no. 20 mesh net (1/2 in.) and at depths of 7-9 m. with a no. 6 mesh net (1/2 in.). Collecting time was 5 minutes for each tow, starting at noon on September 20th, 1969.

Attached is a list of the species or genera of the zooplankton and phytoplankton observed in each sample. No counts were made but observations were recorded on what appeared to be dominant species and also on any form which might indicate environmental pollution.

A random sub-sample of each collection was scanned using a Zeiss binocular microscope (X80) for the no. 6 mesh net collections and the Utermähl recessed microscope (X650) for collections made with the fine no. 20 mesh net at stations A and B, samples made with a no. 6 net showed a high diversity of species of the genera usually found in a temperate water neritic zone in late September. Adult male and adult female neritic copepods were dominant with Labidocera, Centropages, Temora, Tortanus and Acartia occurring in fair numbers, and only one or two Calanus finmarchicus. Calanoid copepod, Parapontella brevicornis, found living in algae in shallow water areas (Sars 1903) between 50° and 59° North latitude was found at all four stations and exhibited a high incidence of parasitism.

At Stations C and D, samples made with the no. 6 net showed a dominance of very small bivalve larvae (< 1.m.m. in length), as well as the calanoid copepods. A larval fish (Gasterosteus sp) appeared at Station D. Diversity of zooplankton species was not as high at stations C and D as at A and B.

The sample made at Station A in the fine no. 20 mesh net viewed under the high-powered Utermähl microscope was filled with debris, The swimming legs of the copepods and other zooplanktons (medusae), clogged by bits of inorganic matter. Round black-brown globules resembling oil were in the sample. Diversity of species was still high consisting of a few nauplii and copepodite states of calanoid copepods and dominated by plytoplankton. Associated with the diatoms and dinoflagellates were fair numbers of two species of the Family Tintinnidae.

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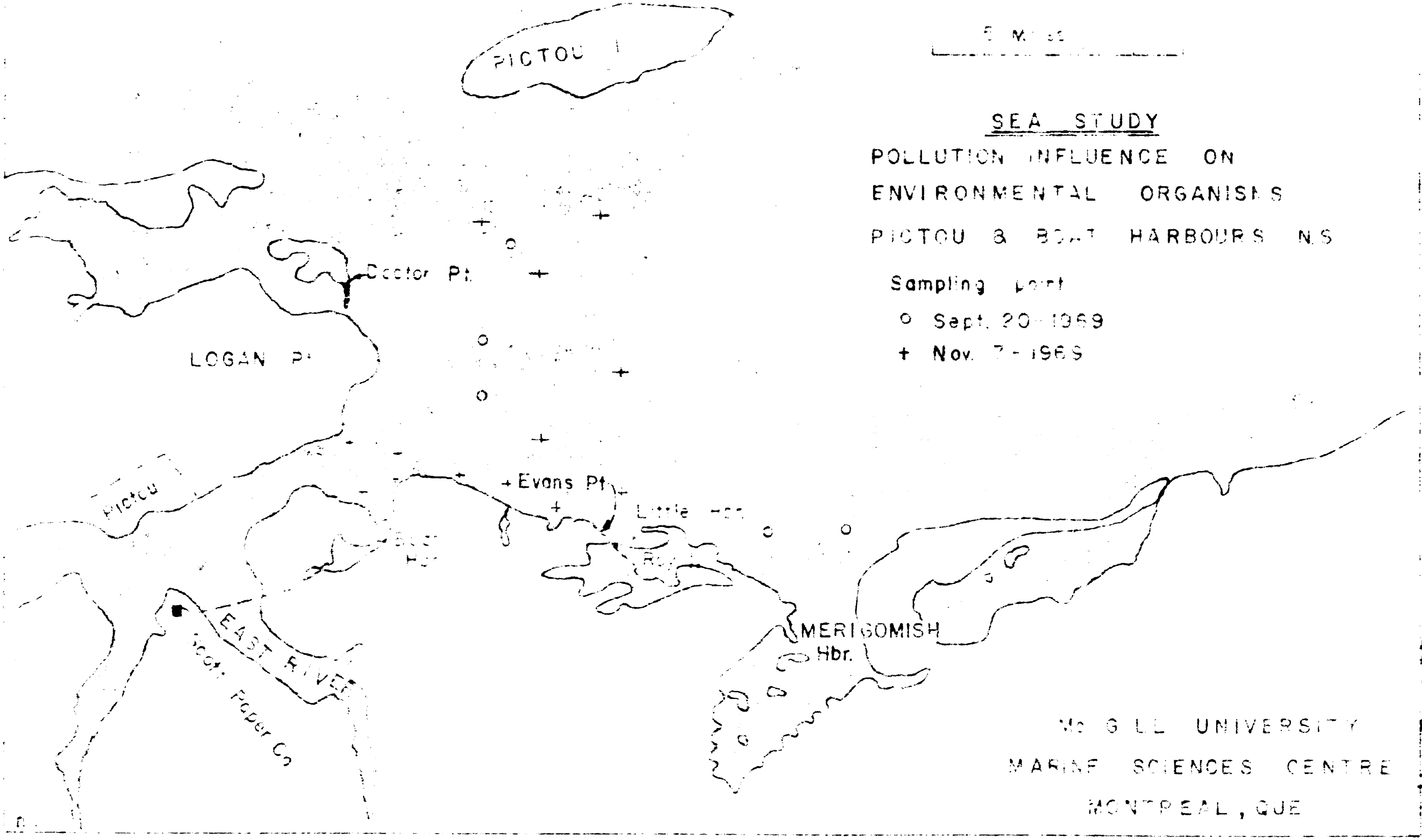
At Stations C and D, collections with the fine net showed many species of phytoplankton but the dominant forms were the Tintinnids; at least five species were observed along with many individuals of the dinoflagellate genera Ceratium and Peridinium and many genera of diatoms as listed for the Gulf of St. Lawrence by Brunel (1962).

DISCUSSION

Biomass in all eight samples was high for the short collecting time (5 minutes) and diversity of species at all stations was also high. Most of the copepods taken with the no. 6 net were in adult male or adult female form, many bearing spermataphores or ovisacs, proof that the life cycles have proceeded to maturity. The large numbers of diatoms and dinoflagellates found in the fine net collections can be expected in temperate waters in late September, indication of autumnal bloom of phytoplankton (Davidson 1934). However, the high incidence of parasitism found in the copepod Parapontella brevicornis at all stations and the considerable numbers of several species of tintinnids, especially dominant at Stations C and D, are perhaps warning signs of deleterious environmental factors. (Olsen and Burgess 1967 - p. 40).

Delphine G. Maclellan

Delphine Maclellan
November 1st, 1969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SEA STUDY
POLLUTION INFLUENCE ON
ENVIRONMENTAL ORGANISMS
PICTOU & BOAT HARBOURS N.S
Sampling point
o Sept. 20 1969
+ Nov. 7 - 1969
PICTOU I
Doctor Pt.
LOGAN Pt
Pictou
Evans Pt
Little Hbr
EAST RIVER
Scott Paper Co
MERIGOMISH
Hbr.
McGILL UNIVERSITY
MARINE SCIENCES CENTRE
MONTREAL, QUE

Sea Pollution Study

Boat Harbour N.S.

Section No.3

Kraft Paper Mill Waste Treatment in upper Canada.

In order to assess the existing capacity and efficiency of treatment at Boat Harbour to handle the wastes from the Scott Maritimes Kraft Mill at Abercrombie Point we have carefully selected a Kraft Mill in upper Canada having as similar a process as possible to that at Scott Maritimes, namely:

a) Kraft Chemical Pulping.

b) Digester.

c) Black Liquor Recovery Boiler.

d) Bleachery Plant.

e) Starting operating within last 2 years.

f) Have waste treatment facility.

g) Plant effluent discharge into a high capacity receiving stream.

We have been requested by the Mill management not to reveal the name or the location of the plant. Therefore all future reference to this Kraft Mill will be in terms of "Kraft Mill X" however we have permission to present the results of their waste treatment process.

We were afforded complete liberty to examine all facets of their operation and we sampled effluents to be used for Comparative purposes with the results now being achieved at Boat Harbour.

Some additional details for "Kraft Mill X" in regard to plant size and waste treatment facilities follow:

1) Sketch No.1 following, shows the location of sampling points.

2) Nominal plant capacity is rated at 500 tons/day but on the day of our visit (Oct 14/69) the actual capacity was 775 tons/day.

3) The waste flow from the plant was composed of the following:

    a) 11,200 G.P.M. High B.O.D. Mill wastes.

    b) 2,000 G.P.M. Alkaline Bleachery wastes.

    c) 7,800 G.P.M. Acid Bleachery wastes.

    21,000 G.P.M. Total waste flow (ie 30.0 Million Gallons/Day)

4) The 11,200 G.P.M. high B.O.D. Mill Wastes were directed to screens before entering a circular concrete settling basin where additional fines were removed. This settled water, then entered an aeration lagoon where the detention was calculated to be approximately 6 days and then emptied into a Mixing Lagoon (See Sketch No.1 at end of report)

5) The 2,000 G.P.M. Alkaline Bleachery Waste was sent directly into the Mixing Lagoon mentioned in 4) above.

6) The 7,800 G.P.M. Acid Bleachery Waste was passed through a small pond filled with crushed limestone thence directly into the Mixing Lagoon mentioned in 4) above.

7) All three combined streams then passed through a small holding pond thence through the effluent line and diffuser to the river.

8) The average daily flow of water in the river is continually measured and on October 14/69 it was 22,000 cubic feet par second (8,316,000 G.P.M.)

9) The average daily waste flow from "Kraft Mill X" to the river was 21,000 G.P.M. (see 3) above. Therefore the dilution ratio was:

$$\frac{21,000}{8,316,000} = \frac{1}{400}$$

A large diffuser was strategically placed across the river, yet 1 mile downstream from the diffuser complete homogeneity was not accomplished as later tests and calculations proved.

10 a) The following Table No.1 (Sect 4 - 5) is a summary of the laboratory analysis carried out on samples taken on October 14th 1969, at the sampling stations indicated in Sketch No.1 at "Kraft Mill X".

b) The following Table No.2 (Sect 4 - 6) is a calculated summation of the material balance entering and leaving the Waste Treatment facility at "Kraft Mill X" including the percent removal of the main constituents.

c) The following Table No.3 (Sect 4 - 7) is a calculated summation exactly as in (10 b) above for Boat Harbour for purposes of comparison.

In the interest of comparison let us review some of the vital statistics at this time, especially for the major constituents of:

a) Suspended Solids

b) Lignin etc

c) Biochemical Oxygen Demand (B.O.D.)

Please Refer to Table No.2 & No.3

A- Boat Harbour

a) Suspended Solids

Entering: ----- 376 lbs/ton pulp

Leaving : ----- 16 lbs/ton pulp.

% Removal-96

The foregoing indicates that the suspended solids removal is excellent at 96%. But consider that this material is actually in fact settling on the bottom of both Lagoon No.1 and Lagoon No.2. This means that the bottom surfaces of both Lagoons are being covered by layer upon layer of pulp fines and bark such that it destroys the natural benthic organism in the bottom mud and these layers will become septic due to natural microbiological degradation. It is a well recognized fact by all persons concerned in this field and by the Pulp and Paper Mill owners that it may take innumerable years to restore the natural habitat. What is even worse, is the deliberate sacrifice of Boat Harbour to a state of septicity especially of the bottom sediment. The odor of septicity will continue to emanate from Boat Harbour for the foreseeable future unless of course these settleable materials are prevented from entering Boat Harbour by recognized methods at the Mill itself where they will be recovered and disposed of in a proper manner.

B – Kraft Mill X

a) Suspended Solids

Entering: ------ 180 lbs/ton pulp.

Leaving : ------ 39 lbs/ton pulp.

% removal – 78

The foregoing is also considered reasonably good removal at 78%. The major portion of this removal is taking place in the settling basin preceeding aeration. The Mill removes this material and burns it along with their bark. This system is by far a better approach than that practiced at Boat Harbour.

It is interesting to note here that there is almost twice the amount of fibers and bark per ton of pulp from Scott as compared to "Kraft Mill X" This would seem to indicate that either Scott has less equipment available to remove this material in the Mill or that our samples are not representative for an average day.

A – Boat Harbour

b) Lignins etc

Entering: ------ 228 lbs/ton pulp

Leaving : ------ 124 lbs/ton pulp

% removal – 45

These are the materials, the complex lignins, tannins, rosin soaps etc, that cause the water to be dark brown in color. It is quite surprising and pleasing to note that 45% of these materials are removed in Boat Harbour, no doubt because of the long retention time.

However in spite of this extremely long detention time the color of the water leaving Boat Harbour is still very high at 1800 with a lignin content of 250 mg/l (see table report No.1) thus causing the obvious pollution of the sea (see photos No.8 to 20). These materials have an extremely complex molecular structure that is not amenable to bacteriological degredation. The removal of 75% or more is readily accomplished by chemical means preferably at the Pulp Mill, then allow the remaining 25% to be properly treated in an aerated lagoon.

B - "Kraft Mill X"

b) Lignins etc

Entering: ------ 74 lbs/ton pulp.

Leaving : ------ 63 lbs/ton pulp.

% removal - 14

The foregoing is considered very minor removal of lignin and this is due to the short retention time of only 6 days. Even though aeration takes place the reduction in lignins are only minor. If however 75% of the lignins were removed by chemical means at the Mill, and then an additional 14% were removed by aeration, the total removal would be in the area of 90% which would be considered excellent.

Again it is interesting to note that Scott produce 228 ÷ 74 = 3.1 times more lignin than "Kraft Mill X" per ton of pulp produced. At this point we can only surmise that Scott's recovery system is less efficient or that there are more spills of black liquor or a combination of both.

A - Boat Harbour

c) Biochemical Oxygen Demand (B.O.D.)

Entering: ------ 100 lbs/ton pulp

Leaving : ------ 36 lbs/ton pulp

% removal - 64

This is the material in the wastes that exerts an oxygen demand and contributes to the septic conditions in Boat Harbour. A 64% reduction is considered minimal, this should be in the range of 85 to 95% B.O.D. removal.

B - "Kraft Mill X"

c) Biochemical Oxygen Demand (B.O.D.)

Entering: ------ 78 lbs/ton pulp

Leaving : ------ 60 lbs/ton pulp

% removal - 23

These results, in spite of the presence of forced aeration, are very poor indeed.

Summary

a) Kraft Mill X is fortunately located on a favorable river course of great capacity and the wastes eminating from this Mill are not readily noticeable in the receiving stream. That is 57 cubic feet per second (CFS) is being continually diluted by 22,000 CFS and in addition the rapid flow creates reasonably good diffusion. (Please refer to Table No.1, Station No.6 is upstream and Station No.7 is downstream.)

Summary (cont'd)

However, a time will arrive when the regulatory agency will demand better quality treatment.

b) Boat Harbour It is unfortunate that the effluent is allowed to find it's way into the sea. You will realize now that the sea is nothing more than a large pond with fluctuating level, however, drastically subject to the effects of wind and tide.

In addition Boat Harbour should not and must not be used as a repository for fibers and bark, the penalty will be an area of stagnant water which will remain septic for innumerable years to come. The whole area and concept of waste treatment at Boat Harbour must be reconsidered so that Lagoon No.1 could function as a proper treatment facility which would have the effect of restoring the very large portion of Boat Harbour (Lagoon No.2) to a viable balanced biological system that would be aesthetic to the surroundings.

Sea Pollution Study

Boat Harbour N.S.

Section No.4

Laboratory Studies

From the previous discussion, it now must seem obvious that some method must be found to alter the existing method of treating the wastes from Scott Maritimes or to modify the existing design in Boat Harbour.

The first most important aspect of this problem has to do with the lignin (Brownish color organic material) contained in the wastes from Scott. Only 45% of this material is removed in the treatment method at Boat Harbour. Photos No.8 to No.20 indicate the deleterious consequences of allowing such an effluent to be permitted to be disposed of,in the sea.

The solution to this problem is certainly not an extension of the outfall line either one mile or several miles out to sea, besides being an expensive undertaking, it is also obvious that this material would rise to the surface, because of it's lower density as it exited, and would then float about the surface as a large mass subject to a return to the shore becuase of winds and tides. In addition, the presence of deleterious organisms from the septic conditions existing in Boat Harbour would still exist and continue as a serious detriment to the normal fish and fauna in the sea.

The second serious aspect, is the deposition of pulp fibers and bark on the bottom of Boat Harbour as previously discussed.

The third serious aspect, is the obvious overloading of Boat Harbour in spite of it's size which results in the whole area of Lagoon No.2 (90% of Boat Harbour) being septic, that is devoid of free oxygen. This phenomenon brings about several very serious consequences such as:

a) A malodorous atmosphere at Boat Harbour itself and over other inhabitated areas depending on wind conditions.

b) The state of septicity, in the presence of a rich source of nutrients will breed a wide variety of undesirable organisms that are pathogenic (disease causative) to man. Therefore , Boat Harbour as a septic body of water is a potential health hazard not only to the people who live in the area who may be bitten by insects (which in themselve may be carriers of pathogens) since these insects use the water of Boat Harbour as a breeding ground, but also pathogens are released in the effluent to the sea where they in turn infect other organisms and eventually they return to man when he uses the fish from the sea.

It would be quite useless to consider the forced aeration (by surface aerators or otherwise) of Boat Harbour in it's present design, for several reasons:

a) The high content of lignins, fatty acids, alcohols etc, which exist in both Lagoons would create such a large mass of foam with aeration, that the surface of both Lagoons would be covered to a depth of 5 to 10 feet of foam and a good wind would disperse this material over the countryside.

b) The bottom layers of deposited materials such as wood fibers, bark, moss, water plants etc would be forced to the surface by the action of the aeration equipment and this condition could seriously hamper, if not seriously damage the surface aerators. (This condition has been experienced at many Mills, to their detriment and expense, when they used ill prepared lagoons for treatment.)

c) Boat Harbour is not a well designed system to handle the load that is now being sent there, and would require extensive modification to make it operate properly as a waste treatment facility.

Therefore, in view of the many arguments presented in the foregoing, the first mandatory objective is to reduce the load from Scott Maritimes as follows:

1) Reduce the lignin content of their wastes.

2) Reduce the settleable solids in their wastes.

3) Reduce the Biochemical Oxygen Demand (B.O.D.) in their wastes.

4) Reduce the Chemical Oxygen Demand (C.O.D.) in their wastes.

5) Redesign Boat Harbour as a proper treatment facility. (This proposition will be discussed further under Section No.6).

Scott Maritimes Ltd officials are no doubt aware that they can and should, in order to reduce the load, pre-treat their effluent before it is sent to Boat Harbour as follows:

> "Use lime added to their General Mill effluent and Alkaline Bleachery Wastes in the order of 1500 parts per Million (ppm) but not to their Acid Bleachery wastes."

We have carried out laboratory scale tests on the actual wastes as they are sent to Boat Harbour and we present these results as Table No.4 Sect 4-4

Table No.4

Date of tests: October 22nd to 30th, 1969.

Date of sampling: October 18th, 1969.

From Scott Maritimes Pulp Ltd		Raw Wastes entering Boat Harbour	After Treatment with 1500 ppm of lime	% Removal
Lignin	mg/l	635	163	74
Color (A.P.H.A.)	units	2,700	400	85
B.O.D.	mg/l	179	57	68
C.O.D.	mg/l	1,001	432	57
Suspended Solids	mg/l	300	10	97

As the foregoing results show the major portion of the elements causing trouble at Boat Harbour would be removed at the Scott Maritimes Ltd Mill. The resulting sludge would be disposed of by Scott.

It is only logical that this pre-treatment be carried out at the Scott Mill since there would be four (4) built-in beneficial results to the Province and people of Nova Scotia:

a) Scott Maritimes have the equipment and facilities to produce lime on their property. It might be necessary for them to expand these facilities to handle the extra requirements for lime, over and above their present needs.

b) In order to overcome the problem of stockpiling the lime sludge from such a process, Scott Maritimes Ltd could readily mix this material with their bark and burn both together in their Bark Burning Furnaces.

(For continuation of text see Section 4-8)

Table No.1

Laboratory Analysis

"Kraft Mill X"

Sampling Stations	1	2	3	4	5	6	7
pH (20° c)	9.6	10.0	2.9	7.1	6.6	6.9	7.15
Color (A.P.H.A.)	550	4000	170	500	650	35	40
Turbidity mg/1 (SiO_2)	68	34	11.5	72	56	1.7	1.15
Settleable Solids(ml/l)	38.0	2.5	0.1	0.1	0.1	Nil	Nil
Total Solids (mg/l)	1040	2200	1360	790	1030	50	70
Lignin (mg/l)	131	790	106	130	163.8	11.1	13.1
Total Suspended Solids	820	32	52	120	100	4	4
Volatile Suspended Solids	630	32	44	100	100	4	4
Non Volatile Suspended Solids	190	0	8	20	0	0	0
B.O.D. (mg/l)	238	159	154	158	150	0.88	2.39
C.O.D. (mg/l)	1202	1231	576	562	533	10.8	21.6
Dissolved Oxygen (mg/l)	2.8	5.4	4.8	0.0	0.0	8.4	9.1

Table No.2

Calculated Summation

"Kraft Mill X"

Test Date Oct 14/69

Daily Average Flow = 21,000 G.P.M.

Production - 775 tons Pulp/day

	Entering treatment System		Leaving treatment System		Removal
	lbs/day	lbs/ton Pulp	lbs/day	Lbs/ton Pulp	%
Total Solids	380,000	492	310,000	402	18
Total Suspended Solids	140,000	180	30,000	39	78
Dissolved Lignin	57,000	74	49,000	63	14
B.O.D.	60,000	78	46,000	60	23
C.O.D.	294,000	380	164,000	212	44

TABLE No.3

Calculated Summation

Boat Harbour N.S.

Test Date June 25/69

Daily Average Flow = 18,000 G.P.M.

Production - 500 tons Pulp/day

	Entering Boat Harbour from Scott Paper Co.		Entering the sea from Boat Harbour		Removal
	lbs/day	lbs/ton Pulp	lbs/day	lbs/ton Pulp	%
Total Solids	560,000	1120	370,000	740	34
Total Suspended Solids	188,000	376	8,000	16	96
Dissolved Lignins	114,000	228	62,000	124	45
B.O.D.	50,000	100	18,000	36	64
C.O.D.	250,000	500	112,000	224	55

c) Since Scott Maritimes no doubt operate a well run Pulp and Paper Mill it would be in their interest to prevent excessive wastes and spillage in order to keep the lime requirements to a minimum, since this would also result in reduced operating costs, thus an incentive to them to keep their wastes to a minimum.

d) Most important of all, the B.O.D. load to Boat Harbour would be reduced by 68% together with reduction of lignin and color of 74 and 85% respectively and the important reduction of settleable solids (wood fibers and bark) by 97%. This would permit the restoration of Boat Harbour and in addition make it feasible to re-design Boat Harbour to take all of the domestic wastes from all of the municipalities in the immediate area as well as the industrial wastes.

In order to justify the foregoing recommendations for " Pre-Treatment" with lime by Scott Maritimes Ltd we present the following:

a) We enclose a copy of an article "How Interstate Paper Lowers Color and B.O.D. in Kraft Mill Wastes" from the Paper Trade Journal August 4th 1969. In this case the State of Georgia required Interstate Paper not to exceed:

B.O.D.	10 ppm
Suspended Solids	10 ppm
Color	30 (A.P.H.A.) units.

b) The costs to Scott Maritimes Ltd for the addition of 1500 ppm of lime to their highly colored streams is calculated as follows:

We estimate that the effluent flow from Scott not including their Acid Bleachery Wastes, is appro - imately 15 Million Gallons per day (M.G.D. Imperial) out of a total flow of about 24 M.G.D.

At a feed rate of 1500 ppm, this would require:

$$\frac{1500 \times 10}{10^6} \times \frac{15 \times 10^6}{2000} = 112.5 \text{ tons/day}$$

Direct costs for Lime

	Per ton of Lime
Indirect Labour	0.13
Direct Labour	0.70
Maintenance	0.32
Fuel	2.85
Power	0.31
Office, Laboratory, etc	0.03
Total	$4.34

Brought forward	$4.34/ton of lime
Rock, trucking and crushing	$3.00/ton of lime
Total	$7.34/ton of lime

Daily operating costs

112.5 tons x $7.34 = $825.75/day

Costs per ton of pulp produced
(Assume production capacity = 500 tons/day)

$$\frac{825.75}{500} = \$1.65\text{/ton pulp produced}$$

We have <u>not</u> taken into consideration the amortization of the lime kiln, rock crushers, sedimentation basins, feeders etc, since these costs rightfully belong to the capitalization of a Mill. Since a 500 ton per day Mill may cost $50,000,000 to build in one locality the costs could be ± 10% in some other locality. Nonetheless the direct costs to Scott Maritimes would be $1.65/ton of pulp produced, which is a small price to pay in as much as they receive their raw water at minimal costs and discharge their wastes to publicly owned property at an extremely nominal costs compared to their fellow competitors in other Provinces of Canada.

We believe and are firmly convinced that Scott Maritimes will be as anxious as are all of our fellow Canadians to exert every effort to reduce to a minimum the pollution of our environment.

We have searched the literature and have made many inquiries in regard to Pulp Mill Waste Treatment practice and we have found no other solution that could be applied to do such a good job as lime treatment. Because of the inherent nature of the sea, especially off Boat Harbour, Pulp Mill effluent <u>can not</u> and <u>should not</u> be indiscriminately allowed to be dumped without adequate and acceptable treatment.

We would ask the reader to please refer to the end of this report for indisputable photographic evidence of the effects and results of lime treatment of the Scott Maritimes Pulp Wastes. These tests were carried out on actual samples of waste water as it entered Boat Harbour.

<u>Photo No.22</u>

Shows 3 beakers each with 1000 cc's of wastes. Please refer to Table No.4, the following laboratory analysis were made on these samples:

Lignin	-	635 mg/l
Color	-	2700 (A.P.H.A.) units
B.O.D.	-	179 mg/l
C.O.D.	-	1001 mg/l
Suspended Solids	-	300 mg/l

Photo No.23

A continuation of Photo No.22 each lime had been added as follows:

No.1 Beaker (left)	-	1000 ppm
No.2 Beaker (center)	-	1750 ppm
No.3 Beaker (right)	-	2500 ppm

The lime had been mixed rapidly for 3 minutes, then slowly for 8 minutes. After 2 minutes of no-stirring the picture was taken to show the rapidity of settling.

Photo No.24

A continuation of Photo No.23 after a total of 10 minutes for settling, note the excellent settling characteristics, the clarity and removal of the color, note also the small volume of sludge at the bottom of the beakers.

Photo No.25

For the sake of comparison, we have added Beaker No.4 which is the untreated waste sample to show the difference. We used Beaker No.2 for laboratory analysis and found the following:

Lignin	-	163 mg/l	74% removal
Color	-	400 A.P.H.A.	85% removal
B.O.D.	-	57 mg/l	68% removal
C.O.D.	-	432 mg/l	57% removal
Suspended Solids	-	10 mg/l	97% removal

Photo No.26

We experimented with the foaming characteristics of the treated and untreated wastes to determine the extent of foam build up after a period of 3 to 4 minutes of rapid agitation with a glass stirring rod.

You will note that the treated sample has very little foam but the untreated sample actually overflowed over the sides of the beaker and we were required to stop.

This would indicate that to attempt to aerate the contents of Boat Harbour as it now exists would create a very serious foam problem and conclusion is that it is imperative to lime treat the Scott foaming elements.

Photo No.27

This photograph shows wood fibers mixed with some seaweed found along the beaches near Mackenzie Head.

Sea Pollution Study

Boat Harbour N.S.

Section No.5

Modifications at Scott Maritimes Ltd.

As previously stated in Section No.4, Scott Maritimes would obviously be required to increase their lime production facilities. Aside from that, Scott would be required to install adequate settling basins for the removal of the lime slurry. It might be added here, that the lime slurry decants rather rapidly and the sludge is not at all voluminous.

In order to protect the future modified Boat Harbour Treatment Facility it would be good practice for Scott to install a proper holding pond to take:

a) Liquor spills

b) Burnt cooks

c) Holding area, during shut-down of the evaporators.

d) Other emergencies

It is inconcievable that Scott Paper would waste Black Liquor direct to Boat Harbour but we wonder what precaution the Nova Scotia Water Authority have taken to prevent such an occurrence. We also suggest that a Recording Spectrophotometer be installed on a sample line after the lime settling basins, in order to monitor the effluent for lignin content. We have found by experience that most firms are rather careless when it involves the quality of their wastes unless there is an incentive to do so.

The incentive would be to live within the limits that must be set by the Nova Scotia Water Authority.

The effluent from the lime settling basins would be mixed with the Acid Bleachery Wastes and the combined stream sent to Boat Harbour for further biological treatment.

The wastes from the new Canso-Chemicals Ltd plant could be added as well as those from the proposed Michelin Tire Co. providing that each were acceptable and amenable to biological treatment.

There is no doubt that Scott Maritimes Ltd would be required to co-operate fully with the Nova Scotia Government and Nova Scotia Water Authority to modify their equipment and processes in order to accomplish the desired level of treatment and to install monitoring equipment on their waste lines, that would insure that the wastes which they will be sending to Boat Harbour will be acceptable to the re-designed process at Boat Harbour.

We feel that it would be appropriate for Scott to re-examine their water consumption with a view towards decreasing their treatment costs. This would of course be in their interest and would also act as an incentive for them to be as frugal as their processes will permit.

We have not given calculations on equipment costs, amortization etc, since we feel Scott Maritimes Ltd would be in better position to determine if they could up-grade their lime handling or if a new kiln would be required. We wish to state again that the cost for lime treatment of $1.65/ton of pulp produced which we presented previously represents the costs of lime only. The nature of the equipment costs and amortization can best be supplied by Scott.

Sea Pollution Study

Boat Harbour N.S.

Section No.6

Boat Harbour Process Modifications

Because it is vital to take immediate steps to reduce and eventually to completely eliminate the gross pollution of the sea which is now pouring out of Boat Harbour, the first and most effective step will be the installation of pre-treatment at Scott Maritimes Pulp Ltd. (As outlined in Section No.4 and No.5). The realization of this preventive measure will have a pronounced effect on existing conditions in Boat Harbour by:

a) Reducing the color, lignin and B.O.D. to a value that will help Boat Harbour to recover, thus reduce the septicity and make the effluent more acceptable, less noticiable and damaging for the time being until a complete re-design can be put into effect.

b) Permit the re-design of Boat Harbour in terms of a new and functional approach that would benefit the whole region including all of the adjacent municipalities and existing industries.

In order to realize the foregoing approach, it is important to review the present status of Boat Harbour, it's enormous overloading and a review of the modifications that would be required to make it an effective system to adequately handle all of the regional municipal wastes as well as the industrial wastes. The only reasonable engineering approach to a regional waste treatment problem of the magnitude encountend for the entire region is a Central Waste Treatment Facility that will be properly operated by knowledgeable people who will insure efficient and effective results instead of having a half dozen or more individually operated plants poorly or ineffectively operated.

Our arguments and justifications for our approach may be summarized as follows:

No. 1 The original concept of Boat Harbour as a non-aerated lagoon is so completely inadequate that it defies the imagination that it could have been conceived as a solution to treat the wastes from Scott Maritimes Pulp Ltd. The manner in which the effluent from Boat Harbour is allowed to enter the sea is strikingly inept. Boat Harbour is now a vast source of pollution covering large expanses of the sea and beaches, it is a public health hazard, it is septic and malodorous and for these reasons it's existence as a treatment facility should be seriously re-considered by the Government of Nova Scotia.

No. 2 From Table No. 3, it will be noted that approximately 50,000 lbs of B.O.D. per day enter Boat Harbour from Scott Maritimes Pulp Ltd.

This load is equivalent to a theoretical population of:

<u>295,000 persons</u>

If Scott Maritimes treated their wastes with lime as recommended this load would be reduced to:

<u>135,000 persons</u>

This is a reduction of nearly 50% or:

<u>160,000 persons</u>

No. 3 In this case, why not then use Boat Harbour as a treatment facility for <u>all</u> of the adjacent municipalities as well as the local industries. This concept would seem proper since Boat Harbour is publicly owned property and why not use it to it's full potential, if properly designed.

No.4 It is our concept that to accomplish the foregoing and at the same time to discharge and diffuse adequately the relatively large quantities of fresh water which inevitably must go out to sea, it will require considerable re-design at Boat Harbour. There is a special problem at Boat Harbour and that is, the proper and adequate dispersion of the fresh water effluent from Boat Harbour with the salt water of the sea. This is a phenomena that requires turbulence and mixing of both the fresh and salt waters under conditions favorable to nature and preferably at minimum costs.

No.5 It is our intention to outline the methods by which the foregoing concepts may be realized and the benefits that would accrue, as follows:

We are assuming that Pre-Treatment of the Scott Maritimes Waste discharge would be in operation then:

a) The raw domestic wastes from all adjacent municipalities would be collected and pumped to Boat Harbour.

b) These domestic wastes would be treated to remove gross solids by Primary Settling before mixing with the Industrial wastes from Scott, Canso Chemical and Michelin Tire Co.

c) The mixed wastes would then be treated in two Aeration Basins for biological reduction of the wastes.

d) Final settling of the waste sludge would take place in specially designed settling basins. Some of the settled sludge would be recycled to the raw wastes entering the aeration basins thus increasing the efficiency.

e) The effluent from the settling basins would pass through a zone of moderate Re-Aeration between Lagoon No.1 and Lagoon No.2 in order to maintain a desirable oxygen level and to promote the growth of zooplankton such as Flagellates, Ciliates and other forms.

f) The effluent from the Re-Aeration Basin would flow into Lagoon No.2 which would comprise about 90% of the area of Boat Harbour and in this area, selected varieties of fish would be introduced to feed on the rich source of zooplankton. Thus a balanced biological system would be established in the whole area of Lagoon No.2 equivalent to that found in natural fresh water lakes. By the time that the water would reach the exit of Lagoon No.2 the animals and fish would be expected to be healthy and normal in every respect.

g) The outlet from Boat Harbour would not go by the present route where completely inadequate dispersion is the general rule between the fresh and salt water. Instead we would recommend a route (see sketch No.3) that would take the effluent via a pipe line, and by gravity, under Pictou Bar Spit and discharge by diffuser into the narrow entrance to Pictou Harbour. There are several reasons for this choice:

1) The water quality eminating from Boat Harbour under this plan would be considered safe, colorless and of no danger to other aquatic life.

2) The main choice for the dispersion of the effluent at this point is to simulate the conditions that nature intended where the East, Middle, and West Rivers meet and mix with the sea and where the turbulence and mixing would be at a maximum.

h) The sludge from the Primary Settling Basins would be directed to Sludge Thickeners as would be the excess activated sludge. Both these materials would then be introduced to Anaerobic Digesters for final treatment. The digested sludge would be dewatered and given to farmers, stockpiled or buried.

i) The Town of Pictou, because of it's geographical location would be required to carry out primary clarification within it's municipal limits then pump the settled water via the Causeway to the Transfer Pump Station at Scott Maritimes for mixing with their Pre-Treatment effluent, and final transfer via the underwater line under the East River to Boat Harbour.

f) There would be no objection to the inclusion of the wastes from Canso Chemicals Ltd and Michelin Tire Co. providing these wastes contained no toxic materials that would damage or destroy the micro-organisms in the Aeration Basins and that their wastes were amenable to biological treatment.

Some will consider the foregoing treatment to be complex and no doubt will voice their objections. Our defense is simple:

a) The total volume of the waste flows from all regional sources under study as of 1969/70 is estimated at about:

Flow = 32 Million Gals/day (M.G.D.)

B.O.D. Eq. population = 180,000 persons.

If we project over the next 20 years, a 100% increase in production for Scott and about 100% increase in population, then by 1989/90 the estimate would be:

Flow = 55 Million Gals/day (M.G.D.)

B.O.D. Eq. population = 340,000 persons.

Note 1) (The B.O.D. Eq. Population means that the wastes from all sources including municipal and industrial would be equivalent to the figure given in terms of population.)

Note 2) (The above calculations have taken into consideration that Scott Maritimes Ltd, pre-treat their wastes with lime for a B.O.D. removal of 68% on all their wastes except the Acid Bleachery wastes.)

b) To handle the large volume and the equivalent population of the magnitude shown above requires a properly designed treatment system that would reduce the wastes to a minimum by strict control in a Central Treatment Plant operated by qualified personnel.

c) It would appear to us that it is by far more economic to have a single well operated plant than several smaller plants each requiring operating personnel.

d) Boat Harbour, as it is now designed, is completely inadequate and as time and population equivalent progress, if not re-designed, it will become a shrine to those who conceived it.

Re: Pollution Study

[illegible]

Section No. 7

Standards in other Provinces

The only province in Canada from which we were able to obtain regulatory directives for Pulp and Paper Mill wastes was from the Province of Ontario. We enclose a copy of these directives as an addendum to this report but for the sake of brevity we will site some of the comments and limits taken out of context:

No.1 "On water receiving effluents from Kraft Mills, the Ontario Water Resources Commission carries out thershold odor studies. Also, taste panels conduct tests on the flesh of fish which are indigenous to the area. The tainting of fish flesh by Kraft Mill Effluents is well established in Ontario and there are numerous instances where commercial fishing catches have been rejected as unmarketable".

No.2 "It is fair to say that most Mills in Ontario can not achieve 50 mg/l (for total suspended solids) in the effluent strictly through in-plant control. Even if this was achieved, we contend that there should be a buffer of some sort between the Mill and the River. This approach stems from the inevitable frequency of batch dumps, accidents and spills of materials."

No.3 "Over and above the minimum D.O. (Dissolved Oxygen) requirement, one of the objection of the O.W.R.C. for receiving waters has been that B.O.D. should not exceed 4 mg/l after initial dilution."

No.4 "Remarks so far have centred around rivers as receiving watercourses. The problem is different when a lake is involved. The application of an assimilation model and interpretation of the term "initial dilution" becomes more complex."

No.5 "Color can present problems, treatment for color removal may be necessary. However, the most important aspect of color is that of aesthetic pollution. The public will always relate colored discharges or colored receiving streams to gross pollution and this factor cannot be overlooked."

No.6 "Lignins and tannins constitute a potential source of monohydric phenols which could result in taste problems in downstream water supplies due to the formation of chlorophenols where chlorination is practised."

In the near future with the advent of pollution control legislation by the Federal Government, the allowable limits for pollution into rivers and the sea will become even more strigent than those of the Province of Ontario. It would seem to us that a review of the situation at Scott Maritimes by their officials would not only be appropriate but mandatory in the light of future legislation but in terms of saving our environment from further careless and wanton pollution.

Sea Pollution Study

Boat Harbour N.S.

Section No.8

Conclusions and Recommendations

It seems to us that the case has been clearly established that gross and continuing pollution of the sea off Boat Harbour is a fact and has been, since the start of operations by Scott Maritimes Pulp Ltd in the fall of 1967.

We believe that it is now appropriate for the Nova Scotia Government to take action in close collaboration with Scott Maritimes to stop this social injustice. Since agreements exist between the Nova Scotia Government and Scott Maritimes to treat Scott's wastes in Boat Harbour, we believe that Scott will realize the total inefficiency of Boat Harbour to treat their wastes with the present design and hopefully they will co-operate willingly to rectify the situation by pre-treatment of their wastes.

We do not believe that Scott Maritimes can justifiably pass off this problem to the Nova Scotia Government simply because of previous agreements, without an effort on their part despite the capital expenditure that this will entail. It might be appropriate to point out that whereas the 500 ton/day Mill at Abercrombie Point cost in the region of $50,000,000.00 a similar Mill built in upper Canada cost over $70,000,000.00 for the same capacity.

It might also be appropriate to point out that any anticipated increase in production by Scott Maritimes will worsen the local pollution problem to a considerable degree and thus result in sufficient public indignation that could result in a legal injunction being taken to stop all pollution, forcing the closure of their Mill.

We recommend that an engineering study be made to determine the feasibility of treating all of the regional wastes (domestic and industrial) in a re-designed Boat Harbour facility.

We are enclosing as an addendum to this report a report by the "Canadian Society of Zoologists" dated September 1969 on "A Statement on Environmental Pollution and Destruction in Canada".

We think that if the readers of our report will take the time to read the contents of the attached report sited above, a far greater concern will be forthcoming as it relates to the control of existing pollution and the prevention of further pollution of the environment.

In closing this report we wish to quote a prominent Ecologist as follows:

<u>Dr. Paul Ehrlich</u>

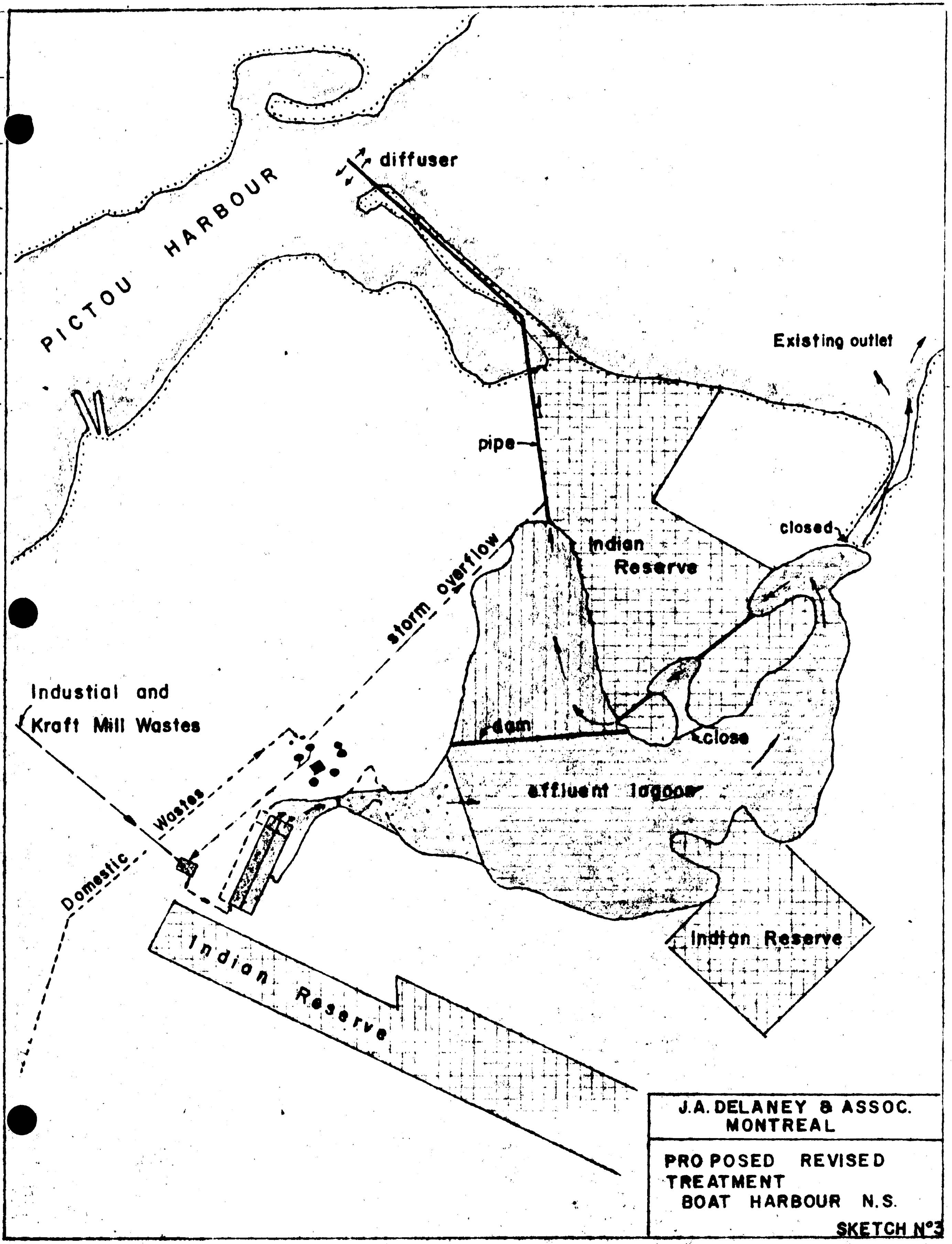
<u>Ecologist</u>

<u>California U.S.A</u>.

"It is unfortunate that the results of the destruction of the environment takes so long to become visible in a population.

We already have people dying of air pollution but they are usually written off because the people are old or already sick.

Nothing short of a major world disaster will convince people that the environment is in serious trouble.

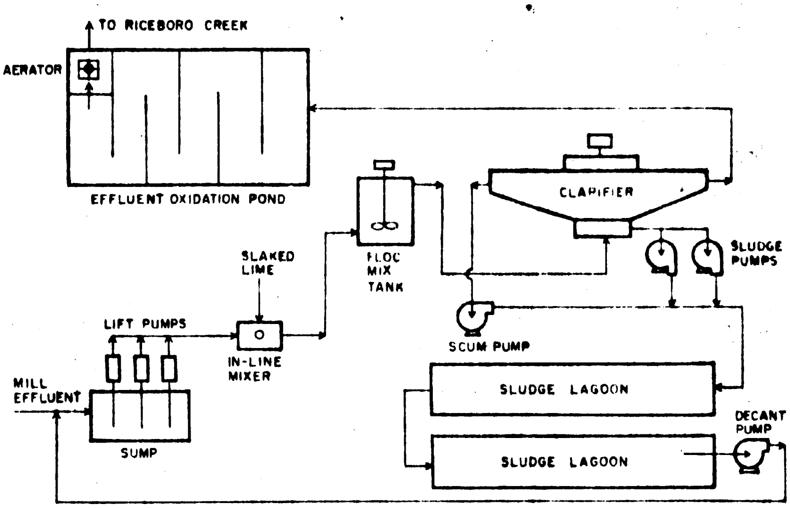

PICTOU HARBOUR
diffuser
pipe
Existing outlet
closed
Indian Reserve
storm overflow
Industial and Kraft Mill Wastes
Domestic Wastes
dam
close
effluent lagoon
Indian Reserve
Indian Reserve
J.A. DELANEY & ASSOC.
MONTREAL
PROPOSED REVISED TREATMENT BOAT HARBOUR N.S.
SKETCH N°3

INTERSTATE RICEBORO MILL is seen in view across the 700-acre secondary treatment pond. Wild birds shown in picture flew in on their own and have lived on the pond ever since. Fish also live in the pond, which is part of the mill's comprehensive waste treatment system.

How Interstate Paper lowers color and BOD in kraft mill wastes

Paper industry's first plant-scale effluent color removal process completes a year of successful operation at Riceboro, Ga., linerboard mill.

Joe H. Olin, Associate Editor



FLOW DIAGRAM indicates typical operation of the waste treatment system in simplified form.

When Interstate Paper Corp.'s 400-tons-per-day unbleached kraft linerboard mill started up at Riceboro, Ga., in the spring of 1968, a new, experimental waste treatment process was part of the plant. Now that the mill has been in full operation for more than a year, and the waste treatment process is successfully performing the functions for which it was designed, it seems appropriate to take a closer look at this unique process and how it works to produce a plant effluent from which most of the color as well as most of the BOD is removed.

Design challenge

Interstate Container Corp., a major corrugated box producer in the northeastern states, formed Interstate Paper to supply its linerboard requirements. The Riceboro mill was located on a 1,900 acre site bordering Riceboro Creek, 32 miles south of Savannah, Ga.

In approving the construction permit for the mill, after a proposal for color removal treatment of effluent was accepted, the Georgia Water Quality Control Board set the following limitations on waste discharged from the mill:

1. Waste discharge not to exceed 10 million gallons per day.

2. Effluent BOD not to exceed 800 pounds per day.

3. Suspended solids not to exceed 10 p.p.m.

4. Color not to exceed 30 color units.

This was the first time that the color of the effluent, as well as the biochemical oxygen demand (BOD), had been used by a state water quality control board to define the treatment required before discharge into a stream.

Design of the waste treatment plant was a cooperative venture of Interstate Paper and Rust Engineering Co., designers and builders of the mill. William J. Veross, Interstate Paper general manager, and James Vamvakias of Rust Engineering worked together to solve the problems. Rust Engineering rose to the challenge and designed a process to meet the requirements of both Interstate Paper and the state of Georgia.

Research and laboratory studies based on a series of "jar tests" of effluents obtained from five typical kraft pulp and paper mills were so convincing that Rust and Interstate eliminated the pilot plant stage in the interests of time. The process was successfully converted from laboratory scale directly into a full-size production unit.

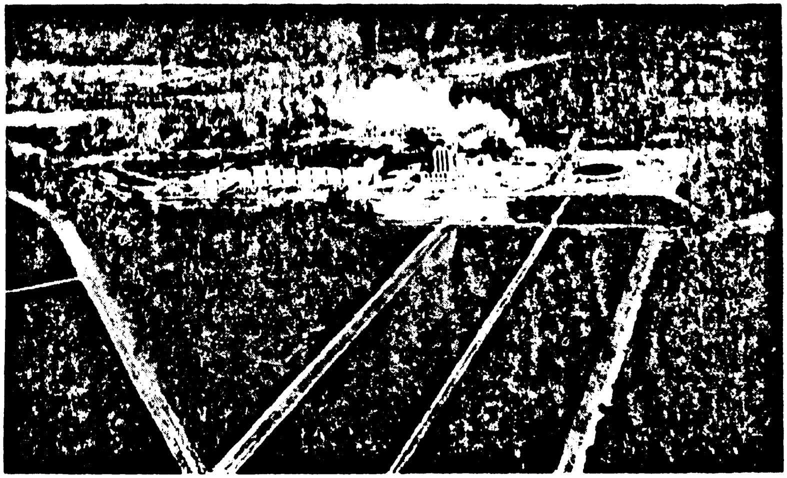
Because of the unique nature of the color removal process and the industrywide interest in its application, the Riceboro mill system was selected by FWPCA as a demonstration plant, and Interstate Paper received a research and development grant of $466,895 to help defray the development and demonstration costs of the new color removal process.

Process details

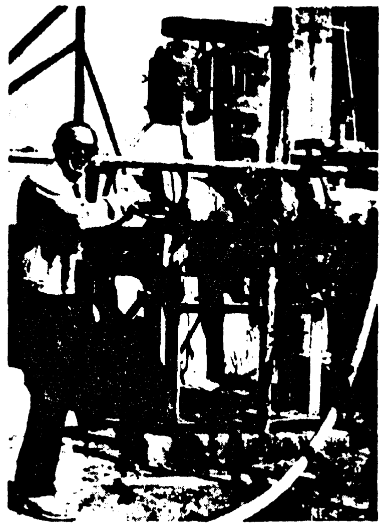
The mill's effluent system includes both primary and secondary treatment. The industry's first full-scale color removal system is included as part of the treatment facilities.

The waste treatment system begins at a common sump to which all process wastes from the kraft pulp and linerboard mill flow by gravity. The mill effluent is screened before entering the sump. Three Hazleton vertical lift pumps (12-inch BN-OI Type VS) raise the effluent to the level of the primary treatment and color removal facilities. These pumps are rated at 3,500 g.p.m. against a 60 foot head and are capable of pumping as much as 6,500 g.p.m. each. Two of the pumps can handle the peak load of effluent in the sump; the third pump serves as an emergency spare.

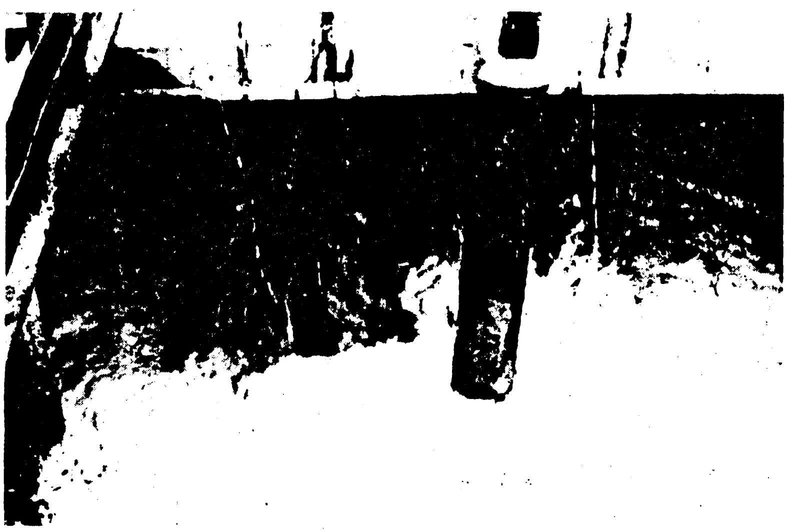
In the waste treatment process calcined lime, CaO, is slaked with evaporator condensate in a Dorr-Oliver slaker to form a calcium hydroxide, $Ca(OH)_2$, slurry of about 15 per cent concentration, which is stored in the lime slurry tank. Slaked lime is injected into the waste effluent through a 24-inch diameter Mixco in-line mixer. Lime slurry addition is proportional to the waste flow. Thoroughly mixed waste effluent and lime slurry go into the 45-foot diameter flocculation tank.



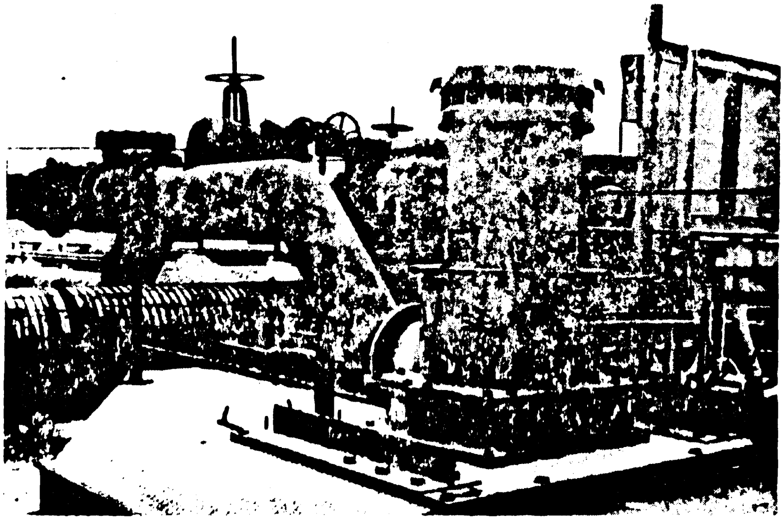
AERIAL VIEW shows paper machine building at left, power house in center and primary clarifier at right. Twin 20-acre sludge lagoons are in center foreground, and edge of 700-acre secondary treatment pond is at left in foreground.



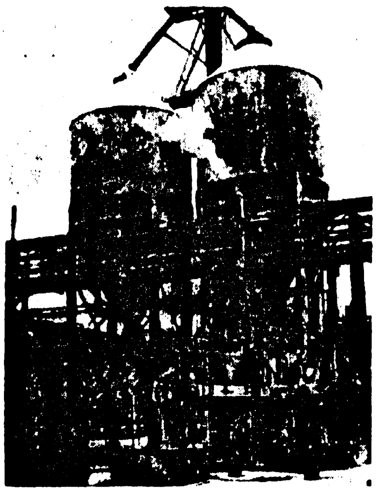
POLLUTION CONTROL DIRECTOR, Charles L. Davis, Jr., explains operation of part of the mill's waste treatment system.



WASTE SUMP receives all process wastes from kraft pulp and linerboard mill.



VERTICAL LIFT PUMPS keep process wastes flowing through the treatment system.



◄CAUSTICIZING AREA is the location for lime storage silos and the slaker (foreground).

MEASUREMENT AND CONTROL of waste flow to treatment system are handled by flowmeter (right) and automatic control valve (left) in process waste line going to floc mix tank.

The flocculation tank provides about 75 minutes retention time at a flow rate of five million gallons per day. A Chemineer 96-inch diameter, turbine-type mixer keeps the floc in suspension as the slaked lime combines with the color bodies in the waste effluent. The suspension flows by gravity into the clarifier.

In the 200-foot diameter, heavy duty Eimco clarifier, which has a center depth of 15 feet, the floc from the color removal process settles out along with the fiber and other solids discharged in the mill waste. Both the sludge, which is moved to the center of the clarifier by mechanical rakes, and the scum, which is skimmed from the surface, are removed by Moyno pumps. At present the sludge is pumped to one of two 20-acre lagoons for storage. These basins are about ten feet deep, providing a total of 400 acre-feet of storage capacity, equivalent to about five years of sludge accumulations at current operating rates. Future plans, however, call for the development of a lime recovery process in which the lime-organic sludge will be dewatered and reburned in a lime kiln.

The clarified and decolorized effluent from the primary treatment overflows the launder of the clarifier and flows by gravity through a 3000-foot, 36-inch diameter pipeline to a natural stabilization basin. Provisions have been made to divert the plant effluent into either of the two sludge lagoons if the clarifier should be out of service for any reason. This would prevent solids from getting into the stabilization basin.

This oxidation basin has an average depth of 4.5 feet and covers an area of about 700 acres. It provides a minimum of 90 days retention (not including rainfall or evaporation and seepage losses) and can provide as much as 180 days retention at a five million gallons per day effluent discharge rate. Five finger dikes are used as internal baffles to prevent short—circuiting of the flow pattern through the basin and to help break up wave action which could damage the earth dikes around the basin.

Final treatment step in the system is carried out in an aeration basin where the effluent is mechanically oxygenated prior to its discharge into Riceboro Creek. A 75 h.p. Mixco float-mounted aerator is used for this purpose. Discharge from the system is controlled according to the prevailing conditions in Riceboro Creek, the receiving stream. Flow controls on the discharge are by Bailey Meter Co.

Tank construction for the waste treatment process is by General American Transportation Co.; instrumentation is by Foxboro Co.; and auxiliary pumps were supplied by Goulds Pumps, Inc.

Operating results

Final design of the waste treatment process was based on a waste flow of ten million gallons per day and BOD load of 14,000 pounds per day. In operation the process incorporates waste flocculation with lime, removal of lime sludge and other settleable solids, natural stabilization and mechanical aeration followed by a controlled discharge.

According to Charles L. Davis,

Jr., pollution control director for Interstate Paper, in a report presented to the Sixth TAPPI Water and Air Conference, the actual waste flow to the treatment process averaged about 6.5 million gallons daily during the first year's operation. This represents about 71 per cent of the total mill discharge, and the waste flow for treatment is further reduced to about five million gallons per day by the completion of surface drainage facilities for certain waste flows which do not require treatment. The normal range of color in the waste effluent pumped is from 600 to 800 p.p.m. The treatment process is successful in removing 90 to 95 per cent of this color. The process also reduces the total BOD in the effluent by at least 90 to 95 per cent and removes virtually all of the settleable solids. The limitations on color and BOD imposed by the Georgia Water Quality Control Board can be met, in that paper mill contaminants can be removed from the waste effluent to the required level.

Average lime usage is only 37 tons per day (as 90 per cent CaO), or 1,650 p.p.m. as calcium hydroxide. Both a high degree of treatment and a relatively consistent color reduction are obtained at this relatively low level of lime feed. Mr. Davis points to the instrumentation which maintains consistent control of lime feed as the key to this operational success. By proportionally controlling the slaked lime injection based on the flow of the waste effluent to the flocculation tank, the process is able to successfully handle the wide variations experienced in amount and color of the effluent.

Minor modifications

After the start-up of the chemical color removal system, several minor changes in design were made to improve the operation of the process.

The in-line mixer and the agitator and discharge on the floc mix tank were modified.

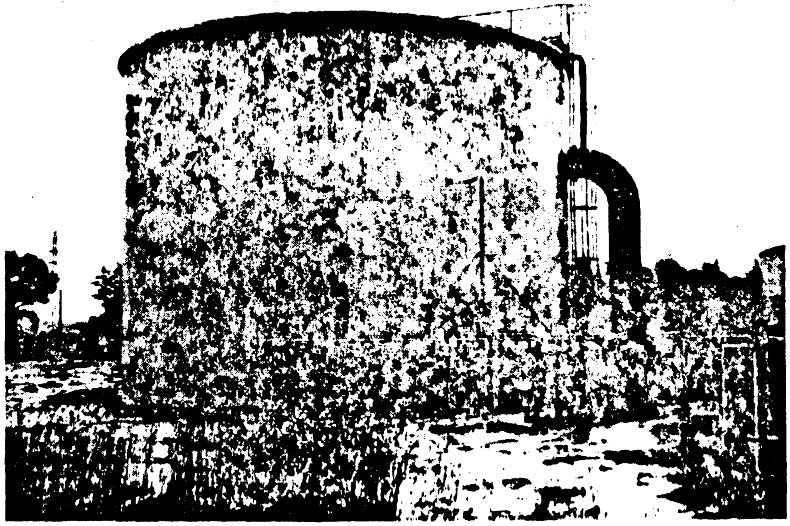
A back flush system was added to the primary clarifier, and a return flow of the supernatant water from the sludge ponds to the process waste sump was installed.

A fifth finger dike was added to the original oxidation basin design to improve the flow pattern. At the outlet end of the natural stabilization pond, the aerator basin was paved to prevent erosion and the pick-up of clay particles.

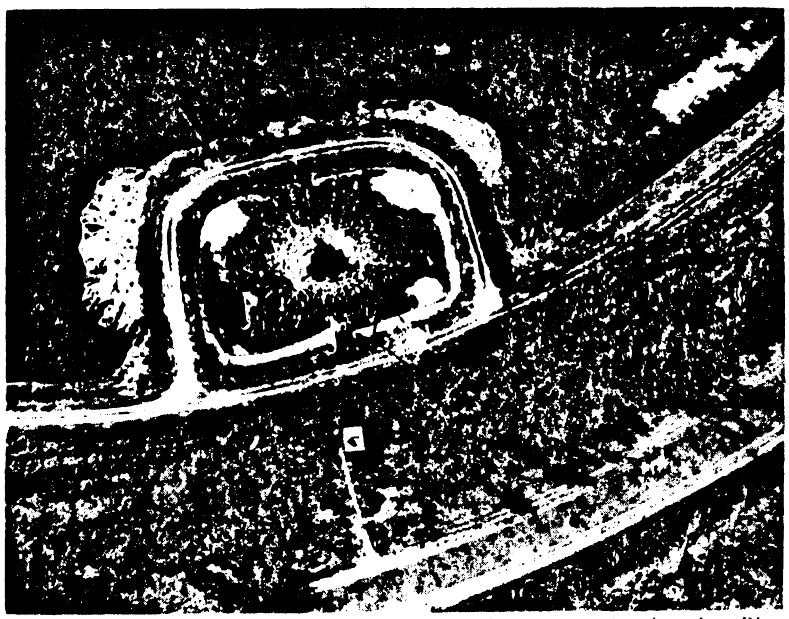
Minor alterations in process instrumentation were also made.

Treatment costs

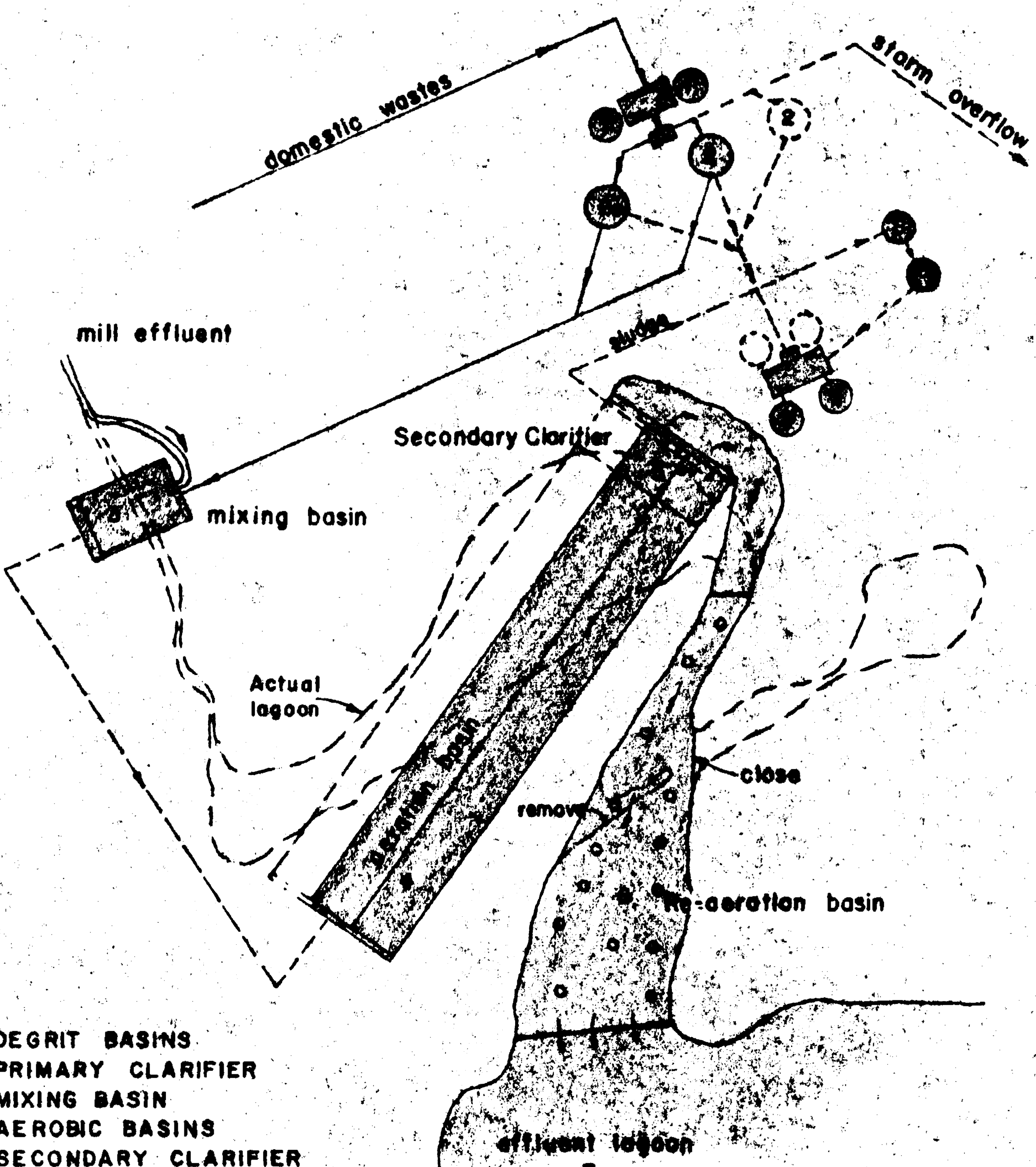
The total capital investment in waste treatment facilities at the Riceboro mill is about $2.5 million, representing ten per cent of the total mill cost. Construction cost of the color removal process plant is estimated at $454,100, including plans, specifications and construction supervision. Site cost and preparation were an estimated $27,500. Estimated costs of chemicals, power and labor for the first year add up to $269,000; and other costs including administration, contingencies and post-construction studies and reports are estimated at $133,100. The total first year cost comes to $883,700. Assuming a straight-line, ten-year depreciation for the equipment and annual production of 140,000 tons of linerboard, Mr. Davis has placed the total cost of the lime color removal system at $3.19 per ton of production for the first year of operation. System performance has been called "a remarkable job."



FLOC MIX TANK is the heart of the color removal process for mill wastes at Riceboro.



AERATOR is the last step in the treatment process before water is released to Riceboro Creek. It is at the end of the secondary treatment pond.



1 DEGRIT BASINS
2 PRIMARY CLARIFIER
3 MIXING BASIN
4 AEROBIC BASINS
5 SECONDARY CLARIFIER
6 RE-AERATION BASIN
7 EFFLUENT LAGOON
● SLUDGE THICKNER
9 ANAEROBIC DIGESTER

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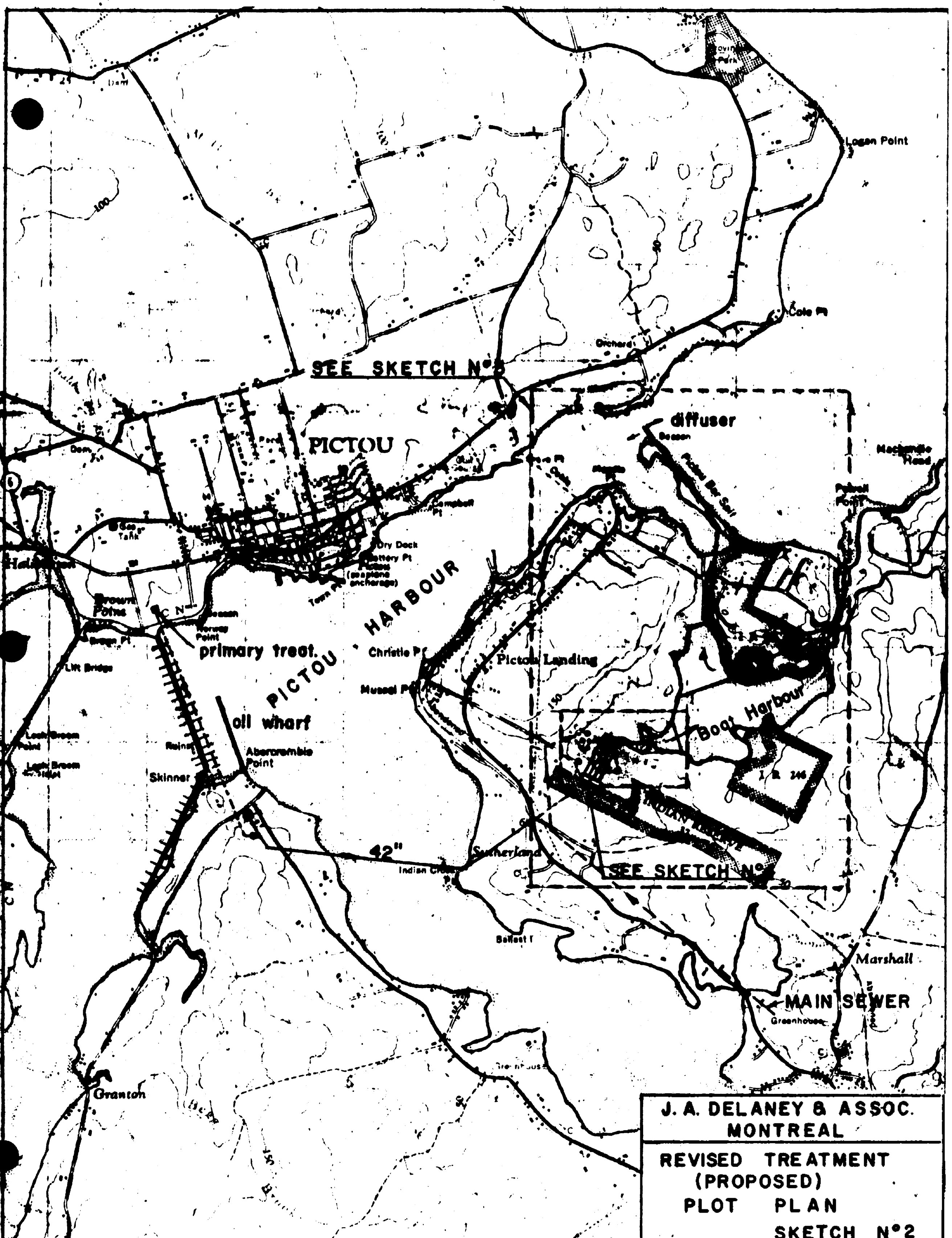
DETAIL ARRANGEMENT FOR REVISED TREATMENT BOAT HARBOUR N.S. SKETCH Nº 4



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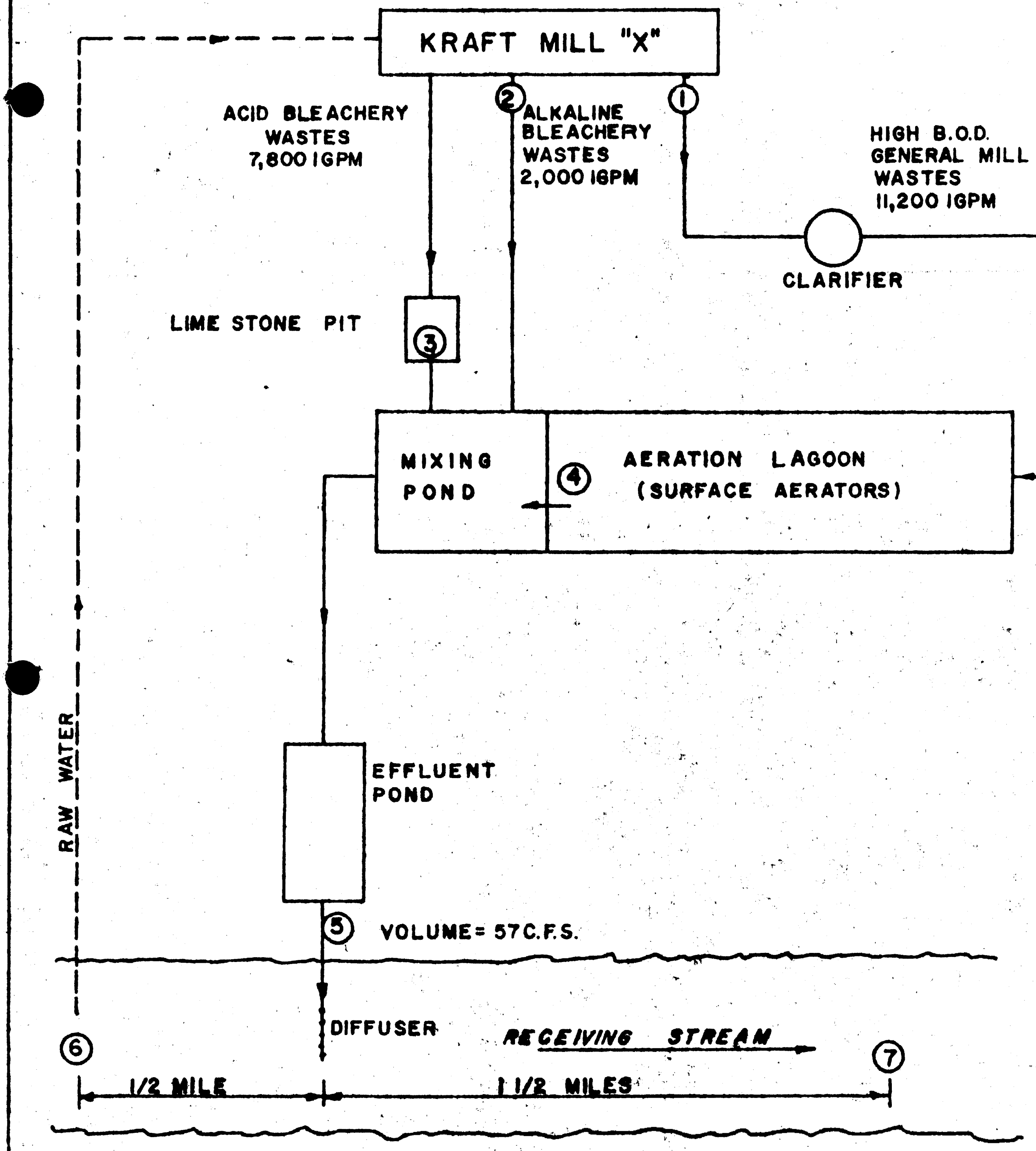
MONTREAL

REVISED TREATMENT
(PROPOSED)
PLOT PLAN
SKETCH N°2



MILL CAPACITY - 775 tons/day
WASTE FLOW - 21,000 I.G.P.M. (30 M.G.D. or 57 C.F.S.)

SAMPLING STATIONS

1 - HIGH B.O.D. (general mill wastes) 4 - AFTER Aeration Lagoon
2 - ALKALINE BLEACHERY WASTES 5 - EFFLUENT
3 - ACID BLEACHERY WASTES 6 - Raw Water - 7 - Stream

J.A. DELANEY & ASSOC.
MONTREAL

KRAFT PULP MILL "X"
WASTE FLOW DIAGRAM
SKETCH N° 1