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Pollution Studies of the Proposed Vancouver International Airport Expansion

Volume I

- Summary of Findings
- Study of Storm Drainage and Sanitary Sewerage Systems
- Effects of Expansion on the Iona Island Sewage Treatment Plant and Sturgeon Bank

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SUMMARY OF FINDINGS

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1. INTRODUCTION:

In late 1972 the Ministry of Transport announced a land expropriation action on Sea Island, in order to prepare for construction of a new runway at Vancouver International Airport. In March, 1973, a Department of Environment Steering Committee, including a representative from Environmental Protection Service (EPS), was brought together to initiate a study of the environmental effects of the airport expansion, with the study duration understood to be one year. Subsequently, this study was incorporated into studies by the Airport Planning Committee (APC) and deadlines have frequently been extended. A more complete understanding of the APC structure is available in the report of that committee.

As part of the overall environmental effects study conducted by Environment Canada, EPS studied the increased pollution that could be ascribed to the Ministry of Transport's construction and operation of an expanded airport facility in Vancouver. The following summaries outline the studies conducted on air and water pollution and discuss the solid waste aspect as understood from a separate program of studies.

2. AIRPORT EXPANSION CONCEPTS:

Studies concentrated on proposed alternative runway locations at Sea Island, rather than the alternative airport sites identified by another Airport Planning sub-committee.

The Federal Ministry of Transport has outlined five different concepts involving land reclamation for the proposed airport expansion, (Figures 1, 2 and 3). These concepts are discussed in more detail in the Environment Canada Summary Report (Environment Canada, 1975). Briefly, Concept One (figure 1) involves a parallel runway configuration as initially considered by the Ministry of Transport, and involves the reclamation of about 68 acres. Concept Two (figure 2) entails an alternative development plan requiring the reclamation of 234 acres. Concept Three (figure 2) represents a longer term and larger development, and requires the reclamation of 508 acres, while incorporating Concept Two as an initial stage. Concept Four (figure 3) is an extended version of Concept Two, involving the reclamation of 627 acres of land. Concept Five (figure 3) is also a longer term development incorporating Concept Four as an initial stage and involves, in total, about 1,494 acres.

3. STUDY OBJECTIVES:

The aim of the pollution studies was to determine, for the several alternative runway layouts, the changes in various aspects of pollution that would be produced. Sufficient detail was sought so that:

1. The amount of pollution generated could be compared to relevant standards.
2. Other environment Canada services could determine the magnitude of the effects of pollution on the resources they managed, and
3. Problems requiring additional investigation, but capable of resolution in a subsequent "Environmental Design" phase were highlighted.

The "Environmental Design" phase is discussed under the title "phase 3" in the Summary Report of the Ecological Sub-Committee (Environment Canada, 1975). Since an environmental assessment should take place very early in the history of a project, there will be many elements of the proposal (certain details of construction techniques, design of certain facilities) which, following standard engineering practise, will not be determined in detail until completion of the assessment and receipt of approval to proceed. Yet, knowledge of many of these details are essential to predicting the environmental effects. Although in many cases, it will be necessary to obtain detailed information on these elements during the assessment phase, it is possible to stipulate approval of a project for implementation subject to Environmental Design requiring minor environmental appraisal. If this type of approval is given, criteria must be established for the environmental design phase.

4. FINDINGS AND RECOMMENDATIONS:

4.1.1 Impact of Dredging on Water Quality

Findings:

1. During the period March through September, the Fraser River has its maximum effect on the estuarine area in terms of sediment load. Dredging operations during this period will have little discernable effect on turbidity because of the already high background suspended sediment values. Suspended sediment levels associated with land reclamation operations will be more pronounced October through February, however,

they will still remain relatively low. Settled sediments will contribute to the degradation of intertidal fish and bird habitat if the spillway discharge is discharged to Sturgeon Banks.

2. The presence of phosphates and release of ammonia in, and from, dredged material respectively will lead to nutrient enrichment during the time that spillway material is discharged. This may contribute to growth of unsightly algae.

3. Oxygen reduction, and increased suspended sediments could present serious, but localized, problems in areas immediately adjacent to the spillway discharge - estuarine water interface. (The latter will physically oscillate with the tidal phase.) If discharged to Sturegon Banks, dilution over the greater Sturgeon Bank area should serve to minimize any such effects attributable to the dredge/fill procedure beyond the immediate area. Any dissolved oxygen reduction would be most severe when dredging the initial four feet of borrow sites 1 or 6. A properly designed discharge to the Fraser River would be more satisfactory.

4. There is a possibility of disrupting existing contaminated sediments, if the spillway discharge is directed to the Iona Island Sewage Treatment Plant outfall channel. The spillway discharge should be directed away from the channel.

5. The sediments dredged from any borrow site (particularly Borrow Site 4) will contain bacteria. Similar dredging activities in the North Arm, Sea Island area, have not been known to cause bathing beach contamination, however, there is a slight possibility of contamination warranting attention, during dredging periods, to results of the health authorities regular sampling.

6. With respect to recommended North Arm borrow sites, liberation of H_2S at the dredging site is not expected to be a problem. Liberation of H_2S in the spillway area could occur when dredging the initial 1.5 feet of sediment <u>if anaerobic conditions were present</u> - this is not expected to occur.

7. Standards and Guidelines used by the U.S. Environmental Protection Agency and Ontario Ministry of Environment (OME) are designed for the dredging and open water disposal of sediments, and are not applicable to this landfill operation on a sensitive estuarine bank. However, the acceptable levels stated for the various parameters were the only levels located through our literature search which distinguish contaminated from uncontaminated sediments, and are useful in judging the likelihood of water pollution in the spillway discharge.

8. Fauna from Sturgeon Bank have higher levels of some heavy metals (notably mercury, but also possibly, cadmium, lead, zinc and copper) than animals elsewhere. In certain strata at Borrow sites 1 and 3, zinc and lead concentrations are encountered which are higher than levels set by EPA and OME for the dredging and open water disposal of spoil. Most of these contaminants will be contained in the landfill. Possible increases in lead and zinc loading to this sensitive area could be avoided by direction of the spillway discharge to the Fraser River.

9. The nature of the effluent from the Iona Island Sewage Treatment Plant discharged in an area adjacent to the proposed land reclamation site would actually, in most cases, dwarf any water contamination produced as a result of the dredge and fill procedure.

Recommendations:

1. Expansion onto Sturgeon Banks should be limited to the smallest area possible because of expected changes in water quality associated with a landfill operation. On the basis of this report alone, only Concept One would be acceptable, and Concepts Two to Five would be unacceptable; however, on the basis of other reports presented by the Ecological Sub-Committee, we recommend no expansion onto Sturgeon Banks.

2. If fill is required, it should be obtained from Borrow Sites 1, 3 or 8. Clayey silt below 18 feet at Borrow site 1 should be avoided.

3. The berm height and spillway location outlined by DPW (Isfeld and Wu, 1974) will lead to increased pollution. If Concept One is approved for construction, the construction techniques should be revised to

ensure no tides or waves will overtop the berm. The spillway discharge should be directed to the Fraser River. This environmental design must be subject to Environment Canada approval.

4. A continous monitoring program should be carred out during the dredge and fill procedures to ensure that no gross changes in dissolved oxygen or turbidity of nutrient concentrations or bacteria develop during the project. A monitoring program without adequate background data is similarly limited in scope, however, it would also prove useful in weighing future land reclamation projects.

4.1.2 Storm Drainage and Sanitary Sewerage Systems:

1. The existing storm drainage collection system should be adequate for present and anticipated future needs. Some of the pump stations and tide gates are in only fair condition and may, if confirmed by further engineering studies need replacement in the near future.

2. Ethylene and propylene glycols used as aircraft de-icers may result in significant short-term oxygen demands on the Fraser River, if allowed to enter the River.

3. The present quantitites of urea used for runway de-icing are unlikely to cause deterioration of the surface and ground waters.

4. Although there have been no reported large fuel spills resulting in serious environmental damage, there exists a potential for a serious spill sometime in the future.

5. A potential pollution source consists of the "dry chemicals" used in the fire training procedures because of their high toxicity to fish and the lack of containment practices in their use.

6. Small quantities of oils, greases, solvents, etc. enter the storm drainage system through accidental spills.

7. Aircraft washing results in a limited discharge to the storm drainage system of a pollutant which in large quantities would be toxic to estuarine life if introduced directly into the Fraser River.*

8. The pollution levels measured during the limited monitoring of the storm drainage discharges to the Fraser River showed no serious contaminant levels. Phenol levels were higher than the federal objectives but all bioassay tests resulted in 100% fish survival. This program is unlikely to reflect the results of such short-term periodic discharges such as aircraft de-icers, runway de-icers, fuel spills, and fire training runoff.

9. The existing airport sanitary sewage collection system effectively conveys all airport sanitary sewage to the Iona Island Sewage Treatment Plant.

   Other than increasing the quantity of sewage, any airport expansion should have little impact on the sanitary sewage collection system.

10. The wastes entering the sanitary sewers from the C.P. Air plating shop may not meet the GVRD regulations governing the admission of wastes into their sewers. This problem is currently being investigated as part of a separate study.

   An awareness of the existing airport operations that are adversely affecting quality of the effluent entering the storm drainage system, as identified above, should enable any new facilities to be designed to minimize future impacts.

<u>Recommendations</u> (based on present operations*)

1. The state of repair of the storm drainage pump stations and tide gates should be investigated and these facilities replaced or upgraded where found necessary.

2. Consideration should be given to providing specially designed loading gates for de-icing aircraft. These gates would permit the spent de-icing liquid to be recycled and re-used without discharging to the storm ditches. This proposal will require further investigation.

3. In order to prevent fuel spills from contaminating the storm drainage system, the ditches leading from all aircraft fuelling areas should be equipped with fuel interceptors.

4. No industrial discharges should be permitted to enter the storm drainage system.

5. All drainage facilities from areas where accidental spills of oils, greases, solvents, etc. may enter the storm drainage system should be equipped with proper traps to recover these materials.

6. More extensive monitoring of the storm drainage discharges to the Fraser River should be undertaken, particularly at times when the effects of intermittent operations such as aircraft de-icing and fire training are likely to be reflected in the results.

7. The Greater Vancouver Regional District Regulations governing the admission of wastes into sanitary sewers and all other applicable regulations should be enforced for all discharges to the sanitary sewers.

<u>Gaps In Knowledge</u>

1. Further studies should be undertaken to determine the magnitude of the pollution problem resulting from the fire training exercises.

2. There have been no identified sources of industrial discharges to the storm drainage system. An industry-by-industry investigation of all firms operating out of the old Airport Industrial Area will be required to verify this gap in collected data.

4.1.3 Effects on the Iona Island Sewage Treatment Plant and Sturgeon Bank:

1. Of the five airport expansion concepts under consideration, Concept 1 causes the least amount of disruption to the existing sewage dispersion mechanism; no expansion onto Sturgeon Bank is the preferred situation.

2. Expansion of theairport onto Sturgeon Bank will possibly restrict circulation and flushing in the vicinity of the Iona Island Sewage Treatment Plant outfall. Moving the outfall location further seaward as a possible means of alleviating this problem should be examined. Upgrading the treatment at the Iona Sewage Treatment Plant, while important, would not independently alleviate the effects of the proposed airport expansion.

3. Alleviating restricted circulation in the vicinity of the outfall may be possible through the installation of a tidal floodgate on McDonald Causeway which would allow fresh water flushing from the North Arm of the Fraser River to Sturgeon Banks in the vicinity of the outfall. While improved flushing may be achieved,some undesirable silt deposition might result in McDonald Slough and in the foreshore area around the existing sewage outfall.

4. Regardless of possible airport expansion or other developments in the immediate area, continuing degradation of Sturgeon Banks appears inevitable, if discharge of effluent continues in its present condition.

Recommendations

1. No expansion of the airport should take place because of anticipated disruption to the existing sewage dispersion mechanism.

2. If any expansion of Vancouver International Airport is to occur:

   a) The choice should be Concept One to minimize disruption to sewage dispersion, if no upgrading of the treatment plant or extension of the outfall occurs.

b) If extension of the outfall is considered in conjunction with any of the concepts, a joint study (MOT, GVSDD, DOE, PCB) be launched to develop the criteria for selecting an acceptable outfall.

3. Pre and post-airport expansion studies be carried out to document the effect and magnitude of the environmental degradation and zone of influence of the Iona Island Sewage Treatment Plant discharge and to generate the necessary data for corrective measures if incremental environmental damages do result.

4. A review of future upgrading necessary to handle (or reroute) storm water at the Iona Island Sewage Treatment Plant should be undertaken. This will ensure adequate effluent treatment of the sewage for a greater portion of the year.

5. The possibility of installing a flood gate on McDonald Causeway to allow flushing of Sturgeon Bank in the vicinity of the Iona Island Sewage Treatment Plant outfall should be studied further.

Gaps in Knowledge

Flow and analytical characteristics of the VIA sewage component to the Iona Island Sewage Treatment Plant are not adequately known. Bioassays should be carried out to determine the toxicity of this sewage stream. If this information indicates that a problem exists, then further work should be done to eliminate the source(s) of toxicity.

4.2 Solid and Toxic Waste Management Study:

Since solid waste had been identified for study in a separate EPS program, no additional studies were undertaken. The EPS Federal Activities Abatement Group manages the Federal Government's own clean-up program.[1]

1. See "Federal Activities Environmental Protection and Clean-Up Programs", EPS, Pacific Region, December, 1973, for a general description of this Group.

The progress and direction of this study was overseen by a special Steering Committee established for this purpose. This Committee was made up of representatives from MOT, EPS, National Health and Welfare and the Health of Animals Branch of the Department of Agriculture. The lead role on the Committee was assumed by the Federal Activities Abatement Group of EPS, as it was under the auspices of the Federal Activities Clean-Up Program that the study contract was let.

The National Health and Welfare major concerns relate to the general sanitation of waste handling and the possiblity of contagious disease entry into Canada via wastes from international passengers. The Health of Animals Branch of the Department of Agriculture administers the major legislation controlling international wastes entering Canada, namely the Animal Contagious Disease Regulations, which call for incineration of all international wastes. The Committee was formed prior to the implementation of the study and had input into the development if its terms of reference and the choice of consultant to carry out the study. In addition,the Committee met regularly throughout the course of the study to review the study progress and, lastly, to review a draft of the final report before publication.

Objectives

The aim of this study was to carry out an investigation of all solid wastes and hazardous and toxic wastes generated within the Vancouver International Airport complex. Airplane and runway de-icing fluids, storm water run-off and sanitary wastes were specifically excluded from the study.

The study considered many aspects of waste management, including elements of materials acquisition, storage and usage, and waste generation, collection and disposal and includes:

1. Identification of present sources, volumes and natures of waste;

2. Projection of quantities of VIA wastes to the year 1980 (and several years beyond);

3. Analysis of waste handling and disposal techniques to lead to the development of alternative disposal plans, which will meet or exceed all applicable provincial and federal guidelines and regulations;

4. **Selection of optimum waste management plan;**

5. **Provision of an implementation program including costs, scheduling and responsibilities.**

The Findings and Recommendations presented here are based on the consultant's report to the Steering Committee described above. The report has been accepted by that Steering Committee, and the recommendations are being considered for implementation.

Findings:

1. The entire Vancouver International Airport complex, at present, generates about 150 cu. yd/day (15 tons/day) of solid waste. By 1980, this rate is expected to more than double, ie. grow in proportion to passenger traffic increase.
2. The entire airport complex, at present, generates over 50,000 gal/year of combustible liquid wastes and this is expected to rise to 75,000 to 80,000 gal/year by 1980.
3. A metal plating shop operated by CP Air generates large quantities of dilute inorganic chemical solutions and presents problems in management of spent but concentrated solutions.
4. Incineration of international wastes is necessary to meet the requirement of the Animal Contagious Disease Regulations.
5. The existing waste disposal procedures at the Airport are inadequate in a number of areas:
   a) Solid waste in the Terminal Building area is managed poorly, resulting in overflowing bins and poor housekeeping;
   b) **International wastes are not fully segregated;**
   c) **Toxic and hazardous wastes, other than international wastes, are removed by contractor and placed in unacceptable landfill areas;**
   d) **There is no central control of waste management.**

Recommendations

1. The overall recommended waste management scheme incorporates the following:

   a) Solid wastes from the industrial area go to designated * landfill areas by contracted disposal services as at present;

   b) All other solid wastes be incinerated at a facility installed at the Airport and owned by the Federal Government (which complies with Federal Government Air Pollution regulations*);

   c) Combustible liquid wastes from the entire airport complex be disposed of through any one of, or a combination of:

      - Incineration in a facility installed at the Airport;

      - Incineration at the GVRD sewage sludge incinerator at the Richmond Sewage Treatment Plant;

      - Recovery by re-refining;

   d) The CP Air Plating Shop wastes be satisfactorily controlled by CP Air;

   e) Terminal Building solid wastes be collected by a unit train to minimize heavy truck traffic in the ramp areas and to provide optimum pick-up service. This function should be activated immediately as a contingency measure;

   f) The Ministry of Transport be assigned responsibility for implementation of the waste disposal scheme and own the on-site disposal facilities. In addition, it will be responsible for ensuring that all wastes are managed properly.

2. The feasibility of heat recovery from waste incineration was examined and there appears to be an economic advantage to burning all wastes and recovering the heat. A final decision on this cannot be made without further information for Airport Expansion.

4.3 Air Quality

Findings:

The major findings with respect to pollutant emission rates from the airport operations as Sea Island are summarized as follows:

1. The total pollutant emissions, on an annual basis, are estimated at 5450 metric tons and 22,600 metric tons for the years 1973 and 2000 respectively. A breakdown of total emissions by type of pollutant for the year 1973 is: carbon monoxide 67%, total hydrocarbons 18%, nitrogen dioxide 11%, sulfur dioxide 4%, and particulates about 1%.
2. Average pollutant emissions on a daily basis, for the year 1973, are estimated at 9.8 metric tons carbon monoxide, 2.8 metric tons total hydrocarbons, 1.6 metric tons nitrogen dioxide, 0.5 metric tons sulfur dioxide, and 0.16 metric tons particulates. Aircraft, again referring to year 1973, account for 47% of the total pollution burden. A breakdown of the aircraft contribution to the total pollution burden at the airport by type of pollutant is as follows: 39% of the total carbon monoxide, 65% of the total hydrocarbons, 72% of the nitrogen dioxide, 24% of the sulfur dioxide, and 60% of the particulates. Reference is made to Figure 4 illustrating total emission rates by type of pollutant from the various sources.
3. Vehicular access traffic, are estimated to account, during the base year 1973, for approximately 44% of the total emission and was, therefore, the second largest contributor to the total pollution burden.

For reference, the National Air Quality Objectives are tabulated in the following table:[1]

[1] The Maximum Acceptable Level is intended to provide adequate protection against effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well-being. It represents the realistic objectives today for all parts of Canada. When this level is exceeded, control action by a regulatory agency is indicated.

The Maximum Desirable Level defines the long-term goal for air quality and provides a basis for an anti-degradation policy for the unpolluted parts of the country and for the continuing development of control technology.

NATIONAL AIR QUALITY OBJECTIVES

	Max. Desirable (ug/m^3) level	Max. Acceptable (ug/m^3) level
Sulfur Dioxide		
1 Hour	450	900
24 Hour	150	300
1 Year	30	60
Suspended Particulates		
24 Hour		120
1 Year **	60	
Carbon Monoxide *		
1 Hour	15	35
8 Hour	6	15
Oxidants (Ozone)		
1 Hour	100	160
24 Hour	30	50
1 Year	20	30
Nitrogen Dioxide		
1 Hour		400
24 Hour		200
1 Year	60	100

* mg/m^3
** geometric mean

It is noted that no criteria have been developed for total hydrocarbons under the National Air Quality Objectives.

Ambient pollutant concentrations were determined theoretically by dispersion modelling. Four urban areas continguous to Sea Island were selected as representative receptors being most directly affected by airport-generated pollutants. The receptors are generally described as located southeast, northeast, north and south of Sea Island, and are specifically defined within the foregoing "sectors" as Site R1 - No. 3 Road and Cambie Street (Richmond), Site R-2 - Granville Street and West 70th Avenue (Vancouver), Site R-3 - Pt. Grey Golf Course area, and Site R-4 - No. 1 Road and River Road (Richmond). The major findings with respect to ambient pollutant concentrations are summarized as follows, noting that values are for years 1975 and 2000 respectively:

1. Nitrogen Dioxide

   Maximum one-hour concentration values, increase from 200 ug/m^3 to 1150 ug/m^3. Average annual concentrations increase from 3 ug/m^3 to 12 ug/m^3.

2. Sulfur Dioxide

   Maximum one-hour concentration values increase from 12 ug/m^3 to approximately 150 ug/m^3.

   Annual average concentration values increase from 1 ug/m^3 to 5 ug/m^3.

3. Carbon Monoxide

   Maximum one-hour concentration values increase from 2 mg/m^3 to 8 mg/m^3.

4. <u>Total Hydrocarbon</u>

   Maximum one-hour concentration values increase from 600 mg/m^3 to 3000 mg/m^3 approximately.

5. <u>Suspended Particulates</u>

   Average 24-hour concentration values increase from 0.3 ug/m^3 to approximately 2 ug/m^3 at year 2000.

   Average annual concentrations increase from 0.2 ug/m^3 to 2 ug/m^3.

SUMMARY AND RECOMMENDATIONS:

In reviewing the calculated ambient concentrations of pollutants, it is evident that air quality in general will deteriorate inherently due to increasing airport activity. Qualitatively short term air quality will be affected most significantly. The portion of ambient pollutant levels attributable to VIA on an annual average basis, is estimated to be within the most stringent levels set forth under federal and provincial air quality objectives, for both the current and future levels of airport activity. This applies to all of the pollutants studied, carbon monoxide, hydrocarbons, nitrogen dioxide, sulfur dioxide and suspended particulates.

On a short-term basis, it is estimated that nitrogen dioxide may exceed the one-hour concentration limit of the maximum acceptable level of the National Air Objectives. This condition is expected to occur very infrequently, estimated at several hours per year, during the joint occurence of peak airport activity and the most adverse climatological conditions. With respect to total hydrocarbons, it is inferred that short term ambient concentrations may also be exceeded at a similar frequency to nitrogen dioxide, when compared with the U.S.A. ambient air quality standards set at 160 ug/m^3 (3-Hour average).

It is unfortunate that the theoretical projections of ambient air quality, cannot be substantiated by existing monitoring data. The network of monitoring stations operated by the Greater Vancouver Regional District in the Lower Mainland includes one station measuring suspended particulates and is located at the main terminal building of the airport. The data record for the years 1972, 1973 and 1974, show three occurrences where the 24-hour maximum acceptable level of the National Air Quality Objectives were exceeded, although annual geometric means are quite low at 55, 53 and 53 ug/m^3 particulates, respectively. A detailed analysis of the data is not possible, and therefore precludes any assessment as to the portion of the total particulate load that is contributed by airport-generated pollutants; however, extensive industrial activity along the North Arm of the Fraser River can be expected to contribute the major portion of the suspended particulate matter noted previously.

In summary, it is concluded that short-term pollutant levels for the scale of airport operations to year 1985 will not result in ambient pollutant concentrations over current federal and provincial air quality objectives. For the scale of airport operations beyond 1985, it is expected that ambient air quality may occasionally exceed air quality objectives. Thus, it appears unlikely that an airport expansion to 25 x 10^6 passengers/year at year 2000 will have a significant environmental impact with respect to air pollution.

In view of the findings of this study, having been based on theoretical considerations, the following recommendations are made:

1. That a site-specific ambient air surveillance study of sufficient time duration be undertaken in order to assess more quantitavely and realistically, the present status of ambient air quality in the vicinity of the airport. Most importantly, such a study would provide information on the disposition of pollutants during prolonged stagnation periods that accompany the land-breeze/sea-breeze air flow characteristic of this coastal location, and at the same time provide needed baseline data against which any future trends in air quality may be compared.
2. That a station with multi-parameter air quality measurement capability be established in proximity to the airport. This station should be capable for integration with the proposed expansion of the Greater Vancouver Regional District network of ambient air quality monitoring stations.

5. DISCUSSION:

Considered together, the studies conducted on water, solid waste, and air pollution come to the conclusion that, of the five expansion concepts originally proposed, Concept One, which involves the smallest extension onto Sturgeon Banks, would cause the least pollution. With increased intrusion onto Sturgeon Banks, pollution from interference with Iona Island Sewage Plant discharge (although technologically correctable) and from dredging progressively increase. As indicated in the Environment Canada Summary Report on the Vancouver Airport expansion proposal, any expansion onto Sturgeon Banks could cause serious environmental consequences and no expansion is recommended.

Within the concerns addressed by the Ecological Sub-Committee, it is our opinion that the loss of fish and wildlife habitat is the most serious concern directly resulting from the proposed runway construction. Pollution will be increased, but can be kept at a minimum. This, however, does not imply that we think the pollution added is of no concern. There is a problem.

The problem is well brought out in the case of air pollution.

The air quality study conducted was a theoretical one utilizing relatively standard techniques for predicting air quality, but having an advantage over similar studies in that long-term meteorological data was available in the immediate locality. The results are intended to determine air pollution from airport activity alone. Although confirmation of this by actual sampling is important, this should be done by extension of the existing National Air Pollution Surveillance system in the area.

Airport activity up to the year 2000 in itself will result in ambient pollutant levels well within the most stringent levels set forth under federal and provincial air quality objectives, on an annual average and a 24-hour average basis.

On a short term basis, it is estimated that of all the pollutants, only nitrogen dioxide may exceed the one-hour concentration limit of the maximum acceptable level of the National Air Quality Objectives. This condition is expected to occur very infrequently and only during the joint occurence of peak airport activity and most adverse climatological conditions. By the year 2000 the local air quality degradation due solely to airport activity will be similar to that presently occurring in central Vancouver due to urban activity, however this is based on activity projections to the year 2000, which are highly uncertain.

While even the short term maximum pollutant concentrations from airport activity will not be serious from an ecological point of view, they may contribute to an overall pollution problem connected with our local topography, described more fully in Volume 3 (Air Quality) of this report series. This problem arises when a persistent, elevated inversion lid forms over the Lower Mainland, and air within the basin is not replenished but is carried backward and forward by land/sea breezes. The airport activity contribution to this is not known, although airport-related emissions are a very small fraction of the total emissions in the Lower Mainland.

It should be evident that the solution to this larger problem is control of individual sources, combined with air resource management planning on a larger scale, and that more research into a realistic air quality model for the Lower Mainland is required. We are fortunate that the control of air pollution problems is on a regional basis, and control of airport generated air pollution (for example by decreasing automobile activity) should be undertaken with recognition of this fact.

The situation with respect to water pollution is somewhat analogous. The study of dredging has concluded that, to the best of our knowledge, limited dredging could take place with proper controls which would not result in a serious pollution problem. A survey of airport generated water pollution discharged through the storm drainage system has identified several intermittent problem areas, which will be further studied and corrected as part of the Federal Government's Clean-Up program described earlier; expansion of facilities without correction would increase pollution, and correction is a pre-requisite to expansion. Limited sampling of outfalls during wet and dry periods, and testing by chemical analysis and laboratory bioassay did not indicate any acute toxicity problem for fish, although the intermittent sources mentioned above could have this effect. The increased amount of sanitary waste from an expanded airport will not have any appreciable effect, by itself, on the effluent discharged from the Iona Island Sewage Treatment Plant (although the Solid and Toxic Waste study identified a source of heavy metal contamination which will be corrected). However, the proposed embayment of the discharge area is of concern because of its effect on dilution.

The total water pollution loading from the existing airport or the proposed airport expansion cannot be accurately determined from our data. We have good reason to believe it is small compared with other sources to the Fraser River; if the recommended corrective action is carried out it could be improved further. Yet, even had this desired data been obtained, we would be little further ahead in our assessment of the impact of water pollution, in view of the lack of data on existing water pollution effects on the aquatic environment of the Lower Fraser.

The best and most recent paper dealing with biology and (in part) water quality in the lower Fraser, is that of Northcote (1974). Parts of his paper are reproduced here:

> "Although published information on water quality in the mainstem lower Fraser is insufficient to draw definite conclusions on its condition (Benedict et al., 1973), and as we have seen, that on its biological communities is even more fragmentary, nevertheless enough is available to permit a few general, if tentative, observations.
>
> Apart from indications of high coliform bacteria numbers in the North Arm portion of the river, there is no conclusive evidence from previous studies on the bacterial, algal, higher aquatic plant, or invertebrate communities that the lower river is at present severely polluted. This should not in any way be interpreted as indicating that all is well. Much more information is needed, even for the two groups (bacteria and invertebrates) for which there are at least some semi-quantitative data, before any meaningful statement can be made regarding water quality effects on these components of the ecosystem.
>
> Water quality conditions summarized by Benedict et al., (1973) do not indicate any obvious threats to the fish community in the mainstem river nor is there clear evidence in the biological information, however scanty, reviewed herein of a major problem existing there at present. Occurrence of rather high mercury levels in adult sturgeon, a species probably spending much of its long life, if not in then closely associated with the lower mainstem, does demand careful attention. Very low mercury concentrations (usually <0.1 ppm) have been reported in adult eulachon and salmon from the lower Fraser, although relatively few individuals have been tested."
>
> (Northcote, 1974, p. 66)

> " What seems evident is that a considerable amount of basic descriptive, but quantitative biological data are required for most major groups in the river before a meaningful approach can be made towards assembling a picture of community structure and ecological functioning of the system. This is not to say that we must have complete dossiers on all dominant species before evaluating impacts of water quality conditions on the biological community of the lower river. But to make such evaluations while knowing so little of major components of the community would appear unwise."
>
> (Northcote, 1974, p. 68)

The information that we need to make accurate judgements about water quality effects is lacking. A decision to add pollution to this system must be based on significant other benefits to outweigh the uncertainty inherent in predicting ecological effects.

Much less is known of the effect of water pollution on aquatic communities than the effects of air pollution on humans. This is understandable, considering the importance we place on human health and the incredible complexity of most aquatic ecosystems. Yet, in the long run, a healthy aquatic ecosystem is essential to our well-being.

Knowing that ecological information is lacking, and also knowing that inevitably some pollution will be discharged, EPS attempts to minimize water pollution by devising regulations which demand the application of best practicable technology to pollution sources. Our immediate aims are to minimize discharges of substances which can become harmful by accumulation in aquatic organisms, and to ensure that the effluent is "non-toxic" to fish (this based on well-founded assumption that dilution by good quality receiving water will minimize sub-lethal effects); both of which aims safeguard human use of the water or the aquatic organisms. At the same time, we recognize that even though individual sources are controlled, the overall problem will increase as population and resource utilization increase. A recent study (Hall et al, 1974), on the Lower Fraser, indicates potential problems with heavy metals and by pathogenic organisms in particular.

Although the loss of habitat for fish and birds may be the more serious problem at present, the necessity for the remaining habitat to be of high quality makes the potential pollution problems even more significant, and increases the need for caution in decision-making.

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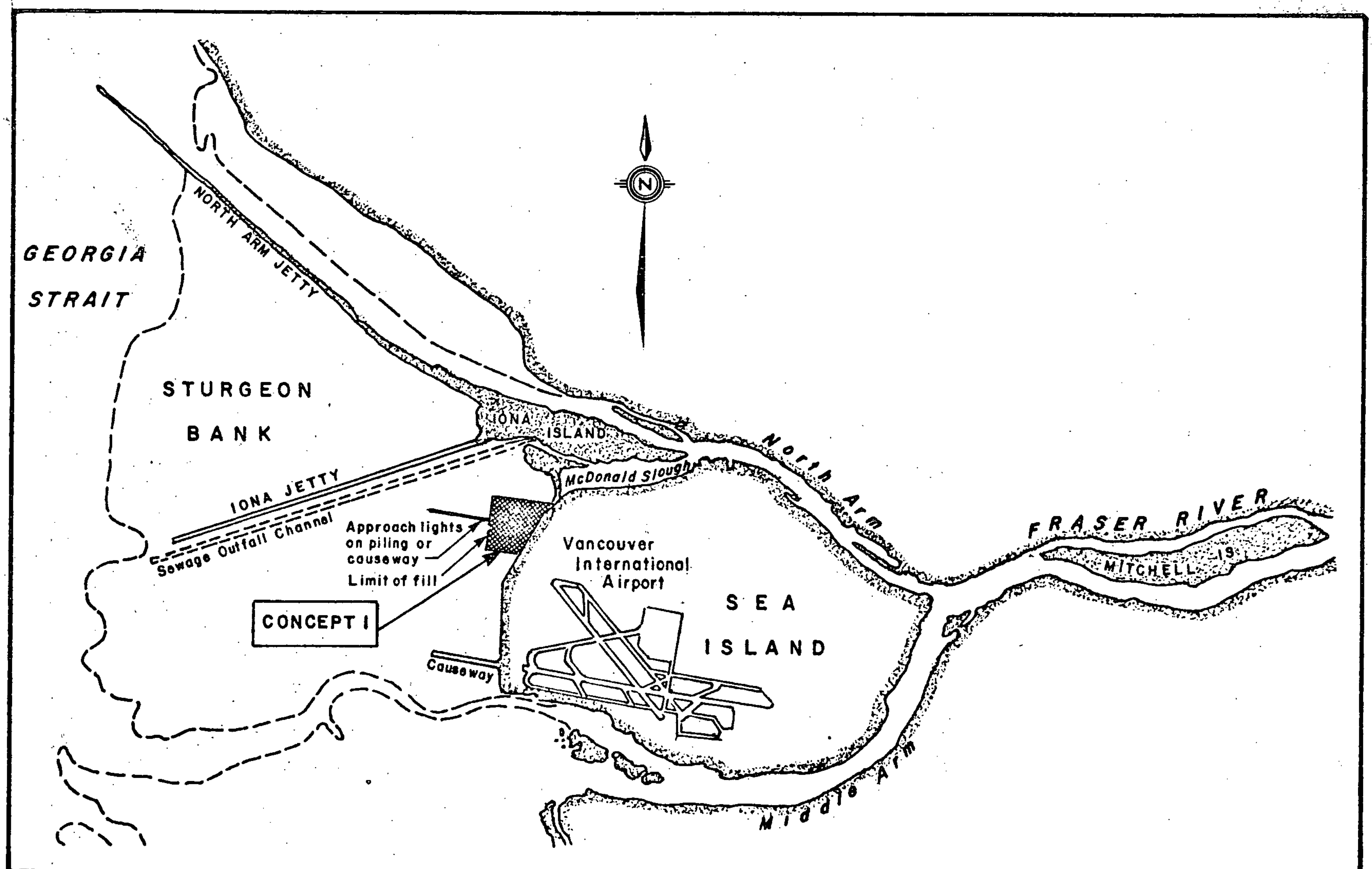


FIGURE I VANCOUVER INTERNATIONAL AIRPORT EXPANSION - CONCEPT I

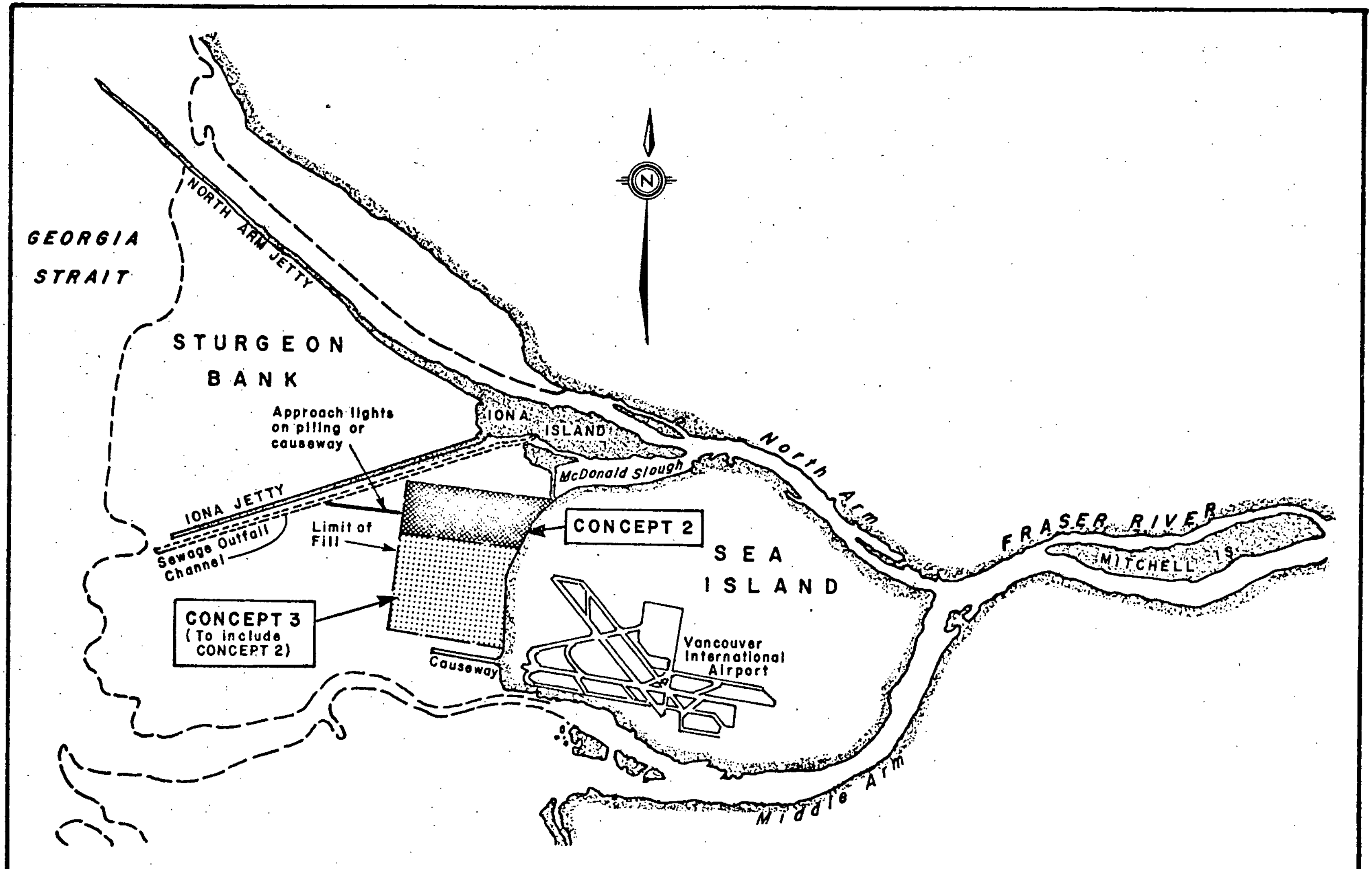


FIGURE 2 VANCOUVER INTERNATIONAL AIRPORT EXPANSION - CONCEPTS 2 & 3

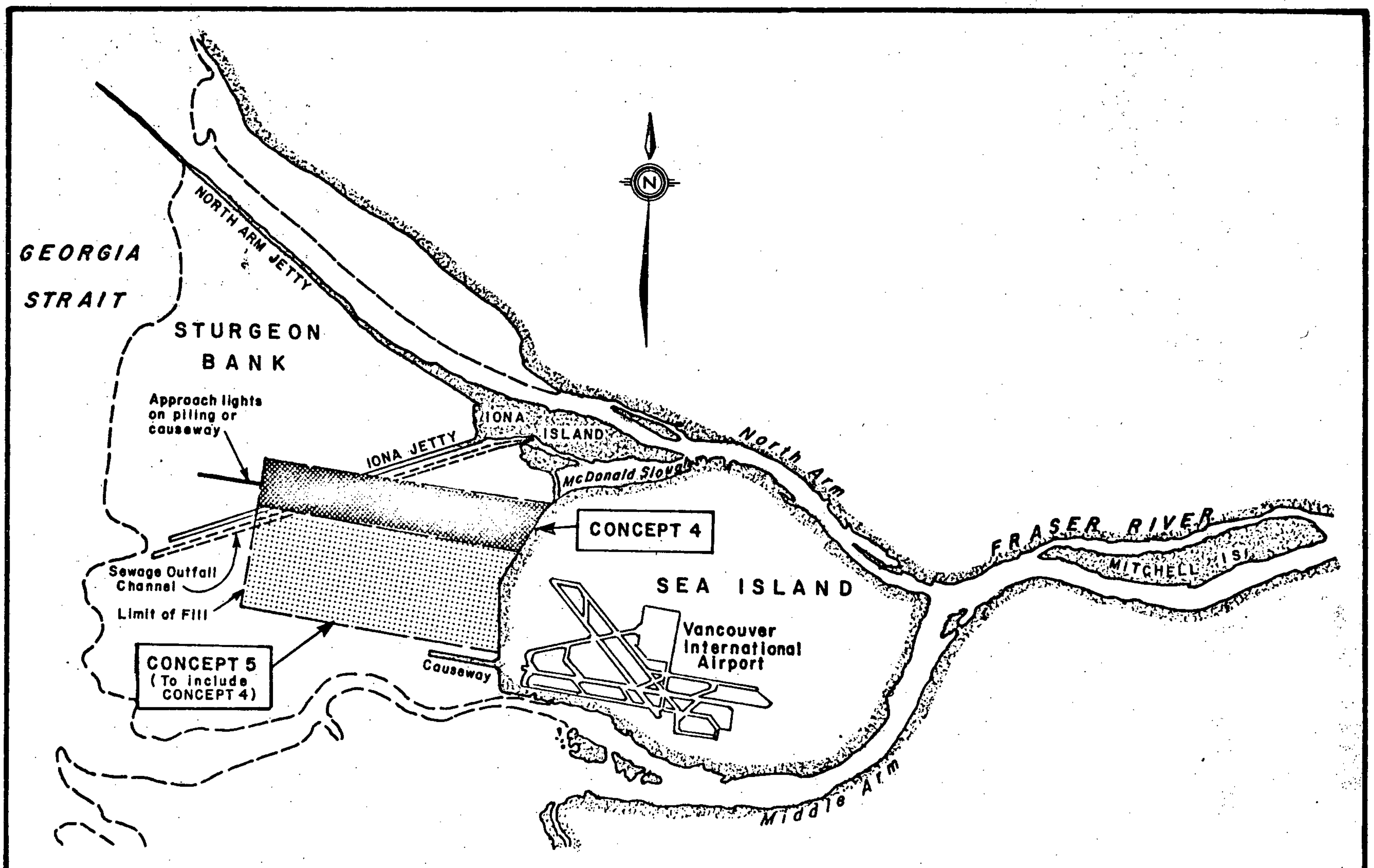


FIGURE 3 VANCOUVER INTERNATIONAL AIRPORT EXPANSION - CONCEPTS 4 & 5

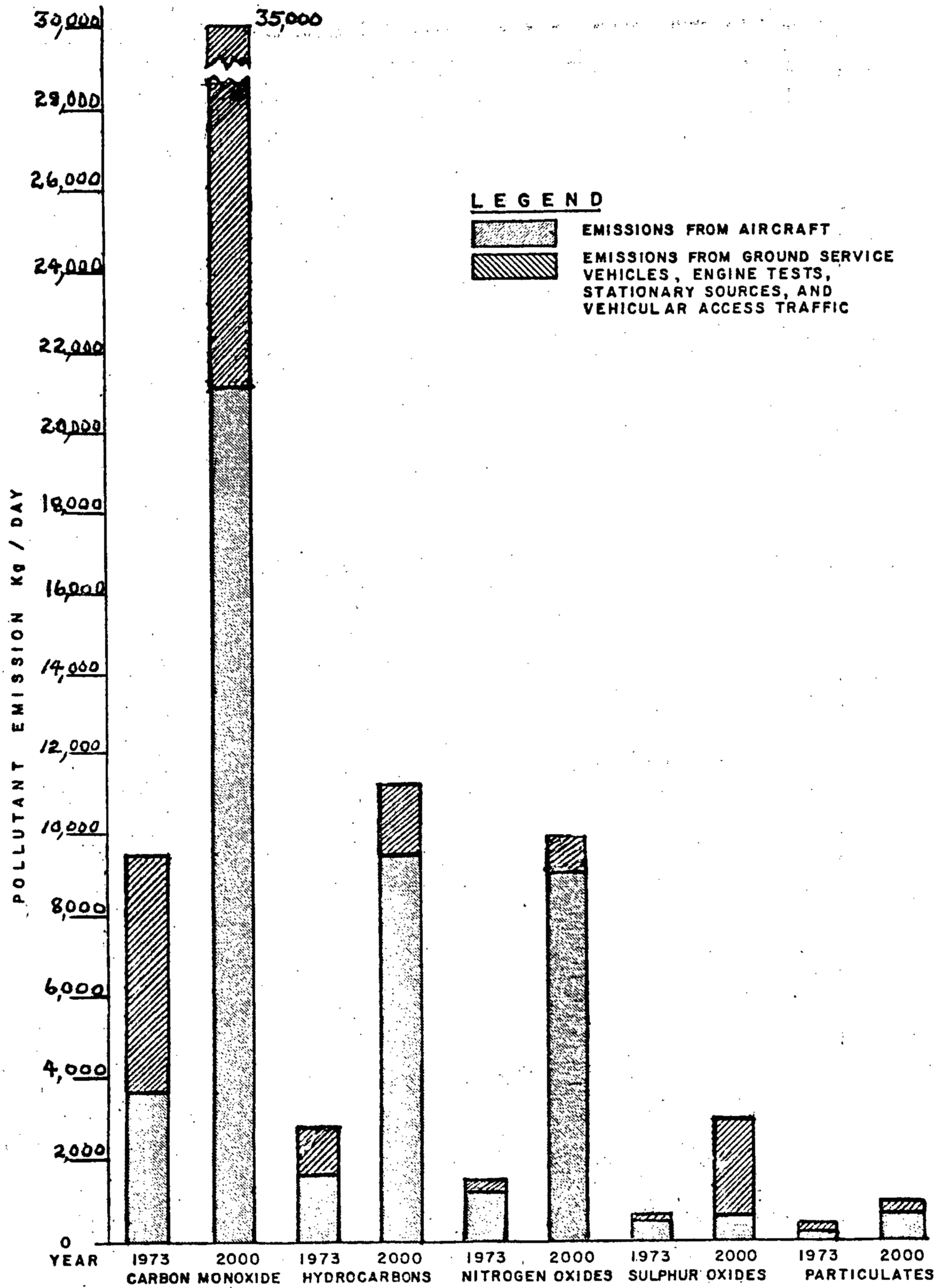


FIGURE 4 ESTIMATED AVERAGE TOTAL EMISSIONS BY VARIOUS SOURCES - VANCOUVER INTERNATIONAL AIRPORT

STUDY OF STORM DRAINAGE AND SANITARY SEWERAGE SYSTEMS AT VANCOUVER INTERNATIONAL AIRPORT

NOVEMBER 1974

by

P.F. Scott

ENVIRONMENT CANADA
ENVIRONMENTAL PROTECTION SERVICE
FEDERAL ACTIVITIES ABATEMENT GROUP
PACIFIC REGION

Vancouver, B.C.

To: MEMBERS OF THE AIRPORT PLANNING COMMITTEE

This report, "Study of Storm Drainage and Sanitary Sewerage Systems at Vancouver International Airport" has been a controversial report and requires comment.

As stated on page 2 of this report:

> "Time constraints have not permitted detailed studies to be undertaken on all aspects of the storm drainage and sanitary sewerage systems at this time. Instead, the studies that have been carried out have emphasized problem identification rather than detailed investigation, and in many cases the recommendations have been for further study rather than definitive recommendations on problem solutions."

This approach is the primary reason for the report's controversiality. Although the report has not examined the conseqences of the problem areas identified, it has recommended further investigation and resolution of the problem. However, the actual solution of these problems has not yet been studied in detail, and this should be done in order to know whether resolution of the problems are feasible.

Related to this first concern is the absence of information on total quantities of pollutants emitted. There has been no measurement of present quantities of runoff, no examination of the planned ditching changes required for the new runway, and no calculations of the effects of new hard surface on runoff co-efficients.

The reason for these deficienceies is that the investigation was carried out under the terms of reference developed in March, 1973, and essentially completed within the time and budget first allowed, ie. by April, 1974. At this time detailed design information on the five concepts considered by MOT were not available. Subsequently, some development concepts have been eliminated by MOT, and apparently detailed design information is available, although this has not been made available to DOE.

It may help to indicate that the recommendations of the study principally refer to existing pollution problems at the airport, although airport expansion will intensify the problems if remedial measures are not undertaken. However, it is clear that the design of new facilities has not been checked.

....cont/2

Environment Canada's position generally on assessment studies (see Section II of the DOE Summary Report) is that studies must be done in sufficient detail to permit definite knowledge of the effectiveness of mitigation measures proposed. In this case that definite knowledge is lacking. These are deficiences that could be remedied during the moratorium which is the principal recommendation of the Ecological Sub-Committee

Yours truly,

S G Pond

S. G. Pond
EPS Representative

SGP/jb

TABLE OF CONTENTS

STUDY OF STORM DRAINAGE AND SANITARY SEWERAGE SYSTEMS AT VANCOUVER INTERNATIONAL AIRPORT

1. INTRODUCTION

The Ministry of Transport are proposing to expand their operations at the Vancouver International Airport, in particular to construct a new runway north of, and parallel to, the present Runway 08. In order to adequately assess the impact of any major airport expansion on the surrounding environment, an environmental effects study has been initiated by the Department of the Environment under the control of a central Steering Committee. The Steering Committee have been responsible for preparing a study design and have allocated specific components of the study to specific agencies, including the Environmental Protection Service.

The EPS study component is to include, amongst other items, an assessment of the storm run-off and sanitary sewage handling practices at the airport and the effect of any airport expansion on these practices. This aspect of the study has been assigned to the Federal Activities Abatement Group.

2. STUDY OBJECTIVES

The purpose of this study can be summarized as follows:

a) To identify the origins and determine the general characteristics of wastes from all major sources entering the airport storm drainage system.

b) To identify the general layout of the existing airport storm drainage system and determine the points of discharge to the receiving waters.

c) To identify and assess any existing treatment procedures applicable to wastes entering the storm drainage system.

d) To carry out a limited sampling and analysis program of the major storm drainage discharges to the Fraser River.

e) To make recommendations on improved runoff management procedures where applicable, taking into account the effects of any airport expansion.

f) To describe the present procedures for collecting and disposing of sanitary sewage at the airport, and comment on any effect airport expansion may have on these procedures.

Time constraints have not permitted detailed studies to be undertaken on all aspects of the storm drainage and sanitary sewerage systems at this time. Instead, the studies that have been carried out have emphasized problem identification rather than detailed investigation, and in many cases the recommendations have been for further study rather than definitive recommendations on problem solutions.

3. EXISTING STORM DRAINAGE SYSTEM

3.1 Physical Layout of System

Vancouver International Airport is situated on Sea Island, a low-lying dyked island at the mouth of the Fraser River delta. Due to the island's low elevation and high water table, the majority of the airport's storm drainage system has been developed in a series of open ditches. The ditches carrying most of the drainage from the terminal area, the Air Canada and C.P. Air maintenance areas and the old airport area drain towards the south side of the airport, where they discharge to the Middle Arm of the Fraser River through five tide gates (Gates 2 to 6, see Layout Plan), all but one of which (Gate 2) are supplemented with pumping capacity. These pump stations and tide gates are approximately thirty years old and some are in only fair condition and may need replacement in the near future.

The quantities of storm runoff handled by the drainage system have not been determined at this time.

3.2 Airport Operations with Potential Effect on Storm Water Quality

3.2.1 Aircraft De-Icing:

Snow and ice are removed from aircraft with de-icers. These de-icers consist basically of glycols and are usually heated and sprayed from tank trucks onto the aircraft at the individual loading gates. Aircraft de-icing could be accomplished with hot water; however, the water left on the aircraft would freeze and cause jamming of the exterior moving parts. The glycols in the de-icers are for protection against freezing, but the removal of snow and ice is effected mainly with the heat and washing effect of the liquid.

The amount of de-icers used varies greatly, being dependent upon weather conditions, size of aircraft and skill of the operator applying the fluid. As an example, a skilled operator would use about 80 gallons to clear one-half inch of snow from a DC-8, whereas as much as 1,000 gallons may be used infrequently to clear a sheet of ice from the same aircraft.

At Vancouver Airport, although some glycol remain on the aircraft, the bulk drains off the aircraft into the loading apron, from which it runs off into the storm drainage system. Almost all of these de-icers end up in the system of ditches which lead to the Middle Arm of the Fraser.

Aircraft de-icing fluid is a mixture of 47% glycols (mostly ethylene, some propylene), 50% water, and 3% thickening agent, with small amounts of anti-foam agent, corrosion inhibitor, and wetting agent.[1] It is a potential pollutant because of its extremely high Biochemical Oxygen Demand (B.O.D.) and its (relatively low) toxicity to fish. $B.O.D._5$ is approximately 439,000 PPM.[1] Toxicity to rainbow trout (96 hour LC_{50}) varies from 6,600 mg/l (Union Carbide product) to 9,200 mg/l (Dow Chemical product),[2] both products are used at Vancouver International Airport.

Approximately 65,000 gallons per year are used at Vancouver Airport by the three major air carriers. Maximum daily use is not known, and de-icer concentrations in airport stormwater discharges have not yet been measured.

It has not yet been possible to determine if an actual problem exists at the discharge locations in the Fraser River. Much dilution is

1 Ministry of Transport, 1971: "Pollutional Effects of Storm Runoff from Large Airports".

2 Jank, B.E., H.M. Guo and V.W. Cavins: "Biological Treatment of Airport Wastewater Containing Aircraft De-Icing Fluids"- Wastewater Technology Centre, Environmental Protection Service 1973 (preprint copy)

available in the ditch system, and much BOD will be lost in the time taken to travel from the site to the discharge location. Fish toxicity is known to decrease with aeration.[1]

Assuming a maximum daily use of de-icers at Vancouver Airport at 6,500 gallons and a BOD of 430,000 mg/l, the maximum one-day oxygen demand will be approximately 28,000 lb. For domestic raw sewage, the average daily per capita BOD is 0.17 lbs. In terms of BOD, 6,500 gallons per day of de-icer, therefore, represents a population equivalent of approximately 160,000 persons. Some of this demand will undoubtedly be met in the ditches prior to discharge to the Fraser; however, very large, albeit relatively short-term, demands will be placed on the waters of the Fraser. Due to the large dilution available in the Fraser, these discharges alone are not expected to result in a significant lowering of the river's oxygen levels; however, they do represent a very large BOD release from one area.

3.2.2 Runway De-Icer:

Urea is used to de-ice the airport aprons and runways. It comes in granular form and is spread over the runways in the dry form. Over the last two years, approximately 90 tons have been used at the Vancouver Airport, however, the actual quantities used in any one year will vary greatly, depending mainly upon weather

1 Jank, B.E., H.M. Guo and V.W. Cavins: "Biological Treatment of Airport Wastewater Containing Aircraft De-Icing Fluids" - Wastewater Technology Centre, Environmental Protection Service 1973 (preprint copy).

conditions. Urea contains almost 50% nitrogen and is an important fertilizer. It is readily soluble in water, is non-toxic, and does not exhibit any significant oxygen demand. No evidence has been found to indicate that urea used at Vancouver Airport has ever been a pollution source. A study conducted at eastern airports * concluded that urea used at Dorval Airport at Montreal and Malton Airport at Toronto has not resulted in any serious pollution problems and that special collection or treatment facilities for runway runoff were not required.

3.2.3 Fuelling Procedures:

Jet aircraft fuel is piped, by Trans-Mountain Pipeline, to large storage tanks on the north side of the airport. From the storage tanks, the fuel is piped under pressure by underground pipelines to the truck fuelling compound (see Layout Plan), to the west of the terminal building. There are no storage tanks in the fuelling compound, and fuel is pumped directly into the tanker trucks, which are used to fuel and de-fuel the aircraft. The tank trucks (up to 14,000 gallon capacity) convey the fuel to the loading gates where fuelling takes place.

In the truck fuelling compound all drainage, including spilled fuel and storm water, is

* Pollution Effect of Storm Runoff from Larger Airports - prepared for MOT by J.L. Richards & Associates Ltd., Ottawa, February, 1971.

conveyed to a central sump equipped with a fuel separator. The recovered fuel is skimmed off to a holding tank, from which it is periodically returned to refineries for reprocessing.

As well as the fuelling system described above, there are also fuel storage tanks on the south side of the airport adjacent to the old terminal area. These tanks have a total estimated capacity of 500,000 gallons and are surrounded by dykes. These tanks are used to service the private aircraft needs, as well as the requirements of the many small aircraft-oriented industries in the old terminal area.

All fuel spills which occur on the airport are cleaned up by the airport fire department. Clean-up procedures consist of washing the fuel away from buildings and aircraft and, invariably, into the drainage ditches. At the present time the number of spills handled by the fire department averages about sixty per year. The size of the spills varies considerably, but they are usually less than 30 gallons (average about 20 gallons). The largest recorded spill to date was 1,000 gallons, and occurred in the fuelling compound, and was almost all recovered through the central sump and fuel separator. Outside of the fuelling compound there are no fuel separators on any of the ramp drainage systems.

3.2.4 Fire Training:

As part of the airport's emergency services training, regular crash fire training is carried out in an area on the south side of the airport (see Layout Plan). These training fires are carried out on an irregular basis, averaging out to about one per week. These fires use regular car gasoline in conjunction with an aircraft mock-up.

Fires are extinguished using foams and dry chemicals. The maximum quantity of foam allocated per year for training purposes is 3,800 gallons and the maximum quantity per year of dry chemicals is 3,800 lbs. The foam is a protein-based foam, and bioassay tests conducted on similar foams used at the CFB Esquimalt Fire Fighting School resulted in 100% survival up to 96 hours at a foam concentration of 20,000 mg/ℓ.* Most of the dry chemicals used at the present time are of a potassium chloride base. Although there have been no toxicity tests conducted on the chemicals used at the airport, tests on similar fire fighting chemicals used at the Esquimalt School have revealed very high

* CFB Esquimalt Firefighting School Assessment Study, April, 1974. Conducted by Underwood, McLellan & Associates Ltd. for the Federal Activities Abatement Group of EPS, Pacific Region.

toxicity levels. The 96 hr. LC_{50} for "Purple K" (K_2CO_3 based powder) was 730 mg/ℓ.

There are ditches alongside the fire training area which will pick up the majority of the runoff from the fire training area. There are no dykes around the training area, and no efforts are made to contain or recover any of the runoff from this area.

3.2.5 Air Canada Operations:

Outside of the main terminal building, Air Canada's main centre of operations is their Air Freight Depot and Maintenance Depot to the east of the Terminal (see Layout Plan). The Air Freight Depot is basically a clean operation, with no identified discharges to the storm drainage system.

At the Maintenance Depot, there are no intentional or continuous discharges of deleterious materials to the storm drainage system. All floor drains in both of the maintenance hangars lead to centralized oil separators. The oils, greases, etc. recovered from these separators are pumped out regularly by a private oil recovery company. All waste solvents are collected and transported to a central solvent tank, which is also pumped out regularly and recovered. The only other identifiable maintenance operations which may result in an unusual discharge to the drainage system is aircraft washing. This takes place within the hangars on an irregular basis, probably less than one aircraft per week, and utilizing a detergent of unknown composition.

3.2.6 C.P. Air Operations:

C.P. Air are headquartered in Vancouver, and have a large office-maintenance complex at the airport (see Layout Plan).

The only identifiable discharges of deleterious material to the storm drainage ditches from C.P. Air operations are accidental spills of oils, greases, solvents, etc. from the maintenance operations and aircraft washing. At present there are no grease traps on the floor drains from the maintenance depot; however, all storm runoff from the C.P. Air operations area leads to a single ditch to the northeast of their property. It is C.P. Air's intention to provide a single oil separator facility on this ditch at some future date.

Other than accidental spills, all waste oils, greases, solvents, etc. are either recycled or recovered.

Aircraft are washed on the tarmac in front of the maintenance depot at the rate of approximately one per week. The solution used to wash the aircraft consists of a mixture of varsols (approximately 4%), detergent and water. The quantities used have not been determined. The spent washing solution runs off the tarmac and into the adjacent ditches.

3.2.7 Pacific Western Airlines (PWA) Operations:

Like C.P. Air, PWA are headquartered in Vancouver and have a fairly large office-maintenance complex in the Old Airport Industrial Area.

PWA have oil and grease traps installed on all floor drains in the maintenance workshop areas. All other sources of deleterious materials are said to be controlled, with none reaching the storm drainage system. Frequencies and procedures followed in washing P.W.A. aircraft have not been identified.

3.2.8 Other Airport Operations:

In addition to the above identified operations, there are a number of miscellaneous operations at the airport which potentially could affect the quality of the storm drainage.

One significant area of operations which has not been investigated in detail involves the numerous small industries located in the Old Airport Industrial Area. Limited investigations have not revealed any continuous discharge of deleterious material to the storm drainage system from any of these industries. In addition, most, if not all, of these industries appear to have effective controls to prevent the escape of oils, greases, etc. into the storm drains. An industry-by-industry survey will be required before a detailed assessment of this situation can be made.

A great deal of the airport property consists of open field areas. The greatest potential source of pollution here would be from the use of insecticides, weed killers and fertilizers, none of which are currently being used at the airport.

3.3 Storm Runoff Water Quality Investigations

A limited sampling program was designed to assist the study objectives by assessing whether or not there was an existing chronic water pollution problem. A 96 hour fish bioassay using full-strength sample with mortality as the criterion was chosen as the prime indicator of problems; most lethal toxicants operate prior to 96 hours. At Sea Island an analysis of an impossible worst case condition (highest recorded monthly rainfall assumed to run off from total airport area to a single point on the Middle Arm during the lowest recorded monthly flow) indicated that a 23x dilution would occur.

In order to identify possible heavy metal problems, a spectral scan technique was utilized. Quantitative determination of significant metals was accomplished with atomic absorption spectrophotometry.

Samples were taken from discharge locations 2 to 6 (see Layout Plan) on a wet day in March, a dry day in March, and on September 6, following a three week period of warm weather with no rain. All samples were bioassayed by placing Rainbow Trout (March) or Coho (September) fingerlings in undiluted sample. In addition, samples were chemically analyzed for a number of pollutant parameters.

Results

There were no deaths in any bioassay sample, and no obvious indications of sub-lethal effects on behavious. It is concluded that for the seasons studied, fish toxicity conditions are not normally present.

Pollutants measured were within limits generally accepted. One noticeable exception was phenols, which in March ranged from 0.30 mg/l to 0.16 mg/l as compared with a draft guideline for Secondary Treatment plants at Federal establishments of 0.020 mg/l. [1] In the September sample this value was exceeded only at discharge location No. 5. Spilled gasoline is a possible source of phenols.

B.O.D. values were generally low, except 28 ppm at discharge location No. 4 (wet day in March). Location No. 4 had a high COD in September only.

Kjeldahl Nitrogen measured in March averaged 1.42 ppm mg/l of N, which is considerably more than the average in the Middle Arm (0.34 ppm). [2] Total phosphate values of 0.3 mg/l of P in March and 0.5 mg/l in September are considerably higher than the reported average of 0.062 mg/l in the Middle Arm. [2] Although a very rough figure

[1] "Draft Guidelines for Effluent Quality and Wastewater Treatment at Federal Establishments"

[2] Hall, K.J., F.A. Koch and I. Yesaki - "Further Investigations into Water Quality Conditions in the Lower Fraser River System - Westwater Tech. Report #4, 1974.

for nutrient loading could be developed [1] it is felt that the data insufficiences are too great for a meaningful result. There is no visible scum or algae problem in the vicinity of the discharge locations. Further downstream (on Sturgeon Banks) the greater contributions from the Iona Island Sewege Treatment Plant, the Fraser, and the saline Georgia Strait water would confuse analysis of the effect of Sea Island runoff.

4. EXISTING SANITARY SEWERAGE SYSTEM

4.1 Description of the System and Wastes Entering the System

The entire airport, with the exception of a portion of the Old Airport Industrial Area, is presently serviced by a sanitary sewage collection system. Work is currently underway on an extension to this system to take in this Old Airport area, and shortly all domestic sewage generated from within the airport boundary will be going to treatment at Iona Island. The quantity of airport sewage presently being discharged to the Iona Island Treatment plant is approximately 500,000 Igpd.

In addition to regular domestic sewage, the sanitary collection system handles aircraft sewage. This sewage is removed from the aircraft to a "honey wagon", which transports it to one of three sewage dumping facilities on the airport. Air Canada, C.P. Air and PWA all have these stations, and together service all carriers flying into Vancouver.

[1] A Crude flow figure can be obtained by converting the average rainfall (42.05 inches/year) on the site (3620 acres) into a flow, which turns out to be 17.5 cfs.

Floor drains from the CARA, C.P. Air and PWA food kitchens are connected to the sanitary sewers, and waste food scraps from C.P. Air's kitchen are garburated and discharged to the sanitary sewers.

The only identified source of toxic wastes entering the sanitary sewers is from C.P. Air's plating shop. The concentrations of these wastes are unknown at this time; however, the plating shop wastes are being studied as part of a separate Federal Activities assessment study. These wastes currently are being discharged to the Iona Island Treatment Plant.

4.2 Iona Island Treatment Plant

The Iona Island Treatment Plant is designed to service a large portion of the City of Vancouver. It is located on Iona Island, directly north of Sea Island and the airport. Many of the sewers leading to the plant are combined sewers, and some carry industrial effluents.

The Iona Plant provides primary treatment, and the plant processes in sequential order are:

i. prechlorination
ii. screening
iii. grit removal
iv. pre-aeration and fine grit removal
v. sedimentation and sludge removal
vi. post chlorination

The effluent is only chlorinated between May and October. Discharge is to Sturgeon Banks via an outfall channel.

The present average flows into the plant are in excess of 60 x 10^6 Igpd (110 cfs). Peak flows during wet weather can reach 500 cfs. When incoming flows become excessive, bypass gates are opened and some flow is bypassed directly to the outfall, without treatment.

Unlike the majority of sewage reaching the plant, the airport sewage is fed into the plant at a point beyond the bypass gates, and is therefore not subject to bypass.

5. EFFECT OF AIRPORT EXPANSION

5.1 Effect on Storm Drainage System

Construction of a new East-West Runway and the anticipated general expansion of airport facilities and services is not expected to have any major impact on the airport storm drainage system. An awareness of the existing airport operations that are having an undesirable effect on the storm drainage system should enable new facilities to be constructed in such a manner so as to minimize any future impacts.

Airport expansion will, of course, result in larger areas of hard surfacing, and subsequently higher quantities of storm runoff. This increase should not be significant, and is unlikely to overtax the existing ditches, pumps and tide gates.

5.2 Effect on Sanitary Sewage System

The major potential impact that airport expansion will have on sanitary sewage disposal will be a possible disruption in effluent dispersion from the Iona Island Treatment plant, resulting from runway construction out into Sturgeon Bank. This impact is being dealt with in a separate report.

Any new airport facilities will undoubtedly be tied into the existing collection system, and airport expansion will therefore result in increased sewage flows going to Iona Island. The airport's contribution to the Iona Plant is very small in comparison to the total flow handled by the Plant (approximately 1%), and even a doubling of this contribution would not have any noticeable effect on the plant's capacity.

6. CONCLUSIONS

A) The existing storm drainage collection system should be adequate for present and anticipated future needs. Some of the pump stations and tide gates are in only fair condition and may need replacement in the near future.

B) Aircraft de-icers may result in significant short-term oxygen demands on the Fraser River.

C) The use of urea for runway de-icing is unlikely to cause deterioration of the surface and ground waters.

D) Although there have been no reported large fuel spills resulting in serious environmental damage, there exists a potential for a serious spill sometime in the future.

E) The chemicals used in the fire training procedures may represent a pollutant of high toxicity.

F) There have been no identified sources of industrial discharges to the storm drainage system. An industry-by-industry investigation of all firms operating out of the Old Airport Industrial Area will be required to verify this.

G) Small quantities of oils, greases, solvents, etc. enter the storm drainage system through accidental spills.

H) Aircraft washing results in a limited discharge to the storm drainage system of a potentially toxic pollutant.

I) The pollution levels measured during the limited monitoring of the storm drainage discharges to the Fraser River showed no serious contaminant levels. Phenol levels were higher than the federal objectives, but all bioassays resulted in 100% survival. This program is unlikely to reflect the results of such short-term periodic discharges such as aircraft de-icers, runway de-icers, fuel spills, and fire training runoff.

J) The existing airport sanitary sewage collection system effectively conveys all airport sanitary sewage to the Iona Island Treatment Plant.

K) The wastes entering the sanitary sewers from the C.P. Air plating shop may not meet the GVRD regulations governing the admission of wastes into their sewers. This problem is currently being investigated as part of a separate study.

L) An awareness of the existing airport operations that are adversely affecting quality of the effluent entering the storm drainage system should enable any new facilities to be designed to minimize future impacts.

M) Other than increasing the quantity of sewage, any airport expansion should have little impact on the sanitary sewage collection system.

7. RECOMMENDATIONS

A) The state of repair of the storm drainage pump stations and tide gates should be investigated and these facilities replaced or upgraded where found necessary.

B) Consideration should be given to providing specially designed loading gates for de-icing aircraft. These gates would permit the spent de-icing liquid to be recycled and re-used without discharging to the storm ditches. This proposal will require further investigation.

C) In order to prevent fuel spills from contaminating the storm drainage system, the ditches leading from all aircraft fuelling areas should be equipped with fuel interceptors.

D) Further studies should be undertaken to determine the magnitude of the pollution problem resulting from the fire training exercises.

E) No industrial discharges should be permitted to enter the storm drainage system.

F) All drainage facilities from areas where accidental spills of oils, greases, solvents, etc. may enter the storm drainage system should be equipped with proper traps to recover these materials.

G) More extensive monitoring of the storm drainage discharges to the Fraser River should be undertaken, particularly at times when the effects of intermittent operations such as aircraft de-icing and fire training are likely to be reflected in the results.

H) The Greater Vancouver Regional District Regulations governing the admission of wastes into sanitary sewers and all other applicable regulations should be enforced for all discharges to the sanitary sewers.

8. STUDY DEFICIENCIES AND COMMENTS

Section 3.1

The quantities of storm runoff from the drainage system have not been determined. This information is necessary to determine pollutant loading.

Section 3.2

The actual pollution caused by aircraft de-icing was not determined. However, whether of not a pollution problem exists, the increasing cost of ethylene glycol indicates an advantage to re-cycling the fluid.

Fish Toxicity of the dry chemicals used for fire-fighting were not checked. The question of air and water pollution from fire-training exercises is being examined by EPS and MOT.

Infrequent or accidental discharges of contaminants at aircraft maintenance operations were not examined. The CP Air operation does not have oil separation facilities yet although this is planned.

Neither the South Side float plane operation, nor the small industries at the Old Airport site were investigated in detail.

Comment: This section has identified possible problems which will be further studied for future clean-up.

Section 3.3

Sampling program is limited. Short term variations are missed, including initial runoff during heavy rainfall, accidental spills, and aircraft and runway de-icer use.

Mercury was not looked for.

Given these limitations an accurate assessment of the pollutant loading is impossible.

Comment: The bioassay is a sophisticated tool that does indicate the overall effect of pollution on fish. The high dilution available indicates that minor short-term variations in BOD or toxicants will not have drastic environmental effects.

The question of total pollutant loading is important, and should be examined in an overall Fraser Estuary context.

Section 4

International Waste is not discussed.

Comment: International solid waste is being studied in a separate EPS study. International sewage is not segregated from domestic aircraft sewage and is discharged to the airport sewerage system and conveyed to Iona Island for treatment.

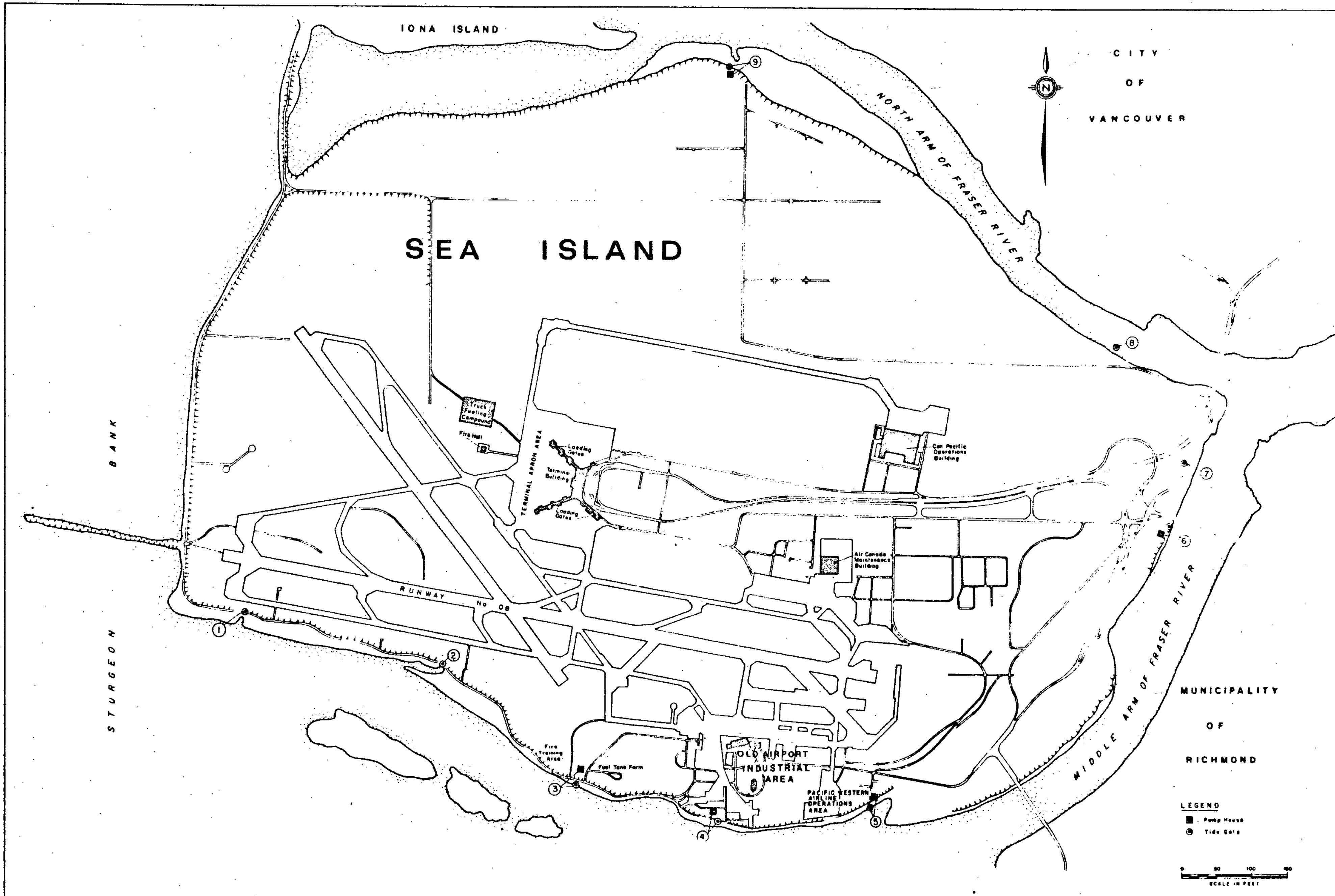
Section 5

There is no data to support the conclusion that airport expansion will not overtax existing facilities.

Comment: This is a judgement.

APPENDIX A

VANCOUVER INTERNATIONAL AIRPORT - LAYOUT PLAN



VANCOUVER INTERNATIONAL AIRPORT - LAYOUT PLAN

APPENDIX B

STORM RUNOFF WATER QUALITY INVESTIGATION REPORT

POLLUTECH

April 11,1974

Mr. Paul F. Scott, P.Eng.
Project Engineer
Federal Activities Abatement Group
Environment Canada
1090 West Pender Street
VANCOUVER, B.C. V6E 2N7

Dear Mr. Scott:

Re: Preliminary Water Quality Investigation of Vancouver International Airport Surface Runoff

This letter summarizes the results of the preliminary water quality investigation of Vancouver International Airport surface runoff. The sampling locations are described as well as the atmospheric conditions which prevailed prior to and during the test periods. The results include pass/fail fish bioassays in addition to biological and chemical analyses of the water samples. A brief evaluation of the foregoing data is presented.

Sampling Locations and Atmospheric Conditions

Water samples were collected at five sites as indicated on Figure 1, a map of the Vancouver Airport area. Sample stations 1, 2, 3 and 5 have supplemental pumping capacity. Actual discharge to the Fraser River is accomplished through five tide gates.

In accordance with your request, the five discharge points were sampled during "wet" and "dry" conditions. To represent "wet" conditions, the samples were obtained on the first day of rain following a period of almost two days without precipitation. These samples (W-1 to W-5) were collected from 1400 to 1800 hours on March 15, 1974. On March 14, no precipitation was observed and on March 13, only 0.15 inches was recorded at the airport. To represent "dry" conditions, the samples (D-1 to D-5) were collected during the

continued...

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interval 1000 to 1400 hours on March 19,1974, after two days of no precipitation. Atmospheric conditions for the relevant period are included in Table 1.

Both sets of samples were obtained under low tide conditions. When samples W-1 to W-5 were collected on March 15,1974, all supplementary pumps were operating and the samples were obtained at the pipes discharging to the river. Fifteen gallons were collected at each station, consisting of three equal volume grab samples taken over a four-hour period.

When samples D-1 to D-5 were collected on March 19,1974, only the supplementary pump at Station 3 was operating. The tide was not sufficiently low to expose the tide gates and thus grab samples at the discharge pipes could not be obtained at Stations 1, 2, 4 and 5. Under these conditions, site composites were prepared, consisting of a series of surface samples from the vicinity of the discharge points of the drainage ditch. In this manner, fifteen gallons of sample was composited at each station over a four-hour period. Station 3 was discharging and the fifteen-gallon composite sample for this station, consisted of three equal volume grab samples collected over a four-hour period as was done for the "wet" sample.

Chemical and Biological Analyses

In order to obtain an approximate indication of the nature of the metallic contaminants in the runoff samples, a semi-quantitative spectral scan of each sample was conducted, using a Jarrel Ash Spectrograph with a carbon arc. The results are given in Tables 2 and 3 for the "wet" and "dry" series, respectively. On the basis of these results, copper, aluminum and iron were selected for accurate quantitative determination, using an atomic absorption spectrophotometer. These and the other chemical and biological analyses were conducted on both series of water samples in accordance with the procedures described in "Standard Methods for the Examination of Water and Wastewater", 13th Edition, 1971. The results for the "wet" and "dry" series are given in Tables 4 and 5, respectively.

continued...

Pass/Fail Fish Bioassays

Pass/Fail bioassays were conducted in undiluted water samples for both the "wet" and "dry" series. These tests were conducted in accordance with the procedures described in a Federal Government Standardization Program co-ordinated through the Environmental Protection Service. Complete survival of the test fish was observed in all cases. The detailed bioassay results and experimental conditions are appended to this letter for your information.

Discussion

Most of the contaminants in the Vancouver International Airport surface runoff samples were approximately of the same order of magnitude as that measured by others in the Fraser River. However there were three exceptions - COD, nitrogen and phenols. The COD and Kjeldahl nitrogen concentrations of the runoff samples were about two to three times higher than in the estuary. The phenol concentrations were substantially higher in the runoff samples than in the estuary. The iron content of the runoff samples was relatively high, ranging from 1.1 to 24.2 mg/l as Fe. All of the runoff samples collected were non-toxic to fish.

I hope that this information is adequate for your purposes at this time. Should you have any questions or comments or should you wish us to elaborate on any aspect of this work, please do not hesitate to contact me. May I take this opportunity to express my sincere appreciation for the opportunity of working with you on this project.

Yours very truly,

A. Maynard, M. Sc.,
Vancouver Laboratory Supervisor

AM:mw
Encls.

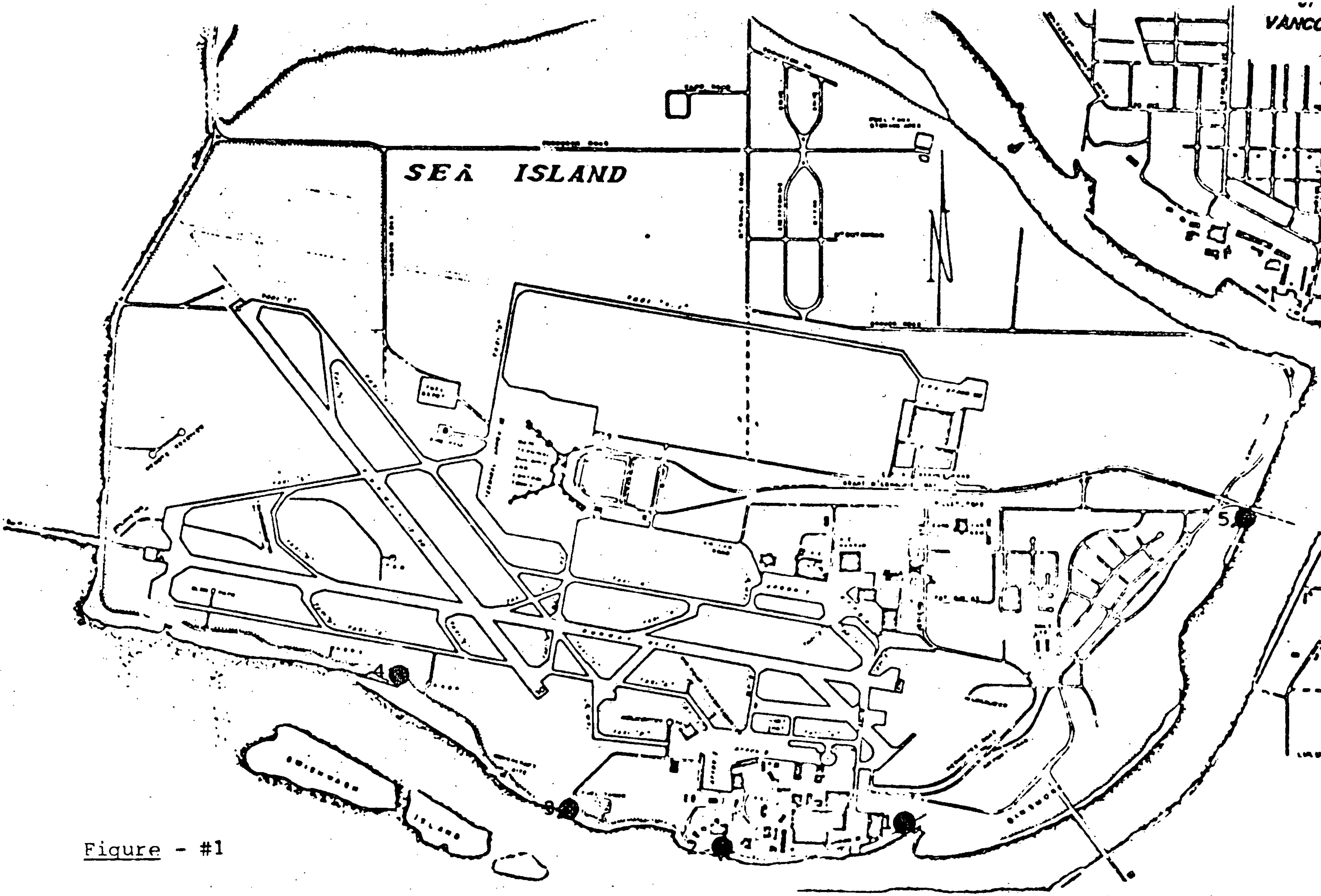

Figure - #1

Sample Stations   #1,#2,#3,&#5 - flood gates with supplemental pumping stations
#4 - flood gate only

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TABLE 1 -ATMOSPHERIC CONDITIONS DURING SAMPLING PERIOD

DATE	SAMPLING PERIOD (HRS.)	DAILY PRECIPITATION		TEMPERATURE		TIDES	
		TOTAL (INCHES)	TIMING	HIGH (°F)	LOW (°F)	HIGH (feet)	LOW (feet)
March 12	-	0.16		51	41		
13	-	0.15	rain stopped 0800 hr.	49	36		
14	-	0.0		46	31		
15	1400-1800	1.45	rain started 0300 hr.	50	40	12.4 at 0915hr	4.8 at 1705hr
16	-	0.94		56	42		
17	-	0.02		50	38		
18	-	0.0		47	34		
19	1000-1400	0.0		50	37	13.5 at 0345hr 11.2 at 1430hr	9.2 at 0935hr

TABLE 2 SEMI-QUANTITATIVE SPECTROGRAPHIC SCAN*

"WET" DAY SAMPLES

		W-1	W-2	W-3	W-4	W-5
Aluminum	Al	3.	7.	5.	6.	6.
Antimony	Sb	ND	ND	ND	ND	ND
Arsenic	As	ND	ND	ND	ND	ND
Barium	Ba	0.03	0.3	0.05	0.06	0.05
Beryllium	Be	ND	ND	ND	ND	ND
Bismuth	Bi	ND	ND	ND	ND	ND
Boron	B	0.1	0.3	0.07	0.4	0.1
Cadmium	Cd	ND	ND	ND	ND	ND
Calcium	Ca	+10.	+30.	+10.	+10.	+10.
Chromium	Cr	0.003	0.01	0.005	0.001	0.005
Cobalt	Co	ND	ND	ND	ND	ND
Copper	Cu	0.01	0.03	0.01	0.02	0.02
Gallium	Ga	ND	ND	ND	ND	ND
Gold	Au	ND	ND	ND	ND	ND
Iron	Fe	3.	10.	3.	4.	5.
Lead	Pb	0.005	0.03	0.01	0.1	0.01
Magnesium	Mg	7.	+15.	5.	10.	10.
Manganese	Mn	0.1	0.7	0.1	0.2	0.1
Molybdenum	Mo	ND	ND	ND	ND	ND
Niobium	Nb	ND	ND	ND	ND	ND
Nickel	Ni	0.001	0.003	0.003	0.005	0.005
Potassium	K	3.	7.	3.	4.	5.
Silicon	Si	+10.	+15.	+10.	+10.	+10.
Silver	Ag	ND	ND	ND	ND	ND
Sodium	Na	7.	+15.	5.	10.	10.
Strontium	Sr	0.2	0.1	0.07	0.1	0.2
Tantalum	Ta	ND	ND	ND	ND	ND
Thorium	Th	ND	ND	ND	ND	ND
Tin	Sn	ND	ND	ND	ND	ND
Titanium	Ti	0.1	0.3	0.3	0.4	0.2
Tungsten	W	ND	ND	ND	ND	ND
Uranium	U	ND	ND	ND	ND	ND
Vanadium	V	ND	ND	ND	ND	ND
Zinc	Zn	0.01	0.03	0.07	0.05	0.05
Total Solids	-	153.	344.	169.	212.	380.
Nitrates	(NO_3)	0.31	0.60	0.40	0.58	0.35

*ALL RESULTS EXPRESSED IN PPM; ACCURACY: ± 50% OF THE AMOUNT PRESENT.

TABLE 3 SEMI-QUANTITATIVE SPECTROGRAPHIC SCAN*

"DRY" DAY SAMPLES

		D-1	D-2	D-3	D-4	D-5
Aluminum	Al	8.	4.	1.2	0.3	4.
Antimony	Sb	ND	ND	ND	ND	ND
Arsenic	As	ND	ND	ND	ND	ND
Barium	Ba	0.04	1.	0.08	ND	0.01
Beryllium	Be	ND	ND	ND	ND	ND
Bismuth	Bi	ND	ND	ND	ND	ND
Boron	B	0.4	0.4	0.8	0.3	0.2
Cadmium	Cd	ND	ND	ND	ND	ND
Calcium	Ca	+40.	+400.	+80.	50.	+10.
Chromium	Cr	0.005	0.03	0.01	ND	0.005
Cobalt	Co	ND	ND	ND	ND	ND
Copper	Cu	0.04	0.04	0.07	0.01	0.01
Gallium	Ga	ND	ND	ND	ND	ND
Gold	Au	ND	ND	ND	ND	ND
Iron	Fe	8.	120.	25.	10.	4.
Lead	Pb	0.03	0.04	ND	ND	0.01
Magnesium	Mg	+40.	200.	+40.	+50.	+10.
Manganese	Mn	0.8	8.	0.8	0.1	0.5
Molybdenum	Mo	ND	ND	ND	ND	ND
Niobium	Nb	ND	ND	ND	ND	ND
Nickel	Ni	0.02	ND	0.01	ND	0.01
Potassium	K	8.	40.	8.	10.	4.
Silicon	Si	+40.	200.	50.	50.	+10.
Silver	Ag	ND	ND	ND	ND	ND
Sodium	Na	+40.	+200.	+40.	+50.	10.
Strontium	Sr	0.8	8.	2.	0.1	0.4
Tantalum	Ta	ND	ND	ND	ND	ND
Thorium	Th	ND	ND	ND	ND	ND
Tin	Sn	ND	ND	ND	ND	ND
Titanium	Ti	0.4	0.4	0.2	0.01	0.2
Tungsten	W	ND	ND	ND	ND	ND
Uranium	U	ND	ND	ND	ND	ND
Vanadium	V	ND	ND	ND	ND	ND
Zinc	Zn	0.1	ND	ND	ND	trace
Total Solids	-	383.	4185.	853.	963.	218.
Nitrates	(NO_3)	0.31	1.00	0.83	1.15	0.15

*ALL RESULTS EXPRESSED IN PPM; ACCURACY: ± 50% OF THE AMOUNT PRESENT.

TABLE 4 QUALITY OF RUNOFF SAMPLES COLLECTED ON A "WET" DAY

PARAMETER AND UNITS	SAMPLE IDENTIFICATION *				
	W-1	W-2	W-3	W-4	W-5
pH	5.9	6.3	6.0	6.1	5.9
Conductance (μmho)	148.	380.	120.	230.	152.
100% Pass/Fail Fish Bioassay	Pass	Pass	Pass	Pass	Pass
Total Coliforms (MPN/100cc)	23.	130.	110.	23.	5400.
Fecal Coliforms (MPN/100cc)	23.	79.	33.	23.	3500.
Total Organic Carbon (mg/l)	9.	10.	11.	10.	10.
Biological Oxygen Demand (mg/l)	<1.	28.	<1.	<1.	3.
Chemical Oxygen Demand (mg/l)	24.8	33.9	24.0	28.2	18.0
Total Solids (mg/l)	153.	344.	169.	212.	380.
Suspended Solids (mg/l)	10.	16.	30.	12.	22.
Volatile Suspended Solids (mg/l)	4.	6.	13.	4.	9.
Ammonia (mg/l as N)	Ø	0.14	0.28	0.21	Ø
Total Kjeldahl Nitrogen (mg/l as N)	0.91	1.19	1.33	1.61	0.77
Nitrate (mg/l)	0.31	0.60	0.40	0.58	0.35
Chloride (mg/l)	35.0	84.0	21.0	53.0	23.0
Phosphate (mg/l as P)	0.2	0.4	0.2	0.3	0.2
Ether Extractables (mg/l)	Ø	0.3	0.5	0.2	0.5
Phenol (mg/l)	0.06	0.06	0.16	0.07	0.08
Aluminum (mg/l)	<1.	1.5	1.0	<1.	1.0
Copper (mg/l)	<0.1	<0.1	<0.1	<0.1	<0.1
Iron (mg/l)	1.6	6.8	1.3	1.1	1.7

*Sample Identification (Sampling Date March 15,1974)

W-1 Collected from River Side of Tidal Gates-Pump House Operative

W-2 Collected from River Side of Tidal Gates-Pump House Operative

W-3 Collected from River Side of Tidal Gates-Pump House Operative

W-4 Collected from River Side of Tidal Gates

W-5 Collected from River Side of Tidal Gates-Pump House Operative

TABLE 5 QUALITY OF RUNOFF SAMPLES COLLECTED ON A "DRY" DAY

PARAMETER AND UNITS	SAMPLE IDENTIFICATION *				
	D-1	D-2	D-3	D-4	D-5
pH	6.4	7.0	6.9	7.1	6.4
Conductance (μmho)	430.	4500.	1000.	1300.	242.
100% Pass/Fail Fish Bioassay	Pass	Pass	Pass	Pass	Pass
Total Coliforms (MPN/100cc)	240.	110.	79.	33.	79.
Fecal Coliforms (MPN/100cc)	13.	40.	33.	23.	33.
Total Organic Carbon (mg/l)	10.	12.	13.	10.	11.
Biological Oxygen Demand (mg/l)	3.	4.	3.	7.	<1.
Chemical Oxygen Demand (mg/l)	34.8	15.3	46.3	49.9	25.3
Total Solids (mg/l)	383.	4185.	853.	963.	218.
Suspended Solids (mg/l)	3.	<1.	60.	4.	1.
Volatile Suspended Solids (mg/l)	<1.	<1.	23.	1.	<1.
Ammonia (mg/l as N)	0.35	0.70	0.28	0.42	0.14
Total Kjeldahl Nitrogen (mg/l)	0.91	1.99	2.03	2.73	0.77
Nitrate (mg/l)	0.31	1.00	0.83	1.15	0.15
Chloride (mg/l)	82.0	1,894.	240.	340.	42.0
Phosphate (mg/l as P)	0.7	1.1	0.4	0.3	0.1
Ether Extractables (mg/l)	Ø	0.8	0.1	0.4	0.5
Phenol (mg/l)	0.05	0.12	0.11	0.04	0.03
Aluminum (mg/l)	<1.	1.0	<1.	<1.	1.0
Copper (mg/l)	<0.1	<0.1	<0.1	<0.1	<0.1
Iron (mg/l)	3.5	24.2	6.2	5.0	1.6

* Sample Identification (Sampling Date - March 19,1974)

D-1 Collected from Airport Side of Tidal Gates-Pump House Inoperative

D-2 Collected from River Side of Tidal Gate - Pump House Operative

D-3 Collected from Airport Side of Todal Gates-Pump House Inoperative

D-4 Collected from Airport Side of Tidal Gates

D-5 Collected from Airport Side of Tidal Gates-Pump House Inoperative

TABLE 6

SUMMARY OF SELECTED WATER QUALITY PARAMETERS IN THE NORTH ARM/MIDDLE ARM REACHES OF THE FRASER RIVER

PARAMETER *	MONTH											
	JAN.	FEB.	MAR.	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Temperature (°C)	0.0-6.0	2.0-6.0	3.5-8.0	6.0-10.0	7.0-12.0	11.0-15.0	13.0-19.0	15.0-20.0	12.0-21.5	0.5-13.0	2.5-9.0	0.5-5.0
Dissolved Oxygen	8.6-14.4	9.7-13.7	10.2-14.5	9.8-12.4	9.7-12.1	9.0-11.6	7.2-11.3	8.2-10.0	2.4-11.0	9.7-11.7	8.0-12.6	10.1-12.3
pH (units)	7.0-7.4	-	7.4-7.8	7.5-7.7	7.4-7.8	7.4-7.7	7.7-7.8	7.4-8.2	6.7-7.9	-	7.2-7.5	-
BOD	2-3	-	<1-2	3-4	< 4	< 1-2	< 1-3	< 1-3	<1-4	1-3	2-4	2-3
COD	-	-	6-9	-	-	-	-	3-7	-	-	-	-
TOC	-	-	-	-	-	-	-	-	1-16	-	-	-
Phenols	-	-	-	-	-	-	-	-	0.0009 - 0.0072	-	-	-
Oils/Greases	-	-	-	-	-	-	-	-	0.5-3.0	-	-	-
Total Coliforms per 100ml	<30 - 150,000	90 - 110,000	<30 - 93,000	<30 - 150,000	<30 - 110,000	40 - 150,000	<30 - 230,000	40 - 430,000	40 - 230,000	40 - 93,000	40 - 230,000	<30 - 93,000
Total Solids	-	-	98 - 23,143	-	-	-	-	77-117	-	-	-	-
Total Volatile Solids	-	-	13 - 3,848	-	-	-	-	22-31	-	-	-	-
Suspended Solids	-	-	5-22	-	-	-	-	47-71	21 - 129	-	-	-
Dissolved Solids	-	-	-	-	-	-	-	70-286	13-3,008	-	68-244	-
Conductance (µmho)	91- 25,280	-	109- 27,800	116-379	93-99	77-92	79-86	92-404	64-3,230	-	66-340	-
Kjeldahl-N	-	-	-	-	-	-	-	-	0.10-0.43	-	-	-
Nitrate-N	-	-	0.20-0.24	0.08-0.18	-	0.05-0.14	-	0.04-0.07	0.04-0.08	-	0.11-0.19	-
Ortho-Phosphorus	-	-	-	-	3-30	-	5-10	<4	<4 - 40	-	< 4	-
Total-Phosphorus	-	-	-	-	-	-	-	-	1 - 24	-	-	-
Chloride	2.4-9,350	-	ND-11,600	1.2-81.1	<10-2.9	<10-1.6	≤ 1	1.0-80.0	1.0-1,120	-	-	-

* All results expressed as mg/l unless otherwise noted.

Reference: Benedict, A.H. et al, Technical Report #2, Westwater Research Centre, University of British Columbia, April, 1973.

PASS/FAIL BIOASSAY DATA SHEET

SAMPLE: W-1 and W-2 Ref. No. 1043-W

Description: Runoff Water

Date Collected: Mar.15 Received: Mar.15 Tested: Mar.18

TEST FISH: RAINBOW TROUT

Collected at: Steelhead Creek (Sun Valley Trout Hatchery)

Collected on: January 15,1974

Held in: Dechlorinated City Tap Water at 10°C

Acclimatization: 60 days

Percent Mortality in test fish 4 days prior to test none

DILUTION WATER: Dechlorinated City Tap Water (From Seymour Creek)

pH: 6.0 - 7.0 Hardness as $CaCO_3$: 5 ppm

Alkalinity as $CaCO_3$ 4 ppm

RESULTS:

W-1				W-2			
Concentration - 100%				Concentration - 100%			
Starting Time - 4:30pm, Mar.18				Starting Time -4:30 pm, Mar.18			
Running temp. - 9°C				Running Temp. - 9°C			
Time	pH	O_2 (ppm)	% Survival	Time	pH	O_2 (ppm)	% Survival
0 hr.	7.0	10.6	100	0 hr.	7.0	10.7	100
24 hr.	7.3	10.7	100	24 hr.	7.7	10.7	100
48 hr.	7.0	11.6	100	48 hr.	7.3	11.7	100
72 hr.	7.1	10.6	100	72 hr.	7.7	10.8	100
96 hr.	7.2	10.6	100	96 hr.	7.6	10.7	100

PASS/FAIL BIOASSAY DATA SHEET

SAMPLE: W-3 and W-4 Ref. No. 1043-W

Description: Runoff Water

Date Collected: Mar.15 Received: Mar.15 Tested: Mar.18

TEST FISH: RAINBOW TROUT

Collected at: Steelhead Creek (Sun Valley Trout Hatchery)

Collected on: January 15, 1974

Held in: Dechlorinated City Tap Water at 10°C

Acclimatization: 60 days

Percent Mortality in test fish 4 days prior to test none

DILUTION WATER: Dechlorinated City Tap Water (From Seymour Creek)

pH: 6.0 - 7.0 Hardness as $CaCO_3$: 5 ppm

Alkalinity as $CaCO_3$ 4 ppm

RESULTS:

W-3

Concentration - 100%
Starting Time - 4:30pm, Mar.18
Running temp. - 9°C

Time	pH	O_2 (ppm)	% Survival
0 hr.	7.0	10.6	100
24 hr.	7.2	10.8	100
48 hr.	7.1	11.7	100
72 hr.	7.2	10.7	100
96 hr.	7.2	10.7	100

W-4

Concentration - 100%
Starting Time - 4:30pm, Mar.18
Running Temp. - 9°C

Time	pH	O_2 (ppm)	% Survival
0 hr.	7.0	10.5	100
24 hr.	7.2	10.6	100
48 hr.	7.2	11.7	100
72 hr.	7.2	10.9	100
96 hr.	7.3	11.2	100

PASS/FAIL BIOASSAY DATA SHEET

SAMPLE: W-5 Ref. No. 1043-W

Description: Runoff Water

Date Collected: Mar.15 Received: Mar.15 Tested: Mar.18

TEST FISH: RAINBOW TROUT

Collected at: Steelhead Creek (Sun Valley Trout Hatchery)

Collected on: January 15,1974

Held in: Dechlorinated City Tap Water at 10°C

Acclimatization: 60 days

Percent Mortality in test fish 4 days prior to test none

DILUTION WATER: Dechlorinated City Tap Water (From Seymour Creek)

pH: 6.0 - 7.0 Hardness as $CaCO_3$: 5 ppm

Alkalinity as $CaCO_3$ 4 ppm

RESULTS:

W-5							
Concentration - 100%				Concentration -			
Starting Time - 4:30pm,Mar.18				Starting Time -			
Running temp. - 9°C				Running Temp. -			
Time	pH	O_2 (ppm)	% Survival	Time	pH	O_2 (ppm)	% Survival
0 hr.	7.0	10.0	100				
24 hr.	7.2	10.5	100				
48 hr.	7.0	11.2	100				
72 hr.	7.1	10.3	100				
96 hr.	7.2	10.4	100				

PASS/FAIL BIOASSAY DATA SHEET

SAMPLE: D-1 and D-2 Ref. No. 1043-W

Description: Runoff Water

Date Collected: Mar.19 Received: Mar.19 Tested: Mar.20

TEST FISH: RAINBOW TROUT

Collected at: Steelhead Creek (Sun Valley Trout Hatchery)

Collected on: January 15,1974

Held in: Dechlorinated City Tap Water at 10°C

Acclimatization: 60 days

Percent Mortality in test fish 4 days prior to test none

DILUTION WATER: Dechlorinated City Tap Water (From Seymour Creek)

pH: 6.0 - 7.0 Hardness as $CaCO_3$: 5 ppm

Alkalinity as $CaCO_3$ 4 ppm

RESULTS:

D-1

Concentration - 100%

Starting Time - 3:30pm, Mar.20

Running temp. - 9°C

D-2

Concentration - 100%

Starting Time - 3:30pm, Mar.20

Running Temp. - 9°C

D-1 Time	pH	O_2 (ppm)	% Survival	D-2 Time	pH	O_2 (ppm)	% Survival
0 hr.	7.0	11.0	100	0 hr.	7.0	10.8	100
24 hr.	7.6	10.3	100	24 hr.	7.9	10.7	100
48 hr.	7.5	10.7	100	48 hr.	8.2	10.9	100
72 hr.	7.7	10.9	100	72 hr.	8.5	11.2	100
96 hr.	7.6	11.0	100	96 hr.	8.3	11.5	100

PASS/FAIL BIOASSAY DATA SHEET

SAMPLE: D-3 and D-4 Ref. No. 1043-W

Description: Runoff Water

Date Collected: Mar.19 Received: Mar.19 Tested: Mar.20

TEST FISH: RAINBOW TROUT

Collected at: Steelhead Creek (Sun Valley Trout Hatchery)

Collected on: January 15,1974

Held in: Dechlorinated City Tap Water at 10°C

Acclimatization: 60 days

Percent Mortality in test fish 4 days prior to test none

DILUTION WATER: Dechlorinated City Tap Water (From Seymour Creek)

pH: 6.0 - 7.0 Hardness as $CaCO_3$: 5 ppm

Alkalinity as $CaCO_3$ 4 ppm

RESULTS:

D3

Concentration - 100%
Starting Time - 3:30pm, Mar.20
Running temp. - 9°C

Time	pH	O_2 (ppm)	% Survival
0 hr.	7.0	11.3	100
24 hr.	7.3	10.3	100
48 hr.	7.5	10.5	100
72 hr.	8.0	10.8	100
96 hr.	8.0	11.2	100

D4

Concentration - 100%
Starting Time - 3:30pm, Mar.20
Running Temp. - 9°C

Time	pH	O_2 (ppm)	% Survival
0 hr.	7.0	10.9	100
24 hr.	8.0	10.7	100
48 hr.	8.1	10.8	100
72 h4.	8.3	11.1	100
96 hr.	8.2	11.3	100

PASS/FAIL BIOASSAY DATA SHEET

SAMPLE: D-5 Ref. No. 1043-W

Description: Runoff Water

Date Collected: Mar.19 Received: Mar.19 Tested: Mar.20

TEST FISH: RAINBOW TROUT

Collected at: Steelhead Creek (Sun Valley Trout Hatchery)

Collected on: January 15,1974

Held in: Dechlorinated City Tap Water at 10°C

Acclimatization: 60 days

Percent Mortality in test fish 4 days prior to test none

DILUTION WATER: Dechlorinated City Tap Water (From Seymour Creek)

pH: 6.0 - 7.0 Hardness as $CaCO_3$: 5 ppm

Alkalinity as $CaCO_3$ 4 ppm

RESULTS:

D-5							
Concentration - 100%				Concentration -			
Starting Time - 3:30pm,Mar.20				Starting Time -			
Running temp. - 9°C				Running Temp. -			
Time	pH	O_2 (ppm)	% Survival	Time	pH	O_2 (ppm)	% Survival
0 hr.	7.0	10.7	100				
24 hr.	7.3	10.9	100				
48 hr.	7.4	11.2	100				
72 hr.	7.6	11.2	100				
96 hr.	7.5	11.5	100				

Environment Canada Environnement Canada

MEMORANDUM NOTE DE SERVICE

DATE September 13, 1974

FROM: DE: D. Morrison

TO: À: P. F. Scott

SEP 16 1974

14501

4861-78

0.20

SUBJECT: SUJET: AIRPORT SURFACE RUN-OFF SAMPLES COLLECTED SEPTEMBER 6, 1974 (1500-1700 hrs.)

Bioassay Samples: Sample No. 2999-15

A low tide of 9' at 1500 hrs. was not low enough to permit the collection of water as it passed from the ditches discharge pipe, therefore, samples were collected just above the tidal gates.

Two, five gallon surface samples were collected from sites numbered 1-5 on the accompanying map. The second five gallon sample was collected approximately 1-1/2 hours after the initial sample.

Other Samples - Sample No. 3000

Separate samples were taken at the time of the initial Bioassay sample collection, for Phenol, COD, metal and nutrient determinations. These samples were preserved as outlined in the E.P.S. sampling handbook.

If necessary, contact Ron Watts about the bioassays and John Davidson about the other samples.

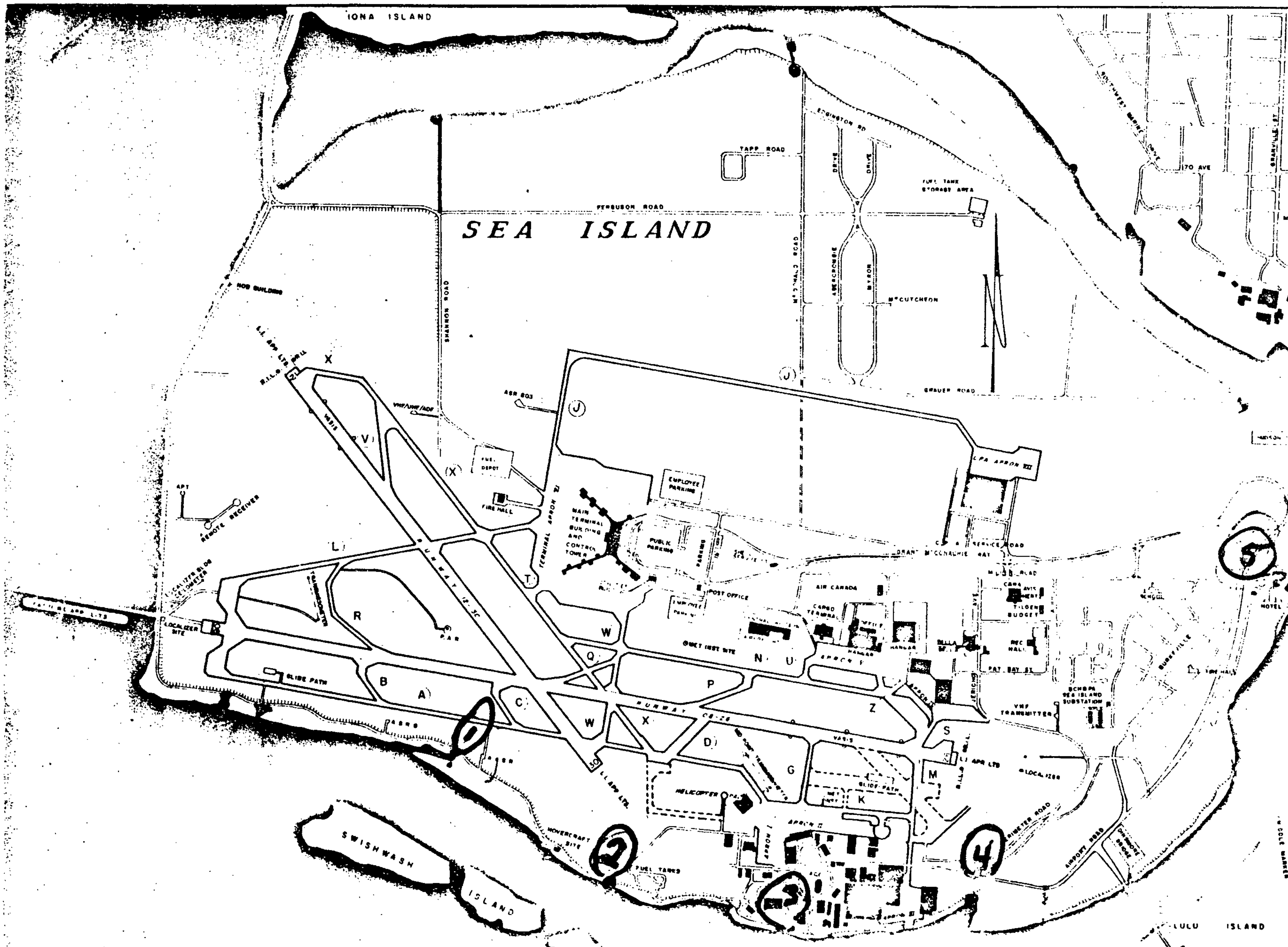
Don Morrison

Don Morrison

DM/jb
Att.

Remarks

Date



Canada
Ministry Of Transport

Vancouver International Airport

VANCOUVER INTERNATIONAL AIRPORT - SURFACE RUNOFF

Samples of September 6, 1974

TEST*	#1	#2	#3	#4	#5	UNITS
NO_3	.015	.043	.058	.043	.023	Mg N/l
NH_3	0.042	0.8	0.3	1.0	0.041	Mg LN
Ortho PO_4	.014	.012	.020	.26	.015	Mg P/l
Total PO_4	.064	.094	.14	.74	.055	Mg P/l
Phenols	< 0.015	< 0.015	< 0.015	0.030	< 0.015	Mg/l phenol
COD	23	124	45	60	< 20	Mg/l COD
Volatile Residue	60	134	106	51	17	Mg/l
96 hr. LC_{50}**	N/Est.					
Cd	< .01	< .01	< .01	< .01	< .01	
Cr	< .02	< .02	< .02	.07	.02	
Cu	.02	.01	< .01	.07	.02	
Pb	< .02	< .02	< .02	.02	< .02	
Zn	.01	No Data	< .01	.035	< .01	

** 96 hr. LC_{50} : Concentration lethal to 50% of the test population in 96 hours.

No deaths occurred in any sample

Test details given for station #1 (over) are identical for all remaining station

A PRELIMINARY REVIEW OF THE EFFECTS OF THE VANCOUVER INTERNATIONAL AIRPORT EXPANSION ON THE IONA ISLAND SEWAGE TREATMENT PLANT AND STURGEON BANK

FEBRUARY, 1975

ENVIRONMENT CANADA
ENVIRONMENTAL PROTECTION SERVICE
WATER AND LAND QUALITY GROUP
PACIFIC REGION

Vancouver, B.C.

TABLE OF CONTENTS

1. INTRODUCTION

This report identifies areas of concern related to the existing Iona Sewage Treatment Plant operations and discharge, and the impact that the various proposed concepts of the Vancouver International Airport expansion might have on this sewage discharge.

Suggested alternative discharge methods are outlined which should minimize the possible adverse changes to the existing estuary environment and local water quality. These suggested alternatives are based entirely on reviewing existing literature, including the report by L. F. Giovando[1] and would have to be confirmed by fairly extensive field studies to substantiate the ideas put forward.

In Figures 1 - 5, maps are presented indicating the various proposed runway concepts and the present areas of water quality degradation in the vicinity of the Iona Sewage Treatment Plant outfall. Appendix 1 provides background information on the Iona Sewage Treatment facilities, while Appendix 2 lists selected effluent data for the Iona Plant discharge.

2. BACKGROUND

The basis for the scenarios developed herein is a report entitled, "Environmental Studies at Iona Island," prepared for the Greater Vancouver Sewerage and Drainage District in July, 1973, by B.C. Research and supervised by I. K. Birtwell. It describes in detail the dispersion and effects of the Iona Island Sewage Treatment Plant effluent on Sturgeon Bank. The figure in Appendix 2 shows the general receiving area and the portion that has been "severely degraded" due to the sewage treatment plant effluent.

By placing acetate overlays of the five proposed airport expansion configurations over maps developed in Birtwell's report

1. L. F. Giovando, "The Proposed Expansion of the Vancouver International Airport: Some Oceanographic and Related Considerations," Marine Sciences Directorate Pacific Region, July, 1974.

which show the degradation associated with the Iona plant's effluent discharge, areas were identified that would be further restricted in terms of flushing and circulation of waters by the airport expansion. Remedial measures to ensure adequate dilution after construction were then formulated by Environment Canada based on (a) the above procedure, (b) examining additional information contained in Birtwell's report, as well as (c) past experience with other estuary sewage discharge situations. Recommendations are included for further water quality and water movement studies as a basic ingredient for any possible change or realignment to the Iona Sewage Treatment Plant and outfall.

3. IONA SEWAGE TREATMENT PLANT OPERATION

It is not presently known if, or when, secondary treatment facilities will be installed at Iona Island, or whether strict control of industrial discharges at source will be enforced by the respective member municipalities of the Greater Vancouver Regional District. Therefore, the proposed development concepts were examined for each of the following situations:

1. The sewage treatment facilities at Iona would not be significantly altered (i.e. continuation of primary treatment plus chlorination, no separation of storm and sanitary sewers).
2. The sewage treatment facilities would be upgraded to secondary treatment with no separation of storm or sanitary sewers.
3. Irrespective of whether primary or secondary treatment is provided at the sewage treatment plant, discharge controls inside the "factory fence" would be enforced to remove toxic chemicals for industries connected to sewer. (While heavy metals and industrial chemical losses to sewer may be a contributing factor to toxicity to fish of raw and primary treated sewage and to the efficacy of the S.T.P., it is not established that they are the only contributing factor. Recent reports indicate ammonia, detergents and

nitrites (substances essentially of domestic origin) are significant sources of toxicity to fish.)

It was also assumed that the location of the effluent outfall would not be markedly changed. It was recognized that the quantity of sewage discharged from Iona will increase because of added industrial activity and increases in population density.

It is highly probable that even with the "best" runway alignment, further significant environmental degradation of Sturgeon Banks will continue. Except for an estimate of volume and characteristics of the airport sewer flow, it has not been possible to quantify the contribution that the VIA expansion would make to further degradation of Sturgeon Bank. However, it should be stressed, that the present level of treatment at Iona is not consistent (e.g. during storms) and remedial action will be required.

Within the framework of these initial conditions, the following discussion on concerns related to the Iona Treatment Plant operation is developed. Figures 1 - 5 supplement this discussion with maps illustrating sediment degradation.

IONA ISLAND DISCHARGE GIVEN PRIMARY TREATMENT -
RUNWAY EXTENSION CONCEPT 1

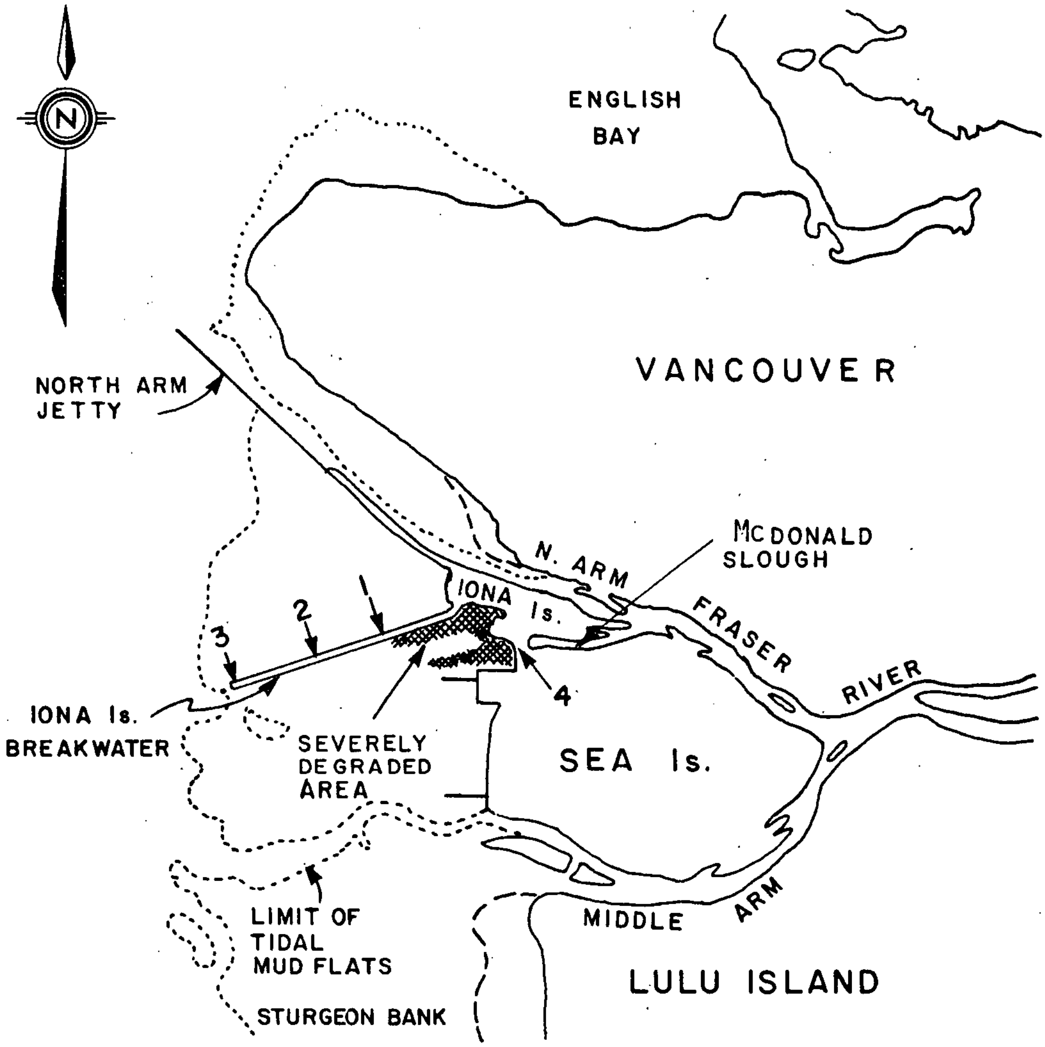
Adoption of Concept 1 would result in further confinement of the area presently bounded by the Iona Island breakwater, Iona Island and Sea Island; the degree of the confinement depending on the method of construction to be used for the airport runway approach lights. In any event, the resultant effect would be restricted flushing and circulation of waters within the semi-embayed area. Considering the findings outlined in the B.C. Research study, it is likely that the adverse effects of the existing sewage discharge on the local environment would be magnified. In this regard, the following paragraphs highlight possible remedial alternatives to the disposal problem:

1. Continuing the present method of disposal will likely prove to be unacceptable to regulatory authorities and a minimum requirement is a closed conduit to replace the existing discharge canal to transport the sewage beyond the entrance of the semi-embayed area (see Figure 1). To properly assess this alternative, additional detailed information would be necessary on the interaction of changing tides, river flow conditions, the effect of wind, to some extent the quantities of sewage being discharged and the dispersion with depth patterns that occur when sewage is mixed with saline water. Some estimate might be made of the effects on sewage disposal of the physical changes which have occurred in the estuary since the Rawn Report[1] were implemented.

2. A second alternative would be to provide a closed conduit to mid-way between the entrance of the embayed area and the end of the jetty (see Figure 1). The sewage discharge would be relocated into more open waters, hopefully permitting more rapid dispersion and mixing. The effect of the discharge on the confined waters close to shore are unpredictable and would depend on whether the area remains enclosed or a channel is opened from McDonald Slough. This would require further study as previously mentioned.

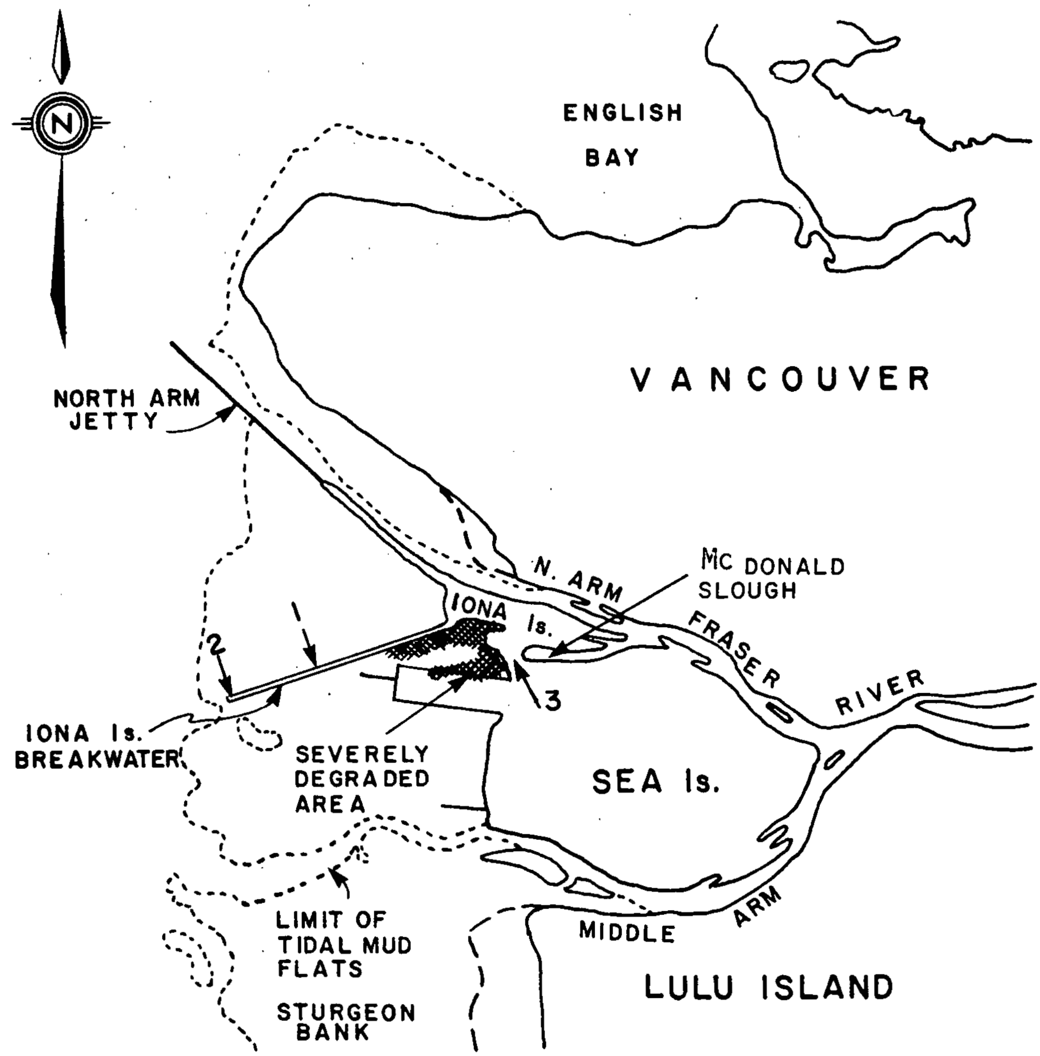
3. A third alternative would be to extend a closed conduit to, or beyond, the end of the jetty with either discharge to depth or shallow waters. The provision of a diffuser also merits consideration (see Figure 1). The construction of an extended outfall would likely remove the effects of the discharge from the Sturgeon Bank area.

1. Greater Vancouver Sewerage and Drainage District Consolidation of Amendments to the Rawn Report, April 1970.



1. CLOSED CONDUIT TO ENTRANCE OF EMBAYED AREA.
2. CLOSED CONDUIT TO MID-WAY BETWEEN THE ENTRANCE OF THE EMBAYED AREA AND THE END OF THE JETTY.
3. CLOSED CONDUIT TO END OF JETTY.
4. POSSIBLE TIDAL GATE CONNECTING MC DONALD SLOUGH AND THE INTERTIDAL AREA OFF SEA ISLAND TO PERMIT CIRCULATION AND FLUSHING.

FIGURE 1 - RUNWAY EXTENSION CONCEPT 1
LAND CREATED: 70 ACRES

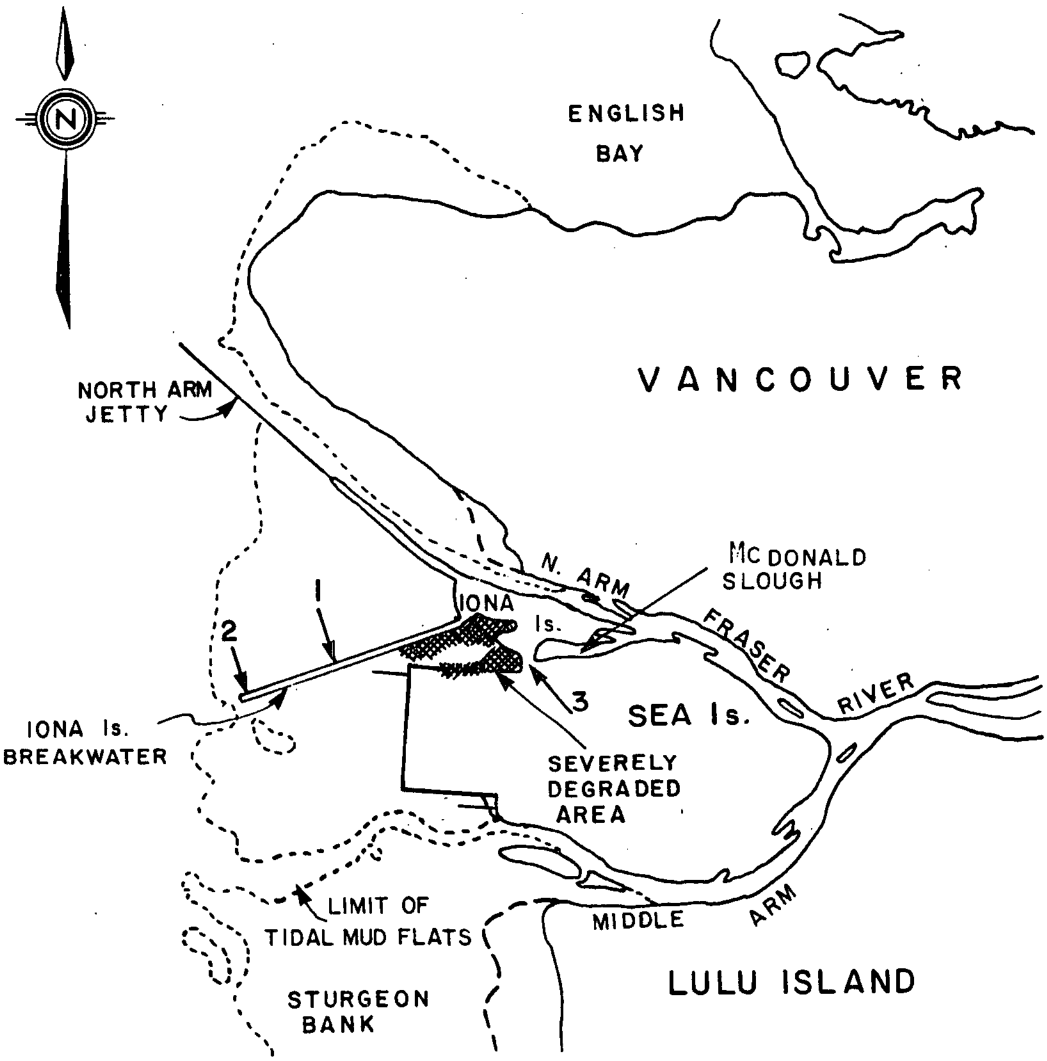


1. CLOSED CONDUIT TO MID-WAY BETWEEN THE ENTRANCE OF THE EMBAYED AREA AND THE END OF THE JETTY.

2. CLOSED CONDUIT TO END OF JETTY.

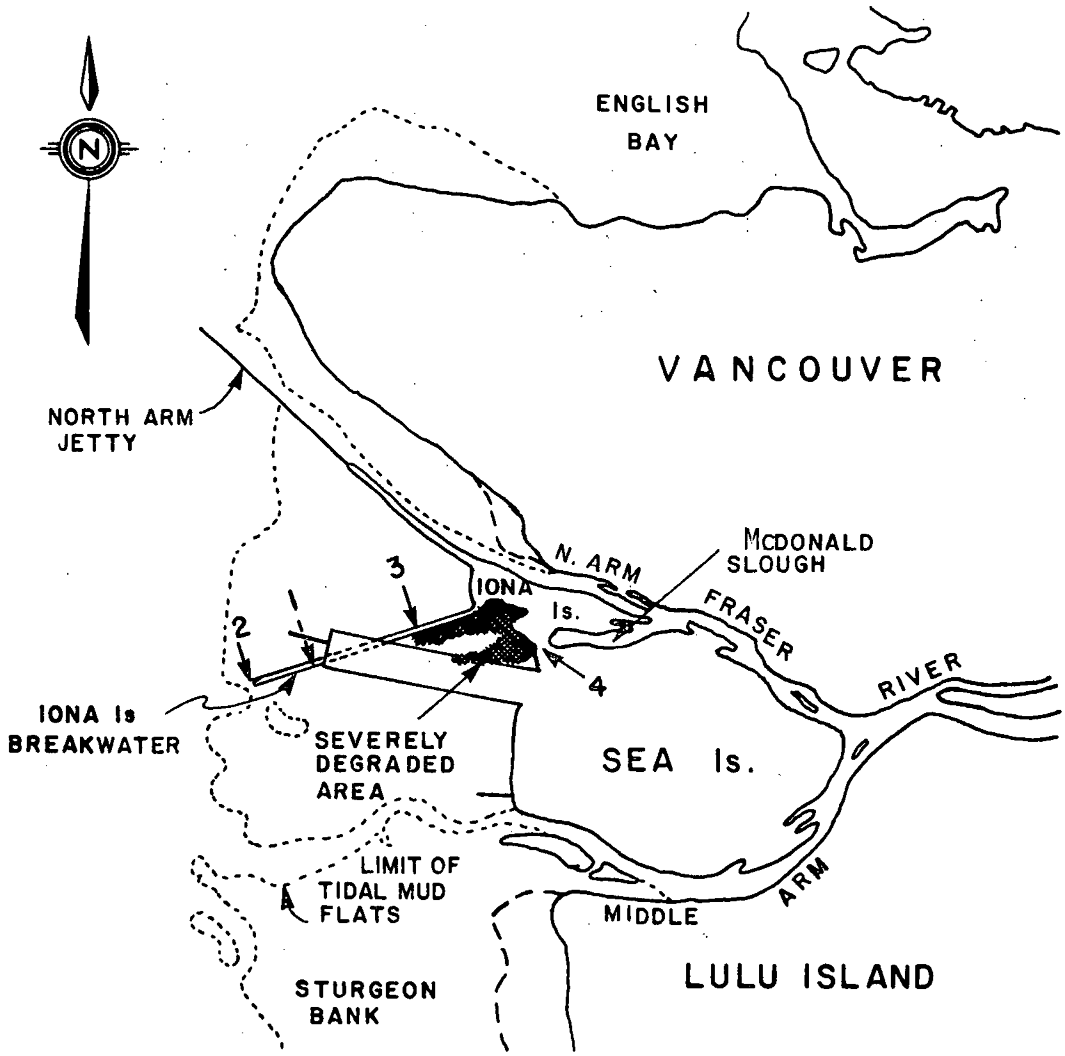
3. POSSIBLE TIDAL GATE JOINING McDONALD SLOUGH AND THE INTERTIDAL AREA OFF SEA ISLAND TO PERMIT CIRCULATION AND FLUSHING.

FIGURE 2 - RUNWAY EXTENSION CONCEPT 2
LAND CREATED: 235 ACRES



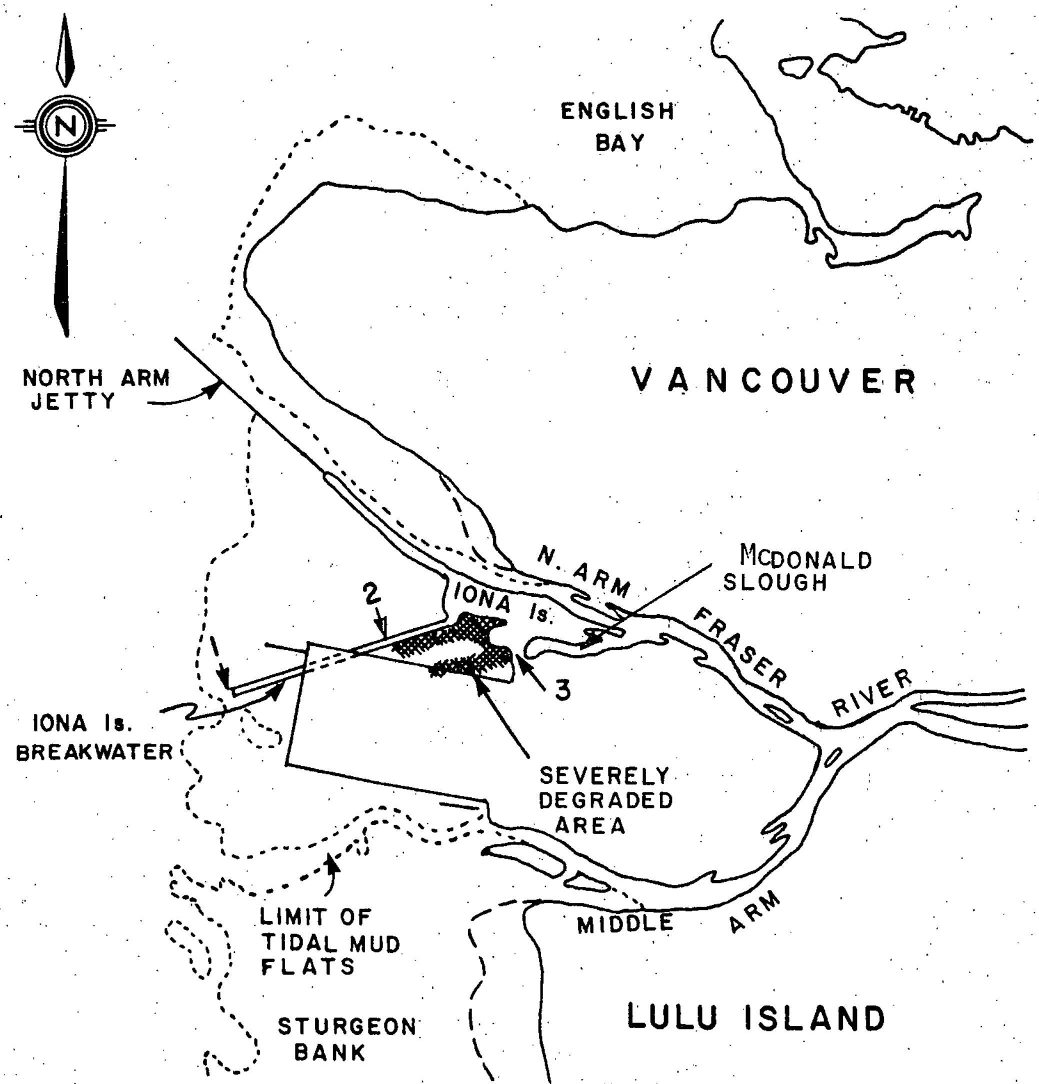
1. CLOSED CONDUIT TO MID-WAY BETWEEN THE ENTRANCE OF THE EMBAYED AREA AND THE END OF THE JETTY.
2. CLOSED CONDUIT TO END OF JETTY.
3. POSSIBLE TIDAL GATE CONNECTING MC DONALD SLOUGH AND THE INTERTIDAL AREA OFF SEA ISLAND TO PERMIT CIRCULATION AND FLUSHING.

FIGURE 3 - RUNWAY EXTENSION CONCEPT 3.
LAND CREATED: 755 ACRES



1. CLOSED CONDUIT THROUGH RUNWAY FILL AND TERMINATING IN THE AREA INDICATED BY ARROW.
2. CLOSED CONDUIT TO END OF JETTY.
3. POSSIBLE OPENINGS IN JETTY TO PERMIT CIRCULATION AND FLUSHING.
4. POSSIBLE TIDAL GATE CONNECTING McDONALD SLOUGH AND THE INTERTIDAL AREA OFF SEA ISLAND TO PERMIT CIRCULATION AND FLUSHING.

FIGURE 4 - RUNWAY EXTENSION CONCEPT 4.
LAND CREATED: 600 ACRES



1. CLOSED CONDUIT TO END OF JETTY.

2. POSSIBLE OPENINGS IN JETTY TO PERMIT CIRCULATION AND FLUSHING.

3. POSSIBLE TIDAL GATE CONNECTING MCDONALD SLOUGH AND THE INTERTIDAL AREA OFF SEA ISLAND TO PERMIT CIRCULATION AND FLUSHING.

FIGURE 5 - RUNWAY EXTENSION CONCEPT 5
LAND CREATED: 500 ACRES

Prior to adoption of any of these proposals, an evaluation of the effect of the sewage discharge on the bacterial water quality of the bathing beaches in English Bay must be conducted.

IONA ISLAND DISCHARGE GIVEN PRIMARY TREATMENT - RUNWAY EXTENSION CONCEPTS 2 AND 3

Adoption of either Concept 2 or 3 would result in more severe confinement of the area bounded by the Iona Island breakwater, Iona Island and McDonald Causeway as compared to Concept 1. Similar comments or remedial alternatives would apply for Concepts 2 and 3 as have been detailed for Concept 1, except that the provision of a closed conduit to the mouth of the embayed area would likely prove to be unsatisfactory. It would be essential to remove the sewage discharge point to at least mid-way along the Iona jetty to prevent degradation of the waters within the embayed area, as illustrated in Figures 2 and 3.

IONA ISLAND DISCHARGE GIVEN PRIMARY TREATMENT - RUNWAY EXTENSION CONCEPT 4

Adoption of Concept 4 would result in the complete enclosure of the area bounded by Iona Jetty, Iona Island and McDonald Causeway. As a minimum requirement, a closed conduit from the Iona treatment facilities through the runway extension fill to open tidal waters would be necessary. The comments previously developed for an outfall mid-way along the jetty or an extended outfall would not apply.

IONA ISLAND DISCHARGE GIVEN PRIMARY TREATMENT - RUNWAY EXTENSION CONCEPT 5

Because of (a) the enclosed nature of the shoreline area bounded by the Iona jetty, (b) the limit of fill for the runway extension, and (c) the complete enclosure of the area north of the runway extension, it is likely that the only alternative would be to construct an extended outfall as previously described for Concept 1. (See Figure 5.)

IONA ISLAND DISCHARGE GIVEN SECONDARY TREATMENT - RUNWAY EXTENSION CONCEPTS 1 THROUGH 5

Should it be decided to upgrade the treatment facilities at Iona to provide secondary treatment, the same lines of reasoning as developed for primary treated sewage would apply, with the realization that the discharge would be of better quality in terms of reduced organics, suspended materials and partial removal of toxic constituents such as heavy metals and organic chemicals. However, even though the discharge would be of better quality, any of the airport expansion concepts will affect the circulation and flushing of the inter-tidal waters; as a result, construction of a closed conduit to the mouth of the semi-embayed area shown in Figure 1 would be a minimum requirement.

IONA ISLAND DISCHARGE GIVEN PRIMARY OR SECONDARY TREATMENT / INDUSTRIAL DISCHARGE CONTROLS - RUNWAY EXTENSION CONCEPTS 1 THROUGH 5

Another aspect which deserves attention, beyond the choice of whether primary or secondary treatment is provided, is the possible development and enforement of "at the source controls" for industrial discharges. It is well documented[2] that specific industries contribute significantly to the pollution load and toxicity characteristics of municipal sewage. In order to control or eliminate the continuing problems associated with industrial discharges, sewer use restrictions should be applied and enforced for certain industrial wastes from, for example, electroplaters, refineries, and chemical producers prior

2(a) "Southern California Coastal Waters Findings," a paper presented to the Second International Study Congress on Marine Waste Disposal, San Remo, Italy, December, 1973, by J. D. Isaacs, Scripps Institute of Oceanography.

(b) "A study on Wastewater Characeristics of Greater Vancouver Sewage Treatment Plants and Major Sewers," E.P.S. Surveillance Report, EPS 5-PR-73-11, December 1973.

(c) "Source of Metals in New York City Waste Waters," by L. A. Klein et al., Dept. of Water Resources, City of New York, January 21, 1974.

to their discharge to sewer. This would result in an upgrading of the sewage feed to the Iona Sewage treatment plant and the effluent quality regardless of the choice of runway extension concept. This would also likely slow down the rate of expansion of the "severely degraded" discharge area.

4. CONCLUSIONS

4.1 Irregardless of possible airport expansion or other developments in the immediate area, continuing degradation of Sturgeon Banks appears inevitable in light of the study by B.C. Research. Some modification to the existing treatment plant and outfall will have to be considered.

4.2 Flow and analytical characteristics of the V.I.A. sewage component to the Iona Island Sewage Treatment Plant needs to be monitored. Bioassays should be carried out to determine the toxicity of this sewage stream. If this information indicates a problem exits, then further work should be done to eliminate the source of toxicity.

4.3 A review of future upgrading necessary to handle (or reroute) storm water at the Iona Island Sewage Treatment Plant should be undertaken. This will ensure adequate effluent treatment of the sewage for a greater portion of the year.

4.4 Of the five runway concepts under consideration, Concept 1 causes the least amount of disruption to the existing sewage dispersion mechanism.

4.5 Any decision to extend the existing outfall by means of a conduit to alleviate restricted flushing and circulation should not be done without an intensive study of the area.

4.6 Giovando recommends in his report that a tidal flood gate be installed on McDonald Causeway to allow fresh water flushing from the North Arm of the Fraser River to Sturgeon Banks in the vicinity of the outfall. While improved flushing may be achieved some undesirable silt deposition might result in McDonald Slough and in the foreshore area around the existing sewage outfall. This aspect should be studied further.

4.7 The consideration of an extended outfall as a possible means of alleviating the effects of the airport expansion should be a responsibility of the proponents (i.e. Ministry of Transport). The question of upgrading the treatment at the Iona Sewage Treatment Plant, while important, would not independently alleviate the effects of the proposed airport expansion.

5. RECOMMENDATIONS

1. Several studies have recommended that the proposed runway, if constructed, be contained within the Sea Island dyke. This, of course, would have no discernable effect on sewage dispersal and is the most satisfactory design.

2. If any expansion of Vancouver International Airport onto Sturgeon Banks is to occur, the choice should be Concept 1 to minimize disruption to sewage dispersion, if no upgrading of the treatment plant or extension of the outfall occurs.

3. If extension of the outfall is considered in conjunction with any of the five MOT concepts a joint study (MOT, GVSDD, DOE, PCB) be launched to develop the criteria for selecting an acceptable outfall.

3. Pre and Post airport expansion studies be carried out to document the effect and magnitude of the degradation and zone of influence of the Iona Island Sewage Treatment Plant discharge and to generate the necessary data for corrective measures if incremental environmental damages do result.

Appendix 1

Iona Island Sewage Treatment Plant

Iona Island Sewage Treatment Plant

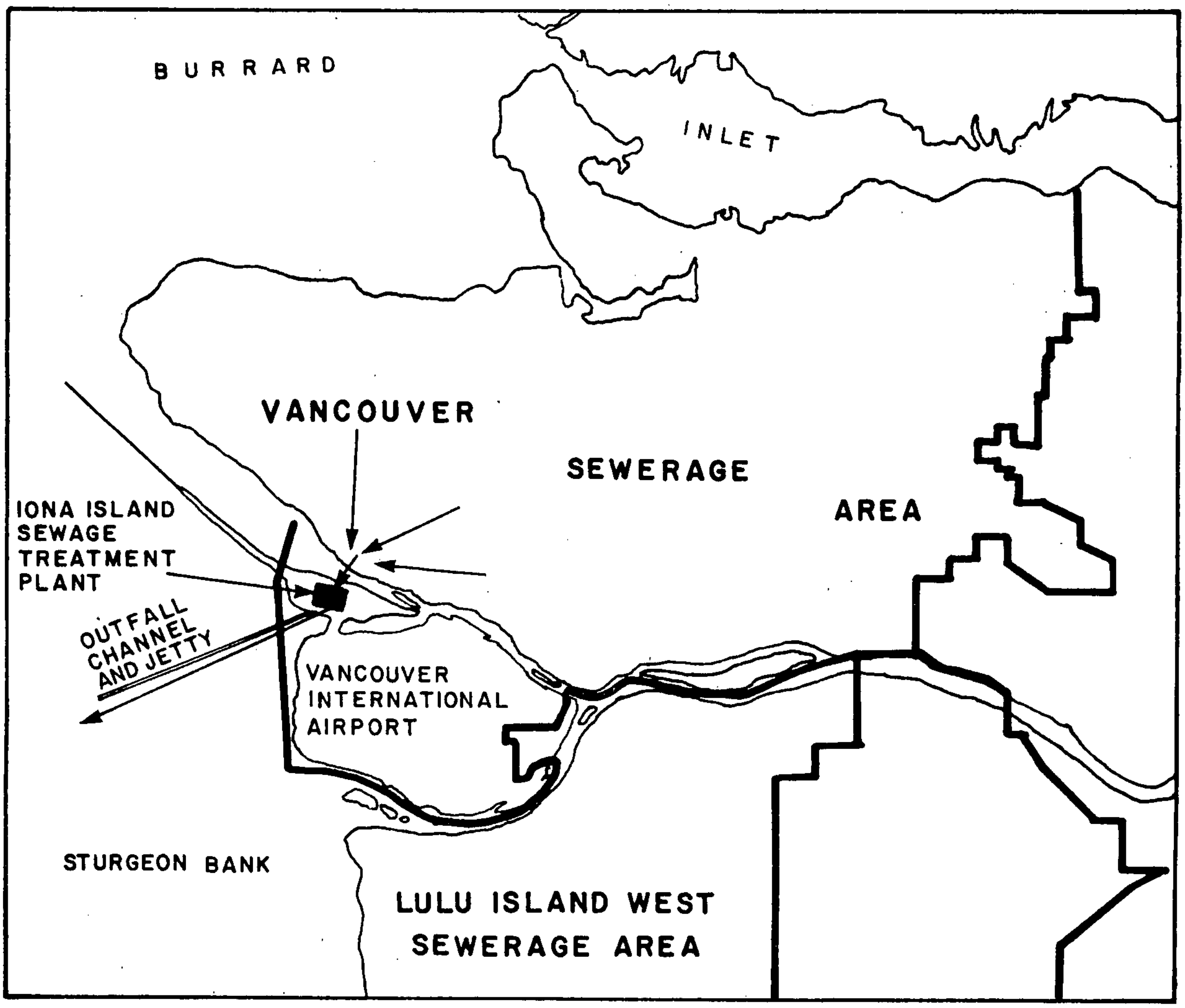
The location of the treatment plant is as indicated on the accompanying map. The plant was constructed and put into service in the early 1960's to treat sewage collected from the Vancouver Sewerage Area. Three large trunk sewers feed into the treatment facilities and these sewers collect both domestic wastewater and industrial effluent, plus storm water runoff. The plant itself provides primary treatment and the plant process in sequential order entails:

1. prechlorination
2. screening
3. grit removal
4. preaëration and fine grit removal
5. sedimentation and slude removal
6. postchlorination and retention in a chlorine contact lagoon prior to discharge.

The sewage treatment plant treats the waste from a population of 320,000 people with a dry weather flow of 65 cfs. This discharge will double in volume in the foreseeable future.

Additional pertinent design data are listed in the accompanying table. A schematic of the treatment system is attached.

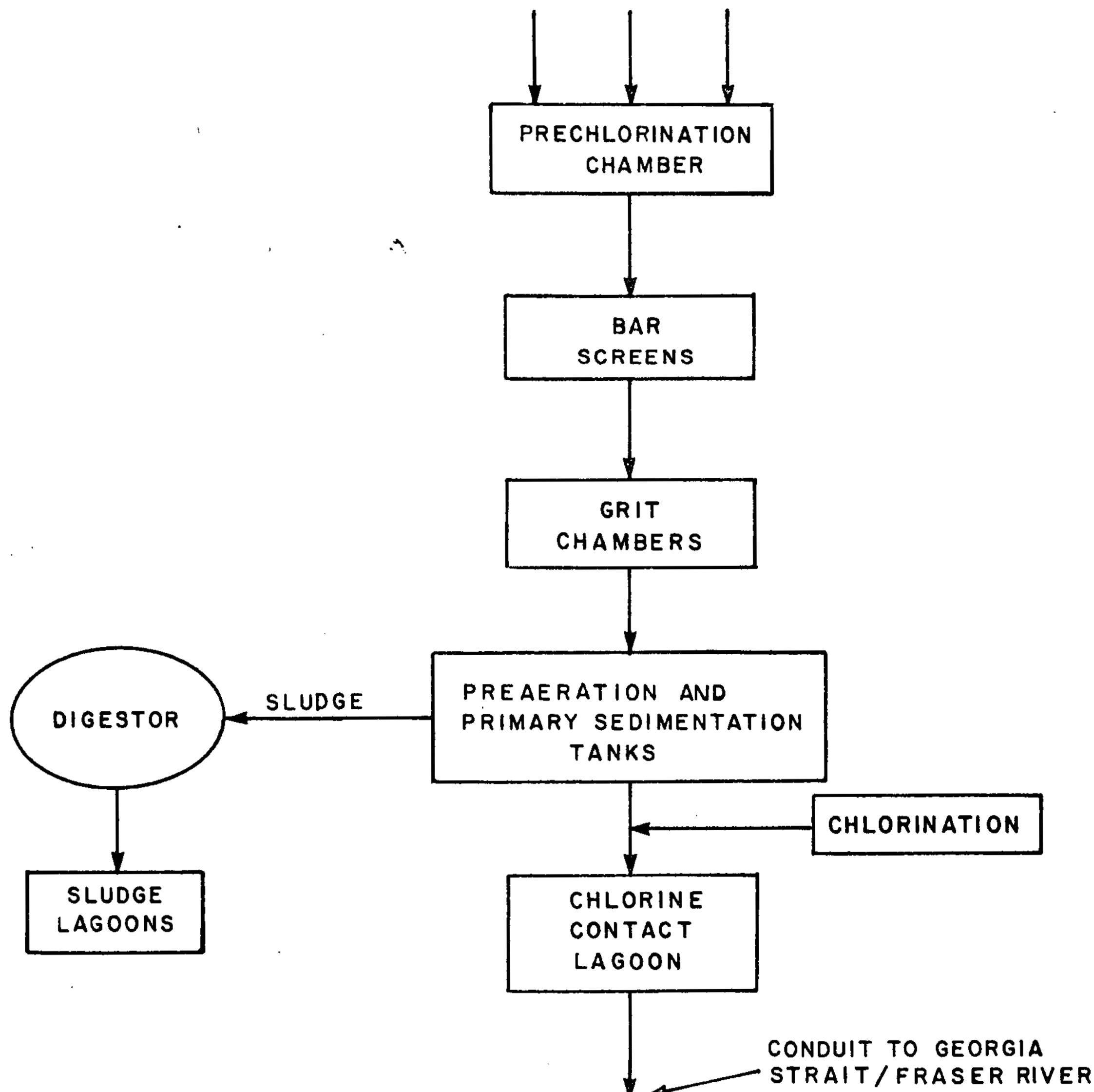
With reference to the plant operation, the trunk sewers connected to the Iona STP collect wastewater from combined sewers. Due to this fact recorded flows vary considerably and at times are excessive. When flows to the plant exceed its design capacity, by-pass gates are opened. The by-passed portion of flow receives no aeration, settling or chlorination.



APPENDIX I-
LOCATION OF IONA ISLAND SEWAGE TREATMENT PLANT

APPENDIX I -

FLOW DIAGRAM IONA ISLAND SEWAGE TREATMENT PLANT



Appendix 2

Selected Data for Iona Sewage Treatment Plant

Wastewater Characteristics of Iona Island Sewage Treatment Plant

During 1971 and 1972, Environement Canada undertook a one year study in the greater Vancouver area to document wastewater parameters specifically related to toxicity, heavy metals, and selected chemical contaminants.[1] Included in this study was the monitoring of the Iona Island Sewage Treatment Plant discharge.

The results of the bioassay determinations and chemical analyses are listed in the accompanying tables. A summary of the results for heavy metal concentrations are also listed.

The Iona Sewage Treatment Plant operates under permit as required by the Pollution Control Act, 1967. Pertinent information regarding the allowable quality and quantity of wastewater, as stipulated in the permit issued November 24, 1971 is listed below:

Average 24 hour flow	- 70 million gallons
Maximum flow	- 625 cfs
Suspended solids	= 70 mg/l
BOD_5	= 100 mg/l
PH range	= 6-8
Temperature	= 50-70° F

Receiving Water Studies - Iona Island Sewage Treatment Plant

In a recent study conducted by B.C. Research[2] on the effects of the Iona Island Sewage Treatment Plant discharge on the local water quality and shoreline environment, the findings principally indicate that:

(i) There is an accumulation of deposits of sewage origin in the embayed area bounded by the McDonald Causeway, Iona Island and the Iona Jetty.

(ii) The water quality in the immediate area of the open sewage conduit is measurably affected.

The area designated as severely degraded is shown on the accompanying map (Figure 1).

1. Tanner, et al, A Study on Wastewater Characteristics of Greater Vancouver Sewage Treatment Plants and Major Sewers, Environmental Protection Service, December, 1973.

2. Birtwell, I.K. et al, Environmental Studies at Iona Island, B.C. Research, July, 1973

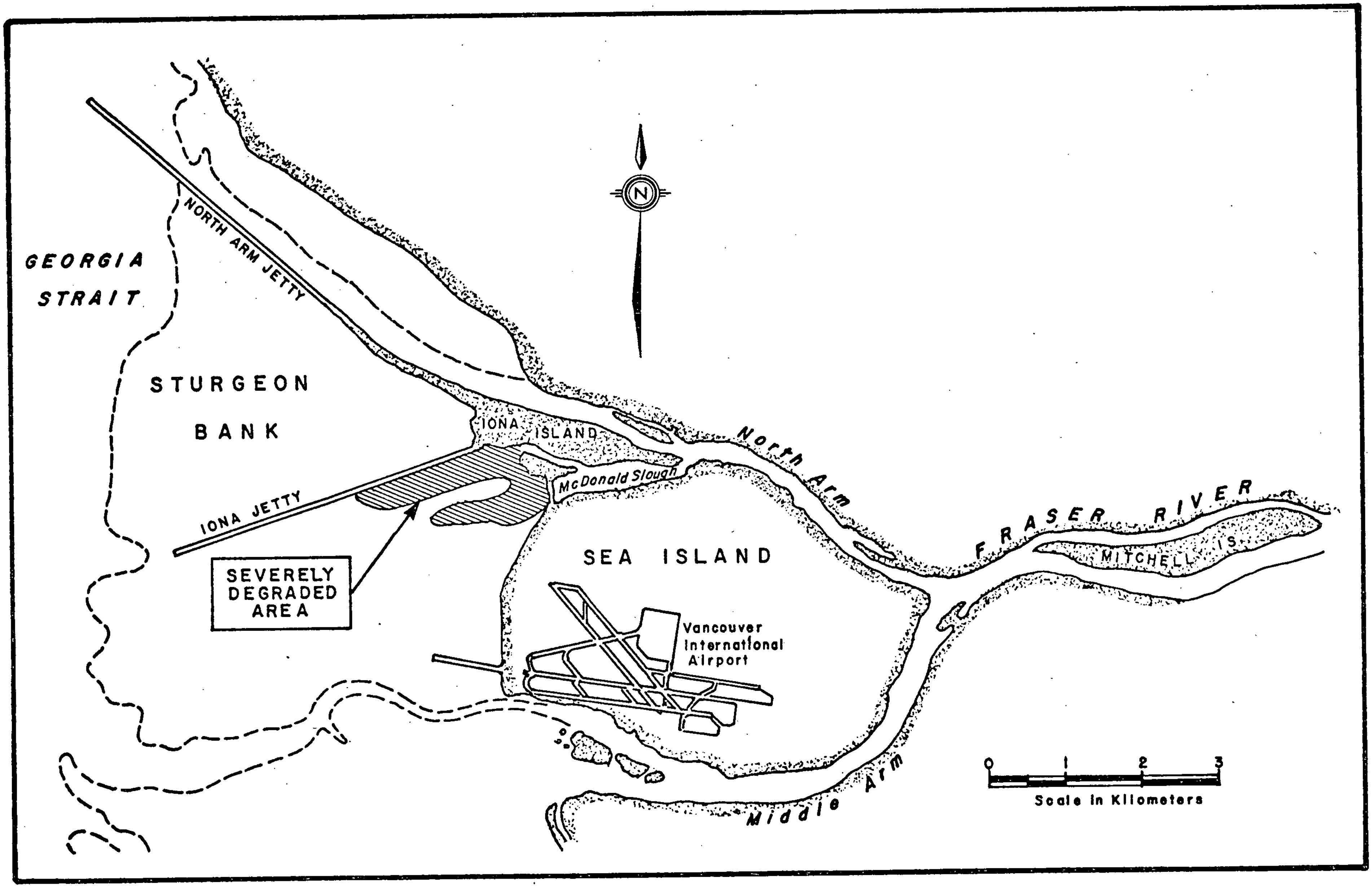


FIGURE I MAP SHOWING SEVERELY DEGRADED AREA
(From B.C. Research, 1973)

TABLE I

Design Data Iona Island Sewage Treatment Plant

TRIBUTARY POPULATION	
Initial Design	320,000
Ultimate Design	640,000

SEWAGE TREATMENT PLANT DESIGN CRITERIA	FLOW (in cu. ft. per second)
Average Dry Weather Flow	65
Initial Design	65
Ultimate Design	130
Minimum Dry Weather Flow	
Initial Design	20
Ultimate Design	85
Maximum Dry Weather Flow	
Initial Design	100
Ultimate Design	200
Peak Wet Weather Flow	625

TABLE 2

Iona Sewage Treatment Plant
Effluent Bioassay Determinations

Bioassay Sample No.	Date	Toxicity (TLm_{96})	Fish Loading Density (gm/L)	Average Flow (cfs)	Precipitation (inches)
1	02/02/71	Non-toxic	11.6	-	0
2	28/06/71	61%	4.6	85.6	0.07
3	13/07/71	69%	4.4	78.2	0
4	12/08/71	86%	6.8	108.0	0
5	26/08/71	Not established 5% mortality @ 100%	6.8	71.7	0
6	27/09/71	24%	7.4	127.2	Trace
7	26/09/71	Non-toxic	16.8	183.9	1.25
8	11/11/71	Non-toxic	5.0	234.9	0.13
9	29/11/71	Non-toxic	7.6	173.0	0.42
10	15/12/71	Non-toxic	8.0	150.0	0.04
11	13/01/72	Non-toxic	9.8	127.6	Trace
12	31/01/72	Non-toxic	9.5	101.5	0
13	15/02/72	Non-toxic	10.7	255.8	0.42
14	02/03/72	Non-toxic	10.2	164.4	0.13
15	16/03/72	Non-toxic	12.0	194.4	0.43
16	04/04/72	Non-toxic	15.4	195.6	0
17	20/04/72	Non-toxic	14.6	145.4	Trace
18	05/05/72	75%	18.4	105.3	0
19	24/05/72	Non-toxic	0.9	88.0	0.01
20	08/06/72	Non-toxic	1.6	97.2	0

TABLE 2

1. Grams of fish per litre of bioassay solution. It should be noted for high fish loading densities (i.e. greater than 0.5 - 1 gm/l) the toxicity of the sample may have been underestimated.

2. Data from Atmospheric Environment Service, readings taken from gauging station located about two miles southeast of the Iona Island Sewage Treatment plant.

TABLE 3

Iona Sewage Treatment Plant

Chemical Analyses

Effluent Concentrations (mg/l)

Sample #	Date	Oil	Phenol	Ammonia-N	Cyanide	Average Flow (cfs)
1	29/11/71	16.60	0.015	9.10	-	173.0
2	29/12/71	36.90	0.306	7.10	-	123.0
3	13/01/72	30.70	0.015	7.10	0.003	127.6
4	31/01/72	30.24	0.015	23.30	N/D	101.5
5	02/03/72	1.80	-	-	-	73.1
6	20/04/72	62.25	-	-	-	145.4
7	24/05/72	10.90	-	-	-	88.0
8	02/06/72	20.20	-	-	-	97.2

TABLE 4

Summary of Results of Heavy Metal Concentrations in Iona Island STP Discharge

	Total No. of Samples		Concentrations of heavy metal not considered acutely toxic to aquatic life.[1]
Cd	63	100% of samples recorded readings less than the detection limit	0.03 mg/l
Cr	62	66% of samples recorded readings in the range N/D-0.05 mg/l. 94% of samples recorded readings ≤ o.10 mg/l	0.05 mg/l
Ni	62	47% of samples recorded readings in the range N/D-0.05 mg/l. 95% of samples recorded readings ≤ 0.10 mg/l	1.0 mg/l
Pb	347	63% of samples recorded readings in the range N/D-0.05 mg/l. 95% of samples recorded readings ≤ 0.10 mg/l	0.1 mg/l
Cu	98	No samples recorded readings less than 0.05 mg/l. 37% of samples recorded in the ranges 0.05 - 0.10 72% of samples recorded readings in the range 0.05-0.15 mg/l 96% of samples recorded readings in the range 0.05-0.20 mg/l	0.02 mg/l
Zn	348	9% of samples recorded readings in the range N/D-10.05 mg/l. 44% of samples recorded readings > 0.10 mg/l. 75% of samples recorded readings < 0.15 mg/l. 90% of samples recorded readings < 0.20 mg/l	0.1 mg/l
Fe	25	100% of samples recorded readings < 1.0 mg/l	0.2 mg/l

TABLE 4 (continued)

The toxicity of metals to aquatic life is dependent on the water hardness and the concentrations, and if often a function of other metals also.*

* Standard Methods 13th Edition (1971) for Examination of Water and Wastewater.

1 A more recent report prepared by the American Fisheries Society indicates that the following concentrations under some conditions are considered lethal to aquatic life: Cd = 0.003 mg/l; Cr = 0.05 mg/l; Cu = 0.01 mg/l; Pb = 0.01 mg/l; Zn = 0.01 mg/l.