WATER RESOURCES STUDY

of the

PROVINCE OF NEWFOUNDLAND AND LABRADOR

for

ATLANTIC DEVELOPMENT BOARD

Volume SEVEN

STUDY AREAS

THE SHAWINIGAN ENGINEERING COMPANY LIMITED
JAMES F.MacLAREN LIMITED

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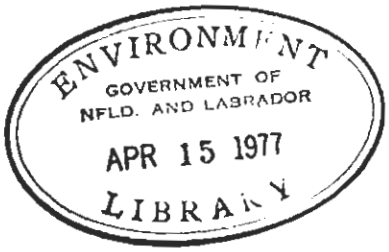
The Shawinigan Engineering Company Limited
James F. MacLaren Limited



VOLUME SEVEN

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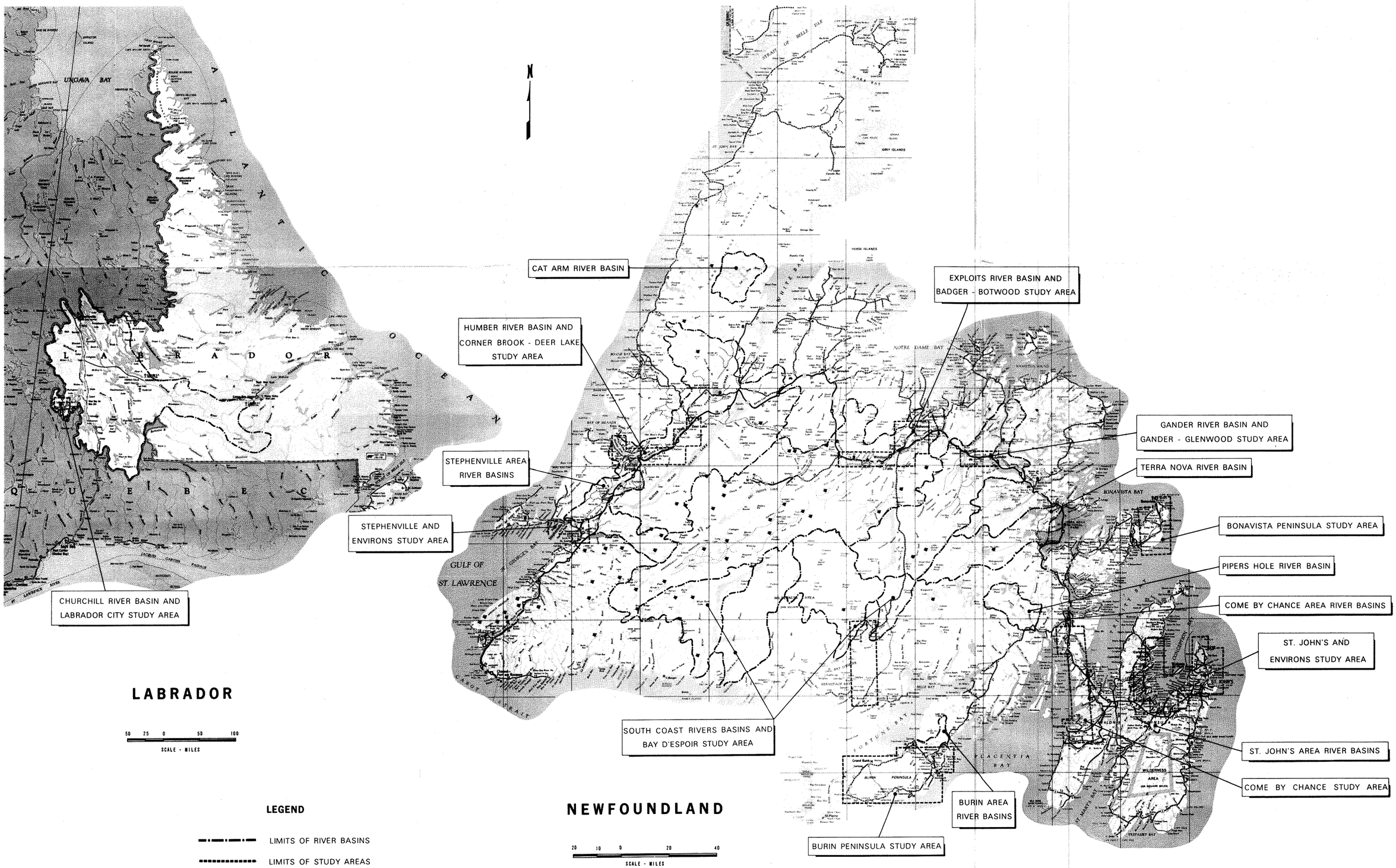
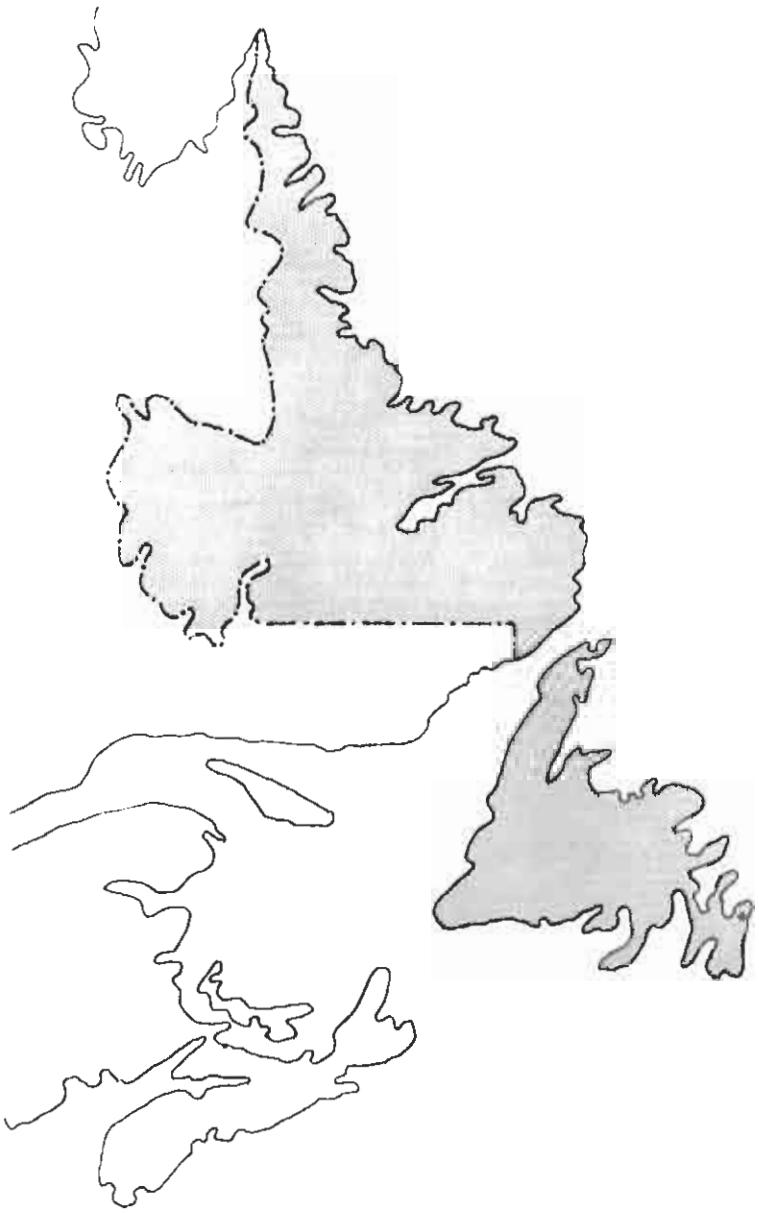


LEGEND

LIMITS OF RIVER BASINS

LIMITS OF STUDY AREAS

NEWFOUNDLAND AND LABRADOR RIVER BASINS AND STUDY AREAS



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STUDY AREA - ST. JOHN'S AND ENVIRONS

PART I - ST. JOHN'S AND ENVIRONS STUDY AREA

1 NATURAL CONDITIONS

1.1 Physiographic Conditions

The St. John's study area embraces the northeasterly portion of the Avalon Peninsula around Conception Bay, as illustrated in Figure 1-1. For the purposes of this report, drainage basins of several small rivers discharging into Conception Bay, and the basins of those rivers discharging into the Atlantic Ocean between Cape St. Francis and the Mobile River are also included in the discussion of the study area.

The topography of the study area is shown in Figure 1-1. It is characterized by 300 to 500 foot high cliffs along the Atlantic Ocean and Conception Bay shores with the ground rising inland to approximately 500 to 800 feet above sea level. The west coastline of Conception Bay contains several broad fjord-like inlets.

The bedrock of the area consists largely of Pre-Cambrian materials, mostly sedimentary in origin but with some volcanic deposits at the southerly and northeasterly parts of Conception Bay. One major igneous intrusion in the area is the Holyrood granite. In the southeastern quadrant of Conception Bay, between Seal Cove and Topsail and on Bell Island there are lower Paleozoic sediments. Over most of the area there is a substantial cover of surficial materials except at Cape St. Francis and along the western shoreline of Conception Bay where it is thin or absent.

Thick deposits of end moraine occur in the southwestern part of the study area. Between Manuels and Seal Cove and to the south of Bay Roberts there are substantial deposits of sand and gravel.

Of the total area included in the St. John's River basin (692 square miles) 53 square miles are covered by lakes and 11 by marshland. The forest growth in the northeastern arm of the Avalon Peninsula, east of Fox Trap, and the area between Holyrood and Goulds in the southwest quadrant of Conception Bay is predominantly balsam fir and black spruce. The growth of these trees is generally stunted owing to the low fertility of the soils. The square grid distribution of forested, barren, and bogland areas, and areas covered by lakes, is indicated in Figure 1-2.

The climate of the Avalon Peninsula is somewhat more temperate than the remainder of the Island, being modified by its proximity to the sea. The mean annual temperature is 40 deg F; the average yearly precipitation is 59 inches; and the average annual evaporation is 15 inches. The areal distribution of mean annual temperature, precipitation, and evaporation in the study area is shown in Figure 1-3. Other climatological characteristics pertinent to the water resources study, as obtained from the relationships detailed in Volume Two A, Part II, are given in tabular form in Table 1-1.

1.2 Water Resources

1.2.1 Surface Water

The hydrographic network of the St. John's River basin area is shown in Figure 1-1. It will be noted that the area is divided into several narrow river basins. The largest of these is Raymond Brook with a drainage area of 52 square miles. It will also be noted that the streams flow through a series of lakes and ponds and are generally of short length.

The hydrological characteristics of the area have been derived using the approach described in Volume Two A, Part IV and are subject to the limitations outlined therein. Of the five sources of data on measured runoff within the river basin, only Station 2ZM6 on the North-east Pond River is a true river gauging station. A gauge has recently been installed on the Broad Cove River. The other four stations are located at flow recording hydro-electric generating stations. A check of the results of the projections of the area's hydrological characteristics was obtained from river gauging station 2ZK1 - Rocky River near Colinet. The average annual runoff for the rivers in the area was determined as 44 inches per annum (about 3.3 cfs), with the range and variation of the runoff being indicated in Figure 1-3.

The other significant hydrological characteristics of the river basin have been synthesized from the generalized relationships and graphs presented in Volume Two A, Part IV, and are summarized for the study area in Table 1-2.

The quality of the surface waters in the study area has been affected to some extent by human activity. However, most of the water may be accepted as being in a "natural" condition, except in the relatively densely populated area of St. John's and in those basins whose regimes have been disturbed by power developments and storage dams.

All of the surface waters analyzed are low in dissolved solids, containing from 0.5 to 1 total equivalents per million. Two exceptions are Quidi Vidi Lake and Waterford River both of which are polluted. The surface waters are very soft with generally 5 to 10 mg/l hardness as $CaCO_3$ but with a maximum of 21 mg/l for the North Arm River and pH ranges from 5.7 to 7.0. Turbidities are normally less than 5 units. Colour varies considerably; in recent analyses results indicated from 0 to 5 units for St. John's water supply and others, and from 10 to 20 units at Bannerman Lake, the source of supply for Harbour Grace. However, the colour of the waters of this study area is generally lower than that for other areas on the Island. Data on oxygen consumed by permanganate is limited but it does indicate a range from 0.2 to 5.3 mg/l for a series of samples obtained in the area during the period of 1958 to 1966.

With the exception of North Arm River, all the waters sampled appear to indicate a predominance of Na^+ and Cl^- - owing to the proximity of the sea and its windblown salt spray, and the low total dissolved solids content of the waters.

Of the fourteen samples of the St. John's water supply collected over the period 1956 to 1966, two taken from the raw water supplies at Windsor Lake and Petty Harbour Long Pond indicated concentrations of 0.37 and 0.50 mg/l respectively of iron. Both of these amounts are in excess of the 0.3 mg/l maximum recommended in the United States Public Health Service (USPHS) drinking water standards. It has been necessary to use quality standards of the USPHS since neither Provincial nor Federal standards have been established. Another sample obtained in October 1962 from Petty Harbour Long Pond indicated a concentration of manganese in the water of 0.10 mg/l as compared to a USPHS standard of 0.05 mg/l. The iron and manganese concentrations of the remaining samples were well below the USPHS recommended limits.

Of the four samples taken from the water supply for Carbonear between 1956 and 1966, one sample, taken in June 1962, indicated a concentration of iron of 1.05 mg/l. The mineral concentrations of the other samples were below the maximum USPHS recommended limits.

Of three samples taken from the water supply for Harbour Grace (Bannerman Lake) only one, which was obtained in June 1966, exceeded the USPHS recommended limit for iron concentration with an amount of 0.48 mg/l.

The only sources of information on bacteriological quality of untreated waters in the study area are the Newfoundland Department of Health analyses on fresh water swimming areas, and data collected in the grab sampling program executed by Shawinigan-MacLaren in the fall of 1967. The Department of Health's analyses are not applicable in that they were taken strictly to determine the public health suitability of waters in built-up areas and provincial parks for swimming. The Shawinigan-MacLaren grab samples indicated that even in cases where pollution would be expected to be light, no counts of less than 240 coliform per 100 ml were found. In the absence of human pollution such counts could be explained only by the presence of soil bacteria of the coliform type (Aerobacter Aerogenes), or coliform from the intestinal tracts of wildlife indigenous to the area. Counts of greater than 2,000 were determined for Quidi Vidi Lake outlet and the Waterford River, both of which are known to contain raw domestic sewage.

1.2.2 Groundwater

Quantitative hydrogeologic information on dug wells and drilled wells is very limited. An estimate of the potential yield of groundwater sources in the area through a study of the surficial deposits and the nature of the bedrock in the inter-relation with climatic and surface water conditions is outlined in Volume Two A, Part VII. This outline indicates the following three locations which appear to offer good sources of surficial groundwater:

a) The unit designated as S4 on Figure 1-4.

b) The southeast shoreline of Conception Bay.

c) From Topsail to Seal Cove and on the west side of Conception Bay at the heads of Spaniard Bay and Bay de Grave.

The bedrock hydrogeology of the area indicates generally low yields of groundwater. Areas of possible higher groundwater yields are the faults and lineaments in the bedrock illustrated in Figure 1-5. The distribution of the different hydropetrologic units and their probable yields is also shown on this figure.

The limited data obtained in relation to groundwater quality does not permit a conclusive evaluation of this subject. For example, Figure 1-6 indicates a considerable variation in groundwater quality

exclusive of those wells which are known to be polluted or affected by sea water intrusion. However, it is known that in general the groundwaters differ from surface waters in the following aspects:

i) They are higher in total dissolved solids.

ii) They have a broader range of pH (6.1 to 9.4).

iii) They are generally low in colour and turbidity (although there are exceptions to this, such as the DOSCO water supply on Bell Island which in November 1966 exhibited a colour of 30 units and a turbidity of 12 units).

iv) They are generally much harder although most of them still contain less than 100 mg/l hardness as $CaCO_3$.

v) They appear to contain larger concentrations of minor chemical constituents which exceed public health standard limits.

The following are wells whose analyses indicate excessive concentrations of minor ions:

COMMUNITY	WELL DESCRIPTION	DATE	CONTAMINANT	CONCENTRATION mg/l	USPHS RECOMMENDED MAXIMUM CONCENTRATION mg/l
Bauline	Upper municipal well*	Oct/67	Iron	1.35	0.30
			Chlorides	250	250
	Lower municipal well	Oct/67	Iron	1.05	0.30
Bay Roberts	Private well	Oct/67	is contaminated by salt water intrusion.		
Bell Island	Wabana	June/66	Manganese	0.20	0.05
	Dosco	Nov/66	Iron	1.16	0.30
East of Holyrood	One nearby well	Apr/62	Iron	0.60	0.05
	Second nearby well	Apr/62	Manganese	0.31	0.05
Long Pond	Private well		Iron	3.80	0.30

* Thought to be contaminated by salt water intrusion

The bacteriological quality of deep well water as indicated by coliform analyses was found to be generally good.

In Volume Two B, Section 37, additional data on special groundwater conditions in the area are presented.

1.2.3 Hydro Power Potential

The small rivers in the study area have no hydro-electric power potential of any significance beyond that which has already been developed as described later in Section 2.4.1.

1.2.4 Fisheries for Fresh Water Dependent Species*

The rivers in the study area contain mostly resident brook trout as well as smaller numbers of anadromous trout, arctic char, brown trout, ouananiche, eels, and Atlantic salmon. Rainbow trout are generally restricted to the streams on the east side of Conception Bay.

The North, South, North Arm, and Salmon Cove Rivers are licensed salmon rivers discharging into Conception Bay. All are entirely accessible to anadromous fish, but appear to be supporting salmon well below their potential for reasons not yet known to the Department of Fisheries.

The Waterford and Rennies Rivers which flow through St. John's each have an abundance of brown trout and lesser numbers of brook trout in spite of considerable pollution.

The numerous lakes and ponds in the study area contain brook trout, landlocked Atlantic salmon as well as rainbow and brown trout. Population levels of fish in these lakes and ponds are not known at this time.

1.2.5 Log Driving and Navigation

The lack of exploitable forest areas and the small flows in the rivers have discouraged the development of log driving operations. Navigation on the rivers is limited to small pleasure craft.

* Abbreviated in text as Fresh Water Fish.

1.3 Natural Resources

1.3.1 Forests

The Avalon Peninsula is characterized by a heath barren surface as a result of widespread burning and reburning in the past. Some portions of this area, notably the northeast section of the peninsula easterly from Fox Trap and the river basins from North Arm River to Goulds Brook, are covered predominantly with black spruce and balsam fir. However, the poor nature of the soil has stunted the growth of these trees and consequently the forest resource is unlikely to become a major source of economic activity in the study area.

1.3.2 Minerals

With the closing of the iron ore mine on Bell Island in 1966, the value of mineral resources produced in the St. John's study area was greatly reduced. The only minerals being exploited now are pyrophyllite at Manuels and building stone at Kelly's Island and in St. John's at Signal Hill and Southside.

1.3.3 Wildlife

Big game in the area is limited to moose; however, snowshoe hare, and ptarmigan, ducks, and sea fowl are plentiful throughout the area.

1.3.4 Recreation and Tourism

The recreational activities in the area are varied as a result of the topography, the availability of fish and game, and the proximity of the ocean. The major attraction to tourists is the City of St. John's. A currently minor but growing attraction is tuna fishing in Conception Bay. The limited intensity of these activities contributes little to the growth of tourism; however, the development of the parks in the area should encourage tourism as well as recreational activity.

1.3.5 Agriculture

The quality of the soil in the study area is poor with respect to agricultural usage, and the topography limits the amount of reasonably level land which is available for cultivation or the grazing of livestock. Nevertheless, in 1966 approximately 12,000 acres of farm land were under development. This represents nearly one-half of the total farm

land of the Province. The principal farming activities consist of dairy farming, the growing of vegetables and blueberries, and the raising of poultry, swine, sheep, and limited numbers of beef cattle. The principal vegetable crops are potatoes, turnips, cabbage, carrots, beets, parsnips, lettuce, cauliflower and broccoli. According to the Provincial Department of Agriculture, the 1966 retail value of agriculture output of the study area was $6,750,000.

Some bogland reclamation has been carried out in the study area particularly around the larger communities. The demands of these centres for agricultural products will likely increase the pressure for further reclamation in the future. The major portion of bogland reclaimed to date is used for growing forage for livestock.

One of two farms on the Island practicing irrigation is located at Harbour Grace.

2 PRESENT DAY DEVELOPMENT

The major industrial and economic development in the study area is centred in and around the City of St. John's. Exceptions are the petroleum refinery at Holyrood and several fish processing plants located elsewhere on Conception Bay.

2.1 Population Pattern

DBS statistics indicate that approximately 32 percent of the Provincial population lived in the St. John's study area during the past four census periods. They also indicate that the annual rate of growth has varied between 2 and 2.7 percent as shown in the following tabulation:

				Growth Rate
1951	Study Area Population	=	114,490	
				2.7 Percent
1956	Study Area Population	=	130,900	
				2.1 Percent
1961	Study Area Population	=	147,760	
				2.0 Percent
1966	Study Area Population	=	156,220	

Between 1951 and 1966, there was a steady increase in the urbanization of the study area. In 1951 the urban population formed 73.9 percent of the total population of the study area. This ratio increased to 75.6 percent by 1956, 77.2 percent by 1961, and 81.3 percent by 1966.

The urban development of the study area has been dominated by the St. John's Metropolitan area which in 1966 had a population of 101,220. This area is now surrounded by ten communities each of which, in 1966, had populations of more than 1000. Their growth has been as follows:

1951 - seven communities with a combined population of 16,931.

1956 - eight communities with a combined population of 21,043.

1961 - nine communities with a combined population of 23,238.

1966 - ten communities with a combined population of 25,750.

The largest of these communities in 1966 was Wabana with a population of 7884, followed by Carbonear with a population of 4584, and Harbour Grace with 2811.

2.2 General Economic Pattern

2.2.1 Primary and Secondary Industry

The St. John's study area has the most complex economic structure of any in the Province.

With regard to agriculture, the following figures were obtained from 1966 DBS data which report agricultural activity in subdivisions whose boundaries do not coincide with the boundary of the study area. Accordingly, they are somewhat higher than would apply within the limits of the study area, but by how much it is not possible to determine.

In the agricultural subdivision applicable to the St. John's study area, there were 454 farms with a total population of 2192. No value of agricultural products sold in the subdivision is available, although the following group of farm sizes gives some indication of the scope of agricultural activity. There were 115 farms under 3 acres in size; 198 between 3 to 9 acres, and 135 between 10 and 69 acres. Five farms were between 70 and 179 acres, 1 was about 1000 acres, and 2 were more than 1600 acres.

The livestock reported for the subdivision was as follows: 3248 head of cattle, 6025 pigs, 1119 sheep, 387 horses, and 291,498 domestic fowls.

The coastline of the study area is situated within 2 fishery subdivisions whose total employment in 1965 was 2792 of which 103 were off-shore fishermen. Of this number most of the off-shore fishermen and approximately 1400 in-shore fishermen probably lived in the study area.

The total value of fish landings in 1966 was estimated to be $3.7 million. In the same year landings in Conception Bay, which includes most of the study area, amounted to 47.2 million pounds having a landed value of approximately $1.8 million. The landings consisted mostly of cod, together with smaller quantities of turbot, salmon, lobster and squid. Capital investment in commercial fishing operations in Conception Bay was estimated to be $1.7 million in 1966. The Department of Fisheries estimated that 1431 fishermen worked in the Conception Bay area during 1966, mostly in the southern part of the Bay. However, only 38 percent of this force were employed for ten months or more.

With regard to secondary manufacturing, Table 2-1 presents the firms which are of significance in terms of water usage.

2.2.2 Tertiary Industry

The most striking factor about the St. John's labour force is its position in relation to total employment. While some change has probably occurred since the 1961 census, the magnitude of the change has probably not been great. In 1961, 70 percent of the St. John's labour force was employed in service industries. There were approximately five service jobs for every primary and secondary job. For the study area as a whole this ratio would probably be at least 4:1. The distribution of service employment is as follows:

	Percentage by Industry		Distribution of Provincial Total	
	City	Metro	City	Metro
Wholesale	12	11	41	52
Retail	23	24	25	33
Finance, Insurance	4	5	51	62
Community Services	21	21	31	40
Government Services	23	21	27	35
Commercial Services	14	14	31	39
Not Stated	3	4	16	21
	100	100	Not applicable	

It can be seen from the above tabulation that the percentage breakdown of tertiary industrial employment in the City of St. John's and the St. John's Metropolitan area is almost the same. However, the comparison of the different types of service employment in the two areas to the provincial total indicates an appreciable difference between the city and the Metropolitan area and emphasizes the residential significance in the census data.

The extent of the St. John's Metropolitan area is less than the study area. Accordingly, it may be assumed that in the study area the percentages of Provincial employment applicable to each service would be larger than those shown for just the Metropolitan area.

2.2.3 Economic, Social and Administrative Inter-relationships

A great deal of the economic, social, and administrative direction of the Province emanates from the St. John's study area. Besides being the key service area, St. John's is also one of the major transportation and distributing centres.

The early development of St. John's as an established urban community and the centre of government was an attraction for the location of both manufacturing and service industries. This factor of urbanization was, to a considerable extent, responsible for maintaining St. John's position in the economy in the face of the westward movement of economic development.

Although major specific developments in the structure and expansion of the Provincial economy are expected to occur outside the St. John's study area the relative position of the area as a centre of government and as a service centre is not expected to change significantly during the forecast period. The magnetic attraction of a large metropolitan area has a fundamental influence on population location and the effects of the geographical shift in economic activity and opportunity will take a long time to counterbalance.

2.3 Withdrawal Water Use

2.3.1 Municipal Uses

St. John's has both a water supply and a system of sanitary and combined sewers. Water supply is obtained by gravity from two local ponds, Windsor Lake and Petty Harbour Long Pond. Apart from

minor corrosivity and indications of higher than recommended iron content, the water is generally of good quality, particularly that from the Windsor Lake source. Difficulties have been experienced with the water obtained from Petty Harbour Long Pond. During the summer months the water has an offensive taste and odour and it is thought that this may be due to the development of algae. This matter is currently under investigation by the Biology Department of Memorial University. Treatment of the water supply to the city is limited to the addition of lime for pH control and chlorine for disinfection.

The fact that the water is fed to the city by gravity has limited the areas which can be supplied directly from the system to those below elevation 350. Supply to areas above this elevation will require pumping.

The problem of an increasing demand for water during recent years was climaxed in 1965 and 1967 when extended periods of drought dictated restrictions on the use of water for lawn and garden sprinkling. However, the matter has been investigated by the city's consulting engineers and suitable remedial works have been recommended. Recently at a cost of $200,000 the level of Windsor Lake was raised three feet which increased the reliable yield of this source from 7.75 million gpd to 9.5 million gpd. In addition, a ten year program for the installation of meters on all water services is being implemented. It is hoped that this move will reduce the water consumption and assist in disclosing any major leaks which may still exist in the water supply distribution system. Pitometer Associates of New York recently completed a leakage survey which disclosed water losses of 2.2 million gpd. The major leaks recorded during this survey have now been repaired.

The installation of water meters is part of an overall program for augmenting water supplies recommended in a report prepared for Council in 1966.[1] The leakage survey was also recommended in that report and in an earlier report presented to Council in 1959.[2]

A number of areas and isolated dwellings within the present boundaries of the City are not connected to the water supply system. In 1961 an urban renewal study by Project Planning Associates Limited for the City of St. John's recommended the extension of the system to serve the Battery and Mundy Pond areas. The report also recommended extension of the system beyond the city boundaries to the Blackhead Road area in the Southside Hills immediately to the south of the city.

The City of St. John's has an agreement with the Town of Mount Pearl whereby the former undertakes to provide the town with up to 2 million gpd through a metered connection off the supply main from Petty Harbour Long Pond.

The city's sewerage system serves most of the totally developed area within the present city boundaries. As in the case of water supplies, the areas requiring immediate sanitary servicing are the Battery, Mundy Pond, and Blackhead Road areas.

In a questionnaire circulated during the course of the investigations conducted for this report, it was indicated that 95 percent of the city's population is served by the sewerage system with the remaining 5 percent served by septic tanks and cesspools. The major portion of the present sewer system discharges into the St. John's harbour with apparently little conflict in use of the receiving water. However, a ten-year program to divert all of the City's sanitary flow to a point of discharge at least beyond Chain Rock has been implemented by the Canada Department of Public Works. The program will minimize potential pollution of the harbour water.

One area of major concern is the deterioration in the bacteriological quality of almost all of the ponds and streams within the city as a result of untreated sewage or septic tank discharges. However, it is considered that this condition could be corrected by:

a) Strict control of private sanitary drain connections to ensure that these are connected to trunk sewers where they exist (most of the houses adjacent to the recently constructed Waterford trunk sewer are not connected to it).

b) A planned program of providing sewer systems to those areas currently without sewers.

The two principal surface drainage systems serving the city area are the Waterford River and Quidi Vidi Lake complex. The Canada Department of Fisheries believe that anadromous brook and brown trout still exist in numbers in both of these river systems, and in a policy statement regarding these rivers, has indicated that, should the Municipal Governments of St. John's and Mount Pearl show their willingness to limit and/or reduce pollution of the two river basins, the Department will undertake to increase the present fish stocks.

Both of these river systems can still be preserved; and, in the interest of local recreational facilities, health, and tourism, it is recommended that corrective measures be undertaken as soon as possible.

The provision of water and sanitary services in the principal communities around St. John's is as follows:

2.3.1.1 Town of Mount Pearl

The town of Mount Pearl obtains its water from the City of St. John's through a metered connection,from the Petty Harbour Long Pond supply main, serving the city. Similarly the town's sanitary sewer system is connected to the City's system via the Waterford trunk sewer.

2.3.1.2 Bay Roberts

Bay Roberts has a population of 4200 with a sewer system serving about 80 percent of its population and discharging untreated wastewaters into the sea. The town has no water supply system. Some existing groundwater supplies are reported to be brown or black in colour indicating undesirable concentrations of iron, manganese, or organics. Unfortunately, there is insufficient analytical data to define this problem exactly.

The only non-fish oriented industries in the town are Dawes Nail and Hardware Limited, and Dawes Concrete Products Limited. The former has stated they would expand their facilities if a good water supply were available. The provision of a water supply system was recently studied by Engineering Services Limited of St. John's who estimated the total cost to be $2.25 million.

2.3.1.3 Carbonear

Carbonear has a population of 4600 persons with 90 percent of the population being served by a sewage system discharging into Carbonear Bay. It has an adequate surface water supply distribution system.

2.3.1.4 Harbour Grace

Harbour Grace has a population of approximately 2800 with a new water supply system using Bannerman Lake as its source and a

system of sanitary sewers serving 80 percent of the households within the municipality. The water system was installed primarily to supply the Northeastern Fish Industries Limited fish processing plant. The sewerage system discharges untreated wastewaters into Harbour Grace.

2.3.1.5 Spaniards Bay

Spaniards Bay is an established town of approximately 800 inhabitants with an unorganized community of equal size adjacent to it. At the present time, the town is served principally by individual shallow wells and septic tanks. In 1965 a report was prepared by Newfoundland Design Associates on water supply for the community.

2.3.1.6 Port De Grave and Ship Cove

These are two adjacent unorganized communities both of which obtain water from shallow wells and dispose of their domestic wastes via septic tanks and directly to the ocean. In 1965 R. J. Noah & Associates studied the possibility of providing water for the Northeastern Fisheries Limited plant at Ship Cove. However, it is understood the scheme was abandoned as being too expensive and the fish plant will utilize salt water for processing.

2.3.1.7 Upper Island Cove

Upper Island Cove is an incorporated town of 200 persons with neither water supply nor sewage collection facilities. Water is currently obtained entirely from shallow wells. Approximately 10 percent of the residents are served by septic tanks, the balance having only outhouses for the disposal of domestic wastes. Investigations pertinent to the preparation of this report reveal that bacteriological tests performed in 1967 on 75 percent of the wells indicated that 60 percent of the water supplies tested were unsatisfactory; that is, exceeded 4 coliforms per 100 millilitres. An investigation of a water supply and distribution system for the town was made by Newfoundland Design Associates in 1966.

2.3.1.8 Wabana

Wabana has a population of about 7000. Small areas of the municipality, totalling about 400 persons, are served by five municipally owned drilled wells. The balance of the town depends

upon individual wells many of which are incapable of providing a continuous supply of water. Approximately 40 percent of the town is served by a municipal sewer system. The balance of the residents are served by septic tanks or discharge their sewage directly into the ocean.

2.3.1.9 Holyrood

Holyrood is a local improvement district situated at the south end of Conception Bay with a population of about 1400. The town is without water or sewerage systems depending on individually owned shallow dug wells and septic tanks. There is a potential problem of sea water pollution associated with this municipality in that the Province's only oil refinery (Golden Eagle Refinery) is located there. This is discussed in detail in Section 2.3.2. of this Volume.

None of the remaining communities on the northeast arm of the Avalon Peninsula have water supply and sewerage systems. Two communities, Bauline and Portugal Cove, have centrally located drilled wells installed by the Department of Municipal Affairs. The upper of two wells at Bauline shows evidence of contamination by domestic sewage and possible sea water intrusion. The well at Portugal Cove was not operative at the time of investigations for this report. (September - October 1967)

On the west side of Conception Bay water is generally obtained from shallow wells. Outhouses are the usual means of waste disposal in this area; otherwise, sanitary wastes are disposed of via septic tanks or direct discharge to the ocean or the nearest water course.

The presence of shallow wells in close proximity to septic tanks in many of the small communities in the study area presents a severe health hazard which should be accorded early and full attention. The coarse nature of the overburden in the area encourages the entry of pollution from the septic tanks. For example, a severe case of such pollution was recently investigated by the Newfoundland Department of Health in the Topsail-Manuels-Fox Trap sections of the east shoreline of Conception Bay. In addition to the foregoing the wells have a tendency to run dry during the summer.

2.3.2 Water Supply for Individual Industries

In general, industrial water requirements in the study area have been obtained as noted in Table 2-1 from the distribution system of the associated municipalities. Exceptions are:

a) The steel mill located on Octagon Pond near the upstream end of the Topsail River basin immediately to the west of Donovans. This mill pumps its cooling water from Octagon Pond at a rate of 8 million gpd and returns it to the Pond via Rock Pond.

b) The Golden Eagle Oil Refinery at Holyrood which obtains its process water, an average of 2.95 million gpd, partly from Butterpot Pond and partly from Holyrood Bay. It is understood this company intends to expand its refinery to include a propane plant thereby increasing the fresh water consumption by about 0.5 million gpd. The company indicated that the expansion will strain the existing supply sources, particularly at the end of a dry summer.

A second problem of this industry is one of sea water pollution. Currently, the wastewaters from the refinery are lagooned, and prior to discharge to Holyrood Bay, oil is skimmed from the surface. This would seem to be a reasonable means of treatment for this situation. However, it is recommended that the effectiveness of this treatment be adequately policed to prevent contamination of the Bay and consequently the destruction of sea life. The Canadian Wildlife Service notes that some of the greatest losses of sea birds from oil pollution occur along the sea coasts of Newfoundland, although at present, oil responsible for these losses does not originate on the Island, but probably from ships at sea. However, refinery oil waste could also cause deterioration of beach spawning areas used by fish such as capelin.

2.4 Non-withdrawal Water Uses

2.4.1 Hydro-electric Power Development

The most significant non-withdrawal water use in the study area is hydro-electric power. The average installed turbine capacity is 5300 hp which is approximately the average capacity of the small plants operated across the Island by the Newfoundland Light and Power Company Limited.

The hydro-electric developments in the St. John's study area are all connected to the Island-wide transmission grid. They are listed in the following table:

HYDRO DEVELOPMENTS IN ST. JOHN'S AND ENVIRONS

STUDY AREA AND RIVER BASIN

Hydro Development	Year Installed First Unit	Year Installed Latest Unit	No. of Units	Total Installed Turbine Capacity H. P.
Mobile	1951		1	13,000
Petty Harbour	1908	1926	3	6,950
Seal Cove	1922	1927	2	4,540
Pierres Brook	1931		1	4,500
Topsail	1932		1	1,600
Victoria	1904		1	500

2.4.2 Other Non-withdrawal Uses

A very considerable amount of angling takes place in the area mostly for trout but some salmon are taken as well. This is mostly by the resident population, but the importance of other non-withdrawal uses including navigation, log driving, and tourism is minimal.

2.5 "Negative" Demand Problems

"Negative" demand problems in the rivers of the St. John's study area are minimal. Some silting of the St. John's harbour occurs at the mouth of the Waterford River. However, this is not a serious problem at the present time nor is it likely to be so during this study period.

3 PLANNED AND FORECAST DEVELOPMENT

3.1 General Municipal Planning

General municipal planning in the study area has been confined to the City of St. John's and the area immediately adjacent to it. Plans which have been prepared include an urban renewal study in 1961 for the City of St. John's[1], a municipal plan in 1966 by the Provincial Planning Office for the St. John's metropolitan planning area[4], and an industrial study of the St. John's metropolitan area in 1967[5].

It is understood that steps have been taken to implement the water distribution and sewerage recommendations of the urban renewal studies, except the section pertaining to the eventual removal of all the housing from the Battery area.

The 1967 industrial study recommended two areas for industrial development, namely the Kenmount Road area and the Donovans area. Their locations are shown in Figure 1-1. The requirements for servicing these areas with water and sewerage facilities were discussed in broad terms in the 1967 report. With regard to water supply, it is recommended that this be taken from the City of St. John's distribution system via the town of Mount Pearl. However, the report stresses that industries consuming large quantities of water will be required to develop their own sources of supply because of the limitations of the existing city distribution system and the difficulty of forecasting the water requirements and development of such industries.

The industrial study also noted the inadequacy of the existing trunk sewers to serve the two recommended areas of development. For example, it was envisaged that full development of the Kenmount Road area would require the installation of an additional trunk sewer paralleling the existing "Housing Interceptor" sewer which traverses the Memorial University campus and the Kelly Brook valley. Also stressed in the study was the inability of the Waterford River valley trunk sewer to serve development beyond the projected residential development of the town of Mount Pearl.

3.2 General Regional Planning

At the time of preparing this report no regional planning studies had been undertaken in the St. John's study area. The implementation of such studies is recommended with regard to water supply and sewerage facilities, particularly for the St. John's

metropolitan area and the area between Topsail and Seal Cove.

3.3 Industrial Development

No major industrial development is known to be under consideration for the study area at this time. However, it is possible that industries allied to the chemical requirements of pulp and paper production may be encouraged to locate in the study area. In addition, the by-products from the proposed petrochemical complex at Come By Chance may foster the development of a plastic industry in the study area. Also at Duffs on Conception Bay near Holyrood, a 300 megawatt thermal generating station is planned for operation in 1970. The cooling water requirements for this station will be obtained from the ocean and the fresh water requirements of approximately 1.5 million gpd will be supplied from a surface source developed adjacent to the plant.

3.4 Population Growth and Level of Living

On the basis of past trends, the population of the study area is projected to increase at a rate of approximately 2 percent per annum throughout the forecast period. Accordingly, it is estimated the 1966 population of 156,220 will increase to 188,450 by 1981. No provision has been made for a net influx of population to the study area. It is assumed the potential labour force in the study area will be sufficient to support known or anticipated developments during the forecast period.

No major agricultural developments are foreseen in the study area during the forecast period. It is expected that the principal change will be in the size and operating efficiency of the commercial farms. Although expansion of greenhouse activity is a possibility, no special studies have been conducted on this subject.

The major development in the primary fisheries will be the change in the structure of the industry. During the forecast period there will be a gradual decline in the number of in-shore fishermen and an increase in the number of men employed in the off-shore fisheries.

The rationalization of the fisheries will in turn affect the fish processing sector of the industry. Studies by the Board and other government agencies indicate that in the future the minimum economic size of processing plants will be 100 million pounds a year. Two areas, Harbour Grace and the St. John's-Bay Bulls area, are potential sites for such plants each of which would provide permanent employment for approximately 800 people.

No expansion is seen for mining and no significant expansion is anticipated for the primary or secondary forestry industries in the study area.

With regard to the expansion of secondary manufacturing industries, it is expected that the large proportion of this will take place in the St. John's study area.

The service industries located in the study area will continue to play a dominant role in the social-economic life of the Province.

A significant increase in the percentage of urbanization of the study area is considered unlikely.

Concerning the economic development of the area, estimates of per capita disposable income indicate a 1965 level for census division 1 of $1,200. The general increase in the economic activity of the Province, and within the St. John's study area, indicates an increase in per capita disposable income of approximately 4 percent per annum from 1965 to 1981. Accordingly, in terms of 1965 dollars it is estimated that by 1981 per capita disposable income will be approximately $2,200.

4 PLANNED AND FORECAST WITHDRAWAL WATER DEMAND AND SUPPLY

4.1 Municipal Water Supply Development

In Section 2.3 it was indicated that the City of St. John's is faced with the prospect of having to increase the capabilities of its water supply and distribution systems as the area develops and the population increases. Measures to achieve this objective were recommended in engineering reports prepared in 1959 and 1966. The recommendations included increasing the capacity of the supply sources and reducing the average per capita per day consumption rate through the installation of meters and the implementation of a leak detection and repair program.

Assuming the installation of meters on all services, the 1966 report prepared by Canadian British Engineering Consultants estimated the following stage development of the City's water supply system:

Supply Stage		Dependable Yield (mgd)	Population Served (at 120 gpcd)	Projected Date at which Population will be reached
I	Present	13.0	108,300	1969
II	I + Stage I, Broad Cove Reservoir	15.75	131,200	1980
III	I + Stage 2 Broad Cove Reservoir	21.75	181,200	2003*

* Extrapolated beyond 1981 from data presented in report.

The assumed per capita per day consumption of 120 gallons in the above table is in general agreement with the data presented in Volume Three B, Part VII of this report. However, an analysis of past and current average rates of consumption indicates that the repair of the leaks discovered during a survey in 1967 by Pitometer Associates of New York will contribute significantly to reducing the average gpcd rate of consumption, and may even eventually reduce the rate to below the projected amount of 120 gpcd. In addition, the rate of consumption may

be further reduced if the amounts charged per thousand gallons consumed are substantially increased over the current flat rate which approximates 15¢ per 1000 gallons for residential consumption.

In this regard, it is interesting to consider the water consumption in the town of Mount Pearl which in 1966 was in the order of 70 gallons per capita per day. The water is sold at a rate of $1.00 per month for the first 5,000 gallons and $1.00 per thousand gallons in excess of this. Individual services are not only metered but the distribution system is new having been installed in 1962. Undoubtedly, the above three factors contribute to establishing a comparatively low rate of consumption, but it is not possible to define exactly their order of contribution.

Further to the above-mentioned 1959 and 1966 reports, a Report on Additional Water Supply - St. John's and Environs was prepared in November 1967 for the Newfoundland ard Labrador Housing Corporation[6]. This report recommended an alternative means of expanding the source of water supply to St. John's using Bay Bulls Big Pond as the water supply reservoir. The reservoir would be connected into the St. John's distribution system via a 24-inch diameter pipeline at the Petty Harbour Long Pond reservoir outlet.

Figure 4-1 shows the estimated future average day water requirements for St. John's together with an indication of the development of the alternative sources of supply recommended in the aforementioned reports on water supply for the city.

Although no plans exist at this time to provide a supply of potable water to the inhabitants of the Topsail to Seal Cove area, such a supply could be readily developed close to the area.

Reports have been prepared for the supply of water to a number of small municipalities in the study area, notably Spaniards Bay, Upper Island Cove and Bay Roberts, with populations of 800, 2,000 and 4,200, respectively. However, there has been no indication as to when these reports will be implemented.

4.2 Municipal Sewage Collection and Treatment

In Volume Five, Part II of this report, guidelines for the treatment and disposal of municipal sanitary wastes are proposed.

The only sewage treatment plant currently under consideration in the study area is that proposed to serve the recommended industrial

area at Donovans. In this regard, the industrial study proposed that the wastes from the industrial area be treated by a package sewage treatment plant, and after chlorination be discharged into the Waterford River. The degree of treatment required will depend upon the assimilative capacity of the Waterford River and the downstream water quality objectives of the local interested authorities. However, the proposal is feasible and it is recommended as being the most economical. Alternatively, it may be just as economical to dispose of the wastes from the industrial area by means of a prefabricated sewage pumping station and forcemain discharging into the upstream end of the "Housing Interceptor" sewer and/or its supplement, mentioned earlier in this report.

With regard to the sewage generated in the City of St. John's, this will eventually be discharged untreated into the ocean at Chain Rock.

As the various communities in the study area become organized, sanitary sewers will be required, particularly in those areas with municipal water supply systems where the greater consumption of water will demand sanitary disposal facilities superior to individual disposal systems such as septic tanks.

4.3 Individual Industries Water Supply and Water Disposal

Large industries whose daily per acre water demand exceeds residential consumption by a factor of about 10 cannot be readily accommodated in most existing supply systems without major modifications to the systems. Accordingly, it is anticipated that industries requiring significant quantities of process water will be located adjacent to readily available, but independent sources of water.

With reference to the possibility of large water consuming industries establishing plants in the area, an analysis indicating 10 drainage basins which could be developed to supply a minimum regulated flow of 10 million gpd is presented in Volume Five, Part II of this report. It will be noted that some of the basins designated as having storage possibilities have already been developed for hydro-electric power generation. However, it may be presumed as previously mentioned, that these hydro developments will in time be superseded. In the interim period it may be possible to buy water currently in use for hydro-electric generation from the Newfoundland Light and Power Company; this possibility has already been investigated in the 1967 report on additional water supply for St. John's and environs where a portion of the Raymond Brook drainage area (upstream of the outlet of Bay Bulls Big Pond) was considered as a source of water supply. This is the largest river basin in the study area

and its estimated total regulated flow is approximately 65 million gpd.

The sale price of the water was set by the Power Company at 0.5¢ per 1,000 gallons. This is considered a reasonable indication of the order of price that will probably be established at other generating stations in the area. Accordingly, the figure will be useful for a preliminary consideration of the economic feasibility of this form of water supply elsewhere in the study area.

None of the individual industries in the study area are planning to treat their liquid wastes in the immediate future, and it is doubtful that they will do so during the study period. With regard to new industries locating in the area and requiring large quantities of water it is understood they will be required to provide treatment facilities to the satisfaction of local authorities.

5 PLANNED AND FORECAST AREAL AND REGIONAL WATER RESOURCES DEVELOPMENT

It is very unlikely that the sizes of the river basins in this study area will allow the economic development of hydro-electric generation beyond that already established. Indeed in the light of the major power generating schemes possible elsewhere in the Province with their low unit costs, it is probable that the increasing maintenance and operating costs of the existing small plants may precipitate their abandonment even before the end of their useful life.

No development of the water resources of the study area for the purposes of logging and navigation is contemplated or required.

The Canada Department of Fisheries has indicated it will be its policy to control pond and lake pollution in the study area so that the maintenance of fish life is not inhibited and existing stocks are preserved at an optimum level. The Department has further indicated that when adequate information is available, by way of a complete fisheries resource study, it will manage the rivers in the study area in the best interests of the sport fishery. Two exceptions to this policy are the Waterford River and Quidi Vidi Lake complex in St. John's. In these instances, the Department has stated it will undertake maintenance and development of these rivers only if the municipalities of St. John's and Mount Pearl indicate a willingness to control existing and future pollution of the rivers. It is estimated that development of the Waterford River and Quidi Vidi Lake complex for anadromous trout will require an expenditure of approximately $45,000, most of which will be devoted to the removal of natural obstructions.

The Canada Department of Fisheries indicated that the above developments would be implemented in keeping with the demands of the sport fishery.

6 PRELIMINARY ASSESSMENT OF WATER RESOURCES MANAGEMENT PROBLEMS

The uncontrolled use (particularly recreational use) of river basins utilized for potable water supply represents a potential source of pollution of these waters. To date, few municipal water supplies exist within the study area and accordingly, the problem is not one of significance at this time. However, as additional surface waters are designated for potable water supplies the problem will intensify and may necessitate the introduction of filtration before these supplies can be utilized for drinking water purposes.

Pollution of the Waterford River and the rivers discharging into Quidi Vidi Lake, as a result of untreated domestic sewage and septic tank effluent entering these waters, has necessitated the prohibition by the Provincial Department of Health of swimming and similar recreational uses of these waters. Accordingly, remedial action will have to be taken if these rivers are to meet the area's future recreational demands.

Some conflict exists between generation of hydro power at the six existing stations and the fisheries, as anadromous fish are unable to reach the upper parts of the basins. There are no present plans by the Canada Department of Fisheries to develop these rivers.

It is considered that within the study period there may be a demand for some portion of the water now used for generation for other uses, particularly industrial or municipal water supplies.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

a) The study area is dominated by the presence of the St. John's metropolitan area which has influenced as well as induced much of the development of the study area. Natural resources are limited and will probably not contribute significantly to the future development of the study area.

b) The major primary industry in the study area is fishery with its associated processing activity. Excluding fish processing and paper manufacturing which dominate the Provincial picture, approximately 60 percent of the Province's manufacturing employment is located in the area and it is probable that a comparable percentage of the Province's tertiary employment is also located there. This situation will probably continue during the study period together with a general trend towards urbanization particularly in and around St. John's. Beyond the immediate area of St. John's the fishery and processing of fish will continue to be a dominant factor in the growth of the area.

c) The study area possesses an adequate supply of good quality surface water. Ten potential storage sites exist, each capable of providing regulated flows of not less than 10 million gpd. Groundwater is not readily available in quantities sufficient for municipal supply.

d) To date water resources management problems have been concerned with the use of surface and sea waters for the dilution of untreated domestic, municipal and industrial liquid wastes, thereby curtailing the use of these waters for recreational and potable purposes. Disposal of domestic sewage by means of improperly constructed or operated septic tanks has resulted in considerable localized contamination of groundwater supplies.

e) It is difficult to assess the cost of constructing wastewater treatment facilities in this area to prevent water quality degradation through the discharge of untreated municipal wastewaters. Disregarding the major discharge of wastewaters to the sea, it might be estimated as requiring an investment of

$8,000,000. with an annual operating cost of $250,000. Water quality control in this area, because of population concentration, should be given a high priority in this implementation.

7.2 Recommendations

a) Although ultimately all communities in the study area with a population greater than 500 persons should be provided with municipal water supplies and sewage systems capable of ensuring the degree of treatment required to avoid conflicts of water use, the construction of these systems may be programmed over the next 15 years if the standards of construction and operation of existing privately owned wells and septic tanks are improved. It is recommended that a program of education and regulation be instituted as soon as possible in order to effect such improvement.

b) Present discharges of untreated wastes to the fresh water resource should be eliminated or well controlled as necessary to protect the public health of the region.

c) Pollution of the Waterford River as well as the Quidi Vidi Lake complex should be reduced to restore the recreational use of these waters.

d) The use of water from Bay Bull's Big Pond as a source of supply for the City of St. John's should be considered as an alternative to the development of high dam storage on the Broad Cove River.

e) In order to ensure the reduction of the average per capita per day consumption of water in St. John's by the installation of residential water meters, a water rate structure which will achieve this objective should be instituted.

f) Consideration should be given to establishing a regional water supply to serve the residential development extending from Topsail to Seal Cove. In view of the unsanitary conditions reported in this area, early action appears to be imperative.

g) Relatively large quantities of water are available at the six hydro-electric generating stations in the study area. It is recommended that the use of these waters for industrial purposes be considered at such times as a generating station ceases to operate, or earlier if satisfactory arrangements can be concluded with the Newfoundland Light and Power Company Limited.

h) To accomplish the foregoing, it is recommended that the Newfoundland Water Authority appoint a local advisory board for advisory purposes and undertake a fully comprehensive water resource management study of the St. John's area.

REFERENCES

1 Canadian British Engineering Consultants. City of St. John's, Report on Water Supply System, April 1966.

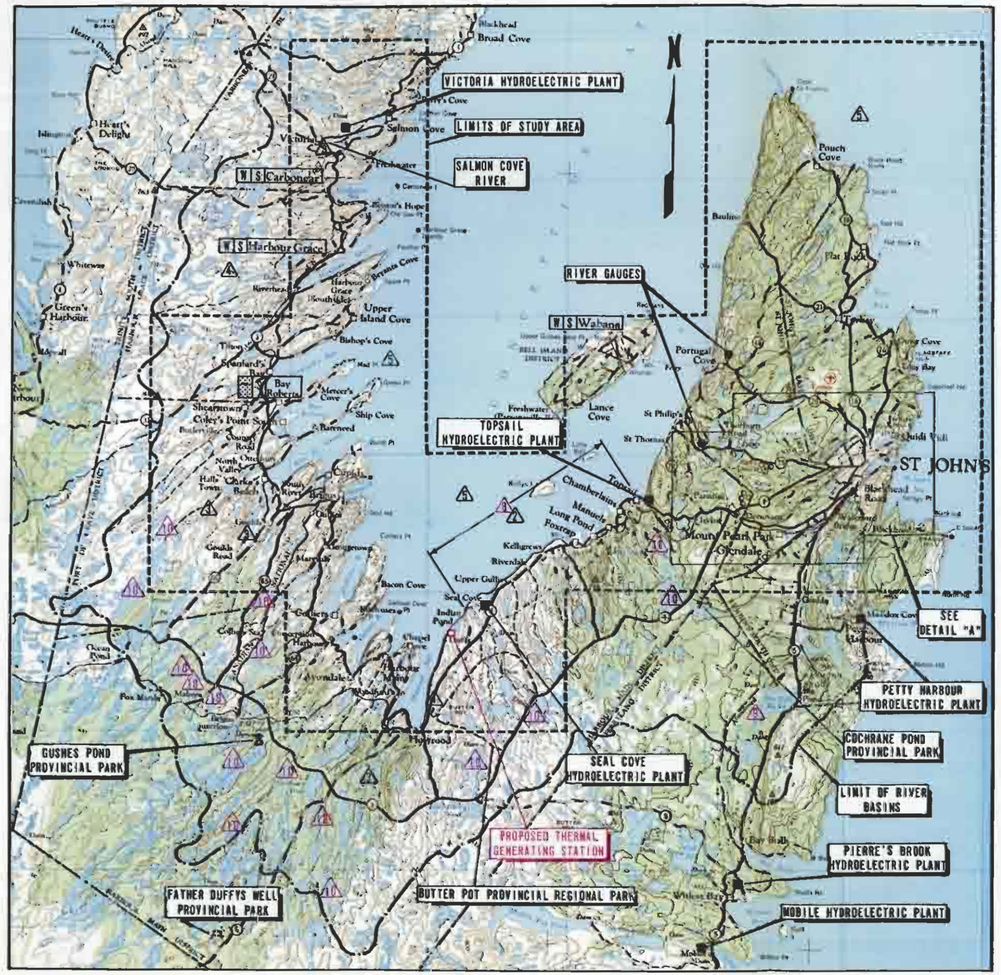
2 Malcolm Pirnie Engineers. St. John's, Report on Water Supply and Sewerage, February 1959.

3 Project Planning Associates Limited. City of St. John's, Urban Renewal Study, 1961.

4 Newfoundland and Labrador. Provincial Planning Office. St. John's Metropolitan Area Municipal Plan, July 1966.

5 Murray V. Jones and Associates Limited. St. John's Metropolitan Area Industrial Survey, April 1967.

6 Newfoundland Design Associates Limited. Report on Additional Water Supply - St. John's and Environs, November 1967.



GENERAL PLAN

NEWFOUNDLAND - KEY PLAN

NOTES: POTENTIAL FUTURE DEVELOPMENTS AND PROJECTS UNDER CONSTRUCTION SHOWN IN RED

- POLLUTION PROBLEMS AFFECTING RECREATIONAL USE OF WATER
- POLLUTION PROBLEMS CREATING DIRECT HEALTH HAZARD
- LICENSED SALMON RIVER
- WATER SUPPLY STORAGE RESERVOIR
- COMMERCIAL FISHING AREA
- WATER METER INSTALLATION PROGRAM
- SANITARY FLOW DISCHARGE FROM ST. JOHN'S
- REGIONAL WATER SUPPLY FACILITIES
- POSSIBLE FUTURE ST. JOHN'S WATER SUPPLY SOURCE
- STORAGE RESERVOIR SITES

LEGEND:

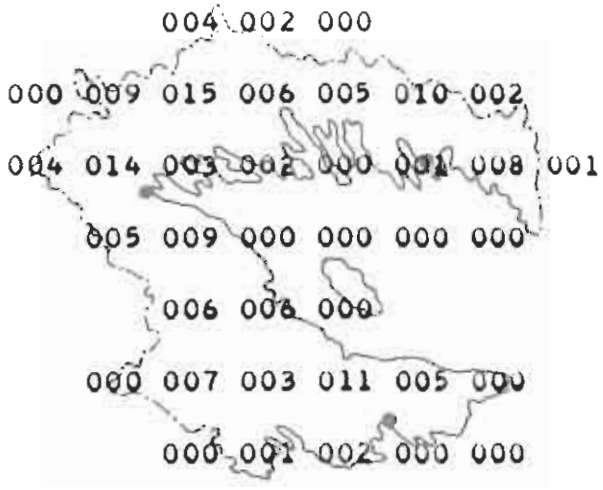
- W S — COMMUNITY WITH WATER SUPPLY AND WASTEWATER DISPOSAL SYSTEMS
- S — COMMUNITY WITH WASTEWATER DISPOSAL SYSTEM ONLY

DETAIL "A"

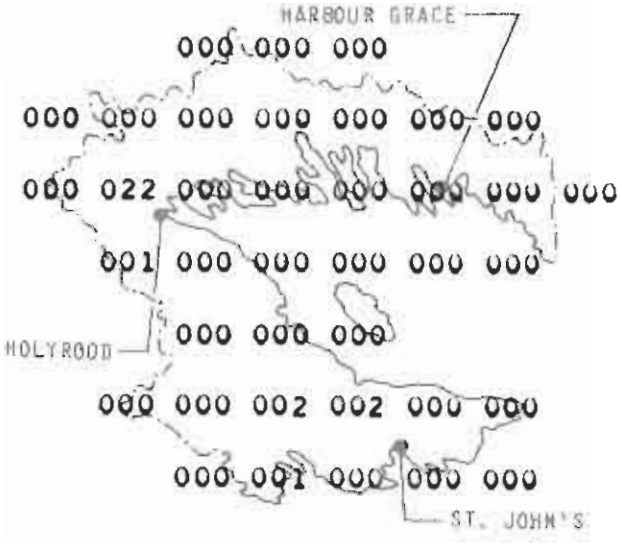
ST. JOHN'S AND ENVIRONS STUDY AREA

FIGURE 1-1

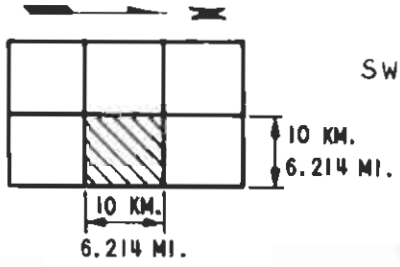
ST.JOHN'S AND ENVIRONS STUDY AREA
SQUARE GRID DISTRIBUTION OF LAKES, BOGS AND SWAMPS, BARRENS AND FORESTS



LAKE AREA - SQ.KM.



SWAMP AREA - SQ.KM.



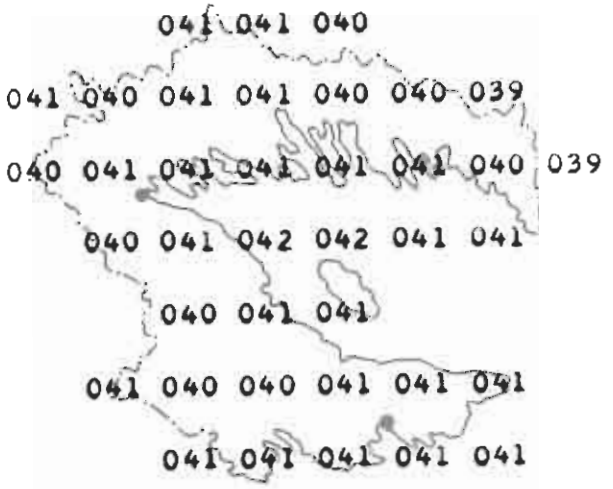
GRID SCALE

AREA OF BARREN - SQ.KM.

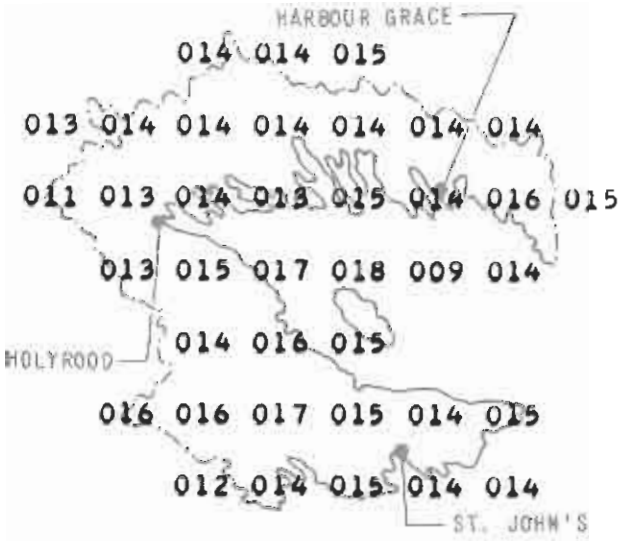
FOREST AREA - SQ.KM.

FIGURE 1-2

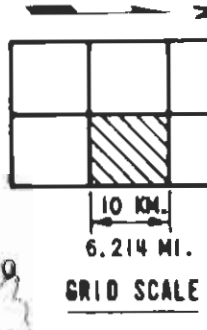
ST.JOHN'S AND ENVIRONS STUDY AREA
SQUARE GRID DISTRIBUTION OF AVERAGE ANNUAL TEMPERATURE, PRECIPITATION, EVAPORATION AND RUNOFF

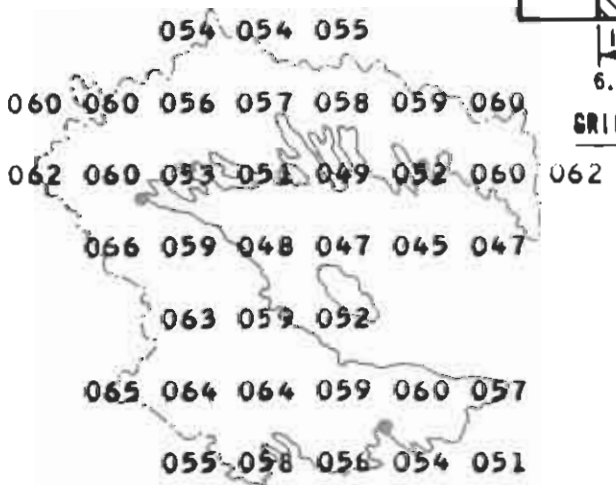


AVERAGE YEARLY TEMPERATURE
-DEGREES FAHRENHEIT

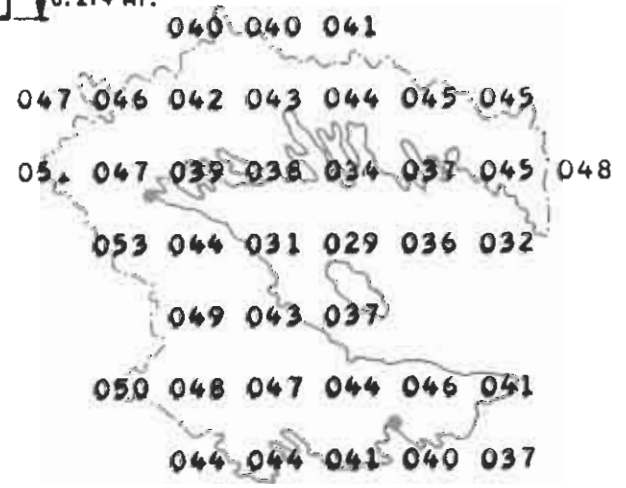


AVERAGE YEARLY EVAPORATION
- INCHES OF WATER





AVERAGE YEARLY PRECIPITATION
- INCHES OF WATER



AVERAGE YEARLY RUNOFF
- INCHES OF WATER

FIGURE 1-3

LEGEND

DIVISION OF SURFICIAL MATERIALS ARRANGED TO SHOW VARIATION IN GROUND WATER POTENTIAL & MATERIAL TYPE

UNIT	GROUND WATER POTENTIAL	TYPE OF MATERIAL
S1	LOW	BED ROCK OR THIN PATCHY MORAINE
SA2	MODERATE TO LOW	GROUND, HUMMOCKY AND ABLATION MORAINES
SA3	LOW TO MODERATE	END MORAINE
S4	HIGH TO MODERATE	ESKERS, KAMES, OUTWASH, BEACHES, RECENT ALLUVIUM
S5	POOR QUALITY	MARSH AND BOG

NOTE:

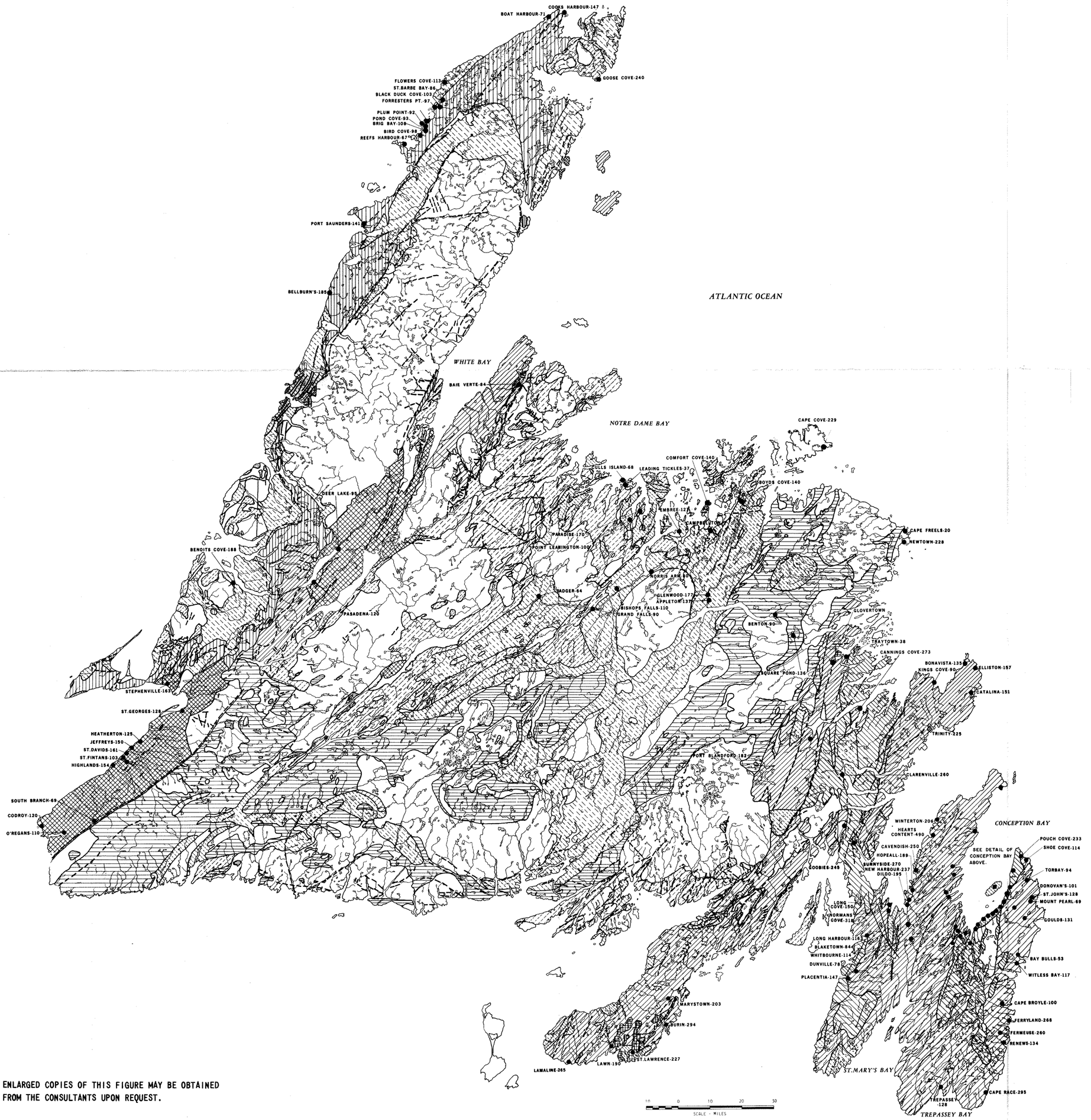
THE HYDROGEOLOGICAL UNITS WERE DEVELOPED FROM PUBLISHED AND UNPUBLISHED MAPS AND REPORTS BY THE GEOLOGICAL SURVEY OF CANADA, AND AVAILABLE DATA ON SURFICIAL MATERIALS AND GROUND WATER.

DISTRIBUTION OF UNITS IS GENERALISED, MANY AREAS ARE TOO SMALL TO BE SHOWN AT THIS SCALE.

ENLARGED COPIES OF THIS FIGURE MAY BE OBTAINED FROM THE CONSULTANTS UPON REQUEST.

AVALON PENINSULA
SURFICIAL HYDROGEOLOGY

FIGURE 1-4



ENLARGED COPIES OF THIS FIGURE MAY BE OBTAINED FROM THE CONSULTANTS UPON REQUEST.

LEGEND

UNITS ARRANGED IN APPROXIMATE ORDER OF GROUND WATER POTENTIAL

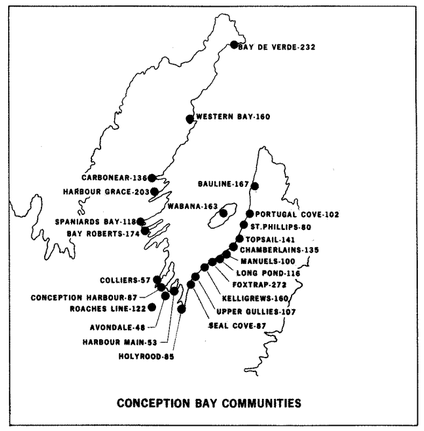
UNITS	GROUND WATER POTENTIAL	ROCK TYPE
R1	LOW	MAJOR IGNEOUS INTRUSIONS
R2	LOW	MAIN PRECAMBRIAN SEDIMENTS
R3	LOW	PRECAMBRIAN VOLCANICS
R4	LOW	PALEOZOIC METAMORPHICS
R5	LOW	PALEOZOIC VOLCANICS
R6	LOW	PALEOZOIC SEDIMENTS
R7	LOW TO MODERATE	CARBONIFEROUS SEDIMENTS
R8	LOW TO MODERATE	SERIES WITH DOMINANT LIMESTONE AND DOLOMITE
R9	LOW TO MODERATE	ST. LAWRENCE GRANITE
———	MODERATE TO HIGH	FAULT OR MAJOR LINEAMENT

● ST.JOHN'S - 128. AVERAGE DEPTH OF WELL IN FEET

NOTE:

THE HYDROPETROLOGIC UNITS WERE DEVELOPED FROM PUBLISHED AND UNPUBLISHED MAPS AND REPORTS BY THE GEOLOGICAL SURVEY OF CANADA, THE DEPARTMENT OF MINES, AGRICULTURE AND RESOURCES, NEWFOUNDLAND, AND AVAILABLE DATA ON WATER WELLS AND MINE DEWATERING.

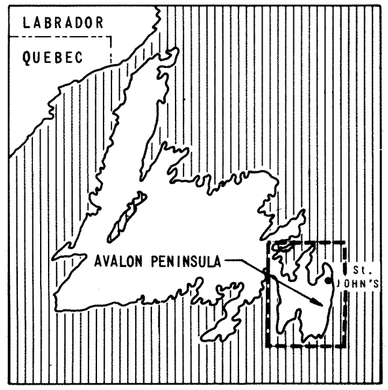
DISTRIBUTION OF UNITS ARE GENERALISED.



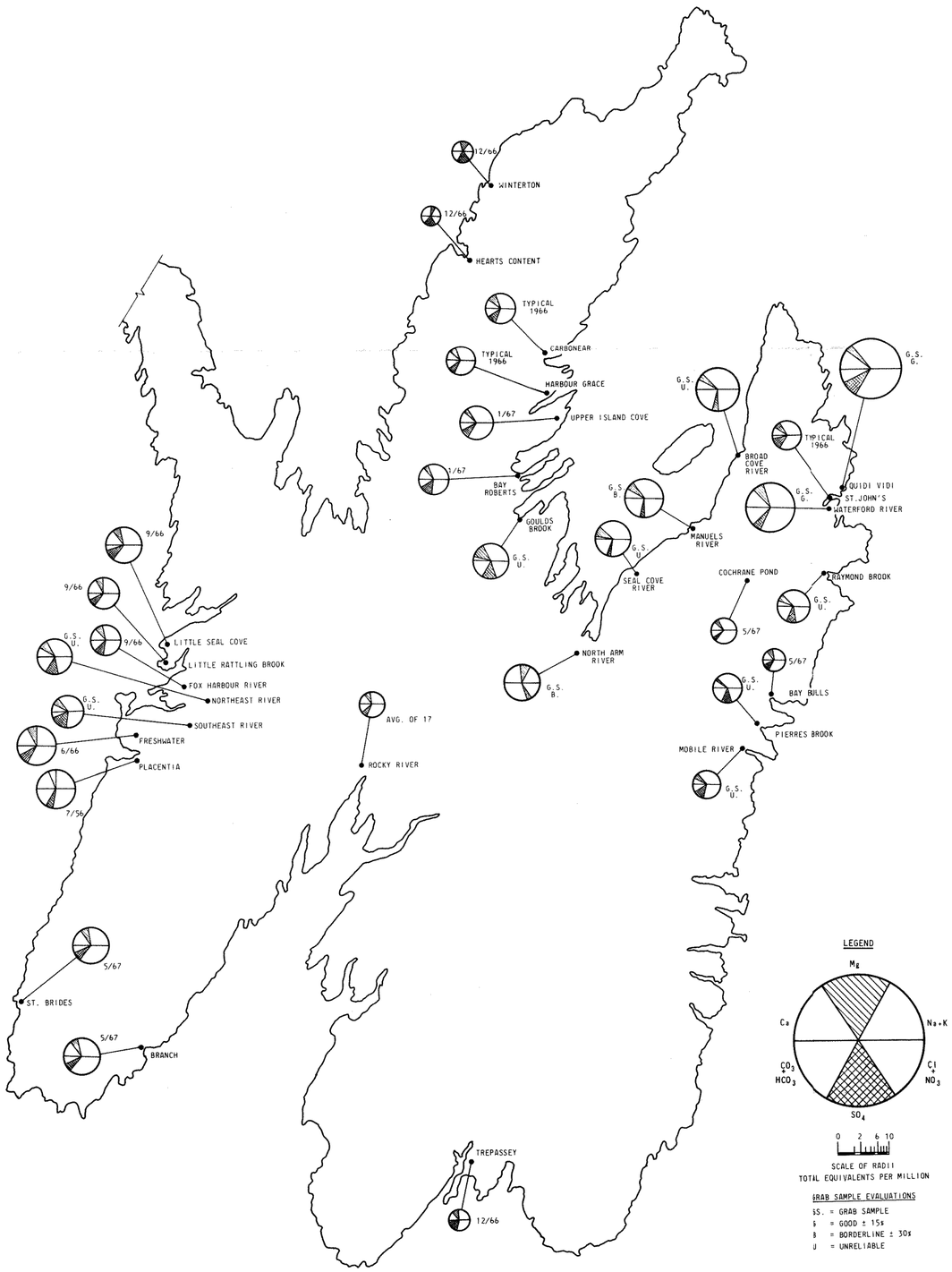
CONCEPTION BAY COMMUNITIES

NEWFOUNDLAND
BEDROCK HYDROGEOLOGY

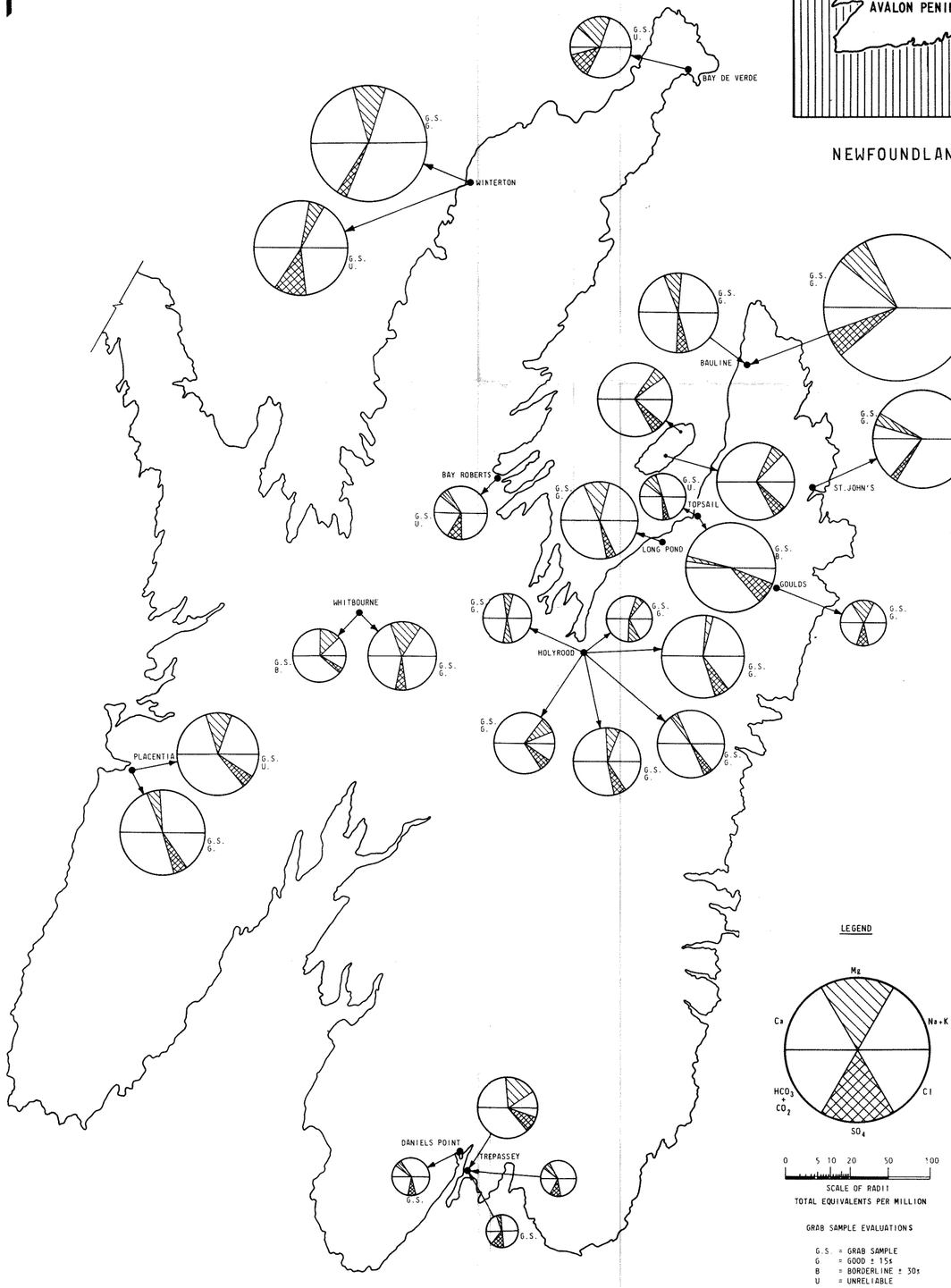
FIGURE 1-5



NEWFOUNDLAND - KEY PLAN



SURFACE WATER-MAJOR CHEMICAL CONSTITUENTS.



BEDROCK WELLS-MAJOR CHEMICAL CONSTITUENTS.

AVALON PENINSULA
MAJOR CHEMICAL CONSTITUENTS IN GROUNDWATER AND SURFACE WATER

FIGURE 1-6

ESTIMATED FUTURE AVERAGE DAY WATER REQUIREMENTS METROPOLITAN ST.JOHN'S

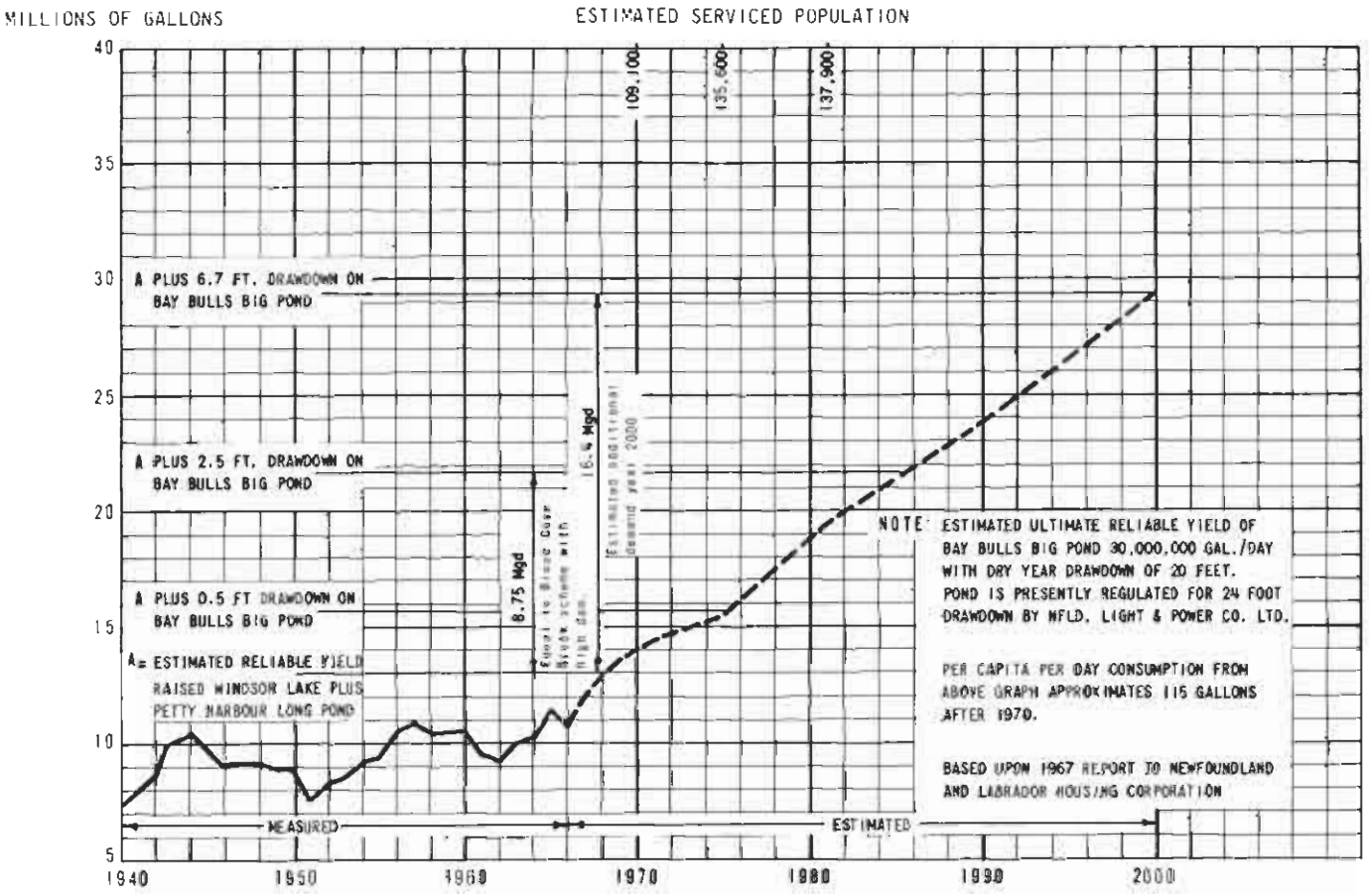


FIGURE 4-1

ST. JOHN'S AND ENVIRONS STUDY AREA

SUMMARY OF CLIMATIC CHARACTERISTICS

A ANNUAL MEANS

Precipitation (inches)	Air Temperature (deg F)	Potential Evaporation (inches)	Relative Humidity (percent)
57.3	40.6	20	86

B MEAN MONTHLY PRECIPITATION (inches)

Stations	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
St. John's	5.00	5.24	5.00	3.71	3.62	2.96	2.86	4.46	3.78	4.93	5.29	6.33
St. John's Torbay	6.02	6.40	5.30	4.77	3.88	3.72	3.49	4.00	4.71	5.43	6.40	6.85
St. John's West CDA	6.85	7.07	6.32	5.18	4.39	3.20	2.89	4.02	4.07	5.40	7.32	7.08
Basin Mean Synthesized	5.60	5.70	5.20	4.30	3.70	3.60	3.20	4.20	4.50	5.10	5.90	6.40

C MAXIMUM POSSIBLE STORM PRECIPITATION (inches)

Area (sq. mi)	Storm Duration (hours) 6	12	18	24	36	48	72
100	4.85	7.30	8.85	10.20	12.10	12.50	14.20
300	4.75	7.25	8.70	10.10	12.00	12.40	14.05

D MAXIMUM POSSIBLE SEASONAL SNOWFALL (inches of water equivalent): 31.5

E CRITICAL SEQUENCES FOR SNOW MELTING (degrees F)

Interval	Date March 1	March 10	March 20	April 1	April 10	April 20	May 1
4 - day	50.0	50.0	51.5	53.0	54.5	56.5	58.5
8 - day	46.0	47.5	48.5	49.7	50.7	52.6	55.0
16 - day	40.5	41.5	42.5	45.0	47.5	49.0	51.0

F DROUGHT

Return Period	2.33-Year	5-Year	10-Year	20-Year	50-Year	100-Year
Length of Drought	12 days	14 days	16 days	18 days	21 days	23 days

TABLE 1 - 1

SUMMARY OF HYDROLOGIC CHARACTERISTICS
ST.JOHN'S STUDY AREA

NOTE:
SINCE THE RIVER BASINS OF THIS AREA ARE VERY SMALL, SYNTHESIZED DATA REPRESENT ROUGH APPROXIMATIONS ONLY.

I - SYNTHESIZED DATA

A. ANNUAL MEANS FOR THE TOTAL BASIN

FLOW (CFS)	RUNOFF (CFS/SQ.MI)	RUNOFF (INCHES)	ACTUAL EVAP. (INCHES)
	3.13	42.6	14.7

B. MEAN MONTHLY FLOWS (Q) AND STANDARD DEVIATIONS (S) (CFS)

RIVER AND LOCATION		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
PETTY HARBOUR AT SECOND POND (53.4 SQ.MI)	Q	182	162	203	380	299	116	107	78	98	161	239	243	192
	S	148	81.3	98	134	118	70.9	64	37	72	81.1	115	91.7	28.7*
SEAL COVE AT WHITE HILL POND (30.0 SQ.MI)	Q	113	100	140	167	180	84.4	46.1	55.2	68.3	104	144	117	114
	S	59.1	50.0	55.3	67.4	70.8	46.3	25.1	34.9	44.4	45.5	61.2	43.6	13.8*
NORTHEAST POND AT NORTHEAST POND (1.4 SQ.MI)	Q	4.3	6.3	5.3	8.8	7.5	3.7	1.6	1.8	2.7	4.3	6.3	5.3	5.1
	S	2.3	3.4	2.5	3.7	3.5	2.7	1.2	1.6	2.4	2.3	3.4	2.5	0.8*

C. MAXIMUM FLOWS (CFS) AND FLOOD VOLUMES (CFS DAY) OBTAINED BY THE MAXIMIZATION PROCEDURE (INSTANTANEOUS PEAKS)

RIVER AND LOCATION	MAXIMIZED RAIN ON SNOW PACK		MAXIMIZED RAIN ONLY		SNOW PACK & AVERAGE RAIN	
	PEAK	VOLUME	PEAK	VOLUME	PEAK	VOLUME
PETTY HARBOUR AT SECOND POND	9,200	27,800	8,400	17,700	1,960	10,800

D. MAXIMUM FLOWS OBTAINED BY STATISTICAL ANALYSIS (CFS) (DAILY AVERAGES)

RIVER AND LOCATION	GENERATED BY SNOW MELT & RAIN		GENERATED BY RAIN ONLY	
	1/10000 YEARS	1/1000 YEARS	1/10000 YEARS	1/1000 YEARS
PETTY HARBOUR AT SECOND POND	3,692	2,905	4,281	3,341
SEAL COVE AT WHITE HILL POND	2,770	2,269	2,656	2,087
NORTHEAST POND AT NORTHEAST POND	181	150	186	143

NOTE: *THIS IS THE STANDARD DEVIATION OF THE MEAN ANNUAL FLOW

SUMMARY OF HYDROLOGIC CHARACTERISTICS
ST.JOHN'S STUDY AREA

E. MINIMUM FLOWS OBTAINED FROM RECESSION CURVES (CFS)

RIVER AND LOCATION	1/2 YEARS	1/5 YEARS	1/10 YEARS	1/20 YEARS

F. MINIMUM FLOWS OBTAINED FROM STATISTICAL ANALYSIS (CFS)

RIVER AND LOCATION	1/2 YEARS	1/5 YEARS	1/20 YEARS	1/100 YEARS
PETTY HARBOUR AT SECOND POND	28	18		4
SEAL COVE AT WHITE HILL POND	15	10		2
NORTHEAST POND AT NORTHEAST POND	0	0		0

G. FULL REGULATION STORAGE

RIVER AND STATION	STORAGE (CUBIC FEET x 10^9)
PETTY HARBOUR AT SECOND POND	7.88
SEAL COVE AT WHITE HILL POND	3.51
NORTHEAST POND AT NORTHEAST POND	0.14

II - RECORDED DATA

H. MEAN MONTHLY AND ANNUAL FLOWS (CFS)

RIVER AND STATION	YEARS OF RECORD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
PETTY HARBOUR AT SECOND POND (SEE NOTE)	35	222	217	257	392	218	103	54	65	97	176	236	260	192
SEAL COVE AT WHITE HILL POND (SEE NOTE)	18	193	145	151	205	133	67	36	34	57	87	148	147	115
NORTHEAST POND AT NORTHEAST POND	13	5.5	4.8	5.7	9.6	6.6	3.4	1.4	1.7	2.1	4.1	6.8	5.8	4.8

ERRORS IN THE MONTHLY VALUES ARE POSSIBLE FOR REASONS INDICATED IN VOLUME II SECTION 15.2

I. EXTREMES RECORDED (CFS)

RIVER AND STATION	MAXIMUM FLOWS			MINIMUM FLOWS		
	FLOW	DATE	COMMENTS	FLOW	DATE	COMMENTS
PETTY HARBOUR RIVER AT SECOND POND			DAILY FLOWS AFFECTED BY POWERHOUSE OPERATION			DAILY FLOWS AFFECTED BY POWERHOUSE OPERATION
SEAL COVE AT WHITE HILL POND			DAILY FLOWS AFFECTED BY CHANGES IN STORAGE			DAILY FLOWS AFFECTED BY CHANGES IN STORAGE
NORTHEAST POND AT NORTHEAST POND	190	DEC.19 1964	REPORTED AS (MEAN) DAILY DISCHARGE	0.0	AUGUST-SEP.61	

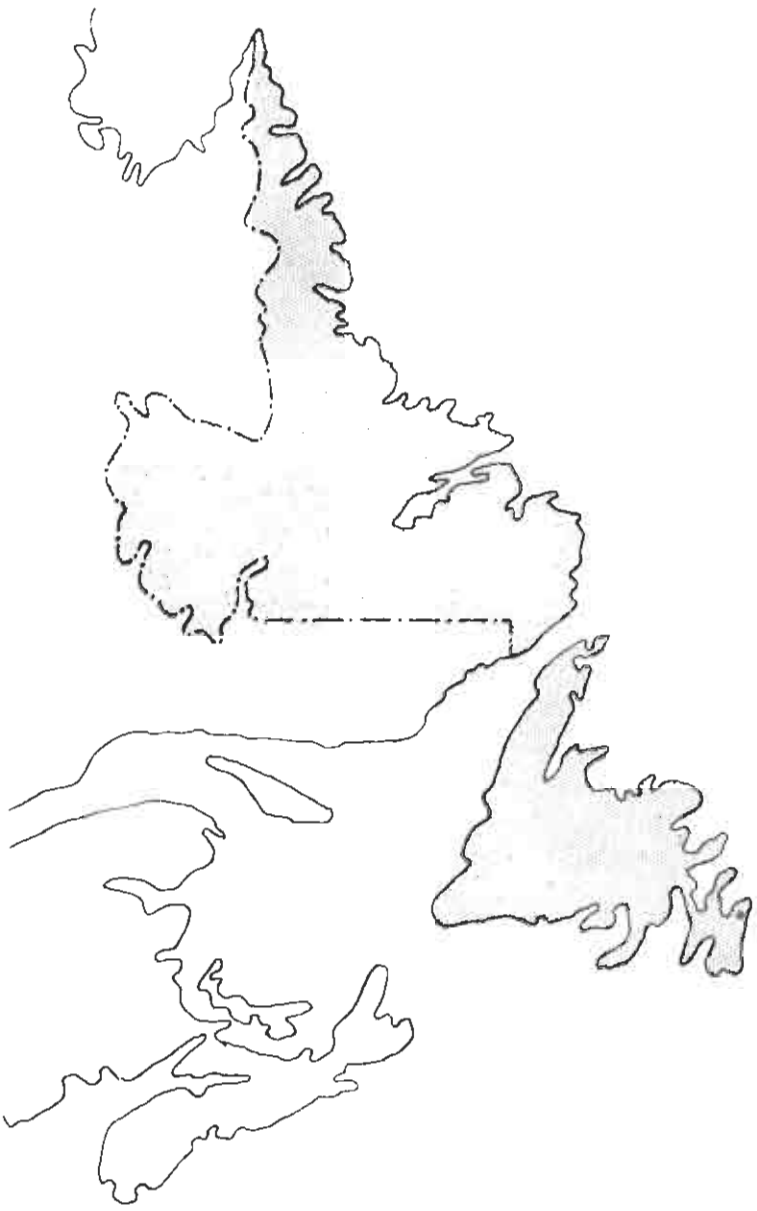
ST. JOHN'S AND ENVIRONS STUDY AREA

WATER USING INDUSTRIES

INDUSTRY	LOCATION	PRINCIPAL PRODUCTS	WATER SOURCE	WATER USAGE	REMARKS
Brookfield Ice Cream Limited	St. John's	Ice cream	Municipal system	80,000 gpd average	
Concrete Products	St. John's	Ready mix concrete	2 drilled wells 2 dug wells	30,000 gpd during summer peak	Considering connection to municipal system
Lundrigan's Concrete (East) Limited	St. John's	Ready mix concrete	Municipal system	300,000 gpd during summer peak	Wash water for aggregates recycled
Bavarian Brewing Limited	St. John's	Beer	Municipal system	150,000 gpd during summer peak	Process water treated by means of carbon filter
Newfoundland Brewery Limited	St. John's	Beer	Municipal system	80,000 gpd average	
The Bennett Brewing Company Limited	St. John's	Beer	Municipal system	135,000 gpd average	
Gaden's Limited	St. John's	Soft drinks	Municipal system	120,000 gpd during summer peak	Process water treated by means of carbon filter
Seven-Up Eastern (1967) Limited	St. John's	Soft drinks	Municipal system	25,000 gpd during summer peak	Process water filtered in plant
Purity Factories	St. John's	Soft drinks	Municipal system	30,000 gpd during summer peak	Process water filtered in plant
Browning Harvey Limited	St. John's	Soft drinks	Municipal system	50,000 gpd during summer peak	Process water filtered in plant
Canadian Liquid Air Limited	St. John's	Industrial gases	Municipal system	3,000 gpd average	Cooling water recirculated reducing consumption by six fold
Newfoundland Steel Company Limited	St. John's	Merchant bar and grinding balls	Octogan Pond and well (artesian)	8,000,000 gpd average	Water used primarily for cooling. Domestic water obtained from well.
United Nail and Foundry Co. Ltd	St. John's	Castings	Municipal system	24,000 gpd average	Water used primarily for cooling
Golden Eagle Refinery	Holyrood	Refined petroleum	Sea, wells, and Butterpot Pond	2,600,000 gpd salt, 360,000 gpd fresh average	
Ross-Steers Fisheries Ltd	St. John's	Frozen fish	Municipal system	1,000,000 gpd average	Plant not in operation at present time (1968)
Cabot Sea Foods	St. John's	Frozen fish	Municipal system	Approx. 25,000 gpd average	Plant operates May to November only
Fort Amherst Sea Foods Ltd	St. John's	Frozen fish	Municipal system	20,000 gpd average	Plant operates May to November only
Bay Bulls Sea Products	Bay Bulls	Frozen fish	Surface supply	Approx. 50,000 gpd average	Plant operates May to November only
North Eastern Fisheries Ltd	Harbour Grace	Frozen fish	Bannerman Lake	Not stated	This plant has estimated annual landings in 1975 will be 120,000,000 pounds
Newfoundland Quick Freeze Ltd	Witless Bay	Frozen fish	Surface supply	Approx. 140,000 gpd average	Plant operates May to December only
Earle Brothers Fisheries Ltd	Carbonear	Frozen fish	Municipal system	Not stated	Present annual landings 10,000,000 pounds

TABLE 2-1

The Shawinigan Engineering Company Limited
James F. MacLaren Limited



VOLUME SEVEN - PART II — SECTIONS 8-14

STUDY AREA - COME BY CHANCE AND ENVIRONS

PART II - COME BY CHANCE AND ENVIRONS STUDY AREA

8 NATURAL CONDITIONS

The Come By Chance area includes most of the isthmus which connects the Avalon Peninsula to the central part of the Island of Newfoundland and extends from Come By Chance in the north to Placentia in the south; the limits of the study area are indicated in Figure 8-1.

8.1 Physiographic Conditions

The study area covers a total area of 332 square miles, a large part of which is either barrens (consisting of rock out-croppings, stony areas of sparse grass cover, clumps of forest, or marshy land) or lakes. Figure 8-2 shows the distribution of areas of barrens, lakes, forests and bogs within the study area.

Most of the study area is at an elevation of less than 400 feet above sea level; the highest peak in the area being Centre Hill at 1133 feet near Come By Chance. On Figure 8-1 the topography of the area as well as the network of rivers and lakes is shown.

The bedrock in the area is comprised almost entirely of Pre-Cambrian sediments and volcanics, in roughly equal proportions with both types having undergone some metamorphism. In the north-eastern corner of the area there is an intrusion of diorite and gabbro. At Sunnyside there is a small inlier of Cambrian sedimentary rocks.

There are large areas in this region that either have only a very thin drift cover or are completely exposed bedrock. Only about half of the total area is covered, mostly with ground, hummocky, and ablation moraines together with some very small areas of alluvium.

The rivers in the study area are numerous but very small; the Southeast River with a total drainage area of 55 square miles, only a small part of which is within the study area, is the largest river flowing through the area. As is the case with the rivers, lakes are numerous in the study area but are generally small in size.

The variation in mean annual temperature, precipitation, and evaporation in the study area is shown in Figure 8-3. The mean annual temperature is approximately 40.5 deg F, with extremes in temperatures being moderated by the proximity of the study area to the sea. The mean annual precipitation is approximately 55 inches distributed fairly evenly

throughout the year. The area is quite susceptible to fog due to the presence of Trinity Bay to the northeast and Placentia Bay to the southwest. Additional climatological data as obtained from generalized relationships are presented in tabular form in Table 8-1.

8.2 Water Availability

8.2.1 Surface Water

Hydrologic data on the Come By Chance study area are available from only one gauging station, located on the Come By Chance River, but only for a period of record of one year, the gauge being abandoned in 1961. Accordingly the areal distribution of runoff in the study area has been derived from the procedure developed in Volume Two A, Part IV, and is indicated in Figure 8-3. The mean annual runoff in this area is 44 inches, equivalent to 3.2 cfs per square mile. Significant hydrologic characteristics of the area have been synthesized from the generalized relationships established in Volume Two A, Part IV, and are summarized in Table 8-2.

A review of twelve available chemical analyses of a number of surface waters in this area (excluding the Come By Chance River) reveals that these waters are low in total dissolved solids, with a total equivalent per million of less than 1.0 in all cases. Total hardness as $CaCO_3$ is very low varying between 6 and 15 mg/l, pH readings ranged from 5.8 to 6.9 with most readings being approximately 6.3. The surface waters of this area appear to be slightly less coloured than most surface waters on the Island probably due to the small amount of bogland making up the surface area; colour varied from a low of 5 units to a maximum of 80 units with most values being less than 20 units. The maximum recorded turbidity was 15 units with most readings being less than 1 unit.

None of the analyses reviewed revealed significant concentrations of iron, manganese, fluorides, or other minor chemical constituents which would adversely affect the quality of the water for either industrial or domestic uses. A single bacteriological analysis of the Northeast River indicated a coliform count of 170 per 100 ml; similarly a single bacteriological analysis of the Southeast River indicated a coliform count of 190 per 100 ml. No other bacteriological analysis of natural waters in the area were available for review.

8.2.2 Groundwater

This study area has a poor potential for the development of large supplies of groundwater from either bedrock or surficial deposits. Most of the bedrock in the area is either Pre-Cambrian sediments, or Pre-Cambrian volcanics, designated as hydropetrologic units R2 and R3 on Figure 1-4 of this volume and as such has a low groundwater potential. Figure 8-4 shows the distribution of the surficial materials in the area together with their groundwater potential.

The groundwater potential of the area is summarized in the following table:

Hydrogeologic Unit	Estimated Yield Range gallons per minute	Percent of Study Area	Remarks
R1	0-40	0.9	poor quality
R2	0.5-10	42.5	
R3	1-10	54.5	
R6	1-20	2.1	poor quality
S1	0-5	53.1	
S2	10-50	45.8	
S4	50-100	1.1	

Partial chemical analyses were available for only two wells in the area, both drilled; in both instances the groundwater had a pH of 8.3; total hardness was 100 mg/l in one well and 120 mg/l in the other expressed as $CaCO_3$.

8.3 Water Resources Potential

The water resources potential of this study area is limited by the lack of any single significant river since the area is made up of many small river systems. No worthwhile hydro potential exists.

The streams utilized by anadromous fish are currently being used at or near their limited capacity and little development potential exists. The many lakes in the study area offer recreational potential for local inhabitants, but it is unlikely that the area will be able to develop a large scale tourist industry in view of its barren physical features, but the development of Provincial parks shown on Figure 8-1 should act as considerable encouragement for the industry.

Fresh water for industrial development is available throughout the area, but generally in quantities of less than 10 million gpd without added expense for diversions to provide the necessary drainage area. Industrial cooling water is readily available from the many small lakes, but once-through processing water is limited. Storage possibilities exist on the Black, Southeast, and Northeast rivers which will provide regulated flows of 47, 30, and 26 million gpd respectively. Details of these possibilities are presented in Volume Five, Part II.

8.4 Natural Resources

Natural resources other than water are not plentiful in the Come By Chance study area. No forest resource exists with the exception of a small unexploited area near Come By Chance. Land suitable for agricultural use is also not available. Because of the lack of forest cover throughout most of the area, wildlife is not overly plentiful.

The long coastline of this area on Placentia Bay provides many potential industrial sites, where ocean transportation is a factor in the industrial development. Placentia Bay is ice free (as are all other south sea coast bays), and the study area is well served by land transportation through the Trans-Canada Highway and the Canadian National Railway both of which traverse the area. These factors, no doubt, were of significance in locating the industrial complex currently under construction at Come By Chance as well as the phosphate reduction plant at Long Harbour.

9 PRESENT DAY DEVELOPMENT

9.1 Population Patterns

The Come By Chance study area forms part of Census Division 1. According to the grid square population distribution, 11,080 persons were living in the area in 1966 which was approximately two percent of the Provincial population.

The population of the study area has almost doubled since the 1951 census and the average annual growth rate has increased between each census period. In 1951 the population was 6120 rising by 5.0 percent a year to 7770 in 1956, by 3.2 percent a year to 9120 in 1961, and by 3.7 percent a year to 11,080 in 1966.

In 1966, 43 percent of the population of the study area lived in three towns: Placentia with a population of 1867, Dunville with 1622 and Freshwater with 1310. The next largest community was Jerseyside with 953, followed by Long Harbour with 355 and Come By Chance with a population of 298.

Between 1951 and 1966 there has been a steady growth in urban concentration (urban defined as a community of 1000 or more). By definition, there were no urban communities in the study area in 1951 although Placentia did approach this status with 903 persons. In 1956, 30 percent of the population lived in urban areas, specifically Placentia and Freshwater. By 1961, 45 percent of the population lived in urban areas. The percentage dropped slightly to 43 by the 1966 census.

The degree of urbanization in the study area is approximately eleven percentage points lower than the Provincial average of 54 percent but is well below the Canadian average of 74 percent.

The most recent data on the age structure of the population were for 1961. Two samples were readily available for the Come By Chance study area, one for Dunville and one for the area around Mount Arlington Heights. The population of Mount Arlington Heights proper was 266, the population included in the age-structure sample was 746.

A comparison between the age structure of the two communities and that of the Provincial pattern is interesting.

Age Group	Percentage Distribution of Population		
	Mount Arlington	Dunville	Province
0-14	48	48	42
15-24	16	14	10
25-64	31	36	42
64 +	5	2	6

The age structure of Dunville is indicative of a new and growing community, particularly the low percentage of older people and the high percentage of young people. The larger proportion of older people in Mount Arlington reflects the established rural non-farm content of the sample.

9.2 General Economic Pattern

9.2.1 Primary and Secondary Industry

It was estimated that 300 fishermen live in the Come By Chance study area. There are no fish plants in the area which confirms a limited inshore fleet. There has been some relocation from the islands in Placentia Bay to the fishing villages along the study area coast line, but any resulting increase in primary activity has not been sufficient to warrant a processing plant in the area.

Therefore, apart from a very limited primary inshore fishery, there is no primary or secondary activity in the area.

9.2.2 Tertiary Industry

At the present time the greatest proportion of the economy of the study area revolves around the tertiary sector, and is dependent on the transportation and defense sectors.

Considerable tertiary employment is generated by the U. S. Naval Base at Argentia (with an estimated on-base population of 3000) which is a main source of employment for the population of Placentia, Dunville, Jerseyside and Freshwater. The other employment is that generated by Canadian National Depot at Argentia which is the base of the coastal service for the south sea coast of the Island and the recently inaugurated ferry service between Argentia and North Sydney, Nova Scotia.

On the assumption that the population age-structure of the area has not changed significantly since 1961, the labour force age group in 1966 was approximately 4650 people. By applying the Provincial labour force participation rate to the area the labour force is estimated to be 2050.

With most of the employment in the area coming from the Naval Base and the CN Depot at Argentia, the employment in this area was probably 900 to 1000 people.

If the employment estimates for the inshore fisheries, the transportation industry, and the naval base reflect the actual employment there is an indicated unemployment rate in the area of 20 to 30 percent.

9.3 Withdrawal Water Uses

9.3.1 Municipal Uses

The U.S. Naval Station at Argentia is the largest municipal consumer of water in the study area using an average of 1,500,000 gallons per day. Water is obtained from nearby Clarke's Pond and treatment is limited to chlorination prior to use. The water supply is of good quality, and no problems with quantity have been experienced by the station.

The station is completely served by a system of separate sanitary sewers discharging untreated wastewater into Placentia Bay. No difficulties have arisen to date from this practice.

The municipality of Dunville in 1967 completed the installation of its water supply and distribution system using Wises Pond as the source of supply. Chlorination of the water is the only treatment prior to use. Not all the houses in Dunville are yet connected to this new system, and until such time as they are, these residents will continue to rely upon individual dug wells for water.

Approximately 75 percent of the municipality is served by a recently installed system of sanitary sewers discharging untreated wastewater into Northeast Arm. The balance of the municipality relies upon individual septic tanks and privies for disposal of wastewater.

The municipalities of Jerseyside, Freshwater, and Placentia are currently supplied from Larkins Pond through a common water supply system. At the present time Southeast Placentia is not connected to the existing distribution system and this area relies upon individual dug wells.

Jerseyside and Freshwater are each served for the most part by a system of sanitary sewers discharging untreated wastewater into adjacent salt water. Placentia, as well as Southeast Placentia, does not have a system of sewers for disposal of wastewater, and individual homes are served by septic tanks and privies at the present time.

The balance of the communities in the study area are each less than 500 persons, and rely upon individual house water supply and sewage disposal systems. In general, the water supply system is a dug well, and the sewage disposal system is either a septic tank, privy, or direct discharge to the sea.

9.3.2 Water Supply for Individual Industries

At the present time the Electric Reduction Company of Canada has the only water supply system serving a major industry exclusively. This supply has just recently been completed, and uses as its source the Rattling Brook watershed immediately to the south of the plant site. The Erco plant will produce elemental phosphorous by the electric reduction process from phosphate ore obtained from Florida. Water is required in the processing of the ore, for the scrubbing of the gases produced by the reduction process, as well as for cooling purposes. The design capacity of the installed water supply system is approximately 12 million gpd; provision has been made for the use of salt water wherever fresh water is not essential in the operation.

The Rattling Brook source, which includes provision for future diversion of the upper portion of Ship Harbour Brook into it to augment the initial supply, appears to be adequate to meet the known quantity and quality requirements of the Erco plant. The total drainage area utilized to meet the demand is 18.5 square miles. Wastewaters from this plant are to be discharged, untreated into Long Harbour; this procedure has been given approval in principle by the Department of Fisheries and should not become a problem.

To meet the fresh water requirements of the Newfoundland Pulp and Chemical Company, which is currently constructing an integrated pulp and paper mill at Come By Chance, a water supply system utilizing the Come By Chance and Black Rivers has been proposed[1]. The pulp and paper mill's initial requirements have been estimated

to be 10 million gpd increasing to approximately 12.5 million gpd by 1972. In addition to the pulp and paper mill's water requirements, water will be required for the oil refinery and ammonia plant proposed as part of the industrial complex to be in operation at the Come By Chance site in 1970. In all, the total water required at this site by 1972 is estimated to be 16.5 million gpd.

The proposed water supply scheme, estimated to cost $3,205,000, consists of the diversion of about 50 percent (35 sq. miles) of the Black River drainage area into the Come By Chance River and the construction of a low (26 feet) dam on the Come By Chance River at tidewater. It is intended that adequate provision for anadromous fish to pass the dam will be incorporated into its design. Diversion of the Black River into the Come By Chance River will result in the loss of fish production potential in the Black River; the Department of Fisheries are aware of this and have indicated that they will attempt to compensate for this loss by increasing development measures on the Come By Chance and North Harbour rivers.

The proposed water supply source is adequate to meet the 16.5 million gpd requirements of the industrial complex expected to materialize by 1971; the water is of acceptable quality and, except for chlorination for sanitary uses and as noted subsequently, it should not require treatment prior to use in processing. It should be noted, however, that on the basis of the limited available analyses, the water from the Come By Chance River is highly coloured ranging from a minimum recorded value of 35 units to a high of 145 units in eight samples analyzed over the past two years. In addition these waters are more turbide than most Newfoundland waters, with a minimum recorded value of 12 units and a maximum of 90 units over the period 1965 to 1967. (In most Newfoundland surface water colour averages about 30 units, and turbidity is usually less than 3 units.) Water of this high colour content and turbidity is normally not acceptable for process use in the pulp and paper industry without treatment.

No treatment of the wastewaters produced by the pulp and paper mill is contemplated, and these wastewaters will be discharged into the sea. Provided fibre wastes are kept to a minimum and bark is disposed of by means other than discharging into the sea, the discharge of untreated wastewaters should not create difficulties. Treatment of wastewaters from the proposed oil refinery in order to remove oil is essential if sea birds and the shoreline are to be protected. It is unlikely that treatment of the wastewaters from the ammonia plant will be required.

9.4 Non-Withdrawal - Non-Consumptive Uses

At the present except for modest fish propagation there is little non-withdrawal non-consumptive use of the water resource in the study area. The four major streams flowing through the area, namely, Come By Chance River, North Harbour River, Northeast River, and Southeast River, each support moderate populations of Atlantic salmon as well as sea-run and resident brook trout. The Come By Chance and North Harbour Rivers are both completely accessible to anadromous fish at the present time, but are not producing at their maximum capability for reasons not entirely known by the Canada Department of Fisheries.

The Canada Department of Fisheries estimates that the total annual production of Atlantic salmon in each of the Come By Chance and the North Harbour Rivers is about 200 fish; the Department further estimates that between 1000 and 2000 sea-run brook trout use the Come By Chance River, and that about 4500 of these fish use the North Harbour River. The Northeast and the Southeast Rivers are considerably larger than the former two rivers and, although not completely accessible to anadromous fish, they are both currently producing at their maximum potential. The Canada Department of Fisheries estimate that each of these two rivers is producing an annual unexploited adult population of about 6000 Atlantic salmon as well as good stocks of anadromous and resident brook trout.

To date there has been very little angling on the Come By Chance and North Harbour Rivers in spite of the easy access to them from the Trans-Canada Highway. Sports fishing on the Northeast and Southeast Rivers is almost entirely by residents of the area adjacent to Placentia, including the U. S. Naval Station at Argentia.

9.5 'Negative' Water Demand Problems

Problems of "negative" water demand in the study area are of a minor nature only. No instances of flooding were encountered and bog reclamation has not been applicable in the area. Road construction has caused minor siltation of both the Come By Chance River and the Northeast River, and is, undoubtedly, responsible for the relatively high turbidity of the Come By Chance River. Siltation of these rivers is not presently severe, but eventually may be sufficient to interfere to some extent with salmon production.

10 PLANNED AND FORECAST DEVELOPMENT

10.1 General Planning in Study Area

None of the municipalities within the study area are contemplating (insofar as could be ascertained) the creation of industrial parks, major residential areas, or recreational areas in the immediate future. The Town of Clarenville, approximately 20 miles north of the northerly limit of the study area, has prepared a draft municipal plan[2] upon which it will base development of the town. This is particularly appropriate in view of the industrial development occurring at Come By Chance, since Clarenville will, undoubtedly, house many of the employees attracted to the Come By Chance development. No regional plan incorporating this study area has been drafted to date, although such a plan for the Placentia region would be desirable for the direction of the growth and development of this region.

10.2 Industrial Development

Industrial development planned for the Come By Chance study area consists of the phosphate reduction plant at Long Harbour, and the integrated pulp and paper mill and industrial complex at Come By Chance, both of which developments are currently under construction. The phosphate reduction plant owned by the Electric Reduction Company of Canada is to be completed in late 1968. This plant will be capable of producing 70,000 tons of phosphorous per year, and will employ approximately 300 persons. Housing for the plant's employees is not being provided by the company, and all employees will reside in existing communities in the region (particularly in the area on the west side of Conception Bay).

The Newfoundland Pulp and Chemical Company is currently constructing a 600 ton per day integrated pulp and paper mill at Come By Chance. This mill, which will use the sodium sulphite process for production of chemical pulp, will employ between 350 and 400 persons when it commences operations in 1970. As is the case with the phosphate reduction plant, housing for this plant's employees will not be provided, and all employees will reside in nearby existing communities. In addition to the pulp and paper mill, the industrial complex at Come By Chance is to include an oil refinery with a capacity of 100,000 barrels of refined petroleum products per day, employing 500 persons, as well as an ammonia plant with a capacity of 1000 tons of ammonia fertilizer per day, employing 170 persons. Although neither of these plants is currently under construction, it is anticipated that both may be in operation by 1971.

As previously mentioned, the Come By Chance study area includes a long shoreline on Placentia Bay, and as such offers ice-free harbours for potential industry. Long Harbour, the site of the Erco plant is probably the best of the several deep water harbours in the area. Because of the proximity of this study area to the labour pool available in the Avalon Peninsula, and the excellent land transportation afforded by the Trans-Canada Highway and the Canadian National Railway, both of which traverse the area, there seems to be good potential for industrial development, especially that dependent upon bulk ocean transportation.

10.3 Population Growth and Level of Living

Based on past trends, the population in the study area is projected to grow steadily over the forecast period; from the 1966 population of 11,080 it is projected to grow to 11,150 by 1971, to 12,200 by 1976, and to 13,210 by 1981.

However, this projection does not take into consideration the major developments which are anticipated in the study area over the forecast period. These developments will affect both the size and the areal distribution of the population. In 1966 there was only one area of population concentration. It is expected that the new developments will create at least one new urban area and create the potential for a second.

Over the forecast period it is assumed that the Erco plant will employ 300 people. The following assumption has been made concerning the number of jobs that will be generated by the primary employment: for each primary job 1.5 secondary jobs will be generated in 1971, rising to 1.75 by 1967, and to 2 jobs by 1981. Therefore, the total employment created by the Long Harbour plant will be 750 in 1971, 825 in 1976, and 900 in 1981.

To calculate the total population supported by this employment, it has been assumed that each job will support four people; the employed and three dependents. On this basis the total population supported by the Long Harbour plant will be 3000 in 1971, 3300 in 1976 and 3600 by 1981. It is assumed that these people will come from communities lying outside the boundaries of the study area. The development of a community of this size may seem optimistic in view of the location of the plant and the number of services that could probably be provided by St. John's. The expansion of the tertiary sector will probably be somewhat slower than the assumptions indicate; however, they are not considered unreasonable for purposes of this study.

With the construction of a pulp and paper mill and an oil refinery at Come By Chance, it is anticipated that a further 900 people will be employed during the study period. Most of them will commute from communities within the study area or from communities to the north in the Clarenville area. The net result is the anticipation that only 20 percent of the required labour force will come from other areas to locate in the vicinity of Come By Chance.

In effect, in terms of total population, movement into the study area will be 1800 by 1971, 1980 by 1976 and 2160 by 1981.

From these calculations it is possible to revise upwards the basic population projection:

	Total Population - Come By Chance Study Area		
	1971	1976	1981
Basic projection	11,150	12,200	13,210
Net movement to Long Harbour	3,000	3,300	3,600
Net movement to Come By Chance	1,800	1,980	2,160
Study Area - Total	15,950	17,480	18,970

The developments will continue the trend towards urbanization within the study area. More important, they will diminish the dependence of the area on the defense sector. This is particularly important because there is always the possibility that the American Naval Station could close, although no plans for such closure are known.

The income of the inshore fisheries is generally low, and this factor, coupled with the indicated unemployment rate and the high percentage of the population under 14 years old, would offset the higher incomes derived from employment at the Naval station. It would then follow that the income levels in the study area are probably lower than the average incomes in St. John's which dominates census division 1, in which both areas lie. Per capita disposable income in the study area is assumed to be lower than the average reported for census division 1. The estimate for 1965 was approximately $1,100. In view of the type of industry locating in the area, the estimate of a per capita disposable income of $2,100, in terms of 1965 dollars, is made for 1981.

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11 PLANNED AND FORECAST WITHDRAWAL WATER DEMAND AND SUPPLY

11.1 Municipal Water Supply Development

The town of Placentia is planning to replace its present source of supply, Larkins Pond, with the Southeast River. The supply main from the Larkins Pond source crosses the saltwater gut at Placentia, and has been broken by ice jams on two occasions in recent years. The supply main from the Southeast River source will not have to cross this gut and will, therefore, provide a much more reliable system. At one time a plan was under consideration whereby Placentia together with Jerseyside and Freshwater, as well as the U. S. Naval Station at Argentia, would be supplied through a common supply system utilizing Beaver Pond as the source; this scheme never materialized. Now that Placentia has decided to use the Southeast River as its source of supply, it is probable that the Larkins Pond source will be adequate for the needs of Freshwater and Jerseyside, at least during the study period.

No other municipal water supply development is known to be under consideration for the area at this time.

Clarenville, not within the study area but certain to be influenced by the development, does not have a municipal water supply, the inhabitants relying upon individual wells and surface reservoirs for water. Most of the town is served by a system of sanitary sewers, the balance of the town using septic tanks. Dark Hole Brook has been recommended as a source of supply for a municipal water system at an estimated cost of $315,000, but this recommendation has yet to be implemented[3].

11.2 Municipal Wastewater Disposal

The municipalities of Dunville, Jerseyside, and Freshwater each have sanitary sewer systems at the present time serving most of their areas. Although no known plans exist for extension to these systems, such extensions are likely within the study period in order to eliminate individual household disposal systems. A 1967 report has been prepared outlining a plan to install a separate system of sanitary sewers in Placentia, exclusive of Southeast Placentia. The outfall from this sytem will discharge its flows to the gut connecting Northeast and Southeast Arms to the ocean; treatment of the sewage is not contemplated. The estimated cost of this proposed system of sewers is $627,000[4].

No other municipal wastewater disposal developments are known to be under consideration in the area at this time.

12 PLANNED AND FORECAST AREAL AND REGIONAL WATER RESOURCES DEVELOPMENT

No non-withdrawal water using developments are known to be planned for the area in the immediate future. The Department of Fisheries have indicated that they will ultimately carry out development work on both the Come By Chance and North Harbour Rivers in order to develop production of anadromous fish from these rivers to a maximum to meet the recreational needs of the area which are expected to increase with the construction of the industrial complex at Come By Chance.

13 'NEGATIVE' WATER DEMAND PROBLEMS

Problems of 'negative' water demand should not occur in the study area during the study period with the possible exception of siltation of rivers adjacent to road construction. As in all other areas of the Province, steps should be taken to minimize soil erosion both during road construction and after the completion of such work; siltation can materially reduce the stream's potential to produce fish, and if of a continuing nature can produce waters of such high turbidity that treatment prior to municipal or industrial use is mandatory. It is possible that the high turbidity and colour observed in the samples of Come By Chance River water were occasioned by road construction activities.

14 CONCLUSIONS AND RECOMMENDATIONS

14.1 Conclusions

a) Natural resources in the Come By Chance and environs study area are quite limited. No exploitable forest resource exists; land suitable for agricultural pursuits is for all practical purposes not available in the area; the lack of rivers of significant size in the area eliminates hydro-electric power potential; wildlife in the area is not plentiful because of the lack of suitable habitat; fresh water fish production in the streams and lakes of the area is moderate but there is potential for improvement.

b) The Electric Reduction Company of Canada Limited's phosphorous plant located at Long Harbour has utilized advantage of one of the area's major assets, that is, the potential of the deep harbour on Placentia Bay for ocean shipping. The industrial complex under construction at Come By Chance by the Newfoundland Pulp and Chemical Company Limited has also been sited in the area to take advantage of the harbour potential on Placentia Bay.

c) Although fresh water is available throughout the area in small quantities, large volumes of water in excess of 10 million gallons per day are available only with storage on the Black, Northeast, and Southeast Rivers. Construction of a storage dam on the Black River will eliminate a small run of anadromous fish from that river; the Department of Fisheries have indicated their intention to improve the fish production of the adjacent Come By Chance River to compensate for the loss of production on the Black River.

d) Multiple use of surface waters in the area has been limited and therefore no significant conflicts of interest have developed; there does not appear to be any potential conflicts of interest in the use of the water resource within the study period with the possible exception of some loss of fish rearing potential as a result of construction of storage facilities on the Northeast and Southeast Rivers.

e) Water quality degradation of the fresh water resource has not occurred since wastewaters are discharged to the Bay curtailing the Bay's recreational value.

14. 2 Recommendations

a) The study area is served by excellent road and rail facilities as well as potential harbour sites on Placentia Bay. Further industrial development in the area should be actively encouraged to complement that already undertaken recognizing the difficulties of supplying larger quantities of fresh water.

b) In view of the importance of the Come By Chance River as a source of water to the industrial complex, the installation of a recording flow gauge on the river is recommended.

c) In the region of Placentia and Dunville, surface waters suitable for recreational use by the region's inhabitants should be developed. In addition, surface waters and their drainage areas required for potable water supplies should be delineated and protected as necessary to maintain water quality.

d) Because of the large volumes of industrial wastewaters to be discharged to the Bay in this area along with municipal wastes, careful oceanographic studies are recommended to determine the degree of dispersion and diffusion necessary to prevent conflicts in the use of the sea water. Some degree of wastewater treatment may be necessary in this location during the study period.

REFERENCES

1 ShawMont Newfoundland Limited. Supplementary Report on the Water Supply for the Come By Chance Industrial Complex, April 1968.

2 Project Planning Associates Limited. Town of Clarenville - Municipal Plan Draft, June 1966.

3 Canadian British Engineering Consultants. Town of Clarenville, Report on Water Supply, 1962.

4 Engineering Services Limited. Placentia - Preliminary Report, 1967.

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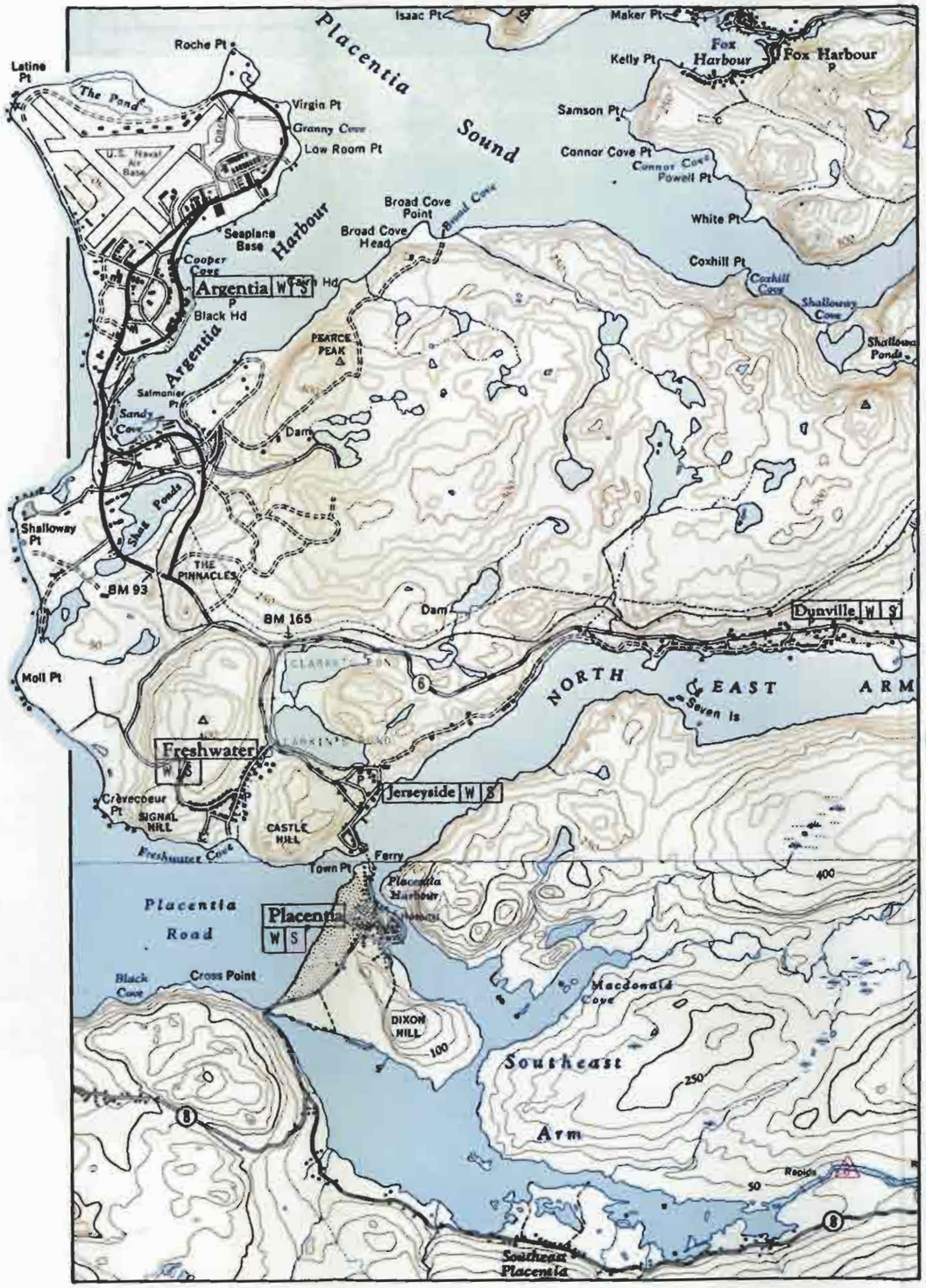
GENERAL PLAN



DETAIL "A"

NEWFOUNDLAND - KEY PLAN

NOTES: POTENTIAL FUTURE DEVELOPMENTS AND PROJECTS UNDER CONSTRUCTION SHOWN IN RED

1. COMMERCIAL FISHING AREA
2. ATLANTIC SALMON AREA
3. FUTURE FRESHWATER SOURCE FOR PLACENTIA
4. STORAGE RESERVOIR SITES

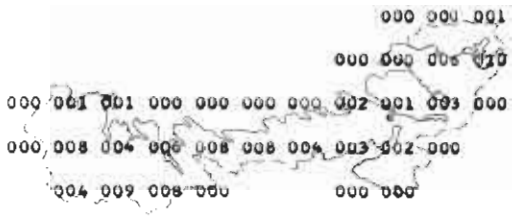
LEGEND:

W S COMMUNITY WITH WATER SUPPLY AND WASTEWATER DISPOSAL SYSTEMS

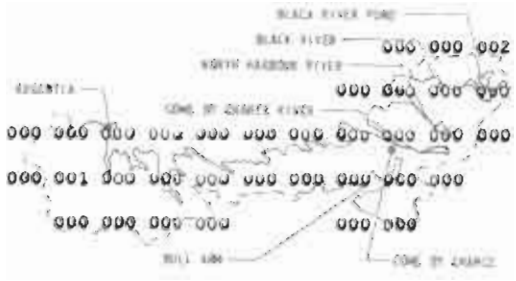
COME BY CHANCE STUDY AREA

FIGURE 8-1

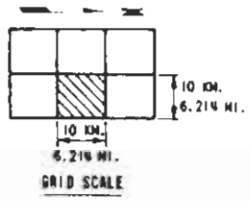
COME BY CHANCE AND ENVIRONS STUDY AREA
SQUARE GRID DISTRIBUTION OF LAKES, BOGS AND SWAMPS, BARRENS AND FORESTS

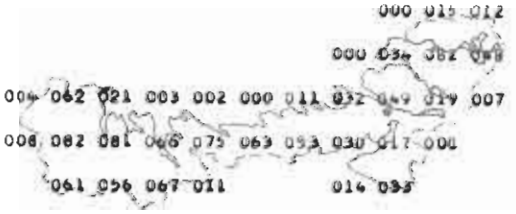


LAKE AREA - SQ.KM.

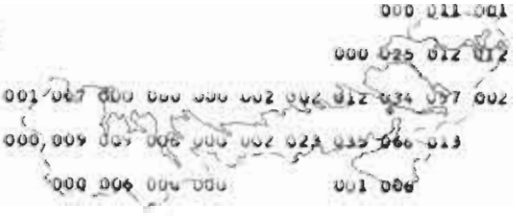


BOG AND SWAMP AREA - SQ. KM.





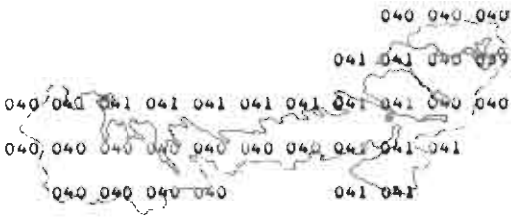
AREA OF BARREN - SQ.KM.



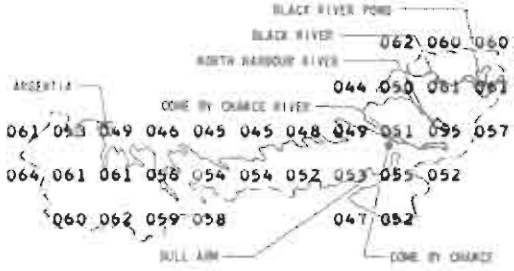
FOREST AREA - SQ.KM.

FIGURE 8-2

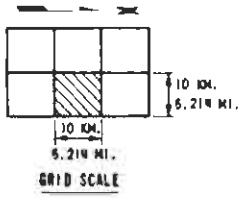
COME BY CHANCE AND ENVIRONS STUDY AREA
SQUARE GRID DISTRIBUTION OF AVERAGE ANNUAL TEMPERATURE, PRECIPITATION, EVAPORATION AND RUNOFF

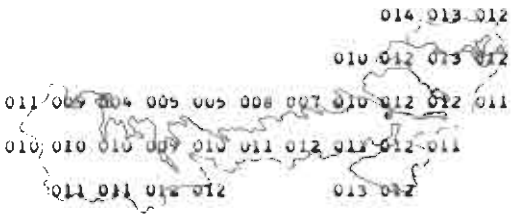


AVERAGE YEARLY TEMPERATURE -DEGREES FAHRENHEIT

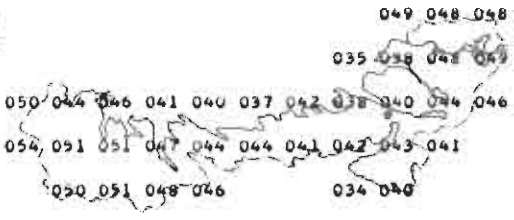


AVERAGE YEARLY PRECIPITATION - INCHES OF WATER



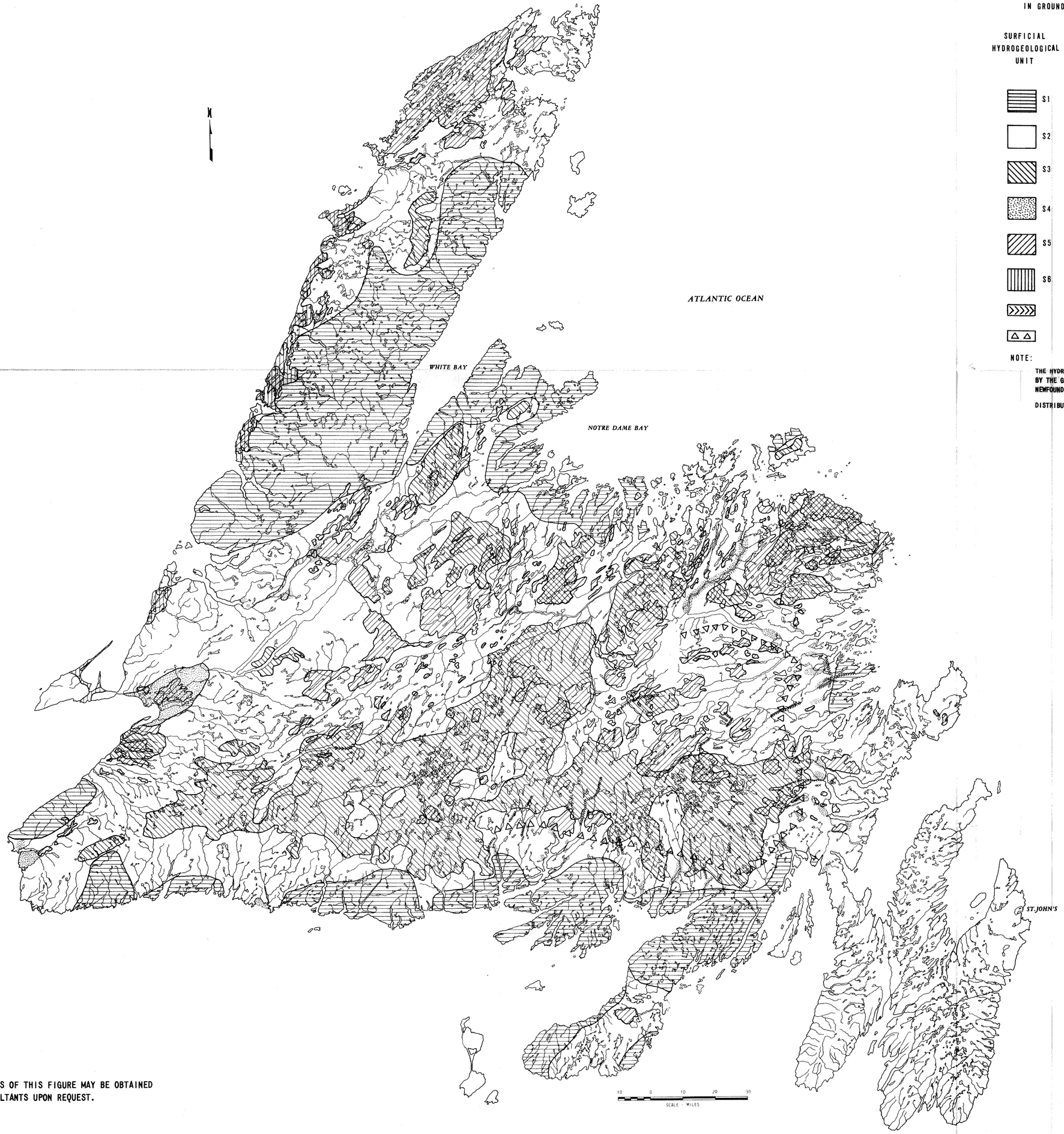


AVERAGE YEARLY EVAPORATION - INCHES OF WATER



AVERAGE YEARLY RUNOFF - INCHES OF WATER

FIGURE 8-3



LEGEND

DIVISION OF SURFICIAL MATERIALS ARRANGED TO SHOW VARIATION IN GROUND WATER POTENTIAL AND MATERIAL TYPE

SURFICIAL HYDROGEOLOGICAL UNIT	GROUND WATER POTENTIAL	TYPE OF MATERIAL
S1	LOW	THIN PATCHY MORAINE OR BEDROCK
S2	MODERATE TO LOW	GROUND, ABLATION AND SOME END MORAINE
S3	LOW MODERATE	RIBBED MORAINE
S4	HIGH TO MODERATE	ESKERS, KAMES, OUTWASH, BEACHES, RECENT ALLUVIUM
S5	POOR QUALITY	MARSH AND BOG (HATCHING FOR UNDERLYING UNITS ALSO SHOWN ON MAP)
S6	VARIABLE	MARINE CLAYS MAY OVERLIE WATER BEARING MATERIAL
		ESKER (DIRECTION OF STREAM FLOW NOT NECESSARILY IMPLIED)
		LINE OF END MORAINE

NOTE:

THE HYDROGEOLOGICAL UNITS WERE DEVELOPED FROM PUBLISHED AND UNPUBLISHED MAPS AND REPORTS BY THE GEOLOGICAL SURVEY OF CANADA, THE DEPARTMENT OF MINES, AGRICULTURE AND RESOURCES, NEWFOUNDLAND AND THE AVAILABLE DATA ON SURFICIAL MATERIALS AND GROUND WATER.

DISTRIBUTION OF UNITS IS GENERALISED. MANY AREAS ARE TOO SMALL TO BE SHOWN AT THIS SCALE.

ENLARGED COPIES OF THIS FIGURE MAY BE OBTAINED FROM THE CONSULTANTS UPON REQUEST.

NEWFOUNDLAND
SURFICIAL HYDROGEOLOGY
(EXCLUDING THE AVALON PENINSULA)

FIGURE 8-4

COME BY CHANCE AND ENVIRONS STUDY AREA

SUMMARY OF CLIMATIC CHARACTERISTICS

A ANNUAL MEANS

Precipitation (inches)	Air Temperature (deg F)	Potential Evaporation (inches)	Relative Humidity (percent)
54.8	40.3	19	85

B MEAN MONTHLY PRECIPITATION (inches)

Stations	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Argentia	5.00	4.51	2.87	2.96	2.76	2.40	3.11	3.36	3.30	3.30	6.42	5.08
Basin Mean Synthesized	5.50	5.60	4.10	3.70	3.30	3.10	3.80	4.20	4.10	4.40	6.60	6.00

C MAXIMUM POSSIBLE STORM PRECIPITATION (inches)

Area (sq. mi)	Storm Duration (hours) 6	12	18	24	36	48	72
100	4.85	7.30	8.85	10.20	12.10	12.50	14.20
300	4.75	7.25	8.70	10.10	12.00	12.40	14.05

D MAXIMUM POSSIBLE SEASONAL SNOWFALL (inches of water equivalent): 31.5

E CRITICAL SEQUENCES FOR SNOW MELTING (degrees F)

Interval	Date March 1	March 10	March 20	April 1	April 10	April 20	May 1
4 - day	50.0	50.5	51.5	53.0	54.5	56.5	58.5
8 - day	46.0	47.5	48.5	49.7	50.7	52.6	55.0
16 - day	40.5	41.5	42.5	45.0	47.5	49.0	51.0

F DROUGHT

Return Period	2.33-Year	5-Year	10-Year	20-Year	50-Year	100-Year
Length of Drought	14 days	17 days	19 days	21 days	24 days	27 days

TABLE 8-1

SUMMARY OF HYDROLOGIC CHARACTERISTICS
COME BY CHANCE STUDY AREA

1 - SYNTHESIZED DATA

A. ANNUAL MEANS FOR THE TOTAL BASIN

FLOW (CFS)	RUNOFF (CFS/SQ.MI)	RUNOFF (INCHES)	ACTUAL EVAP. (INCHES)
	3.26	44.4	10.3

B. MEAN MONTHLY FLOWS (Q) AND STANDARD DEVIATIONS (S) (CFS)

RIVER AND LOCATION		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
COME BY CHANCE RIVER AT SEA	Q	72	65	70	112	102	62	27	27	34	56	79	67	75
	S	48	31	40	46	44	25	26	22	27	31	33	32	11
COME BY CHANCE RIVER AT GOOBIES	Q	40	36	36	61	63	39	16	15	20	31	45	37	42
	S	26	18	22	27	27	17	12	13	16	17	19	19	7
	Q													
	S													

C. MAXIMUM FLOWS (CFS) AND FLOOD VOLUMES (CFS DAY) OBTAINED BY THE MAXIMIZATION PROCEDURE (INSTANTANEOUS PEAKS)

RIVER AND LOCATION	MAXIMIZED RAIN ON SNOW PACK		MAXIMIZED RAIN ONLY		SNOW PACK & AVERAGE RAIN	
	PEAK	VOLUME	PEAK	VOLUME	PEAK	VOLUME

D. MAXIMUM FLOWS OBTAINED BY STATISTICAL ANALYSIS (CFS) (DAILY AVERAGES)

RIVER AND LOCATION	GENERATED BY SNOW MELT & RAIN		GENERATED BY RAIN ONLY	
	1/10000 YEARS	1/1000 YEARS	1/10000 YEARS	1/1000 YEARS
COME BY CHANCE RIVER AT SEA	2290	1965	1730	1380
COME BY CHANCE RIVER AT GOOBIES	1270	1060	980	770

SUMMARY OF HYDROLOGIC CHARACTERISTICS
COME BY CHANCE STUDY AREA

E. MINIMUM FLOWS OBTAINED FROM RECESSION CURVES (CFS)

RIVER AND LOCATION	1/2 YEARS	1/5 YEARS	1/10 YEARS	1/20 YEARS

F. MINIMUM FLOWS OBTAINED FROM STATISTICAL ANALYSIS (CFS)

RIVER AND LOCATION	1/2 YEARS	1/5 YEARS	1/20 YEARS	1/100 YEARS
COME BY CHANCE RIVER AT SEA	3	1	0	
COME BY CHANCE RIVER AT GOOBIES	1	1	0	

G. FULL REGULATION STORAGE

RIVER AND STATION	STORAGE (CUBIC FEET x 10^9)

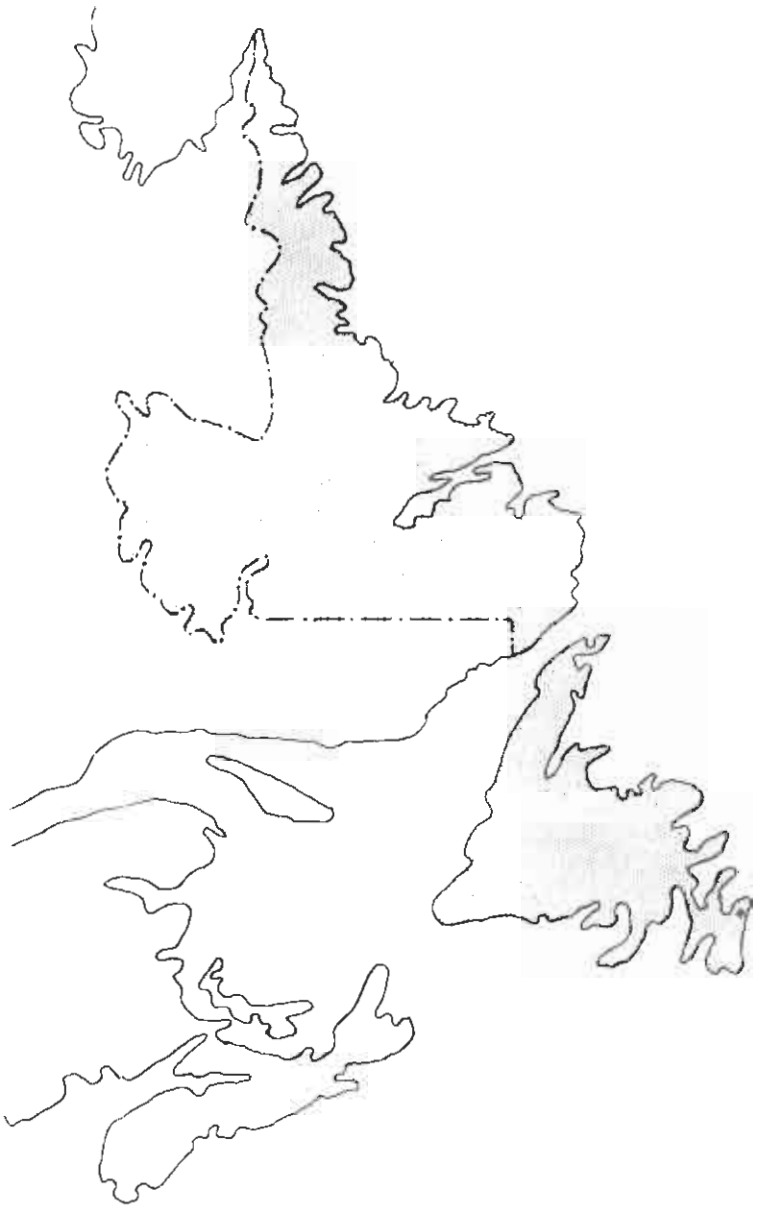
II - RECORDED DATA

H. MEAN MONTHLY AND ANNUAL FLOWS (CFS)

RIVER AND STATION	YEARS OF RECORD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE

I. EXTREMES RECORDED (CFS)

RIVER AND STATION	MAXIMUM FLOWS			MINIMUM FLOWS		
	FLOW	DATE	COMMENTS	FLOW	DATE	COMMENTS



PART III

VOLUME SEVEN - PART III SECTIONS 15-18

STUDY AREA - BURIN PENINSULA

PART III - BURIN PENINSULA STUDY AREA

15 NATURAL CONDITIONS

The Burin Peninsula is a narrow neck of land, nowhere exceeding 25 miles in width, extending approximately 100 miles in a southwesterly direction into the Atlantic Ocean from the south sea coast near the point at which the Avalon Peninsula also joins the main body of the Island.

15.1 Physiographic Conditions

The study area includes the portion of the peninsula lying south of Garnish and encompasses a total area of 716 square miles, approximately 90 percent of which is barren, represented by rock outcroppings, stony areas of sparse grass cover, clumps of forest or areas which contain peaty or marshy land. The balance of the study area is more or less equally divided between lakes and areas of forest. Figure 15-1 shows the study area while Figure 15-2 shows the distribution of areas of barrens, lakes, forest and bogs within it.

Most of the bedrock in the area is Pre-Cambrian in age, made up largely of volcanic materials and sediments, all of which have been metamorphosed. There are also some patches of Cambrian sediments near to the sea coast. The main igneous intrusions are situated near the town of St. Lawrence, and are of granite, as is a smaller intrusion near Burin.

Along the whole of the western side of the area there is only a thin veneer of moraine at best on top of bedrock and the bedrock is exposed in many places; similar conditions prevail in the southeastern corner of the area. The central part has a cover of moraine of variable thickness, normally ranging up to about 30 feet in this area. There are a few eskers developed, and there are minor outwash deposits and sand bars associated with some of the streams.

In the study area a large portion of the land lies between 300 and 600 feet above sea level, the only peaks of any height being on the east sea coast near Marystown where elevations over 700 feet occur.

The rivers in the study area are all quite small, the Garnish River with a drainage area of 79 square miles being the largest. Other rivers worthy of mention include Grand Bank Brook, Salmonier River, Main Brook, and the St. Lawrence River, none of which is of great length. The only substantial area of fresh water is Freshwater Pond

near Marystown, fed by Main Brook (occasionally known as Tides Brook).

The variation of mean annual temperature, precipitation, and evaporation in the study area is shown in Figure 15-3. The mean annual temperature is approximately 41 deg F with extreme minimum and maximum temperatures being moderated by the proximity of the area to the sea. The mean annual precipitation is about 60 inches per year with precipitation falling on 160 days in the average year. Evaporation averages about 9 inches per year. Climatic characteristics are summarized in Table 15-1. The area is quite susceptible to fog, more so than any other area along the south sea coast of the Island.

15.2 Water Resources

15.2.1 Surface Water

Hydrologic data on the study area are available from only one gauging station, located at Garnish on the Garnish River, with a period of record of ten years. The areal distribution of the mean annual runoff as derived from the generalized relationships with physiographic and meteorologic factors (developed in Volume Two A, Part IV) is indicated in Figure 15-3. The mean annual runoff in the study area is approximately 51 inches, equivalent to 3.75 cfs per square mile. Significant hydrological characteristics of the area have been synthesized and are summarized in Table 15-2.

Surface water quality in the area is generally unaffected by man's activities which up to the present time have been confined to areas immediately adjacent to the sea coast. The surface waters of the study area are rather high coloured ranging from a recorded minimum of 20 units to a maximum of 50 units during the period 1956 to 1967. The pH of these waters is low with a minimum recorded value of 6.4 and a maximum of 7.1. The high colour and low pH are undoubtedly a result of the high proportion of barrens in the drainage areas. Total hardness is less than 15 mg/l as $CaCO_3$ and the total dissolved solids are similarly low, being less than 1 equivalent per million, due to the relative insolubility of the bedrock. Although only a total of 13 analyses of surface waters were available none showed excessive concentrations of iron, manganese, or fluoride.

Although virtually no data are available on the overall bacteriological quality of untreated surface waters, it is unlikely that any of the drainage areas are significantly bacteriologically polluted. This is due primarily to the fact that the interior of the study area is mostly inaccessible and all population is concentrated along the sea coast.

15.2.2 Groundwater

No data are available on the overall availability of groundwater excepting that assembled in the preparation of this report and presented in the form of Figure 1-4, Volume Seven, Part I, and Figure 8-4, Volume Seven, Part II.

From an examination of these two figures it may be seen that groundwater in any quantity is available only from the St. Lawrence granite near St. Lawrence and from the faults and major lineaments in the bedrock; even in these areas only low to moderate yields can generally be expected. Seventy-eight percent of the area is underlain by unit R2, which has a low groundwater potential, as does unit R6, which occupies another 15 percent of the basin. Five percent of the basin is underlain by unit R9, the St. Lawrence granite,which has a higher groundwater potential than that observed in other granites.

Almost 65 percent of the area has a cover of moraine material of moderate thickness which is capable of producing only small supplies of water. The thin overburden in the study area is not conducive to the yielding of groundwater in quantity as noted on Figure 8-4.

The groundwater potential of the study area is summarized as follows:

Hydrogeologic Unit	Estimated Yield Range Gallons per Minute	Approximate Percent of Study Area	Remarks
R1	0 - 40	0.7	
R2	0.5 - 10	78.3	
R6	1 - 20	15.4	
R9	1 - 100	5.6	high fluoride and radon content
S1	0 - 5	32.5	
S2	10 - 50	64.7	
S4	50 - 1000	0.9	
S5	-	2.9	poor quality

Water derived from the St. Lawrence granite and associated rocks generally contains concentrations of fluoride and radioactive material which are higher than desirable in drinking water supplies.

Analyses of the water from two wells at St. Lawrence showed fluoride concentrations ranging between 2.0 and 3.2 mg/l for the municipal supply and 1.0 mg/l for the only analysis from the Canada Department of Transport Decca station; for potable use the maximum concentration of fluoride is 1.0 mg/l with concentrations exceeding 1.5 often considered as sufficient to reject the water. Although fluoride in concentrations of 1.0 mg/l is considered beneficial in the prevention of dental caries, it is known that ingestion of water containing more than 3.0 mg/l of fluoride will produce mottling of teeth. A more detailed discussion of fluoride content of groundwater in the area is presented in Volume Two B, Section 37.5.

The Canada Department of National Health and Welfare has determined that the well water at the Decca station near St. Lawrence contains radon (Ra^{222}), but advises that, although the concentration is higher than in most drinking waters (which are generally non-radioactive), it is considered to be below the level that might cause concern on health grounds. As noted elsewhere in this report, radiation in the fluorspar mines at St. Lawrence is one of the subjects of a Royal Commission investigation, the results of which are expected toward the end of 1968.

In most small communities individual dug wells are used as a source of water. These wells are prone to contamination from nearby domestic waste disposal systems and frequently run dry during extended dry periods in the summer. No data are available on the chemical quality of water from these dug wells except for some fluoride figures shown in Volume Two B, Part VII.

15.2.3 Hydro Power Potential

Due to the low topography and small drainage areas of the rivers in the study area, there is no possibility of developing additional economical hydro power.

15.2.4 Fisheries for Fresh Water Dependent Species

The numerous small river basins within the area are the habitat for Atlantic salmon, as well as anadromous and resident brook trout, but not in large quantity. Removal of minor natural obstacles in the Garnish River would enable full use of this, the largest river in the area, by anadromous fish. Utilization of the St. Lawrence River is limited by the presence of three regulating dams each without a fishway, thus creating a complete barrier to fish.

15.2.5 Navigation and Log Driving

Other than limited use by very small boats for angling and hunting there is no navigation on the waters of the study area. Because of the complete lack of exploitable forests no log driving on the rivers is practiced.

15.3 Natural Resources

15.3.1 Forests

Exploitable forests exist only in the Marystown Salt Pond area and even there the resource is extremely limited. A number of small saw mills are in operation at the present time, but there is little likelihood of any significant growth in any form of forestry exploitation in the Burin study area.

15.3.2 Minerals

At present the known commercial mineral resources in the study area are limited to the fluorspar deposits at St. Lawrence. Mining of a fluorspar deposit by the St. Lawrence Corporation of Newfoundland Limited began in 1933 and production reached a maximum of 111,000 tons in 1956. Production ceased in 1961.

Newfoundland Fluorspar Limited (Newfluor) was formed in 1940 to take over the properties of American Fluorspar Limited where underground development had been carried out on two vein systems.

In 1965 the properties of the St. Lawrence Corporation of Newfoundland Limited were taken over by Newfluor. The St. Lawrence area has supplied virtually all the fluorspar produced in Canada. The annual production during recent years has been in excess of 100,000 tons, and it is expected that ore production can be maintained more or less at current levels into the late 1970's. The ore is concentrated at St. Lawrence and shipped to Arvida where it is used in the reduction of alumina to aluminum.

Mining operations have had to overcome several difficulties. They have been handicapped by the large quantities of water which must be removed from the workings, and by rock bursts which occur intermittently. Also there had been a high incidence of lung cancer among fluorspar miners who had worked underground for many years, and investigations indicated that high radiation levels were present in the workings. Once these conditions were recognized, the adaptation of mining practices compatible with local conditions, including changes

in mine ventilation and in water supply for the mine, resulted in a substantial reduction in radiation levels throughout the active workings. In 1960 the Newfluor Mine was considered to be a safe place to work. The miners' health, radiation conditions, and rock burst problems are currently under investigation by a Royal Commission appointed by the Province. The Commission's report is not yet published.

15.3.3 Wildlife

The area is the habitat for small numbers of snowshoe hare, beaver, and ptarmigan as well as moose and caribou. The population of moose has declined in recent years owing to the imperfect habitat for this species and severe overhunting. Caribou, which once numbered several thousand animals but were depleted by overharvesting, have recently been successfully reintroduced. The range on the Burin Peninsula is excellent for caribou which depend upon lichens, plentiful in the area, for their fall and winter range.

15.3.4 Recreation and Tourism

The natural conditions are not especially conducive to development of a large tourist industry, although excellent coastal scenery is found near Red Harbour, Mortier Bay, and at Frenchman's Cove where a provincial park is under development. The 100-mile drive from the Trans-Canada Highway to the study area across bleak barrens on the existing gravel road undoubtedly deters all but the hardiest of tourists from visiting the area. Fortune is the Newfoundland terminus of the summer passenger ferry to St. Pierre and Miquelon and as a result attracts tourists to the study area.

15.3.5 Agriculture

Due to the high broken terrain and the lack of good soil, agricultural activity is carried out on a small scale only. Most of the area's soils are coarse textured and the preponderance of boulders severely restricts the suitability of the land for cultivation. An area of bog land near Marystown, following proper drainage and agricultural practices, could be amenable to reclamation. The large areas of bedrock on the east sea coast have no agricultural potential.

16 PRESENT-DAY DEVELOPMENT

Present-day development of this study area is almost exclusively related to exploitation of the nearby fishing grounds and the mining of fluorspar. No other industry of any major significance is situated within the area with the exception of the recently completed shipyard at Marystown. Frozen fish and fish meal processing plants are located at Grand Bank, Fortune, Burin and Marystown; fluorspar mines are located at St. Lawrence.

16.1 Population Patterns

In 1966 the population of the Burin Peninsula study area was 18,140 reflecting the steady growth which has taken place since 1951. In that year the population was 13,980 increasing at a rate of just under 2.1 percent a year to 15,250 by 1956, then increasing at 2 percent per year to 16,390 by 1961, rising again at 2.1 percent to its 1966 level.

There are five major towns in the study area whose populations in 1966 were: Grand Bank - 3143, St. Lawrence - 2130, Marystown - 1894, Fortune - 1703, and Burin - 1167. In terms of urban concentration (urban being defined as a community of 1000 people or more), the growth in the degree of concentration has been steady over the last 15 years.

In 1951, 34 percent of the population lived in urban areas. By 1956, 53 percent of the population was living in urban areas. This jump in concentration reflects the growth of Fortune from a population of 867 in 1951 to 1194 by 1956. The degree of urbanization remained constant at 55 percent in 1961 and 1966. This is slightly higher than the Provincial rate of 54 percent but lower than the Canadian average of 74 percent.

The most recent data on the age structure of the population were for 1961. Compared to the Provincial average of 42 percent, 43 percent of the population was 14 years old or under. There are fewer people in the 15 to 64 age group in the study area, 50 percent compared to 52 percent in the Province. While 6 percent were in the 65 and over age group in the Province, there were 7 percent in the study area.

16.2 General Economic Pattern

16.2.1 Primary and Secondary Industry

The economy of the region is heavily dependent on the primary and secondary fisheries sector.

The study area lies in fisheries areas H and I; however, these two areas include more than the study area alone. It is therefore possible only to estimate the number of fishermen actively employed. Of the total employment of 2615 men in the two fisheries areas, probably about 1500 are located in the study area of which the greater portion are in the inshore fisheries.

The season for the inshore fishermen is limited by the size of their boats and their method of fishing. In the Lawn and Lamaline areas, the fishing season is from July to mid October, a factor which would change with a transition to larger vessels.

The secondary industry is to a great extent dependent on the primary fisheries. There are four processing centres: freezing and fish meal plants are located at Marystown, Burin, Fortune, and Grand Bank, the latter also having a salt fish plant.

The inshore fisheries support these plants although most of the boats do not deliver their catch directly to them. The existing practice is for the catch to be weighed and sold at the smaller ports and to be trucked to the large processing establishments.

Detailed employment figures are not available, but in view of the size of the plants and the fact that fisheries areas H and I report more than 50 percent of the total Provincial offshore employment, the involvement in secondary fisheries represents about 1200 people. This includes the new processing establishment at Marystown, but at a considerably lower employment level than the 800 forecast for full capacity operations.

The recently completed shipyard at Marystown is capable of building trawlers up to 250 feet in length and the main shed at the yard has capacity to build two trawlers at one time. Preliminary estimates indicate that the yard could produce up to twelve trawlers a year. Repair facilities are also available for trawlers. The present equipment is also capable of manufacturing commercial and industrial products, such as pylons, tanks, and pressure vessels. Current employment at the shipyard is not known in absolute terms but is considerably below capacity (800 employees).

The other major primary activity as previously indicated is the fluorspar mining which takes place at St. Lawrence. In 1966 the average employment by the company was 230. Production at the mine is now approximately 100,000 short tons a year.

There is some agricultural activity which supports a farm population of about 500 people according to the 1966 census. Of the 120 farms reported in census division 2, approximately 108 lie in the study area, therefore the use of statistics for the subdivision unit will be indicative of the activity in the area.

Of the 120 farms in the census division, 118 are operated by their owners, and according to the 1966 census the value of agricultural products sold was $82,000. Of this amount the 15 commercial farms account for, at a minimum, $72,000. This figure is based on the lower limit of the range for each size of farm. The annual sales of the 105 census farms was below $2,500. Sixty-eight percent of the sales came from cattle and 18 percent from the sale of hay and fodder.

The forestry resource of the area is very small and commercial exploitation is limited to a number of small sawmills of the push-bench type.

16.2.2 Tertiary Industry

Tertiary industry is based on transportation and the service industries. There are three CN coastal services to the Burin Peninsula, all originating at Argentia. There are no air transportation facilities and no bus connections with points outside the study area. The other main transportation activity is the trucking industry which at the present time is fairly limited.

According to the 1961 census, two commodity producing jobs were required to support one tertiary job. This is considerably lower than the average assumed for 1966 and through the forecast period. However, the proportion of the labour force dependent on the low-paying inshore fisheries would indicate that this ratio was probably correct. Also, the shift to offshore activity since the 1961 census and the general improvements occurring on the Island have probably resulted in a relative increase in tertiary employment.

16.3 Withdrawal Uses

16.3.1 Mining

The mine at St. Lawrence uses approximately 1,500,000 gallons of process water per day. This water is obtained from the requisite dewatering of the mine whereby approximately 3,600,000 gallons per day are removed from the workings. Water for sanitary use at the mine is obtained from Hay Pook Pond, a nearby surface supply. Wastewaters from the mine together with the balance of the water pumped from the dewatering of the mine are discharged to Salt Brook and thence into the sea. The mine wastewaters pass through small settling ponds for removal of the coarser tailings prior to discharge into Salt Brook. Although the mine is less than a mile from the sea and the workings are approximately 850 feet below sea level, the water removed from the mine is not contaminated by salt water intrusion.

16.3.2 Agriculture

Agriculture is not a major contributor to the economy of the study area with less than 1000 acres under cultivation in 1966 and with much of this acreage being in the form of small farms having annual sales of less than $1200. Livestock in the area in 1966 was estimated to be as follows:

Hogs	nil
Cattle	1350
Chickens	9500
Sheep	1400
Horses	625

The major concentration of livestock during 1966 was at Marystown where beef cattle were raised on a large scale on two areas of leased land totalling 20 square miles; the one area between Marystown and Garnish Pond was used for the pasturing and breeding of cattle while the second area at Winterland was used for the raising of forage crops from about 1250 acres of reclaimed bog lands. The operation was unfortunately a commercial failure and the company closed down its

operation in 1967; it is understood, however, that this enterprise is to be restarted during 1968. Vegetables grown in the area are potatoes, turnips and cabbages but with very poor yields and subsequently high production costs. The water demands resulting from agriculture are insignificant; similarly the livestock population is too widespread and limited in number to be a pollutional threat to the water resource.

16.3.3 Water Uses for Industry

The only water consuming industries in the study area (other than mining previously discussed) are the fish processing plants located at Marystown, Grand Bank, Burin and Fortune, and the shipyard at Marystown.

At Marystown, the Atlantic Fish Processors Company Limited produces frozen cod fillets and fish meal from offal and herring caught specifically for the production of meal. This plant commenced operations in March 1967, and when interviewed in late 1967 were unable to provide detailed data on production or water consumption. Current annual landings of round fish were estimated to be 60,000,000 pounds per year with an average daily consumption of water of approximately 800,000 gallons. Water for processing as well as sanitary use at the plant is obtained from Clam Pond by means of a water supply system recently constructed. The system was designed to be adequate for fish landings of 80,000,000 pounds per year as well as to meet the requirements of a projected population in Marystown of 12,000 persons. Wastewaters from the fish processing plant are discharged without treatment to Mortier Bay. At Grand Bank, the Bonavista Cold Storage Company Limited produces frozen cod fillets and fish meal from landings of round fish estimated to be 10,000,000 pounds during 1966. Water used at this plant is obtained entirely from the municipal supply and averages 100,000 gpd. Wastewaters from the plant are discharged untreated to the harbour.

At Burin, Fishery Products Limited produces frozen cod fillets, and fish meal from offal from annual landings of round fish estimated to be approximately 10,000,000 pounds during 1966. Water consumption at this plant averages about 180,000 gpd obtained wholly from the municipal supply. All wastewaters from the fish plant are discharged without treatment into the sea.

Booth Fisheries Canada Company Limited at Fortune also produces frozen fish fillets as well as fish meal from current annual landings in the order of 12,000,000 pounds. Both salt water and fresh

water are used at this fish plant - approximately 800,000 gpd of chlorinated sea water are used for fluming of round fish and fillets and the pumping of herring (used in meal production); the balance of the water consumption, approximately 140,000 gpd, is fresh water obtained from the municipal supply. Salt water is obtained through a recently installed sea water line.

The Newfoundland Marine Works Limited at Marystown commenced operations in 1967; this firm constructs and maintains fishing trawlers. At the present time water consumption is approximately 45,000 gpd for sanitary and cooling uses, with an estimated future demand of about 100,000 gpd. Water is currently obtained from a nearby pond, Muddy Pond, and chlorinated prior to use. The future supply to this industry will be the water supply development utilizing Clam Pond currently under construction. As noted previously this supply has been designed to serve the fish processing plant as well as Marystown and its industrial development.

16.3.4 Municipal Water Supply and Wastewater Disposal

Only the municipalities of Marystown, St. Lawrence, Burin, Grand Bank, and Fortune have a municipal water supply and distribution system; with respect to collection of sewage in these municipalities only St. Lawrence, Grand Bank, Fortune and Burin have a complete system of sewers, Marystown being only partially sewered. None of these municipalities operates sewage treatment plants, all discharging untreated wastewaters into the sea.

a) Marystown, with a 1966 population of 1894, is the most rapidly growing municipality in the study area. Its growth is due to two recently (1967) constructed industries, namely, the fish processing plant and the shipyard.

Prior to the construction of these industries, Marystown did not have a municipal water supply system and relied upon individual dug wells for water. To meet the water demands of these two industries, the construction of a water supply scheme utilizing nearby Clam Pond as the source was initiated. Capacity for the anticipated future population of Marystown (12,000) was provided in the water supply system and newly developed housing areas are being serviced from this system. At the present time the older areas of Marystown are not connected to the distribution system and continue to rely upon individual dug wells; it is planned, however, to serve all of these older areas of the municipality within the next few years.

Only the new housing subdivision in Marystown is currently served by sanitary sewers. Sanitary sewers are planned for the balance of Marystown during the next few years.

Only the new housing subdivision in Marystown is currently served by sanitary sewers. Sanitary sewers are planned for the balance of Marystown during the next few years, all to discharge to the sea.

b) St. Lawrence, with a population of 2130, relies upon groundwater for its water supply. A single drilled well is capable of meeting the average daily demand of 180,000 gallons; to ensure bacteriological safety the well water is chlorinated. As stated previously this water contains fluorides up to 3.2 ppm which is sufficient to cause some mottling of teeth; in addition, the water contains some radioactive gases, reportedly not at a level considered to be deleterious to health. Nevertheless, because of fears of radioactivity in the municipality, there is considerable agitation for the abandonment of this supply in favour of river water to be obtained from the nearby power canal. The municipality is served by a water distribution system. As previously noted, the Newfoundland Fluorspar mine does not rely upon the municipality for its water for sanitary purposes but has developed a nearby surface source, Hay Pook Pond, to meet these requirements.

All households in St. Lawrence are connected to the sanitary sewage system which discharges to the sea.

c) Burin, with a 1966 population of 1167, has a water distribution system installed in 1965 serving the whole of the municipality. The source of the water supply is Long Pond which provides a gravity system; treatment of the water is limited to chlorination. No data were available on the water consumption in Burin, excepting that the supply was more than adequate to meet present domestic demands as well as the requirements of the fish processing plant, Fishery Products Limited.

Most of the municipality is served by the sanitary sewer system which has a number of outfalls to the sea. Those houses not connected to the sewer system generally have individual outfalls to the sea.

d) Grand Bank, with a population of 3108 in 1966, has a municipal water system serving all of the town with water obtained from Grand Bank Brook. The water is drawn from the brook immediately upstream of the town and after chlorination is pumped into the distribution system. In recent years the brook at the point of the water intake has become polluted from the sewage discharged from homes constructed adjacent to it and upstream of the intake; under these circumstances chlorination alone is inadequate to ensure a safe water supply at all times. This problem is discussed in Section 17. 3. 3. The quantity of water available from Grand Bank Brook is more than adequate to meet the requirements of the municipality, including the 180, 000 gpd required by the Fishery Products Limited fish processing plant. Grand Bank is serviced by a central sanitary sewer system with several outfalls to the sea as well as the estuary of Grand Bank Brook.

e) Fortune, with a 1966 population of 1703, has a water distribution system serving the whole of the municipality. Until 1967 the source of water was Fortune Brook but the supply system using this source proved to be inadequate to meet the requirements of the local fish processing plant, owned by Booth Fisheries Canada Company Limited. The present source of supply is Horse Brook through a water supply system recently constructed with adequate capacity to meet the future requirements of the town and to provide approximately 275, 000 gpd of fresh water to the fish plant; in this connection, it should be noted that the fish plant will also be using 425, 000 gallons of salt water per day to satisfy its total water requirements. Water from Horse Brook is of good quality and accordingly treatment is limited to chlorination alone. The intake of the water system is at an elevation which permits a gravity system to serve the town and the fish plant.

Fortune is completely served by a system of separate sanitary sewers discharging untreated wastewaters to the sea. No instance of adverse occurrences from this procedure has been recorded to date.

Two other municipaltities worthy of individual mention with respect to water supply and sewerage facilities are Lawn and Lamaline. Lawn with a 1966 population of 870 persons has constructed 6 dug wells for use of those property owners unable to obtain water from wells of their own. A sewage collection system serves a portion of this community discharging untreated wastes to the sea. In Lamaline with

a 1966 population of 643 persons, the community has constructed one well to supply water to those unable to obtain water from their own individual wells. Sewage disposal is by septic tanks and direct discharge to the sea.

The balance of the population in the study area relies upon individual wells for their supply of water, the majority being dug rather than drilled. In general these wells are of satisfactory bacteriological quality but many of them do not provide a dependable supply, frequently drying up during extended dry spells. Sewage disposal in these communities is by means of septic tanks and direct discharge to the sea.

16.4 Non-withdrawal Water Uses

16.4.1 Hydro-electric Power Development

Three very small hydro-electric generating stations are located within the Burin study area. These stations are owned by the Newfoundland Light and Power Company Limited and were constructed to meet the domestic needs of the area as well as modest industrial demands.

The following table summarizes the characteristics of the small hydro plants in the Burin Peninsula.

HYDRO POWER DEVELOPMENT ON THE BURIN PENINSULA

Development	Lawn	Fall Pond	West Brook
Year Commissioned	1930	1939	1941-1942
Total Drainage	31 sq. mi.	13 sq. mi.	18 sq. mi.
Head Developed	82 feet	50 feet	154 feet
Total No. of Units	2	1	1
Total Capacity	500 hp	500 hp	1000 hp
Location of Plant	near Village of Lawn	on Waterfall Brook	on St. Lawrence River
Storage Capacity	299 cfs-days	633 cfs-days	1691 cfs-days

16.4.2 Commerical Fishery

The total number of offshore and inshore fishermen in Fortune and Placentia Bays in recent years has varied between 2500 and 3000; in 1966 there were 2645 fishermen in these Bays, 75 percent of whom fished for 10 months or more. In 1962, the annual total landings of fish in Fortune and Placentia Bays was 130,000,000 pounds; by 1966 the annual landings had increased to 213,000,000 pounds, the more important species landed being cod, plaice, herring, redfish, and lobster. During recent years there has been a decrease in the inshore landings to 6,400,000 pounds landed in 1966. The inshore fishery in this study area during 1966 employed 977 fishermen, 80 percent of whom were employed for 5 months or more. At the present time, annual landings of salmon are very small, with an annual value of about $20,000; it is unlikely that the small rivers of the study area are capable of producing enough salmon to significantly increase the annual landings of this fish.

16.4.3 Other Non-withdrawal Uses

Non-withdrawal use of the water resource for purposes other than hydro development is of little significance. The Salmonier River and Main Brook support local sport fishing of salmon, yielding approximately 68 and 200 fish respectively each year with an average weight of just over 4 pounds. Resident and sea-run brook trout are also angled locally in these rivers. The numerous small rivers are not navigable on a commercial basis and in general are not suitable for even pleasure boats. Because of the absence of exploitable forests no log driving use of the rivers is required.

Recreational and tourist use of the study area's water resources is for the most part limited to residents of the immediate area. The density of population of the Burin study area is quite low; this coupled with the availability of ample bodies of water has enabled local residents to enjoy unrestricted recreational use of the water resources in the area. Every effort, however, should be made to maintain the sandy beaches at Freshwater Pond near Marystown free of pollution, by proper inspection of septic tanks, etc., so that the residents will have easy access to a good quality bathing beach.

16.5 Present Day Water Resources Problems

Changes in the water regime of the Burin study area have been relatively minor, occasioned only by the construction of dams for flow regulation in connection with the small hydro generating stations referred to previously.

The generation of hydro-electric power is the only non-withdrawal use of the water resource that has any potential implications with respect to the utilization of the water resource. At such time as the existing generating stations on the St. Lawrence River, Little St. Lawrence River and near the Village of Lawn are not required for either the continuous or standby generation of power, it is conceivable that the flows at these sites could be made available for industrial purposes should that demand materialize. The minimum regulated flows at these sites are estimated to be as follows:

West Brook (St. Lawrence River)	-	11 million gpd
Fall Pond (Little St. Lawrence)	-	12 " "
Lawn	-	22 " "

At the present time no major water resource problems exist in the Burin study area although full utilization of the St. Lawrence River by anadromous fish is restricted by the presence of the three hydro storage dams each lacking fishways.

In a number of small communities individual dug wells are incapable of supplying sufficient water to meet demands during extended dry periods. The high concentration of fluoride in the St. Lawrence water supply (Section 16.3.4) is a cause of some concern.

17 PLANNED AND FORECAST DEVELOPMENT

17.1 General Planning in Study Area

A regional plan covering the study area was prepared in 1966[2] together with municipal plans for Fortune[3], St. Lawrence[4], Grand Bank[5]. It recommends numerous highway improvements, revisions to municipal boundaries, and makes various proposals in connection with the supply of electricity, medical services, and education. Of significance to this study, the plan recommends the establishment of a Provincial park in the Marystown area which would include Freshwater, Salmonier, and Beaver Ponds. Such a park is most desirable to ensure preservation of Freshwater Pond with its sandy beaches for recreational uses.

17.2 Population Growth and Standard of Living

The population in the study area based on past trends is projected to grow steadily over the forecast period. From the 1966 population figure of 18,140, the population is projected to grow to 19,720 by 1971, to 21,130 by 1976, and to 22,930 by 1981.

No provision has been made for a net inward movement of population to the study area resulting from new developments or those anticipated to occur over the study period. The underlying assumption is that under-employment exists in the area, and that major changes in the structure of the labour force will occur in order to satisfy the labour requirements.

The following estimates were made by applying the labour force age-group and labour force participation-rate assumptions to projected population.

Size of Labour Force Age Group and Labour Force

	1971	1976	1981
Labour Force Age Group	9,250	10,100	10,750
Labour Force	4,250	4,820	5,375

The major changes in the labour force over the study period will probably be structural rather than rapid total growth. The only major developments seen for the area have already taken place, although their maximum potential impact on the area has certainly not yet been realized.

The first development is the new fish processing establishment at Marystown with a capacity in excess of 100 million pounds a year. The scale of this plant is such that it should be competitive in the international markets where it must sell its products. Employment at the plant may reach 800 during the forecast period.

The second development in the area is the new shipyard at Marystown. Future employment estimates vary with the highest quoted figure being 800.

No significant change is envisioned in forestry, agriculture, or mining. As far as the primary fisheries are concerned, the major change will be a probable shift to offshore activity.

It is doubtful whether in this area the ratio of commodity producing industries employment to the tertiary sector employment will be much above one to one over the forecast period.

There will probably be only minor increases in the degree of urbanization with the main concentration taking place around Marystown and the other areas remaining about the same size.

Personal disposable income per capita was estimated to be $900 in 1965. In terms of 1965 dollars this will probably rise to approximately $1600 by 1981. This figure is below the indicated Provincial average and reflects the basic industry structure of the study area.

17.3 Withdrawal Uses of Water

17.3.1 Mining and Agriculture

Fluorspar is the only known exploitable mineral in the study area and water requirements for its present and future production can be readily met either from surface water or groundwater (which is presently used). As previously indicated, agricultural activities are not expected to exert any demands on the water resources because of the very limited amount of soil available for farming.

17.3.2 Water Uses for Industry

There are no specific new industrial developments known to be under consideration for the study area during either the planned or forecast period. Continued growth, however, is anticipated for the four existing fish processing plants as well as the recently established shipyard at Marystown; this will create an increased demand on the water resource which it is quite capable of meeting. At Marystown the recently constructed water supply has been designed to meet the needs of both the fish processing plant and the shipyard to beyond the study period, 1981. This situation prevails at Burin and Fortune as well where recently installed water supply systems have included provision for future industrial growth. In addition to the water potentially available from existing hydro developments for withdrawal use referred to in Section 16.5, five storage possibilities with regulated flows ranging from 18 to 106 million gpd exist in the study area. Details of these possibilities are presented in Volume Five, Part II.

Wastewaters from all of the fish processing plants in the study area and the shipyard as well are discharged without treatment into the adjacent sea. It is unlikely that any changes in this procedure will be required during the study period although it is possible with increased volumes of wastewater from larger production that relocation of the wastewater outfalls may be required in order to ensure rapid dispersion of the wastes into the sea.

17.3.3 Municipal Water Supply and Wastewater Disposal

At Marystown, Burin, and Fortune recently installed water supply systems have included adequate provision for future water demands by these municipalities as well as for the fish processing plants located there.

At Grand Bank an adequate quantity of water to meet requirements during the study period can be obtained from the existing municipal source, Grand Bank Brook. However, because the intake from the brook is downstream of a number of residences, pollution is reaching the intake point on occasion and it will be necessary to either relocate the intake upstream of all dwellings and control future building within the drainage area or alternatively filter the water prior to chlorination. It is understood that consideration is being given to relocating the intake upstream of its present location.

At St. Lawrence the present groundwater source is more than adequate for the municipality's requirements, but there is some local concern over the quality due to the presence of varying amounts of radioactive gases and fluorides in the water. An alternative surface water supply from the St. Lawrence River has been estimated by the Provincial Department of Municipal Affairs to cost $153,500[8].

Disposal of municipal wastewaters from Marystown, Burin, Fortune and St. Lawrence will continue to be through municipal sewer systems discharging untreated wastes to the sea; provided future sewer outfalls are judiciously located this method of wastewater disposal should not result in conflicts in use of the sea water.

The remainder of the municipalities are generally less than 500 in population and are unlikely to grow significantly during the study period. Water supply for these communities will continue to be from individual dug wells because of the relatively high cost of providing a municipal system. Accordingly, every effort should be made to acquaint these home owners with the proper procedures to follow in the construction and maintenance of wells in order to ensure a bacteriologically safe water supply. Disposal of wastewaters from the small communities in the study area will undoubtedly continue to be by means of septic tank or direct discharge to the sea. Provided such disposal is carried out in a manner which does not pollute the groundwater, conflicts of use should not develop; again every effort should be made to acquaint home owners with the proper procedures to follow in the construction and operation of septic tanks and other methods of disposing of domestic wastewaters.

17.4 Non-withdrawal Uses of Water

17.4.1 Hydro Power Development

With the availability of electric power in 1967 from Bay D'Espoir, it is unlikely that any development potential previously given consideration in the area can be economically justified.

17.4.2 Fisheries

The Canada Department of Fisheries has no specific project planned or forecast for the rivers of this study area. However, the Department has noted that with the industrialization of the study area, particularly at Marystown, increased angling pressure will be placed on Main Brook and the Garnish River. Accordingly, when required the Department will develop these two rivers to provide for the recreational needs of the area; in essence this may mean planting of hatchery stocks of Atlantic salmon and anadromous brook trout in Main Brook which is currently accessible to anadromous fish throughout its length, and the removal of a number of minor obstructions on the Garnish River to make that river accessible to sea-run fish at all stages of river flow (the river now is completely accessible only at high flows).

The estimated potential of the Main Brook is 3500 to 4500 Atlantic salmon and a like number of anadromous brook trout; the present production is estimated to be 2000 to 3000 of each species. The estimated potential of the Garnish River is 5000 to 6000 Atlantic salmon and a similar number of anadromous brook trout; the present production is estimated to be 700 to 1000 of each species from a limited portion of the total length of the river. The development of these rivers, primarily for sport fishing, will contribute only slightly to the commercial fishing of salmon since neither of these streams when developed will be the source of significant numbers of salmon for commercial exploitation.

17.4.3 Recreation and Tourism

The establishment of a provincial park to include Freshwater Pond near Marystown was proposed in a Burin Peninsula study by Project Planning Associates[2], and every effort should be made to accomplish this. The proposed park area is close to Marystown, a

growing town, and would contain the largest body of fresh water on the peninsula with good sandy bathing beaches. If the road connecting Grand Bank and other communities to the Trans-Canada Highway is improved, this part and other areas may attract tourists.

17.4.4 Other Non-withdrawal Uses of Water

Forest exploitation and log driving have played no part in the development of the study area due to the limited forest resource available; no activity in these fields is planned or forecast for the study period. This also holds true of navigation on the waterways of the study area which is limited by the very small size of the numerous river basins within the area.

Wildlife demands on the water resource during the study period will not materially differ from those existing at the present time, even though caribou are to be re-introduced to the area. Should caribou become plentiful in the area it may be possible to develop a modest tourist industry associated with the hunting of these animals.

18 CONCLUSIONS AND RECOMMENDATIONS

18.1 Conclusions

a) The Burin study area has limited natural resources, so that, with the exception of mineral exploitation at St. Lawrence, all development of the area to date has been directly concerned with the commercial fishery; this is true even of the new shipyard at Marystown which was established primarily for the construction and maintenance of fishing vessels.

b) It is likely that future growth of this area will depend upon growth of the commercial fishery and as such will be concentrated in the municipalities of Marystown, Burin, Fortune, and Grand Bank. It is probable that the offshore fishery will grow significantly with a corresponding decline in the inshore fishery. Future activity in the mines is currently somewhat uncertain pending the report of the Royal Commission investigating radioactivity, and this will have considerable bearing on the future of St. Lawrence.

c) Tourism has played little part to date in the development of this area, and because of its location the area will be little influenced by tourism in the immediate future, unless access roads are considerably improved.

d) Water of adequate quantity and quality to meet present domestic, industrial and fisheries requirements is generally available throughout the area. Should abandonment of the two hydro generating stations near St. Lawrence and the station near Lawn occur, relatively large quantities of water will become available for withdrawal use.

e) Disposal of wastewaters, by the fish processing plants and the municipalities within which these plants are located, into the sea without prior treatment is acceptable only with proper location of these outfalls to ensure minimal pollution of adjacent waters.

f) Conflicts of interest with respect to the use of the water resource are minor in nature at this time and are unlikely to become significant during the study period.

18.2 Recommendations

a) Because of the somewhat limited resources available in the study area and the lack of major water supply sources compared to other areas on the Island, the Burin study area should not be assigned a high priority with respect to the establishment of a development plan.

b) Steps should be taken to preserve Freshwater Pond for recreational use by the population of the Marystown area.

REFERENCES

1 Slaney, R., quoted Toronto Daily Star, May 7, 1968.

2 Project Planning Associates. The Regional Plan - Burin Peninsula Study, December 1966.

3 Project Planning Associates. Fortune Municipal Plan - Burin Peninsula Study, December 1966.

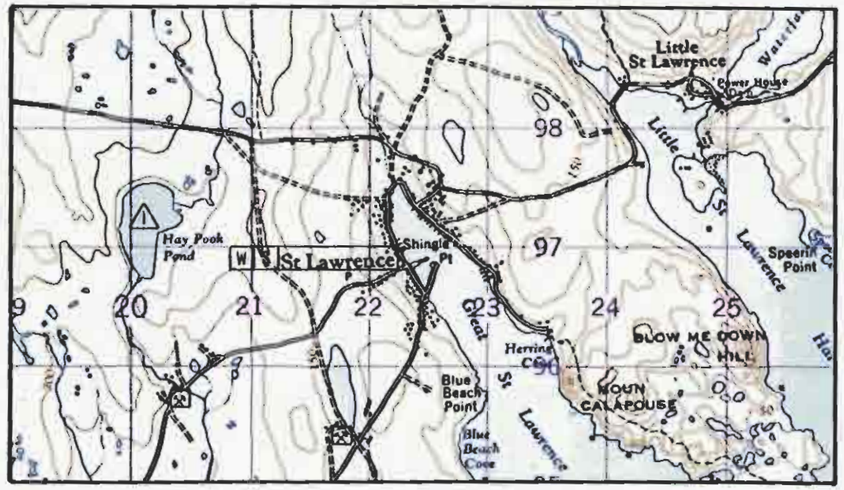
4 Project Planning Associates. St. Lawrence Municipal Plan - Burin Peninsula Study, December 1966.

5 Project Planning Associates. Grand Bank Municipal Plan - Burin Peninsula Study, December 1966.

6 Project Planning Associates. Marystown Municipal Plan - Burin Peninsula Study, December 1966.

7 Newfoundland and Labrador. Department of Municipal Affairs. Water Supply System for the Town of St. Lawrence, March 1968.

The Shawinigan Engineering Company Limited
James F. MacLaren Limited



0 ½ 1 MILE

DETAIL "A"

0 5 10 MILES

GENERAL PLAN

NOTES:

POTENTIAL FUTURE DEVELOPMENTS AND PROJECTS UNDER CONSTRUCTION SHOWN IN RED

1. WATER SUPPLY SOURCE
2. FREEZING AND FISH MEAL PLANT
3. ATLANTIC SALMON AREA
4. COMMERCIAL FISHING AREA
5. STORAGE RESERVOIR SITES

LEGEND:

- MINES
- W S — COMMUNITY WITH WATER SUPPLY AND WASTEWATER DISPOSAL SYSTEMS
- W — COMMUNITY WITH WATER SUPPLY SYSTEM ONLY

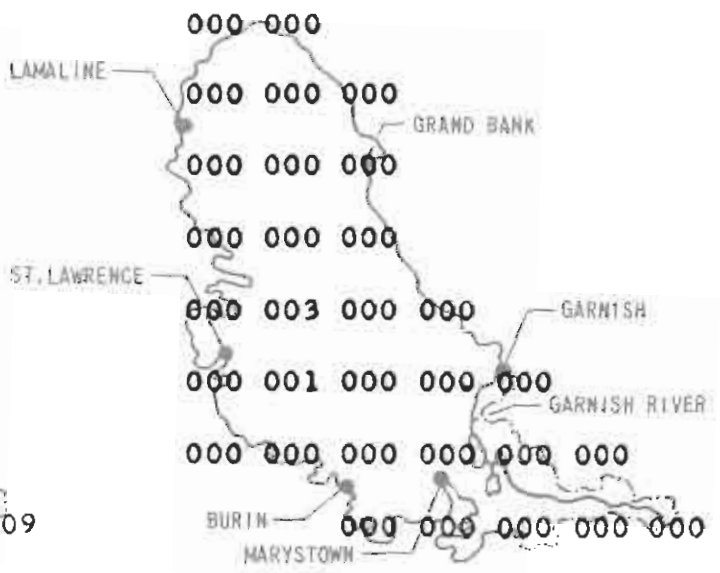
NEWFOUNDLAND - KEY PLAN

BURIN PENINSULA STUDY AREA

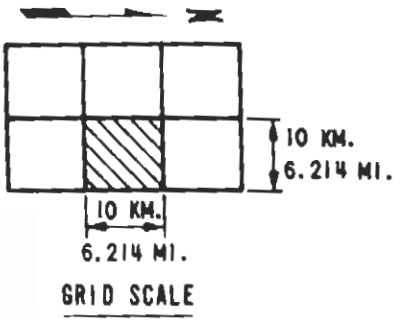
FIGURE 15-1

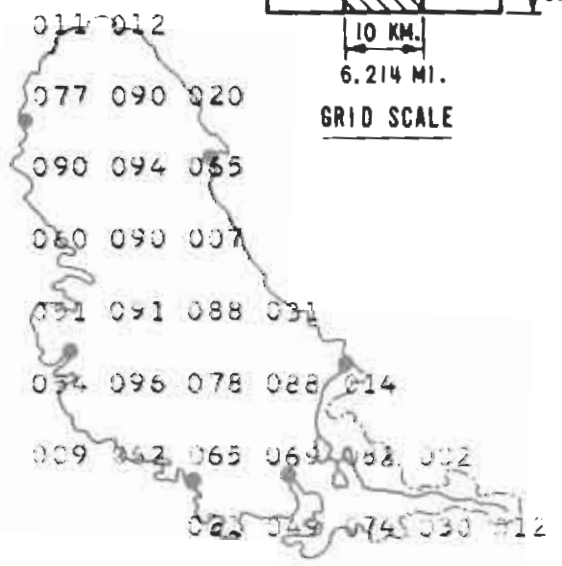
BURIN PENINSULA STUDY AREA
SQUARE GRID DISTRIBUTION OF LAKES, BOGS AND SWAMPS, BARRENS AND FORESTS

LAKE AREA - SQ.KM.

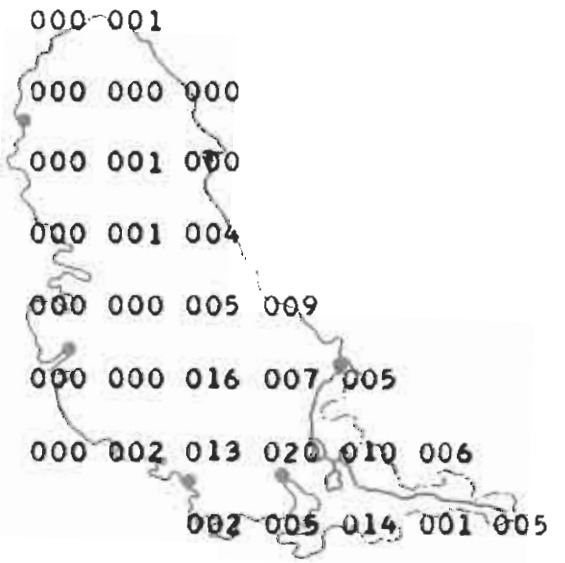


BOG AND SWAMP AREA - SQ. KM.





AREA OF BARREN - SQ.KM.

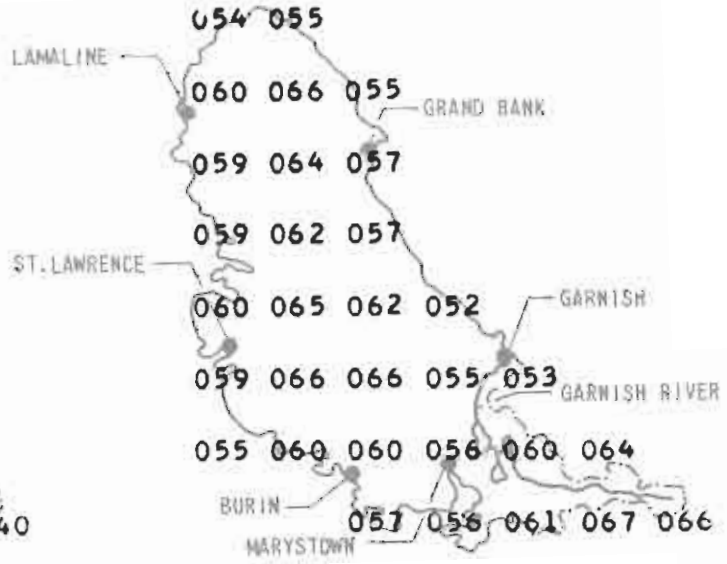


FOREST AREA - SQ.KM.

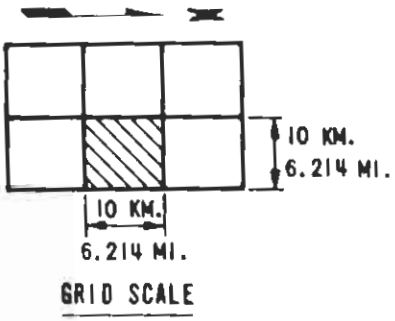
FIGURE 15-2

BURIN PENINSULA STUDY AREA
SQUARE GRID DISTRIBUTION OF AVERAGE ANNUAL TEMPERATURE, PRECIPITATION, EVAPORATION AND RUNOFF

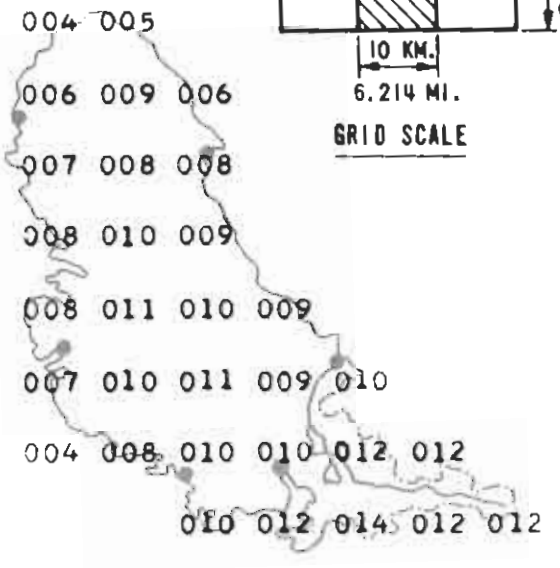
AVERAGE YEARLY TEMPERATURE
-DEGREES FAHRENHEIT



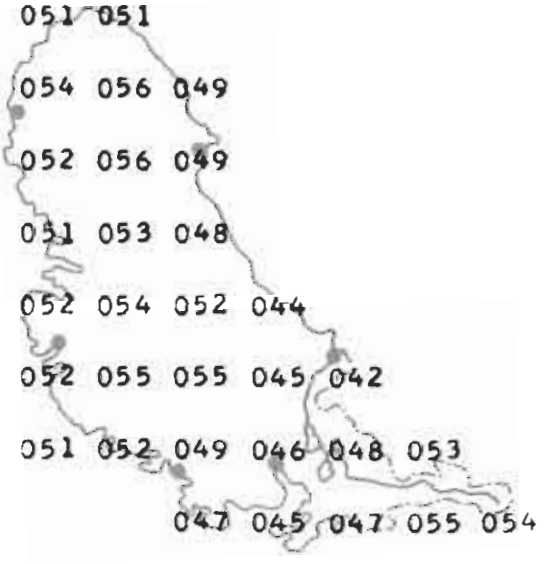
AVERAGE YEARLY PRECIPITATION
- INCHES OF WATER



GRID SCALE



AVERAGE YEARLY EVAPORATION
- INCHES OF WATER



AVERAGE YEARLY RUNOFF
- INCHES OF WATER

FIGURE 15-3

BURIN PENINSULA STUDY AREA

SUMMARY OF CLIMATIC CHARACTERISTICS

A ANNUAL MEANS

Precipitation (inches)	Air Temperature (deg F)	Potential Evaporation (inches)	Relative Humidity (percent)
60.2	40.6	19	85

B MEAN MONTHLY PRECIPITATION (inches)

Stations	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Grand Bank	4.91	4.46	4.17	3.52	3.85	3.71	3.12	3.38	4.01	5.18	6.38	5.69
Basin Mean Synthesized	5.70	5.30	4.50	4.00	4.20	4.40	3.90	3.90	4.50	5.90	7.70	6.40

C MAXIMUM POSSIBLE STORM PRECIPITATION (inches)

Area (sq. mi)	Storm Duration (hours) 6	12	18	24	36	48	72
100	5.55	7.35	9.65	10.60	12.05	12.40	16.10
300	5.45	7.30	9.20	10.40	12.00	12.30	15.60

D MAXIMUM POSSIBLE SEASONAL SNOWFALL (inches o water equivalent): 33.9

E CRITICAL SEQUENCES FOR SNOW MELTING (degrees F)

Interval	Date March 1	March 10	March 20	April 1	April 10	April 20	May 1
4 - day	43.5	45.0	46.5	49.5	52.0	55.0	58.5
8 - day	41.5	42.5	44.0	46.5	49.0	51.6	56.0
16 - day	39.0	39.5	41.0	44.0	46.0	52.5	52.5

F DROUGHT

Return Period	2.33-Year	5-Year	10-Year	20-Year	50-Year	100-Year
Length of Drought	13 days	17 days	20 days	24 days	29 days	32 days

TABLE 15-1

SUMMARY OF HYDROLOGIC CHARACTERISTICS
BURIN PENINSULA STUDY AREA

I - SYNTHESIZED DATA

A. ANNUAL MEANS FOR THE TOTAL BASIN

FLOW (CFS)	RUNOFF (CFS/SQ.MI)	RUNOFF (INCHES)	ACTUAL EVAP. (INCHES)
	3.74	50.8	9.4

B. MEAN MONTHLY FLOWS (Q) AND STANDARD DEVIATIONS (S) (CFS)

RIVER AND LOCATION		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
GARNISH RIVER NEAR GARNISH	Q	300	270	410	565	440	205	110	140	170	270	395	350	285
	S	210	135	170	165	175	100	65	105	125	110	180	125	37
	Q													
	S													
	Q													
	S													

C. MAXIMUM FLOWS (CFS) AND FLOOD VOLUMES (CFS DAY) OBTAINED BY THE MAXIMIZATION PROCEDURE (INSTANTANEOUS PEAKS)

RIVER AND LOCATION	MAXIMIZED RAIN ON SNOW PACK		MAXIMIZED RAIN ONLY		SNOW PACK & AVERAGE RAIN	
	PEAK	VOLUME	PEAK	VOLUME	PEAK	VOLUME
	13,600	47,000	10,130	27,000	3,970	23,100

D. MAXIMUM FLOWS OBTAINED BY STATISTICAL ANALYSIS (CFS) (DAILY AVERAGES)

RIVER AND LOCATION	GENERATED BY SNOW MELT & RAIN		GENERATED BY RAIN ONLY	
	1/10000 YEARS	1/1000 YEARS	1/10000 YEARS	1/1000 YEARS
GARNISH RIVER NEAR GARNISH	6000	4900	7900	6250

SUMMARY OF HYDROLOGIC CHARACTERISTICS
BURIN PENINSULA STUDY AREA

E. MINIMUM FLOWS OBTAINED FROM RECESSION CURVES (CFS)

RIVER AND LOCATION	1/2 YEARS	1/5 YEARS	1/10 YEARS	1/20 YEARS

F. MINIMUM FLOWS OBTAINED FROM STATISTICAL ANALYSIS (CFS)

RIVER AND LOCATION	1/2 YEARS	1/5 YEARS	1/20 YEARS	1/100 YEARS
GARNISH RIVER NEAR GARNISH	31	18	8	

G. FULL REGULATION STORAGE

RIVER AND STATION	STORAGE (CUBIC FEET x 10^9)

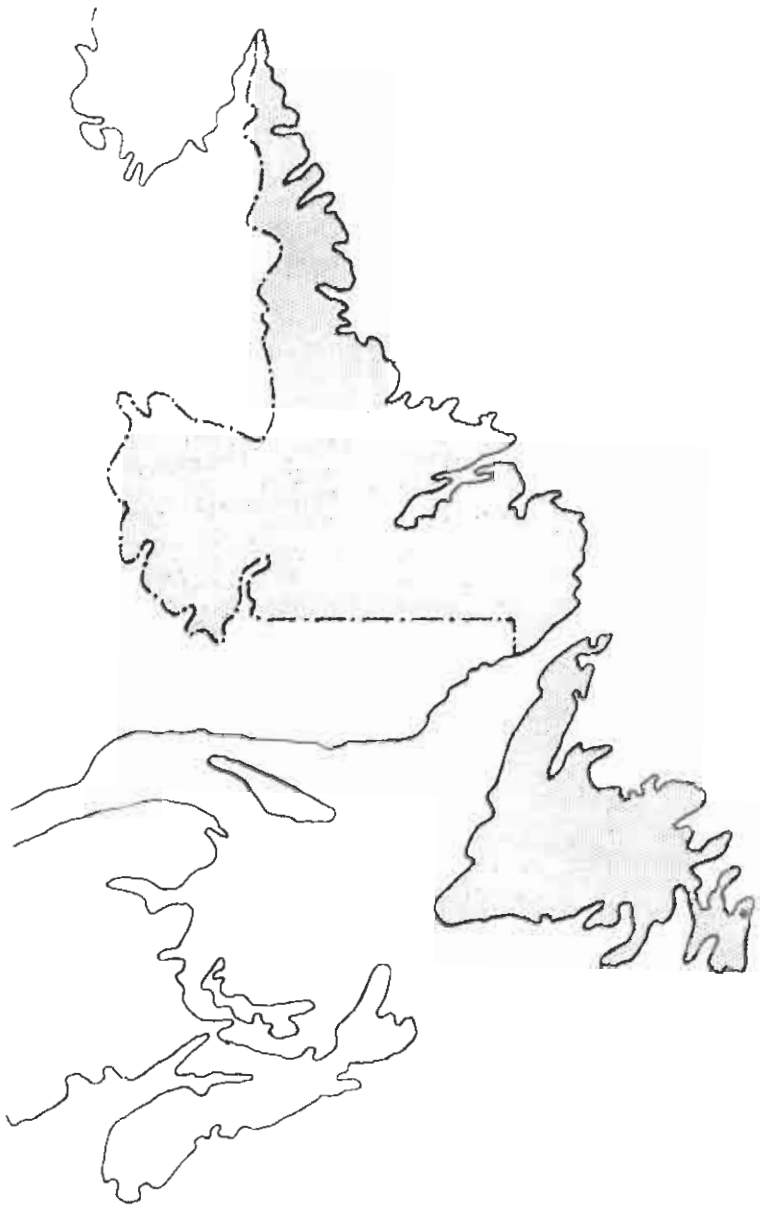
II - RECORDED DATA

H. MEAN MONTHLY AND ANNUAL FLOWS (CFS)

RIVER AND STATION	YEARS OF RECORD	JAN	JEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
GARNISH RIVER NEAR GARNISH	8	287	302	425	520	301	191	129	140	156	219	339	315	277

I. EXTREMES RECORDED (CFS)

RIVER AND STATION	MAXIMUM FLOWS			MINIMUM FLOWS		
	FLOW	DATE	COMMENTS	FLOW	DATE	COMMENTS
GARNISH RIVER NEAR GARNISH	2840 CFS	OCT.12. 1964	DRAINAGE AREA = 79 SQ. MILES	2.2 CFS	SEPT.9 1961	PERIOD OF RECORD OCT.1958 TO SEPT. 1966



VOLUME SEVEN - PART IV SECTIONS 19-22

STUDY AREA - STEPHENVILLE AND ENVIRONS

PART IV - STEPHENVILLE AND ENVIRONS STUDY AREA

19 NATURAL CONDITIONS

The area under study is located in the southerly portion of the west seacoast of the Island, and is composed primarily of the drainage basins of Harry's River, Southwest Brook, Bottom Brook, and certain areas immediately adjacent to Stephenville extending from Port au Port to St. Georges referred to hereafter as the study area. This area is traversed by approximately 40 miles of the Trans-Canada Highway as well as the Canadian National Railway line. Development to date was highlighted by the establishment of the Ernest Harmon U. S. Air Force Base at Stephenville in 1941. With the closure of the base in 1966 growth of the area temporarily ceased, but an active policy of industrial development is currently being followed by the Provincial government.

19.1 Physiographic Conditions

The Harry's River-Southwest Brook River basin constitutes the major portion of the study area (only a small portion of Stephenville and its environs lie outside the river basin area) and has a drainage area of 749 square miles. The limits of the river basin area are shown in Figure 19-1. The major sub-areas of the total drainage area are as follows:

a) 124 square miles which drain into the salt water through Romaines, Blanch, and Wheeler Brooks.

b) 322 square miles which comprise the drainage basin of Harry's River.

c) 220 square miles which comprise the drainage basin of Southwest Brook.

d) 83 square miles which comprise the drainage basin of Bottom Brook.

Of the total drainage area approximately 45 square miles are lakes, 36 square miles are bogs, 542 square miles are forested, and the balance of 126 square miles are barrens. Figure 19-2 shows the distribution of these areas.

Most of the area is above 1000 feet in elevation with a number of peaks over 1500 feet. The three major rivers making up most of the area discharge into St. George's River, a salt water inlet, partially isolated by a sand spit developed from sediments carried down by Harry's River. A number of large lakes are situated in the area particularly in the Southwest Brook basin; the largest lake in the area is Georges Lake at the upper end of Harry's River. The topography and the network of rivers and lakes is shown on Figure 19-1.

Average annual temperature, precipitation, and evaporation in the area are shown in Figure 19-3. The climate is cool with an average annual temperature of 38.5 deg F, an average annual precipitation of 63.5 inches, and an average evaporation of 15 inches per year.

A detailed discussion of the climate of the Island is presented in Volume Two A, Part II, and pertinent data with respect to the climatic conditions of the basin are summarized in Table 19-1.

The bedrock of the area contains a wide range of rock types. Near the seacoast it consists of Carboniferous sediments; the eastern arm of the basin crosses a major basic intrusion and rises in the mixture of highly metamorphosed Ordovician and Silurian material and igneous rocks that make up the Long Range Mountains; the northeasterly arm rises in Cambrian and Ordovician sediments which includes some limestone.

The coastal area has a thick cover of deltaic deposits and glacial outwash material including sands and gravel. The inland areas have a cover of ribbed and ablation moraine, except in areas of high elevation where there is often no cover of surficial material or at best a thin cover of felsenmeer.

19.2 Water Resources

19.2.1 Surface Water

No river gauging stations were in operation in the area prior to 1968 although a number of such stations have been in use in the adjacent Humber River basin for many years. Accordingly, runoff data in the area have been derived entirely through the generalized relationships meteorological and and physiographic factor established in Volume Two A, Part IV. The hydrologic characteristics of the main rivers are summarized in Table 19-2. The areal distribution of the average annual runoff as derived from the above relationship is indicated in Figure 19-3. The average annual runoff is 47.7 inches, equivalent to 3.6 cfs per square mile.

The quality of the surface waters of the area have been little affected by man's activities to date because of the sparsely populated nature of the basin area. (The 1966 population, excluding those on the sea coast from Port au Port to St. George's, numbered less than 500 persons residing in five small communities on the CNR between Stephenville and Georges Lake).

A review of available analyses of surface waters, none of which were undertaken prior to 1966, confirms the observation set forth in Volume Two B, Part V, that the chemical constituents of the waters of Harry's River differ markedly from those of Southwest and Bottom Brooks. The difference in chemical composition of Harry's River is because 32 percent of the bedrock of Harry's River drainage area is composed of hydro-petrological unit R8 which is dominated by limestone and dolomite; on the other hand the drainage areas of Southwest and Bottom Brooks contain none of unit R8 bedrock and are influenced by the major igneous intrusions of hydropetrological unit R1 which makes up most of the bedrock of these two drainage areas. (Figure 1-5).

These rivers are low in total dissolved solids, Harry's River having a total equivalent per million of major ions of 2.98 and Southwest Brook indicating a value of 1.04. For Newfoundland, the waters of Harry's River are very hard; the total hardness averaging 75 mg/l as $CaCO_3$ with an observed maximum of 102 mg/l and a minimum of 60 mg/l in 14 determinations; the waters of Southwest Brook in two determinations showed a total hardness as $CaCO_3$ of 7.7 and 10 mg/l. The average pH of Harry's River is approximately 7.8 ranging from a minimum recorded value of 7.5 to a maximum value of 8.2; the pH of this river is significantly higher than most surface waters of the Island (which are generally 6.8 or less) which reflects the influence of the limestone and dolomite bedrock on the quality of the water in the drainage area. The pH of Southwest Brook averaged 6.5. Turbidities of both Harry's River and Southwest Brook were low, usually less than 3 units; the maximum recorded value on Harry's River was 36 units and on Southwest Brook a maximum of 15 units was noted. The waters of Harry's River are generally less coloured than other surface waters of the Island, the average colour being less than 20 units, ranging from a recorded minimum of 5 units to a maximum of 100 units. One analysis for colour on Southwest Brook indicated a value of 50 units, somewhat higher than the average colour of most Newfoundland surface waters.

None of the analyses reviewed indicated excessive concentrations of iron, manganese, fluorides, or similar chemical constituents which would adversely affect the quality of the water. The only bacteriological data available on the waters of this river basin area were those obtained by the Shawinigan-MacLaren grab sampling program of 1967. Through this program a coliform count of 170/100 ml on Harry's River (at Black Duck) was obtained, and a count of 70/100 ml on Southwest Brook (at the Trans-Canada Highway) was similarly obtained; the relatively high count on Southwest Brook, an uninhabited drainage area, is not in itself indicative of pollution by man.

19.2.2 Groundwater

The availability of groundwater in the area can be assessed in very general terms only because of the limited data available for interpretation. In Volume Two B, Part VII the general hydrogeologic conditions on the Island are discussed together with Figures 1-5 and 8-4 of the volume which show respectively bedrock and surficial hydrogeology of the Island (exclusive of the Avalon Peninsula). From Figure 1-5, it may be seen that the hydropetrologic units R7 and R8, Carboniferous sediments, and dolomite and limestone respectively which make up 54 percent of the drainage area of Harry's River, should yield low to moderate amounts of groundwater; in both units R7 and R8 extensive solution channels may be present which will be excellent sources of groundwater. Owing to the presence of gypsum and other evaporite deposits in this area some of the groundwater may have a high dissolved solids content. The balance of the drainage area of Harry's River as well as all of the drainage area of Southwest and Bottom Brooks are made up of bedrock with little potential for groundwater.

From the surficial outwash deposits in the Harry's River drainage area extending from near Gallants to the sea, moderate to high yields of groundwater should be available; this area is composed of hydropetrologic unit S4 as shown on Figure 8-4. A feasibility study carried out at the U. S. Air base showed that 2 million gpd could readily be obtained from three wells developed in the S4 material. The remainder of the drainage area of Harry's River and all of the drainage area of Southwest Brook and Bottom Brook are composed of thin patchy moraine or bedrock and cannot be expected to yield much suficial groundwater.

19. 2. 3 Hydro Power Potential

The rivers of the area were investigated for hydro potential and one scheme appeared to have merit. This scheme is described in Volume Four, Part I, and involves the diversion of Southwest Brook into Bottom Brook near the mouth of the rivers. Although the scheme had an advantage such as minimum road construction, the high dam costs involved increased the firm energy costs to about 12 mills and the scheme was not recommended for further investigation.

19. 2. 4 Fisheries for Fresh Water Dependent Species

Harry's River ranks among the top Atlantic salmon rivers in Newfoundland and also supports good production levels of resident and anadromous brook trout as well as ouananiche and eels. With the exception of 27 miles on North West Brook which is inaccessible because of a falls which constitutes a total obstruction, most of the river system is available and used by anadromous fish.

Both Southwest and Bottom Brooks support good runs of Atlantic salmon as well as resident and anadromous brook trout. Most of the tributaries of these brooks are inaccessible to anadromous fish because of the numerous falls.

19. 2. 5 Navigation and Log Driving

Navigation of the rivers is not feasible other than by canoes and similar small craft used primarily in angling. Although lakes such as Georges Lake and many of the larger ponds are navigable they are used only for small pleasure craft.

Both Harry's River and Bottom Brook were used extensively for log driving when these areas were cut several years ago. Although further logging operations in the area were not contemplated for some years in the future, because of the current infestation by hemlock looper, Bowaters Newfoundland Limited, the leaseholder, decided to carry out salvage logging in the area during 1968. It is unlikely, however, that the rivers will be developed for the transportation of these logs, in view of the general trend to trucking as opposed to river driving.

19.2.6 Tourism and Recreation

Although the extensive network of rivers and lakes together with the existing wildlife and scenic beauty have potential for the attraction of tourists, most of the area, particularly the drainage area of Southwest and Bottom Brooks, is inaccessible to all but the most intrepid. The Harry's River drainage area, however, is traversed throughout its length by the Trans-Canada Highway which makes much of this area accessible.

With the exception of a small number of hunters and anglers, the area has attracted few tourists other than transients enroute to, or from, St. John's.

The area has all of the attributes to meet the outdoor recreational requirements of the local population; the cool climate is the only serious limiting factor with respect to water oriented activities.

19.3 Natural Resources

19.3.1 Forests

Approximately 542 square miles of the study area is forested, being 71 percent of the total area of the Harry's River, Southwest and Bottom Brooks drainage area. The forests are predominantly balsam fir and are very productive. No logging operations are currently being carried out since all reaily accessible areas have been cut over, and regrowth has not yet reached the maturity to enable recutting. The entire area is presently infested with hemlock looper which threatens to destroy these forests. A spraying program to control this infestation has been planned for 1968.

The timber limits in the area are held by Bowaters Newfoundland Limited; most of the forested area is considered merchantable. Figure 1-10 of Volume V I shows the location of the timber limits held by this company.

19.3.2 Minerals

There are no metallic mineral occurrences being exploited in the study area at this time. Gypsum is being mined at Flat Bay immediately south of St. George's but just beyond the limits of the area under study. At Romaines just west of Stephenville a gypsum deposit suitable for commercial exploitation is known to exist.

19.3.3 Wildlife

The study area is the habitat for moose and black bear both of which are plentiful. However, this area is not suited to caribou and consequently they are not found to any significant extent. Snowshoe hare and other small game are harvested locally for food and fur.

19.3.4 Agriculture

Much of the drainage area of Harry's River south of Georges Lake has some, albeit little, agricultural potential subject to intensive development and maintenance practices. Practically none of the drainage area of Southwest and Bottom Brooks has any agriculture possibilities. During 1966 a total of less than 1000 acres in the study area was in use as farm land.

20 PRESENT DAY DEVELOPMENT

20.1 Population Pattern

In 1966 the population of the Stephenville area (which is exclusive of the major portion of the basins of the rivers included in the total study area) was just under 3 percent of the total provincial population. Although the population of earlier census data does not include U. S. military personnel, even though many lived off the base, the effect of having a large U. S. Air Base in the area was pronounced.

In 1951 there were 7700 people living in the study area, rising to 9720 by 1956, and to 13,520 by 1961. The effect of the closure of the U. S. Air Base in 1965 is quite apparent in the 1966 census data when population had leveled off at 13,630.

In terms of urban concentration (urban area defined as a community of 1000 or more), this is one of the most urbanized study areas in the Province. However, in terms of geographical boundaries, it is also one of the smallest areas considered in this study.

In 1966 there were four centres of urban size: Stephenville, the largest, with a population of 5910, followed by Stephenville Crossing with 2433, St. George's with 2046, and Kippens with 1086. These centres represent 84 percent of the population living in the study area. This high degree of urbanization has been fairly consistent since 1951 when 81 percent of the population lived in urban centres; by 1956 the urban population had dropped to 79 percent, but had risen again by 1961 to 83 percent. This is markedly higher concentration of urban dwellers than the provincial average of 54 percent and of the Canadian average of 74 percent.

The most recent data on the age structure of the population is for 1961, and only that for Stephenville was readily available. However, as Stephenville represents close to 50 percent of the study area population the structure may be representative of the average.

Age Group	Percentage Distribution of Population	
	Stephenville	Province
0 - 14	47	42
15 - 24	16	10
25 - 64	35	42
65 +	2	6

The differences reflected in the youngest and oldest age groups reflect the urban concentration in Stephenville and the developing nature of the area. The reflection of urbanization in age structures is probably more pronounced in the Island than on the mainland because of the historical patterns of population distribution and occupations.

20.2 General Economic Patterns

20.2.1 Primary and Secondary Industry

The agricultural activity of the study area is limited. The study area lies in two census divisions which, because there are only two farms in the St. George's area, are combined in the agricultural census with those of the Stephenville area. It is impossible to ascertain whether the 18 farms which support 105 people all lie within the study area boundaries; therefore, these figures indicate maximum activity.

These farms have a total of 1234 acres of which 507 are considered as improved land. Unfortunately, the value of agricultural products sold are reported on the basis of census division and not sub-division. From the acreage and livestock reported in the sub-division, the value could not be significant.

There is no forestry activity, primary or secondary, in the study area at the present time.

The fisheries activity is not significant at the present time. The study area lies in fisheries area K which includes the coast line from Port aux Basques to the tip of the Port au Port peninsula. The employment for the whole area in 1966 was only 656, of which 26 were in the offshore fleet. It is assumed that most of these fishermen live outside the actual study area boundaries.

Secondary manufacturing is limited and the employment generated is small. According to the 1966 data contained in a special listing obtained from the DBS Central Register, the following manufacturing establishments were located in the study area; bakery, soft drink, household furniture, concrete products, and ready-mix.

20.2.2 Tertiary Industry

The economy of the study area was, to a great extent, dependent on the U.S. Air Base at Stephenville. It was estimated that in 1961 in addition to the 6043 Canadians living in Stephenville, 3500 Americans were living off the base.

In 1966, the labour force was estimated to be 2600 of which certainly no more than 800 people were employed in the primary and secondary sectors. This would indicate that the tertiary sector had been developed even though, with the withdrawal of the Americans, it was under-utilized in 1966.

20.3 Withdrawal Water Demand and Supply

20.3.1 Mining, Forestry and Agriculture

Mining activity is limited to the mining and crushing of gypsum at Flat Bay south of St. George's. This operation does not require the use of water except for domestic use by the 50 employees, and this water is obtained in adequate quantity and quality from two drilled wells at the site.

No forestry activity is currently being carried out; consequently no demands on the water resource are being made.

Agricultural demands on the water resource are quite limited even though some of Newfoundland's best agricultural land is located in this river basin area. Approximately 1000 acres of farm land were in use during 1966, but none of this land was irrigated. The total agricultural output in 1966 had a retail value of approximately $100,000, most of which resulted from the operation of numerous small acreage, non-commercial farms.

20.3.2 Former U.S. Air Force Base at Stephenville

The Ernest Harmon U.S. Air Force Base at Stephenville ceased operations in 1966, and is presently being developed as an industrial site by the Provincial Government in order to take advantage of buildings and services highly suitable for industrial use.

The water supply for the base is obtained from nearby Noels Pond which provides a more than adequate quantity of water to meet the 2.5 million gallons per day capacity of the existing pumps, chlorination facilities, reservoirs, and distribution system. The quality of this water is, however, questionable as existing reports indicate that the pond is polluted by domestic sewage from the adjacent Cormiers Village and treatment is limited to chlorination only. It will be necessary either to filter the water prior to chlorination or to take measures that will ensure that no pollution enters Noels Pond if continued use is to be made of the pond as a source of water. At the present time the only significant water using industry located on

the former base is the Atlantic Brewing Company Limited which commenced production in late 1967; although no data were available on the water consumption of this brewery, it is unlikely to exceed 100,000 gallons per day.

The base property is served by a complete system of sanitary sewers discharging untreated wastewater to the salt water of St. George's Bay. This procedure created no problems during the peak occupancy of the base by the U.S. Air Force; and, provided no unusual industrial wastes are introduced to the sewers, it should continue to be adequate for the present requirements of the base property. Indications are that the sewerage system is of adequate capacity to transport all the wastewaters produced by both light industry and residences on the former base property.

20.3.3 Municipal Water Supply and Wastewater Disposal

The major centres of population located in the river basin area are Stephenville, Stephenville Crossing, St. George's, and Kippens. None of these centres has any industry which uses an appreciable amount of water, the municipal demand being almost entirely residential and commercial in nature.

a) Stephenville, with a 1966 population of 5910, declined markedly in population with the closure of the base. Stephenville's peak population occurred in 1965 with 9500 persons in the municipality; 6000 persons of this total were Canadian citizens, the balance, 3500 persons, were American citizens living off the base. With the closure of the base all American citizens associated with it left Stephenville.

Stephenville has a water distribution system serving the municipality from a surface supply obtained by damming a stream near Noels Pond. There appears to be an adequate quantity of water available to meet the municipal requirement of Stephenville, but on occasion the quality of the water has not been entirely satisfactory because of high colour. Treatment is limited to chlorination.

Stephenville is completely served by a separate system of sanitary sewers discharging untreated wastewaters into the Blanche Brook at its point of discharge into St. George's Bay. This procedure over the years appears to have eliminated a small run of salmon from the brook.

b) Stephenville Crossing had a population of 2433 in 1966 approximately 600 of whom were served by a municipally-owned drilled well and distribution system. The balance of the residents of Stephenville Crossing rely on individual dug wells which generally provide an adequate quantity of water of good quality. There is no immediate intention of extending the existing distribution system to serve the balance of the municipality.

Separate sanitary sewers serve that area of the town provided with the water distribution system; the sewer system discharges untreated wastewaters into St. George's Bay. The balance of the municipality relies upon privies and septic tanks for disposal of domestic wastewaters.

c) St. George's, with a 1966 population of 2046, has neither a municipal water distribution system nor a system of sanitary sewers. All residents of this municipality rely upon individually owned wells most of which are dug rather than drilled. In general, these wells provide an insufficient quantity of water much of which is bacteriologically unsatisfactory as a result of pollution from adjacent septic tanks and privies. Construction plans for a municipal water supply and distribution system together with a system of sanitary sewers have been prepared, but there is no indication as to when these works will be commenced. The proposed source of water is from a drilled well (or wells). Sewers will discharge untreated wastewaters into St. George's Bay.

d) Kippens in 1966 had a population of 1086 persons all of whom relied upon individually owned wells for water. Of the 132 wells in use in Kippens in the fall of 1967, 119 were dug, the remainder being driven sand-points. The wells in this area are extremely productive providing ample water of good quality.

Sewage disposal in Kippens is entirely by septic tanks with no evidence of groundwater pollution resulting thereby.

The remainder of the population of this river basin area live in small communities of less than 500 persons mostly adjacent to Stephenville. Gallants and Berry Head each have a community water distribution system using a local stream as the source of supply; neither municipality disinfects the water prior to use and thereby exposes the residents to possible bacteriological pollution of the water supply. The remaining communities rely for water upon dug wells and

driven sand-points which are individually owned, and in most instances both the quality and quantity are satisfactory. Sewage disposal from all of these communities is by means of septic tank systems and/or privies.

20.4 Non-withdrawal Water Uses

20.4.1 Hydro Power Development

No hydro power developments exist within the river basin area at the present time.

20.4.2 Fisheries

20.4.2.1 Sport Fishing

Harry's River together with Southwest and Bottom Brooks are major salmon streams in Newfoundland primarily for sport fishing, although these rivers do contribute to the commercial salmon fishing carried out in adjacent salt waters.

According to data from the Canada Department of Fisheries, from 1952 to 1966 the annual recreational catch of salmon and grilse in these three streams and their tributaries averaged 1325 with a tendency towards increased catches in each succeeding year. The angling effort during that period averaged 2977 rod-days per year ranging from 568 rod-days in 1962 to 6308 rod-days in 1964. Since the peak of 1964 the demands on the river have been reduced due, undoubtedly, to the closure of the U. S. Air Force base at Stephenville. In 1966 the total rod-day demand on these rivers was 4083 producing 1815 salmon and grilse weighing a total of 9448 pounds.

On Harry's River excellent fishing pools are distributed throughout the length of the river; on Southwest and Bottom Brooks fishing is generally limited to the lower 10 miles of these streams due primarily to the more difficult access to other stretches of the streams for anglers. In addition to salmon, resident and sea-run brook trout are plentiful in these streams and are sought by local anglers.

The present stock of salmon attributable to the river basin streams is estimated by the Canada Department of Fisheries to be between 13,000 and 18,000, 50 percent of which are caught in the commercial fishery; approximately 25 percent of the stock are caught by sportsmen, with the balance providing an escapement of approximately 25 percent. A like number of anadromous brook trout are probably

attributable to these streams, but do not contribute to the commercial fishery, although they have a significant role in the sports fishery.

20.4.2.2 Commercial Fishery

Data on the commercial fishery conducted from the shores included in the river basin area is not exclusive for that area alone, but includes all commercial fishing from Cape St. George to Codroy.

In this area cod, salmon, lobster, and recently herring comprise the majority of the landings, the total value of which in 1966 was $258,000 from landings of 2,200,000 pounds, only part of the catch being fresh water-dependent. Cod and salmon each accounted for approximately 25 percent of the value of the landings; lobster for approximately 45 percent; and herring and other fish for the remaining 5 percent.

With the exception of 26 men employed in the herring fishery all fishermen in this area are classified as inshore fishermen. The commercial fishery provided direct employment in 1966 for a total of 656 persons, 384 of whom fished less than five months, 236 of whom fished between five and ten months, and the remaining 36 who were active in the fishery for more than 10 months.

20.4.3 Navigation and Log Driving

Navigation on these rivers is limited to canoes and similar small craft associated with angling and hunting.

The rivers of this basin are not in use for log driving since, with the exception of some salvage logging, the area is not being harvested due to immaturity. It is unlikely that future movements of logs will be via these rivers in view of the trend by Bowaters Newfoundland Limited towards trucking.

20.4.4 Recreation, Tourism, and Wildlife

Recreational and tourist use of the area's water resources is primarily associated with fishing and hunting. Fishing on Harry's River attracts many angling tourists and moose hunting in the drainage area of Southwest Brook is a popular tourist attraction; however, in terms of economic advantage to the river basin area, tourism at this time is of minor value. Wildlife is plentiful in the area and has been

little affected by any of man's activities; hunting is controlled by the Provincial Department of Mines, Agriculture and Resources through its Wildlife Division which has carried out a management program to ensure a continuing abundance of game suited to the area.

20.5 "Negative" Demand Problems

No problems as a result of a "negative" demand for water exist in the river basin area although at the mouth of Harry's River where it enters St. George's River extensive sand bars have developed from sediment carried by Harry's River.

21 PLANNED AND FORECAST DEVELOPMENT

21.1 Population Growth and Standard of Living

Based on past trends, the population of the study area is projected to increase over the forecast period. Potential industrial developments anticipated for the area are considered sufficient to offset the closure of the U. S. Air Base. Part of the effect of the closure was reflected in the 1966 census so this assumption is not unchecked optimism.

From the 1966 base of 13,630, population is projected to grow to 14,890 in 1971, to 15,840 by 1976, and to 16,800 by 1981. This population will be supported by the limited existing economic base described in Section 20.2 and by new developments.

No change is anticipated in the agricultural sector with the possible exception of a greenhouse industry[1]. No change is envisioned for the mining industry.

Primary fisheries will probably experience a decline in the number of inshore fishermen and an increase in offshore activity. This should not necessarily be interpreted as the movement of some of the present inshore fishermen to offshore activity. While this could happen, the labour skill requirements are not the same.

A new 50,000 barrel a year brewery has recently been built in the area, but the effect of the direct and indirect employment generated by it is not yet reflected in published data. The Aluminum Company of Canada Limited is planning to open an aluminum wire plant which will employ about 50 people. During 1968 a milk reconstituting plant, a transportable home plant, and a plant to produce magnesium hydroxide from sea water will be in operation; no data were available with respect to employment to be generated by these plants but it is unlikely to be significant on an area basis.

One of the two major developments planned for the area is the establishment of a 1000 ton per day linerboard mill. This will provide direct employment for about 400 people and by 1981 indirect employment for an additional 800 people. Because it is felt that under-employment as well as unemployment exists in the study area, no provision was made for a net inward movement of population in response to this industrial expansion.

The other major development being considered is the establishment of a 225,000 ton per year aluminum plant. Should this plant be built in the study area (Bay D'Espoir is considered as a possible alternate location), then a net inward movement of population would take place. On the assumption that two thirds of the employees would be drawn from outside the study area, the total net inward movement of population would occur.

	Study Area Population		
	1971	1976	1981
Basic Projection	14,890	15,840	16,800
Net Inward Movement	5,280	5,750	6,336
Total Adjusted	20,170	21,590	23,136

Although the number of people living in the urban centres of the study area will increase significantly if the aluminum plant is established, the degree of urbanization will probably not increase very much.

In 1965 per capita disposable income was estimated to be $1,100 for the census division in which the study area falls. Approximately 50 percent of the census division population live in the study area. As the greater portion of the population outside the area are engaged in agriculture or the primary fisheries, it is not unreasonable to suggest that the average per capita disposable income of the study area is higher than the census division average. The disparity will increase over the forecast period although there is no precise measure to support this statement. The average for the census division is anticipated to rise, in terms of 1965 dollars, to $2,200 by 1981. This increase will stem primarily from anticipated developments within the study area.

21.2 Non-withdrawal Water Uses

No navigational use of the rivers in the basin is known to be under consideration during the study period. Similarly it is unlikely that log driving on Harry's River and Southwest Bottom Brook will be carried out when recutting of the area commences, in view of the trend towards trucking of logs to the mills.

No definite proposals for future developments associated with recreation, tourism, and wildlife are known at this time. However, increasing population in the Stephenville area as a result of industrial development planned for the immediate future will create demands for recreational use of adjacent waters. Water to satisfy the industrial demand as well as the accompanying municipal requirements of Stephenville will be diverted from Harry's River. In order to maintain the quality of this water and thereby avoid treatment in excess of chlorination, it is advisable to restrict the recreational use of the surface waters proposed for conveyance to Stephenville. As discussed in Volume Five, Part II, of this report, recreational use of domestic water supplies should be limited to boating and angling, both subject to rigid controls; failure to do this will result in the need to filter all potable water prior to its chlorination, at considerable expense from both capital and operating considerations.

The Canada Department of Fisheries has noted that the full potential of Harry's River for the rearing of Atlantic salmon and sea-run brook trout can be realized by the removal of a number of old logging dams at various headwater ponds and by construction of a fishway over West North Brook Falls, which falls make 27 miles of river inaccessible to anadromous fish. Although no definite timing for these works has been prepared, they will be carried out whenever required by recreational pressures associated with the industrial growth of Stephenville.

Spraying of the forested portions of the basin has been planned for 1968 by Bowater Newfoundland Limited in order to control the current infestation of these forests by hemlock looper. The Canada Department of Fisheries has been deeply involved in the planning of this spraying programme in order to ensure that the fish in the river basin area are not unduly affected by the spraying; the chemical to be used is sumithion, which is the least harmful of chemical sprays capable of controlling hemlock looper.

21.3 Withdrawal Uses

21.3.1 Mining, Forestry and Agriculture

No plans are known to exist which will result in an increased demand upon the water resource in mining, forestry or agriculture; but, it is most likely that adequate water will be readily available for any future expansion of these segments of the area's economy during the study period.

21.3.2 Water for Manufacturing

Planned and forecast industrial development in the river basin area has centered on Stephenville in order to take advantage of facilities acquired by the Provincial Government when the U. S. Air Base closed in 1966[1]. Major industries planned in the immediate future are aluminum smelting, herring reduction to fish meal, and production of linerboard. Major industries forecast include the production of caustic soda and of ferro-silica.

Few details of the planned industries are available other than general production capacity in some instances. The aluminum smelter proposed for Stephenville is to have three potlines, each of 75,000 tons per year capacity, installed by 1972. No data are availabe on the proposed wire plant other than by 1971 it will be employing 50 persons. The details of the proposed herring reduction plant were to have been evolved from a pilot reduction plant which was destroyed by fire in 1967; it is understood that this pilot plant is to be rebuilt during 1968. The proposed linerboard mill at Stephenville is to be in operation by 1971 producing 1000 tons per day of linerboard from wood chips obtained from Labrador.

Water requirements for the aluminum smelter could be as high as 60 million gpd but are more likely to be in the order of 25 million gpd. The main use of water will be for the scrubbing of exhaust gases to remove fluorine and, if used in the process, chlorine. Water for gas scrubbing as well as some cooling water can be salt water thereby reducing fresh water requirements to approximately 7.5 million gpd. A detailed discussion of the water requirements for the smelting of aluminum is presented in Volume Eight, Appendix B.

Water requirements for the proposed wire plant would be relatively small, approximately 60,000 gpd, the main uses of the water being for wire cooling during the drawing process and for sanitary purposes.

The herring reduction plant's water requirements would not be excessive regardless of the ultimate size since the main uses of fresh water would be for plant clean-up and sanitary purposes; cooling water requirements could be readily met through the use of sea water.

Of all industries proposed for Stephenville the linerboard mill has the greatest water demand, estimated to be 40 million gpd for the production of 1000 tons per day of linerboard. As with other paper mills, the water used in the production of linerboard must be fresh water. In Appendix B, Volume Eight, a detailed discussion of the water requirements for the production of linerboard is presented.

The two industries forecast for the Stephenville area, the production of caustic soda, and the production of ferro-silica, both employ the electrolytic reduction process and consequently the major water requirement will be for cooling; it should be possible to site these plants so that sea water can be used to meet their cooling requirements.

In order to meet the fresh water requirements of the industries planned and forecast for the Stephenville area, together with the municipal demands of the immediate area, in 1966 a report was authorized on the feasibility of supplying 100 million gpd of fresh water to Stephenville[1]. That report recommended Harry's River as the source of supply, transmission to Stephenville being via existing lakes connected as required by canals. The report has been reviewed and the recommendation that Harry's River be utilized as the source of supply and that transmission be by canal appears reasonable. Figures 19-4 and 19-5 show the routing of the proposed supply scheme.

The proposed supply of 100 million gpd, estimated by Resources Engineering of Canada Limited to cost $4,967,000, will be more than adequate to meet the fresh-water requirements of the currently planned and forecast industrial development in the Stephenville area, even allowing for a 50 percent increase in the capacity of the linerboard mill thereby increasing its requirements to 60 million gpd.

Disposal of wastewaters from the planned and forecast industrial developments should be carefully considered particularly if these are to be discharged into Stephenville Pond rather than the open sea. There should be no difficulties arising from the discharge of cooling waters into Stephenville Pond; similarly wastewaters from the aluminum smelter could be discharged directly into Stephenville Pond. However, wastewaters containing organic material from such industries as the proposed herring reduction plant and the linerboard mill should be piped to the open sea for disposal regardless of whether or not the wastes are treated prior to disposal. If this is not done, Stephenville Pond is likely to become grossly polluted in short order since it does not appear to be self-cleaning either by the tide or by an outward flow of water to flush out pollutants.

In late August 1968 the Provincial Government announced the discovery of large potash and salt occurrences near Stephenville. At the time of writing no details were available on the physical size or commercial value of the deposits. Based on the history of potash development in Saskatchewan and existing market conditions, it was

agreed, in consultation with the Board, to assume no development of these occurrences would take place over the study period. Should development be undertaken the water resource implications should be carefully reviewed.

21.3.3 Municipal Water Use

The 1981 population of the Stephenville and environs study area (the major municipalities of which are Stephenville, Stephenville Crossing, St. Georges, and Kippens) is estimated to be 24,000 as a result of the industrial developments planned and forecast being taken into account, together with the natural increase in the area population. The 1966 population of this area was just over 14,000 persons.

In Stephenville the existing water source should be capable of providing an adequate quantity of water to meet the municipal demands of the 1981 population, particularly since this supply has served 12,000 persons in the past. The bacteriological quality of this water must be carefully protected, however, since treatment is limited to chlorination. The source of supply is quite accessible as is the whole drainage area feeding the source, and these conditions are conducive to gross bacteriological contamination with an increase in area population. If the source of supply cannot be protected, it will be necessary to filter the water before chlorination to ensure bacteriological purity. The present system of discharging untreated municipal wastewaters at the mouth of Blanche Brook should be reviewed, and its effect on fish attempting to enter the river determined. It could well be that the outfall should be relocated so that it discharges into the ocean proper thereby making Blanche Brook available to anadromous fish.

In Stephenville Crossing, water demands during the study period can probably be met from groundwater through drilled municipal wells, if the existing municipal distribution system is extended, or through the continuation of the use of individual dug wells, if necessary. Extension of the existing distribution system and development of municipal wells sufficient to meet the requirements of a 1981 population of 3500, that is, approximately 350,000 gpd, should be carried out at an early date in anticipation of the expected growth of Stephenville Crossing. Similarly the existing system of sanitary sewers should be extended to meet the needs of a population of 3500 by 1981. Provided the outfall of the sewer system is to the sea, treatment of the wastewaters prior to discharge should not be necessary during the study period.

St. George's municipal water requirements can more than likely be met from groundwater. With a possible 1981 population of 3000, the total municipal requirement will be approximately 300,000 gpd. As indicated previously, construction plans for a water supply and distribution system have been prepared. Plans also exist for a sanitary sewer system discharging untreated wastewaters into St. George's Bay.

Although Kippens is adequately served by individual wells at the present time, by 1981 the population could be close to 2000, and the continued reliance on individual wells at that time would be unwise because of the high risk of groundwater pollution from septic tank effluent. The municipal water requirements of Kippens in 1981, approximately 200,000 gpd, should be readily supplied from groundwater sources. Disposal of municipal wastewaters to the sea without treatment appears to be feasible for the study period at least.

The balance of the communities in the river basin area during the study period will probably continue to be entirely residential in nature with populations generally less than 500. In that part of the river basin area adjacent to the sea coast between Port au Port and St. George's, the water demands of these communities, probably less than 25,000 gpd, should be met from groundwater sources. Elsewhere in the river basin area community water supplies will have to be from surface sources although individual dug wells will provide adequate water where no community supply exists.

Central sewer systems in these small communities can generally discharge untreated wastewaters into the sea without treatment. Inland communities discharging to fresh water must be provided with sewage treatment facilities if pollution of these fresh waters is to be avoided; this is particularly true of communities such as Gallants and Georges Lake discharging wastewaters into Harry's River, the proposed source of water for the Stephenville industrial complex.

21.4 "Negative" Water Demand Problems

21.4.1 Soil Erosion

The only instance of a problem relating to "negative" water demand is the build up of sand bars in the St. George's River at the mouth of Harry's River. Material from which these sand bars are built is derived from the beds of the various watercourses making up the hydrologic network of Harry's River. This bed material originates primarily from raised alluvial terraces through which these water courses flow.

21.4.2 Bog Reclamation

Although a large area of bog land lies east of Stephenville and immediately north of St. George's River, no known plans exist for its drainage.

21.4.3 Flooding

No record of property-damaging floods exists; consequently remedial works are not necessary nor planned.

22 CONCLUSIONS AND RECOMMENDATIONS

22.1 Conclusions

a) The dominant natural resources in the area are the forests and the fresh water resources of Harry's River and Southwest and Bottom Brooks. The forests have been and are being exploited by Bowaters Newfoundland Limited for the production of pulp. The fresh water resources produce large quantities of Atlantic salmon and other fish and are capable of meeting the water requirements of all foreseeable industrial and municipal development.

b) Although the mining of gypsum takes place at Flat Bay (just beyond the limits of the study area) the known mineral resources of the area are not significant. Similarly agricultural potential in the area is limited by a lack of suitable land. The rivers in the area have no potential for hydro power development.

c) Most of the population of the study area resides along the sea coast between Port au Port and St. George's; the population within the interior of the river basins of the area is less than 500 persons residing for the most part along the CNR between Spruce Brook and Black Duck. No dramatic change in the distribution of population within the study area is anticipated during the study period.

d) Stephenville and the area immediately adjacent to it, specifically the former Ernest Harmon U. S. A. F. base, have potential for significant industrial development, including an available water supply which could be expanded.

e) The withdrawal demand is not of a high level for industrial, municipal, or agricultural use. With discharge of wastewaters to the sea only minor bacteriological pollution of the fresh water resource causes any problem and this could be readily controlled without any significant investment. Discharge of wastewater to Stephenville Pond would in all probability destroy its usefulness since it has a very poor self-purification potential.

22.2 Recommendations

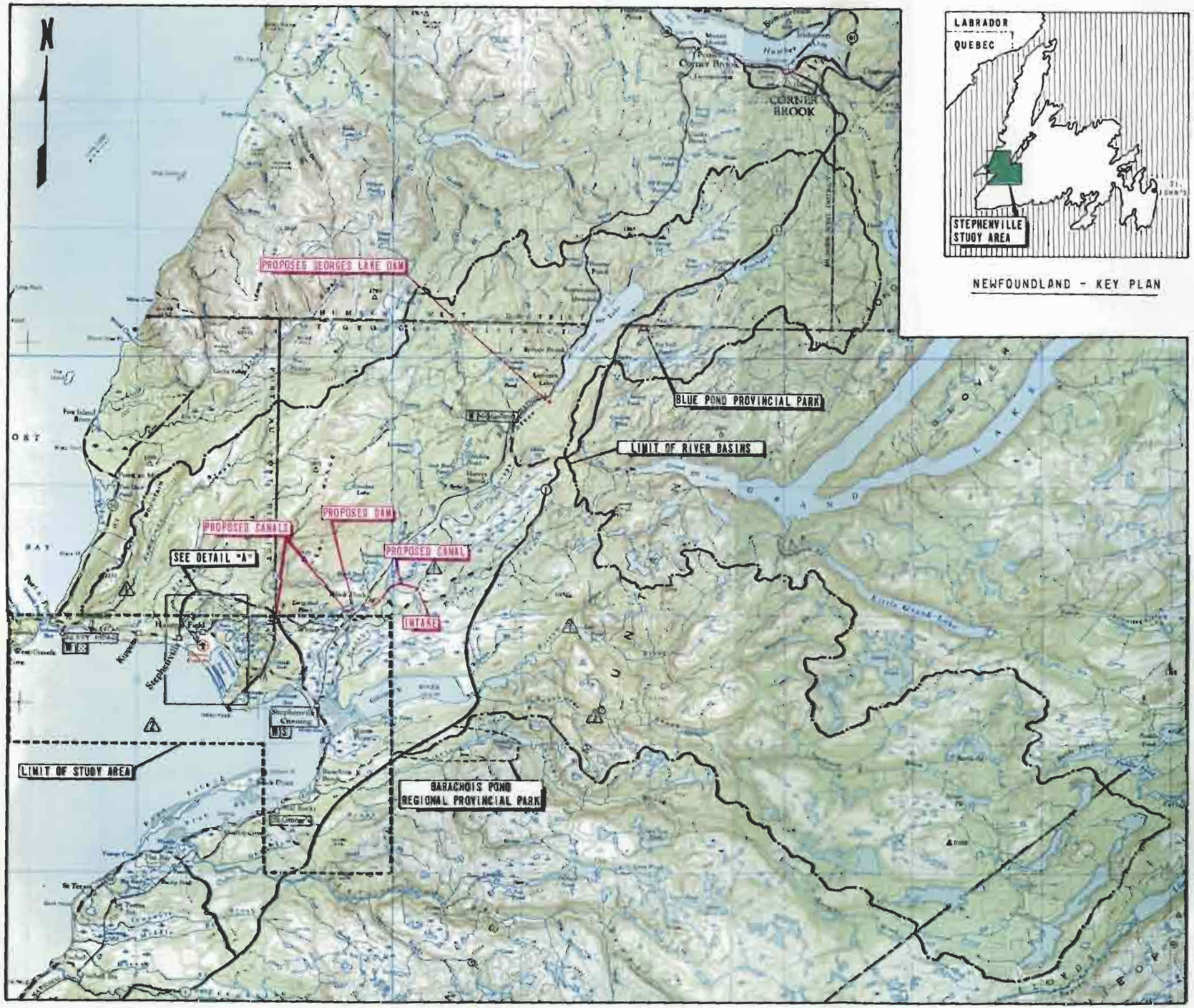
a) Development of the drainage areas serving the town of Stephenville as well as the former Ernest Harmon U. S. A. F. base without adequate domestic wastewater treatment should be curtailed to ensure a satisfactory quality of raw water for use by Stephenville and the former base. If this cannot be accomplished it will be necessary to treat all potable water derived from these drainage areas by filtration as well as chlorination in order to ensure water of acceptable bacteriological quality.

b) Wastewater from industrial development in the Stephenville area should in general be discharged to the sea (St. George's Bay) rather than to Stephenville Pond in order to prevent pollution of the pond; cooling waters and wastewaters containing no organic pollutants or settleable solids could be discharged into the pond but all other wastewaters should be conveyed to the sea for ultimate disposal.

REFERENCES

1 Acres Research and Planning Limited. Harmon - Stephenville Development Plan Phase I, May 1967.

2 Resources Engineering of Canada Limited. Feasibility Report - Water Supply for Stephenville, October 1966.



GENERAL PLAN

NEWFOUNDLAND - KEY PLAN

DETAIL "A"

NOTES:
ROUTING OF PROPOSED WATER SUPPLY FOR STEPHENVILLE AREA SHOWN IN RED

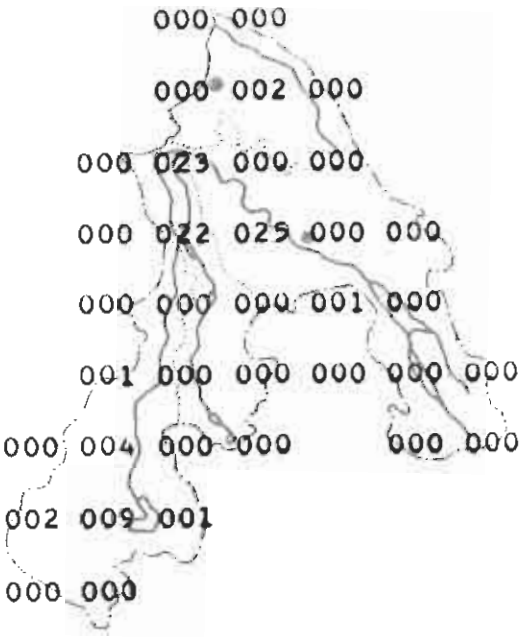
- ATLANTIC SALMON AREA
- COMMERCIAL FISHING AREA
- WATER SUPPLY SOURCE

LEGEND:
- WS COMMUNITY WITH WATER SUPPLY AND WASTEWATER DISPOSAL SYSTEMS
- W COMMUNITY WITH WATER SUPPLY SYSTEM ONLY

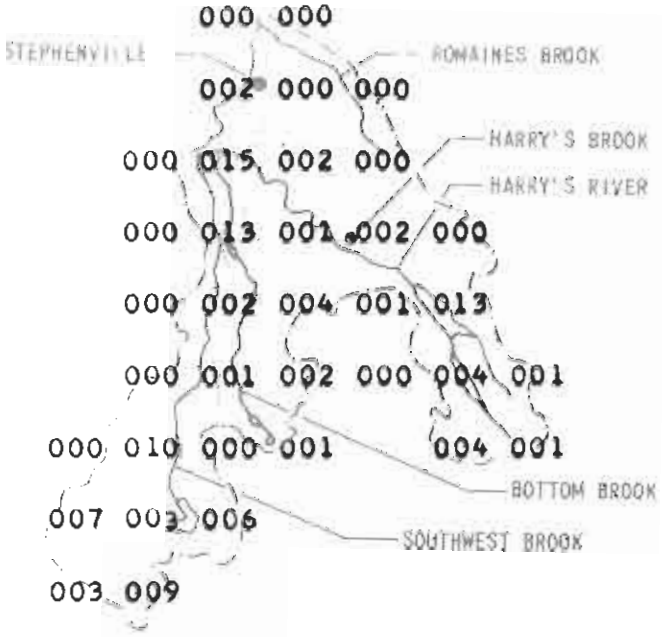
STEPHENVILLE AND ENVIRONS
STUDY AREA

FIGURE 19-1

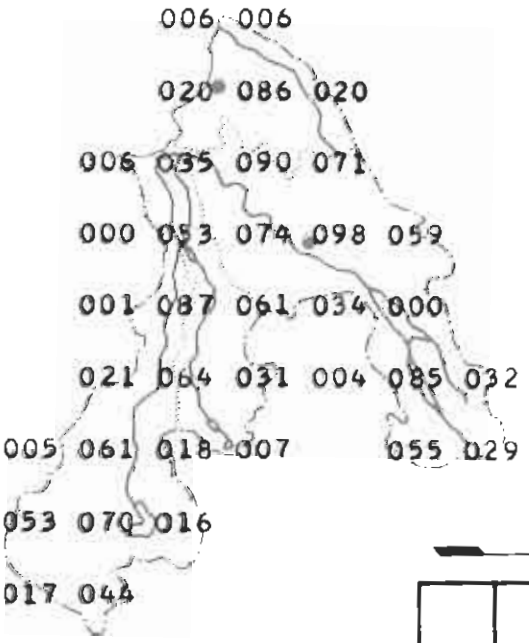
STEPHENVILLE AND ENVIRONS STUDY AREA
SQUARE GRID DISTRIBUTION OF LAKES, BOGS AND SWAMPS, BARRENS AND FORESTS



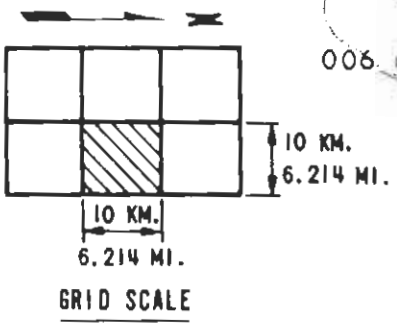
BOG AND SWAMP AREA - SQ. KM.



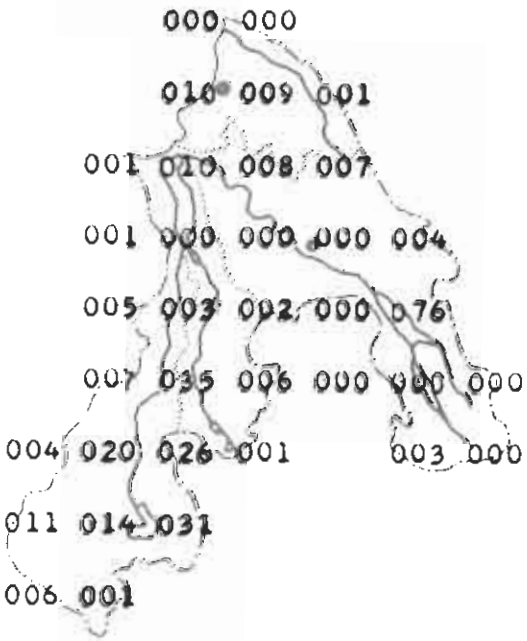
LAKE AREA - SQ.KM.



FOREST AREA - SQ.KM.



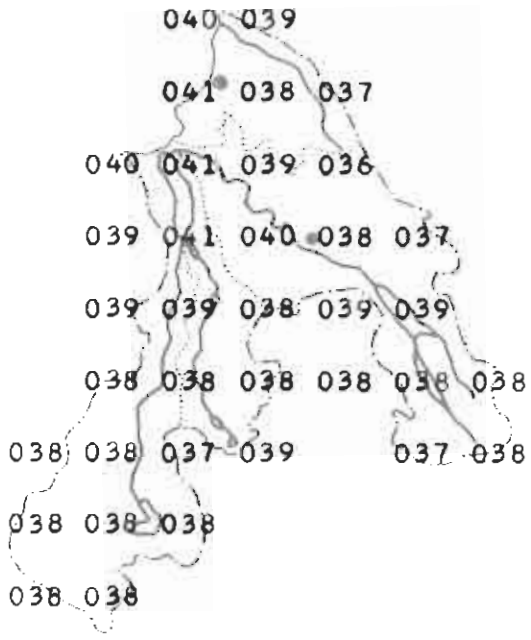
GRID SCALE



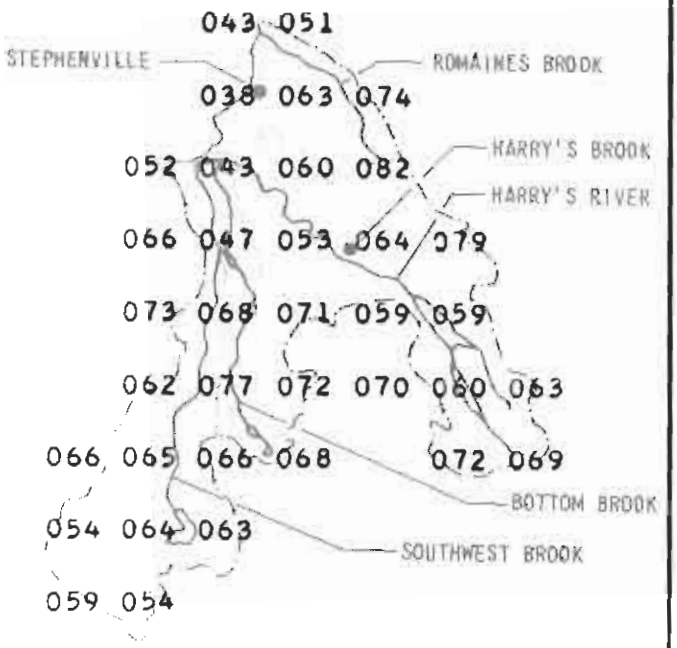
AREA OF BARREN - SQ.KM.

FIGURE 19-2

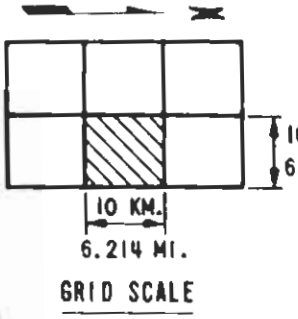
STEPHENVILLE AND ENVIRONS STUDY AREA
SQUARE GRID DISTRIBUTION OF AVERAGE ANNUAL TEMPERATURE, PRECIPITATION, EVAPORATION AND RUNOFF

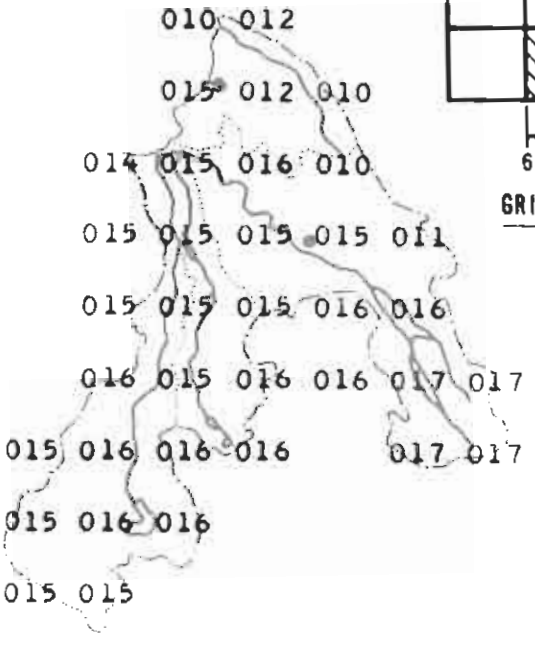


AVERAGE YEARLY TEMPERATURE
-DEGREES FAHRENHEIT

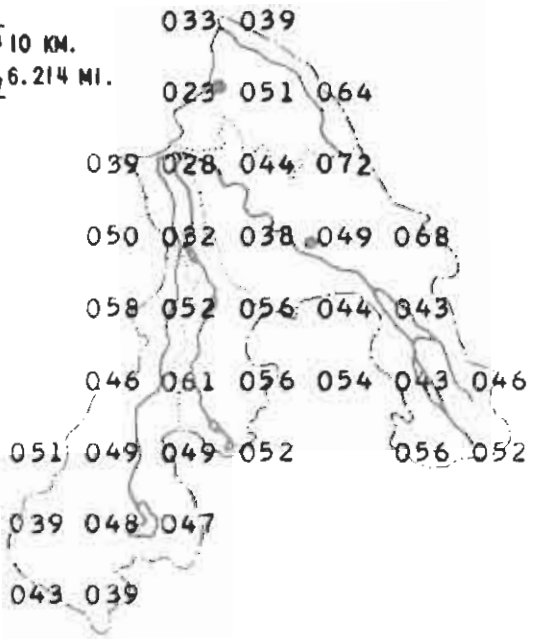


AVERAGE YEARLY PRECIPITATION
- INCHES OF WATER



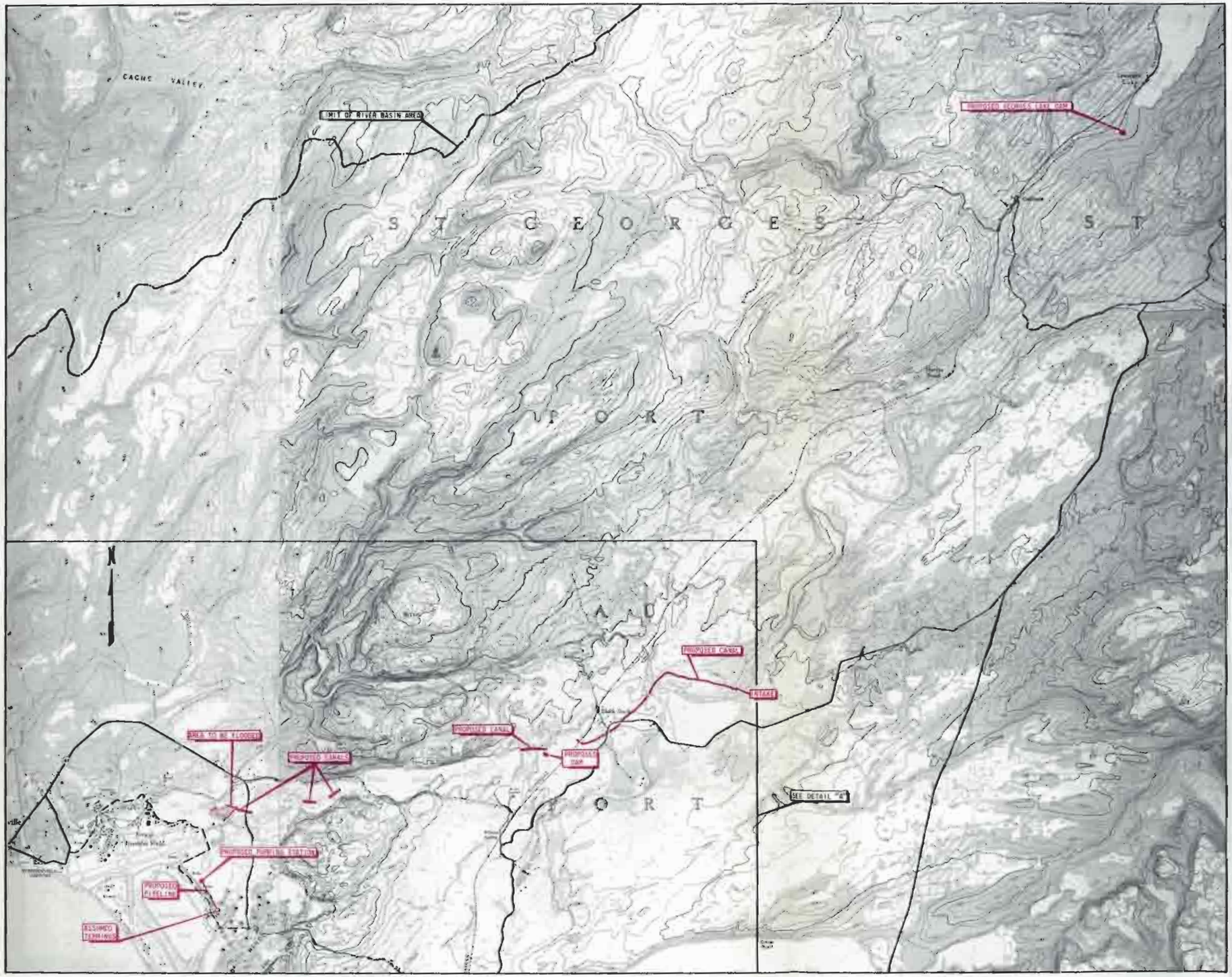


AVERAGE YEARLY EVAPORATION
- INCHES OF WATER



AVERAGE YEARLY RUNOFF
- INCHES OF WATER

FIGURE 19-3

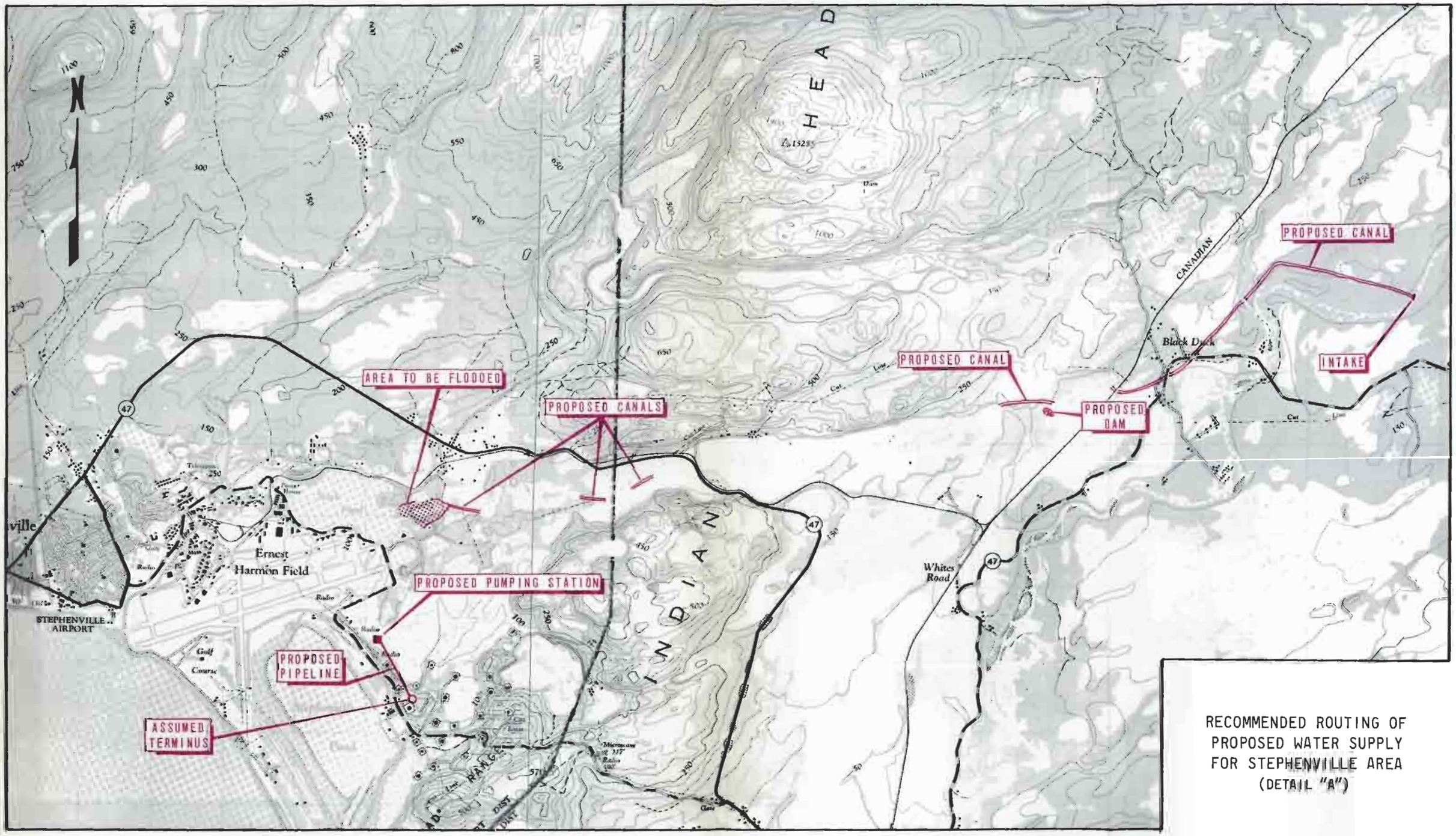


GENERAL PLAN

NEWFOUNDLAND - KEY PLAN

RECOMMENDED ROUTING OF
PROPOSED WATER SUPPLY
FOR STEPHENVILLE AREA
(GENERAL PLAN)

FIGURE 19-4



RECOMMENDED ROUTING OF PROPOSED WATER SUPPLY FOR STEPHENVILLE AREA (DETAIL "A")

0 1/2 1 2 MILES

DETAIL "A"

FIGURE 19-5

STEPHENVILLE AND ENVIRONS STUDY AREA

SUMMARY OF CLIMATIC CHARACTERISTICS

A ANNUAL MEANS

Precipitation (inches)	Air Temperature (deg F)	Potential Evaporation (inches)	Relative Humidity (percent)
40.0	40	18	79

B MEAN MONTHLY PRECIPITATION (inches)

Stations	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Stephenville	4.01	3.70	2.12	2.02	2.81	3.03	3.39	3.32	4.18	3.88	4.37	3.79
Basin Mean Synthesized	4.00	3.70	2.20	2.10	2.70	3.00	3.50	3.30	4.10	3.80	4.20	3.80

C MAXIMUM POSSIBLE STORM PRECIPITATION (inches)

Area (sq. mi)	Storm Duration (hours) 6	12	18	24	36	48	72
100	3.85	4.65	5.90	6.55	8.90	9.50	16.10
300	3.70	4.55	5.85	6.45	8.70	9.30	15.60
500	3.50	4.50	5.65	6.40	8.55	9.15	15.20

D MAXIMUM POSSIBLE SEASONAL SNOWFALL (inches of water equivalent): 45.5

E CRITICAL SEQUENCES FOR SNOW MELTING (degrees F)

Interval	Date: March 1	March 10	March 20	April 1	April 10	April 20	May 1
4 - day	48.0	50.5	52.5	56.5	59.0	60.5	62.5
8 - day	44.0	46.0	48.5	52.0	54.0	55.5	55.5
16 - day	38.5	40.0	42.0	47.0	50.0	51.5	52.0

F DROUGHT

Return Period	2.33-Year	5-Year	10-Year	20-Year	50-Year	100-Year
Length of Drought	12 days	14 days	17 days	21 days	23 days	26 days

TABLE 19-1

SUMMARY OF HYDROLOGIC CHARACTERISTICS
STEPHENVILLE STUDY AREA

I - SYNTHESIZED DATA

A. ANNUAL MEANS FOR THE TOTAL BASIN

FLOW (CFS)	RUNOFF (CFS/SQ.MI)	RUNOFF (INCHES)	ACTUAL EVAP. (INCHES)
	2.34	31.8	14.0

B. MEAN MONTHLY FLOWS (Q) AND STANDARD DEVIATIONS (S) (CFS)

RIVER AND LOCATION		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
SOUTHWEST AND BOTTOM RIVERS AT GEORGE RIVER	Q	660	565	535	1080	2660	1510	605	575	615	900	1190	830	1100
	S	360	310	335	620	865	555	355	365	375	475	420	430	145
HARRY'S RIVER AT STEPHENVILLE	Q	730	615	690	1180	3270	1990	715	710	740	940	1370	850	1120
	S	410	360	400	750	1070	680	475	460	460	510	500	515	167
	Q													
	S													

C. MAXIMUM FLOWS (CFS) AND FLOOD VOLUMES (CFS DAY) OBTAINED BY THE MAXIMIZATION PROCEDURE (INSTANTANEOUS PEAKS)

RIVER AND LOCATION	MAXIMIZED RAIN ON SNOW PACK		MAXIMIZED RAIN ONLY		SNOW PACK & AVERAGE RAIN	
	PEAK	VOLUME	PEAK	VOLUME	PEAK	VOLUME

D. MAXIMUM FLOWS OBTAINED BY STATISTICAL ANALYSIS (CFS) (DAILY AVERAGES)

RIVER AND LOCATION	GENERATED BY SNOW MELT & RAIN		GENERATED BY RAIN ONLY	
	1/10000 YEARS	1/1000 YEARS	1/10000 YEARS	1/1000 YEARS
SOUTHWEST AND BOTTOM RIVERS AT GEORGE RIVER	20,600	16,900	14,700	11,900
HARRY'S RIVER AT STEPHENVILLE	23,900	20,200	17,000	13,700

SUMMARY OF HYDROLOGIC CHARACTERISTICS
STEPHENVILLE STUDY AREA

E. MINIMUM FLOWS OBTAINED FROM RECESSION CURVES (CFS)

RIVER AND LOCATION	1/2 YEARS	1/5 YEARS	1/10 YEARS	1/20 YEARS

F. MINIMUM FLOWS OBTAINED FROM STATISTICAL ANALYSIS (CFS)

RIVER AND LOCATION	1 2 YEARS	1 5 YEARS	1/20 YEARS	1/100 YEARS
SOUTHWEST AND BOTTOM RIVERS AT GEORGE RIVER	180	140	100	
HARRY'S RIVER AT STEPHENVILLE	160	110	60	

G. FULL REGULATION STORAGE

RIVER AND STATION	STORAGE (CUBIC FEET x 10^9)

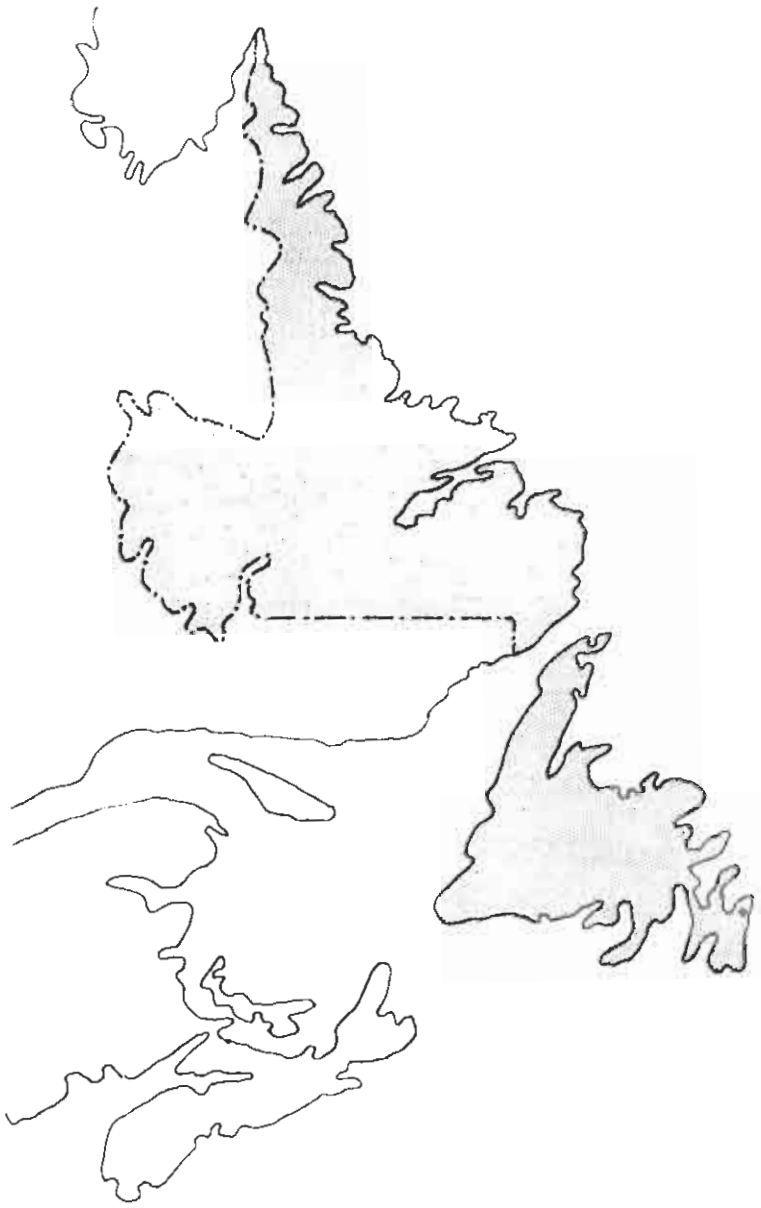
II - RECORDED DATA

H. MEAN MONTHLY AND ANNUAL FLOWS (CFS)

RIVER AND STATION	YEARS OF RECORD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE

I. EXTREMES RECORDED (CFS)

RIVER AND STATION	MAXIMUM FLOWS			MINIMUM FLOWS		
	FLOW	DATE	COMMENTS	FLOW	DATE	COMMENTS



VOLUME SEVEN - PART V - SECTIONS 23-26

STUDY AREA - BONAVISTA PENINSULA

PART V - BONAVISTA PENINSULA STUDY AREA

23 NATURAL CONDITIONS

The Bonavista study area consists of that portion of the southern peninsula forming Bonavista Bay, easterly from Blackhead Bay; the limits of the area are shown on Figure 23-1.

23.1 Physiographic Conditions

The study area totals 177 square miles, 48 percent of which is forest covered; 45 percent is barrens, mostly at the extreme tip of the peninsula; the balance is more or less equally divided between lakes and bogs. Figure 23-2 shows the distribution of areas of barrens, lakes, forests, and bogs within the area.

The average elevation is about 300 feet above sea level with a maximum elevation of 675 feet in the central portion. The area contains many lakes and rivers all of which are quite small; Champney's Brook with a drainage area of 30 square miles is the largest. The only other river of note is the Port Union River with a drainage area of 28 square miles. The area has a moderate cover of ground and ablation moraine which thins out on the high ground near the sea coast in some places, but leaves no large areas of exposed rock. The bedrock consists of sedimentary rocks, largely sandstones and shales of Pre-Cambrian age. The topography and the network of rivers and lakes are shown on Figure 23-1.

The square grid distribution of mean annual temperature, precipitation, and evaporation is shown in Figure 23-3. The mean annual temperature is just over 40 deg F; the mean annual precipitation is 52.9 inches, and the mean annual evaporation is 10.0 inches.

23.2 Water Resources

23.2.1 Surface Water

No flow data were available for any of the rivers and the areal distribution of mean annual runoff indicated in Figure 23-3 has been derived from the generalized relationships with physiographic and meteorologic factors developed in Volume Two A, Part IV. The mean annual runoff so derived is 42.9 inches. The quality of the surface water in this area appears to be rather typical for the Island on the basis of a review of the limited number of chemical analyses available. Colour is about 30 units, turbidity is generally less than 3 units, pH is about 6.6, hardness is usually less than 10 mg/l as $CaCO_3$, and

total dissolved solids are very low, the equivalents per million being less than 1.0. Bacteriological analyses of four different rivers in the study area showed the presence of coliform per 100 ml ranging from 130 to 470, which is probably indicative of pollution since much of the area is traversed by provincial highways making it accessible to man.

23.2.2 Groundwater

The groundwater potential is low to moderate from the surficial deposits and is generally low from the bedrock. Reference is made to Figures 8-4 and 1-5 of this volume which were prepared from available information to show, respectively, surficial hydrogeology and bedrock hydrogeology of the Island. The groundwater potential of the area is summarized as follows:

Hydrogeological Unit	Yield gallons per minute	Percent of Study Area	Remarks
S2	10 to 50	100	
S5	-	4	poor quality
R?	1/2 to 10	100	

Surficial wells installed in hydrogeological unit S2 can provide good supplies of water but, where the drift deposits are thin, there is a tendency for the wells to dry up during the summer months. Insufficient data were available to make any observations on the chemical content of water from wells in the area other than to say that no adverse analyses were encountered.

23.3 Natural Resources

23.3.1 Forests

Exploitable forests exist in much of the area particularly in the western half adjacent to Blockhead Bay. Forest cover north of Catalina has been removed by repeated burning which probably occurred prior to permanent settlement of the area.

23.3.2 Minerals

There are no mineral resources of known commercial value in the area.

23.3.3 Wildlife

The study area is the habitat of moose which are harvested locally in season. In 1965 caribou were introduced, but the success of this operation has yet to be determined. The area is also the habitat of most species of Newfoundland's small fur bearing animals.

23.3.4 Agriculture

Agriculture in the study area is restricted to small non-commercial farms and is of little significance.

24 PRESENT DAY DEVELOPMENT

Present day development is almost exclusively related to the commercial fishery since no other industry of any major significance is located in the study area. At Catalina there are fresh, salt, and frozen fish processing plants as well as a fish meal plant; at Bonavista fresh and frozen fish plants; and at Port Union a salt fish plant.

24.1 Population Pattern

In 1966 the study area accounted for 1.9 percent of the Provincial population. Since the 10 percent increase which occurred in the area between 1951 and 1956, there has been a slow but apparently steady decline in population to the 1966 census level of 9380. This decline is probably indicative of an outward movement within the labour force age group reflecting the limited job opportunities in this area.

In 1966, 64 percent of the population of the study area lived in three towns: Bonavista - 4192, Catalina - 1089, and Little Catalina - 725. Over the 15 year period since 1951, this represents an increase of four percentage points.

In terms of urban areas (urban area defined as a community of 1000 people or more), the concentration has been more pronounced. In 1951, 42.5 percent of the population lived in urban areas; in 1956, the concentration remained the same; by 1961 it had risen to 55.5 percent with another minor gain to 56.3 percent by 1966. This is slightly higher than the Provincial concentration of 54 percent but still well below the Canadian average of 74 percent.

The most recent data on the age structure were for 1961, and the only ones readily available were for Bonavista.

Compared to the Provincial average of 41.8 percent, 34.2 percent of the Bonavista population was in the 0 - 14 age group. In the 65 and over age group, the Bonavista population was considerably higher with 10 percent of the population compared to 5.9 percent for the Province.

Removing the 65 and over population from the labour force age group, the comparison is quite revealing. Although the Bonavista percentage is higher in the 15 - 64 group, 55.1 percent compared to 52.3 percent, the sub-structure is different. Only 11.2 percent of the Bonavista population are in the 15 - 24 age group compared to

16.2 percent for the Province. This may be another indication of the outward movement of the younger population in search of greater job opportunities.

24.2 General Economic Pattern

24.2.1 Primary and Secondary Industry

The economy of the study area rests on the activity in the primary and secondary fisheries. Since it lies in fisheries areas C and D, it is only possible to estimate the number of fishermen in the actual study area. In 1966 the employment in the two fisheries areas was estimated at 3500, of which all but 66 were in the inshore fisheries. It is estimated that approximately 1500 fishermen were in the study area.

No detailed information is available on the fish processing sector other than the type and location of plants, listed in Section 24. If the employment pattern in these plants follows the general pattern of the industry, there is a marked seasonal employment factor in the area.

On an annual basis for the industry as a whole, the processing employment is about 10 percent of fisheries employment which means about 150 people are employed in the plants.

24.2.2 Tertiary Industry

Because of the lack of accurate statistics, only generalized estimates can be made of employment in the tertiary sector.

By applying the Bonavista population structure of the study area population, it is possible to estimate the size of the labour force age group. In 1966 the labour force age group was estimated to be 5200. By applying the Provincial labour force participation rate, the labour force is estimated to be 2300.

Assuming that between 1500 and 2000 are employed in primary and secondary fisheries, the possible tertiary employment is limited. However, considering the average income of inshore fishermen and the fact that much of the employment in fish processing is seasonal, this low tertiary employment is not unreasonable. It is probably between 300 and 800 people.

While this is below the employment 1 to 1 ratio of commodity producing sectors to the tertiary assumed for fisheries by 1981, it is probably a fairly accurate reflection of conditions in the area.

24.3 Withdrawal Water Demand and Supply

Present day withdrawal water use in the Bonavista study area is confined to fish processing plants and to municipal users. There is no mining activity in the area; exploitation of the forest resource has not been undertaken to date; agricultural development in the area is insignificant and consequently does not create a demand on the water resource.

24.3.1 Water Uses for Industry

The only water consuming industries in the study area are the fish processing plants at Bonavista and at Catalina-Port Union. Fishery Products Limited at Catalina produces frozen cod fillets and fish meal. Current annual landings are approximately 5,000,000 pounds with an average daily consumption of water estimated to be 125,000 gallons, all but about 5000 gallons of which is salt water. Fresh water for sanitary purposes is obtained from nearby Suttons Pond.

Fisherman's Union Trading Company at Port Union processes saltbulk only, their present production being about 5,000,000 pounds per year. Process water is salt water; water for sanitary purposes in the plant and for approximately 40 adjacent houses is obtained from Whirl Pond by means of a connection to the penstock serving the nearby hydro generating station owned by the Newfoundland Light and Power Company Limited.

S. W. Mifflin Limited at Catalina also process saltbulk only using salt water for processing. No data were available on the production or water consumption at this plant.

At Bonavista, the Bonavista Cold Storage Company Limited process about 3,000,000 pounds of frozen cod fillets annually. Although some salt water is used for cooling, all processing water and water for sanitary purposes is obtained from Long Pond through a water supply system installed in 1967. No data were available on water consumption but it is probably in the order of 100,000 gallons per day.

24.3.2 Municipal Water Supply and Wastewater Disposal

None of the municipalities in the area has a water distribution system or a system of sanitary sewers, and all rely upon individually owned wells and wastewater disposal systems. Bonavista with a 1966 population of 4192 persons is the largest municipality in the study area. Although plans for a water distribution system have been prepared using the Long Pond source recently developed as the source of supply, virtually all municipal demands for water are currently supplied from individually owned wells, most of which are dug; the municipality maintains approximately ten wells which supply householders unable to obtain water otherwise. Bonavista is one of the most populated municipalities in the Province without a municipal water supply and distribution system. Sewage disposal is by means of individual septic tanks. Because of the reliance upon septic tanks for sewage disposal in the area of impervious soil, many of the wells are contaminated and there has been considerable local concern for the health of the residents.

In the municipalities of Catalina and Port Union with 1966 populations of 1089 and 633 persons, the situation is similar. Plans have been prepared for a joint water distribution system utilizing Whirl Pond as the source of supply, but at the present time the municipalities continue to rely upon individually owned dug wells, many of which are contaminated and unreliable as to quantity during the summer months. Disposal of domestic wastewaters is generally by means of septic tank systems.

24.4 Non-withdrawal Water Uses

24.4.1 Hydro Power Development

The only hydro power development in the study area is the Port Union plant owned by the Newfoundland Light and Power Company Limited. The drainage area regulated by the plant is about 29 square miles; the rated head is 70 feet, and two installed units have a total capacity of 900 hp. There are several small storage reservoirs developed in the drainage area including Whirl, Island, and Wells Ponds. The regulated outflow available from the plant has been estimated at about 33 cfs.

24.4.2 Commercial Fishery

The following data on the commercial fishery conducted from the shores included in the study area are not exclusive for that area, but include all commercial fishing from Salvage to Random Sound.

In this area, cod as well as other groundfish, lobster, and salmon comprise the majority of the landings, the value of which in 1966 was $979,000. The estimated composition of landings for 1966 is as follows:

Groundfish	$ 578,000
Salmon	66,000
Lobster	251,000
All others	84,000
	$ 979,000

Most of the fishermen in the area are classified as inshore fishermen. In 1966 there were 1510 inshore fishermen, 56 percent of whom were active in the industry for 10 months or more in the year. The number of fishermen is not expected to change much during the study period. Exploitation of the Labrador fishery could increase the quantity of fish landed by fishermen from the Bonavista area.

24.4.3 Other Non-withdrawal Uses

Non-withdrawal use of the study area's water resources for purposes other than hydro development is of little significance. Champney's Brook supports an Atlantic salmon run estimated to total 200 to 600; annual catches of salmon (and grilse) have averaged 35 in recent years, and are made almost exclusively by local sport fishermen.

Many of the small rivers which support runs of anadromous fish may not be exploited by sportsmen because the fish enter the rivers late in the fall when angling is prohibited by law. Other small rivers support only resident brook trout.

The small rivers are not commercially navigable and are generally unsuitable for even pleasure craft. To date no logging has been carried out in the area and consequently the rivers have not been used for log driving.

Recreational use of the area's water resources is for the most part limited to residents of the immediate area since there are few tourists. The density of population of the Bonavista study area is quite low which, coupled with the availability of ample bodies of water, has enabled local residents to enjoy unrestricted recreational use of the area's water resources.

24.5 "Negative" Demand Problems

No problems of soil erosion, reservoir silting, or flooding are present in the area, and to date there has been no reclamation of bog lands.

25 PLANNED AND FORECAST DEVELOPMENT

25.1 Non-withdrawal Water Uses

Non-withdrawal water uses during the study period are expected to remain minimal. There is virtually no potential for economical hydro power development, and the Department of Fisheries have indicated that they have no plans for developing the limited potential of the rivers in the area. Log driving is not likely on the small rivers of the area should logging of the area be undertaken. Recreational use of the water resource will more than likely continue to be by local residents only whose demands can readily be met. Similarly, the water resource is amply able to meet the requirements of the area's wildlife.

25.2 Withdrawal Uses

Major withdrawal uses during the study period will most likely be limited to the existing fish processing plants and a few municipalities since no developments in mining, forestry exploitation, agriculture, or manufacturing are known to be under consideration.

Storage possibilities exist on Champney's Brook and Whirl Pond which would permit the withdrawal of 24 and 18 million gpd, respectively; details of these possibilities are presented in Volume Five, Part II.

25.2.1 Water Uses for Industry

The Bonavista Cold Storage Company Limited fish processing plant at Bonavista is currently provided with water from Long Pond adequate to meet its anticipated demands through the study period.

At Catalina-Port Union a water supply system utilizing Whirl Pond has been proposed to meet the fresh water needs of the three existing fish processing plants, Fishery Products Limited, S. W. Mifflin Limited, and Fishermen's Union Trading Company. Capacity will be provided in the system for the municipalities of Catalina and Port Union. Whirl Pond is in the drainage area utilized by the Newfoundland Light and Power Company Limited for generation of hydro-electric power, and an arrangement has been reached whereby that company will sell water to the water supply authority at approximately 0.5 cents per 1000 gallons, which is equivalent to the cost of alternate energy from the Newfoundland and Labrador Power Commission.

None of the fish processing industries plan to alter their present method of wastewater disposal, that is, directly to the sea without treatment. Provided the outfalls are located to ensure rapid dispersion of the wastes, this should not create pollution problems during the study period.

25.2.2 Municipal Water Supply and Wastewater Disposal

Bonavista is planning to install a water distribution system utilizing Long Pond as a source of water. Long Pond was recently developed as the source of supply for the fish processing plant located in the municipality and adequate capacity was provided in the system to meet the municipality's requirements during the study period. It is anticipated that a system of sanitary sewers will be installed discharging untreated domestic wastewaters into the sea, in conjunction with the installation of the water distribution system.

A water supply system utilizing Whirl Pond has been proposed for the Catalina-Port Union area but construction has been deferred, presumably because of the difficulties associated with financing the scheme. A system of sanitary sewers discharging to the sea is under consideration for this region as well.

It is unlikely that any of the other communities in the study area, none of which have a current population exceeding 725 persons, will install central water distribution systems and systems of sanitary sewers because of difficulties in financing such works.

25.3 Population Growth and Level of Living

In 1966 the population of the study area was 9380; the projections anticipate a continuation of the downward trend of the last two census periods. The population projected for 1971 is 9270; for 1976 it is 9120; and for 1981 it is 8970.

The economy of the area is dependent on the inshore fisheries and at the present time no diversification is anticipated, although there is some possibility that logging may be carried out in the area to supply the mill at Come By Chance. Because of the structural changes which are expected to take place in the fisheries sector, no increase in fisheries employment is anticipated for this area.

No precise measures of the level of living in the area are available. However, estimates of per capita personal income are available for the census division in which the study area falls. In 1965 it was estimated that per capita personal disposable income in the study area was $900.

The study area represents about 25 percent of the population of the census division in which it falls, and Bonavista is the largest population concentration. From experience in other parts of the Province, which reflects the Canadian pattern, it may be assumed that the income levels are higher in areas of relative population concentrations. Therefore, it could be argued that the per capita personal income in the study area is at least equal to and probably higher than the average for the census division.

The outlook for the area is not promising and it is unlikely that there will be any improvement of the area's position in terms of income disparity. In view of the development anticipated in other areas of the Province, its relative position will probably deteriorate. Under the circumstances, it is doubtful whether per capita personal disposable income will rise to more than $1,500 by 1981 in terms of 1965 dollars.

26 CONCLUSIONS AND RECOMMENDATIONS

26.1 Conclusions

a) Growth of this study area will continue to be almost exclusively dependent upon the development of the local and Labrador commercial fishery and the fish processing plants located in the area.

b) Continued reliance on individual dug wells and septic tank systems in the study area entails risks to health as long as these facilities do not conform to generally accepted standards.

c) Cutting of pulp wood in the western portion of the study area is possible when the pulp and paper mill at Come By Chance commences operation.

d) There are limited opportunities for tourism in the area caused in part by the lack of significant fresh water fishing streams.

e) At the present time no conflicts of interest with respect to the water resource exist.

26.2 Recommendations

a) Settlement in the Bonavista study area outside of the municipalities of Bonavista, Catalina, and Port Union should be discouraged.

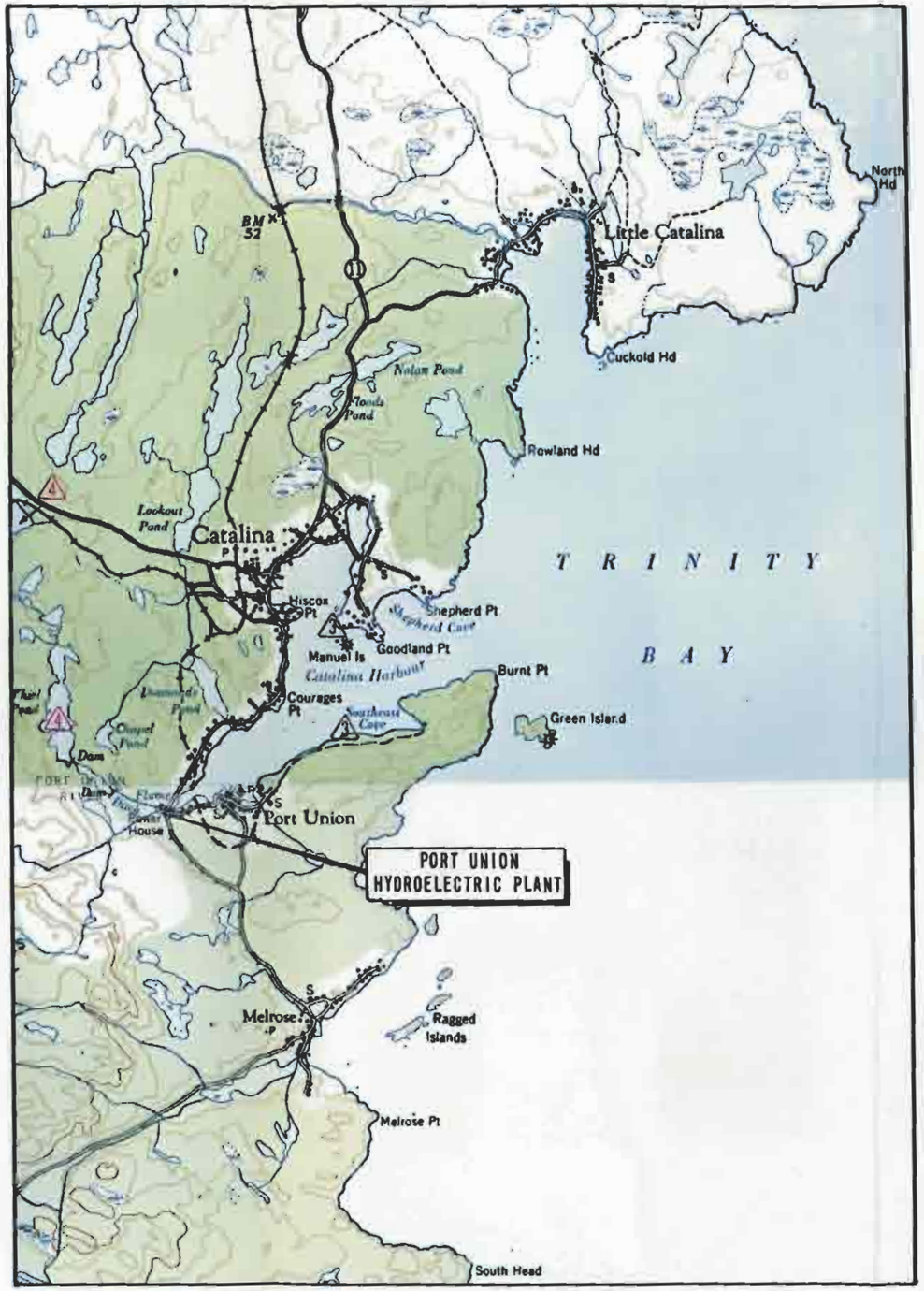
b) Individual dug wells and septic tank systems in the study area should be brought up to acceptable Provincial standards; construction of new wells and septic tank systems should be regulated to ensure compliance with acceptable standards.

REFERENCES

1 R. J. Noah and Associates. Proposed Water Supply System - Catalina and Port Union, Preliminary Report, August 1965.

GENERAL PLAN

0 5 MILES



DETAIL "A"

0 1/2 MILE

NEWFOUNDLAND – KEY PLAN

NOTES: POTENTIAL FUTURE DEVELOPMENTS SHOWN IN RED

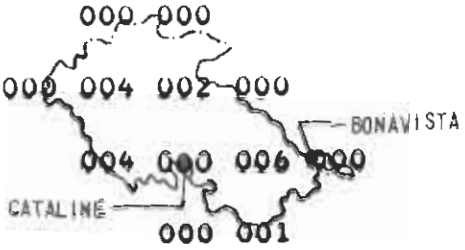
1. ATLANTIC SALMON AREA
2. COMMERCIAL FISHING
3. FISH PROCESSING PLANTS
4. POSSIBLE STORAGE RESERVOIR

BONAVISTA PENINSULA
STUDY AREA

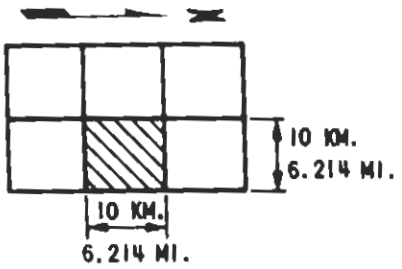
FIGURE 23-1

BONAVISTA PENINSULA STUDY AREA
SQUARE GRID DISTRIBUTION OF LAKES, BOGS AND SWAMPS, FORESTS AND BARRENS

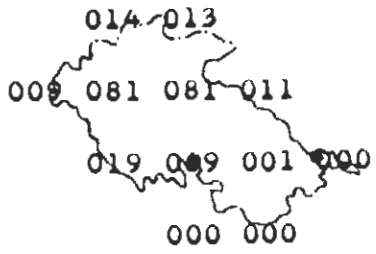
LAKE AREA - SQ.KM.



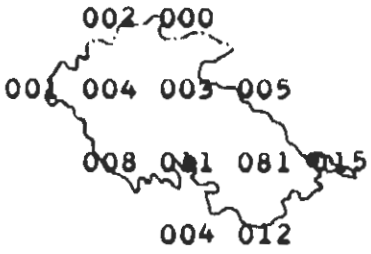
BOG AND SWAMP AREA - SQ. KM.



GRID SCALE



FOREST AREA - SQ.KM.

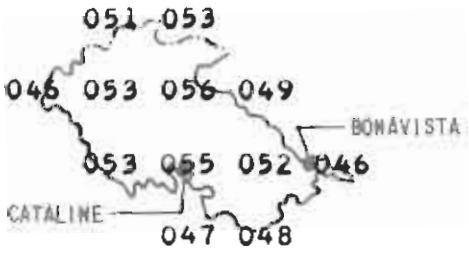


AREA OF BARREN - SQ.KM.

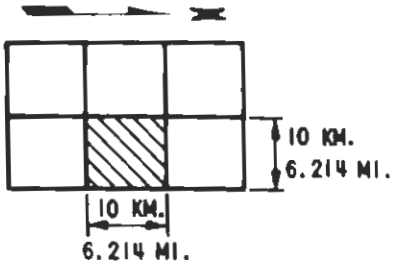
FIGURE 23-2

BONAVISTA PENINSULA STUDY AREA
SQUARE GRID DISTRIBUTION OF AVERAGE ANNUAL TEMPERATURE, PRECIPITATION, EVAPORATION AND RUNOFF

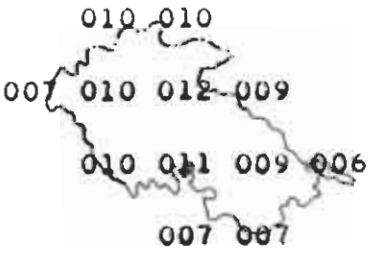
AVERAGE YEARLY
TEMPERATURE -DEGREES FAHRENHEIT



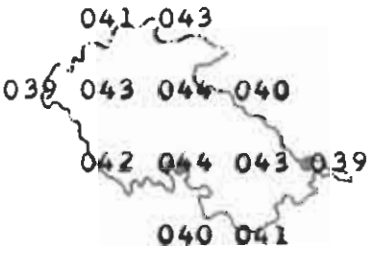
AVERAGE YEARLY
PRECIPITATION - INCHES OF WATER



GRID SCALE



AVERAGE YEARLY
EVAPORATION - INCHES OF WATER



AVERAGE YEARLY
RUNOFF - INCHES OF WATER

FIGURE 23-3

BONAVISTA PENINSULA STUDY AREA

SUMMARY OF CLIMATIC CHARACTERISTICS

A ANNUAL MEANS

Precipitation (inches)	Air Temperature (deg F)	Potential Evaporation (inches)	Relative Humidity (percent)
52.9	40.1	19	85

B MEAN MONTHLY PRECIPITATION (inches)

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Basin Mean Synthesized	4.8	5.0	4.8	3.7	3.7	3.2	4.1	4.0	4.2	4.6	5.6	5.3

C MAXIMUM POSSIBLE STORM PRECIPITATION (inches)

Area (sq. mi)	Storm Duration (hours) 6	12	18	24	36	48	72
100	4.85	7.30	8.85	10.20	12.10	12.50	14.20
300	4.75	7.25	8.70	10.10	12.00	12.40	14.05

D MAXIMUM POSSIBLE SEASONAL SNOWFALL (inches of water equivalent): 31.5

E CRITICAL SEQUENCES FOR SNOW MELTING (degrees F)

Interval	Date: March 1	March 10	March 20	April 1	April 10	April 20	May 1
4 - day	50.0	50.5	51.5	53.0	54.5	56.5	58.5
8 - day	46.0	47.5	48.5	49.7	50.7	52.6	55.0
16 - day	40.5	41.5	42.5	45.0	47.5	49.0	51.0

F DROUGHT

Return Period	2.33-Year	5-Year	10-Year	20-Year	50-Year	100-Year
Length of Drought	12 days	14 days	17 days	20 days	23 days	26 days

SUMMARY OF HYDROLOGIC CHARACTERISTICS
BONAVISTA STUDY AREA

I - SYNTHESIZED DATA

A. ANNUAL MEANS FOR THE TOTAL BASIN

FLOW (CFS)	RUNOFF (CFS/SQ.MI)	RUNOFF (INCHES)	ACTUAL EVAP. (INCHES)
	3.15	42.9	10.0

B. MEAN MONTHLY FLOWS (Q) AND STANDARD DEVIATIONS (S) (CFS)

RIVER AND LOCATION		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE
HALFWAY POND AT PORT UNION	Q	77	69	120	163	223	99	25	27	36	72	95	82	92
	S	97	37	47	101	90	57	31	44	42	39	58	48	18
	Q													
	S													
	Q													
	S													

C. MAXIMUM FLOWS (CFS) AND FLOOD VOLUMES (CFS DAY) OBTAINED BY THE MAXIMIZATION PROCEDURE (INSTANTANEOUS PEAKS)

RIVER AND LOCATION	MAXIMIZED RAIN ON SNOW PACK		MAXIMIZED RAIN ONLY		SNOW PACK & AVERAGE RAIN	
	PEAK	VOLUME	PEAK	VOLUME	PEAK	VOLUME

D. MAXIMUM FLOWS OBTAINED BY STATISTICAL ANALYSIS (CFS) (DAILY AVERAGES)

RIVER AND LOCATION	GENERATED BY SNOW MELT & RAIN		GENERATED BY RAIN ONLY	
	1/10000 YEARS	1/1000 YEARS	1/10000 YEARS	1/1000 YEARS
HALFWAY POND AT PORT UNION	2,060	1,670	2,440	1,880

TABLE 23-2
Page 1 of 2

SUMMARY OF HYDROLOGIC CHARACTERISTICS
BONAVISTA STUDY AREA

E. MINIMUM FLOWS OBTAINED FROM RECESSION CURVES (CFS)

RIVER AND LOCATION	1/2 YEARS	1/5 YEARS	1/10 YEARS	1/20 YEARS

F. MINIMUM FLOWS OBTAINED FROM STATISTICAL ANALYSIS (CFS)

RIVER AND LOCATION	1/2 YEARS	1/5 YEARS	1/20 YEARS	1/100 YEARS
HALFWAY POND AT PORT UNION	6	4	2	

G. FULL REGULATION STORAGE

RIVER AND STATION	STORAGE (CUBIC FEET x 10^9)

II - RECORDED DATA

H. MEAN MONTHLY AND ANNUAL FLOWS (CFS)

RIVER AND STATION	YEARS OF RECORD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVGE

I. EXTREMES RECORDED (CFS)

RIVER AND STATION	MAXIMUM FLOWS			MINIMUM FLOWS		
	FLOW	DATE	COMMENTS	FLOW	DATE	COMMENTS