



BROAD BROOK FLOODPLAIN STUDY

YARMOUTH 1977

**Prepared By
MARITIME RESOURCE
MANAGEMENT SERVICE,
AMHERST N.S.**

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Mr. John Simpson
Community Planning Division
Dept. of Municipal Affairs
Yarmouth, Nova Scotia

Dear Mr. Simpson:

I submit the accompanying report entitled the Broad Brook Floodplain Study prepared jointly by the Planning and Engineering Divisions of the Maritime Resource Management Service. The report documents an environmental study of the Broad Brook floodplain in the Municipality of Yarmouth entailing an investigation into flooding. The report examines several environmental factors of the Broad Brook floodplain and watershed in order to outline development potential as well as development controls necessary to protect the floodplain and prevent flooding.

The study was executed as outlined under the terms of reference with the exception of two criteria. Interviews with area residents were found to be immaterial in establishing flood boundaries. Difficulties in having water samples of Broad Brook tested necessitates having to forward the results to you.

I am indebted to Mr. Charlie Allan of Tusket, Nova Scotia who provided information concerning distinctive natural features of flora and fauna throughout the study area and also to Mr. Gavin Hubley of MRMS who provided assistance on the recreational potential of the Broad Brook floodplain.

Hydrology expertise by Mr. Greg Bishop, soil-hydrological systems and development potential by Mr. Ray McBride and cartographic services by Mr. Brian Wood.

Sincerely,

Veryl Horsley
Resource Planner/Project Manager

VH/bp

BROAD BROOK FLOODPLAIN STUDY

A REPORT
PREPARED FOR
COMMUNITY PLANNING DIVISION
OF YARMOUTH, NOVA SCOTIA

by

PLANNING & ENGINEERING DIVISION
MARITIME RESOURCE MANAGEMENT SERVICE
AMHERST, NOVA SCOTIA

February 1977

TERMS OF REFERENCE

The purpose of the floodplain study is to investigate the flooding of the Broad Brook within the Town of Yarmouth. This will entail the delineation of the floodplain and watershed boundaries; remedial measures in alleviating flooding; and a discussion of the potential for the development of the area.

The following is a breakdown of the work program:

1. Floodplain and Watershed Delineation and Description;

- (a) Delineation of the floodplain and watershed requiring air photo and map interpretation, examination of alluvial deposits and interviews with area residents.
- (b) A description of the floodplain involving a soils inventory and a description of vegetation and existing wildlife.

2. Examination of Possible Remedial Measures:

Possible remedial measures to alleviate flooding conditions will be determined upon examination of the floodplain cross-section, stream profile, soil characteristics and the capacity of existing culverts.

3. Development Potential:

Upon studying the floodplain characteristics and possible remedial measures to alleviate flooding, a floodplain management plan will be prepared. The plan will outline the type of development compatible to the area under question and controls necessary to prevent further flooding.

Documentation will take the form of a written report for presentation purposes to Town Council. It will include necessary maps and diagrams.

Subsequent to consultation with municipal representatives a check may be made on water purity and possible sources of pollution. Also an impact on wildlife will be examined where development may alter the habitat.

The study will be carried out with the assistance of a hydrologist, soils engineer and resource planner.

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INTRODUCTION

The Broad Brook Floodplain Study is an investigation into the flooding of Broad Brook within the Municipality of Yarmouth and the potential for development within the study area. Maritime Resource Management Service was requested by the Community Planning Division, Yarmouth, to undertake the study in agreement with the Department of Municipal Services.

Housing developments close to Broad Brook suffer flooding during spring run-off and periodically throughout the year during heavy rainfalls. Random development and the purchase of less expensive land close to Broad Brook by developers will eventually lead to intensive urban land use of the flood plain and associated lowlands, irregardless of future repercussions, to either the natural habitat or the developments.

The information discussed in this study was requested by the Community Planning Division who wished to acquire data on the Broad Brook floodplain and to assist them in land-use planning in the Town of Yarmouth. M.R.M.S. was requested to concentrate their efforts on the floodplain within the town limits of Yarmouth, but certain investigations of the watershed upstream of the C.N.R. railroad crossing was necessary to formulate accurate observations and recommendations.

The report opens with a discussion of the hydrological characteristics of the watershed and floodplain. Obstructions to proper drainage are described and recommendations to alleviate the flooding problem are suggested.

Section 2 describes the characteristics of the surficial deposits of glacial till, recent alluvium and organic soils. The area surveyed represents those areas most threatened by development.

III

The soil-hydrological system of the study area is discussed establishing the significant role of soil deposits in stream flow maintenance system and how such systems would be affected by development. Adverse impacts of intensive urban land use are listed in Section 3.2.

Having established such criteria, development constraints and remedial measures to reduce the impact of development are suggested.

Section 6 discusses the significance of the study area with regard to its flora and fauna. It does not attempt to provide a full inventory of vegetative and wildlife species but simply to stress the distinctive natural features of the Broad Brook flood plain and watershed.

The Broad Brook Flood plain study concludes with a summary of recommendations established throughout the study area.

SUMMARY AND RECOMMENDATIONS

1. To alleviate the flooding in the Broad Brook Floodplain, two hydrological solutions are suggested:
 - (a) Install a larger discharge structure beneath the railroad tracks;
 - (b) Create a diversion channel into the organic area west of the floodplain.

2. Intensive urban development would have adverse impacts on the soil-hydrological system of the watershed, in the form of:
 - (a) Permanent lowering of the groundwater table levels.
 - (b) Reduction of groundwater recharge.
 - (c) Changes in the quality and quantity of surface runoff.
 - (d) Increased soil erosion and sediment production.
 - (e) Inappropriate or expedient exploitation of unsuitable lands for intensive and/or passive recreation.
 - (f) Change in diversity of surface vegetation.

3. It is therefore recommended that:
 - (a) Due to severe physical constraints to urban development and the necessity for maintaining an intact soil-hydrological system, intensive urban development within the flood plain should be avoided.
 - (b) Organic deposits should not be disturbed as they are important in natural flood control.
 - (c) The micro-drainage network consisting of seepage and local discharge areas should be maintained due to its significant role in sustaining stream base flow.
 - (d) The headwaters must be protected from any development which would alter the water table level or reduce the areas effectiveness as a natural reservoir and filtration system for surface runoff.

- (e) Remedial measures pertaining to design concept for urban development will reduce the impact of projected development on the soil-hydrological system.
4. The fresh water-marsh environment is significant as a natural area and wildlife habitat. The preservation of such a habitat should be encouraged by designating it as open space but not precluding certain forms of passive recreation.
 5. In conclusion, it is recommended that a policy of conservation should compliment development throughout the watershed.

1. HYDROLOGY

The Watershed area of Broad Brook above the railroad crossing is approximately 2.5 square miles. As can be seen from Figure 1, the watershed is elongated and tends to become narrow near the upper reaches.

Within the floodplain area, there are three main obstructions to the natural flow of water;

- (a) the railroad,
- (b) Argyle Street, and
- (c) South East Street.

There are two conduit systems located beneath South East Street. The eastern culvert through which Broad Brook proper flows, is a 2'6" x 4' rough stone culvert with an invert elevation of 46.1 feet. The western conduit system, which is composed of two 24" concrete culverts, normally drains only a small 100 acre section which is located on the midwestern side of the total watershed. The elevation of the road surface over both of these conduit systems is 50.8 feet.

The bridge over Broad Brook on Argyle Street will not present any significant obstruction to the passage of water. The approximate cross-sectional dimensions of the stream at this point are 6'9" by 3'6". The deck of the bridge has an elevation of 50.0 feet.

There are two 4' x 4' stone culverts beneath the CNR railroad crossing, both with an invert elevation of 40.6 feet. The culverts are in good condition, with no noticeable silt build-up or protruding stonework. The bed of the railroad directly above the culvert lies at an elevation of 55.2 feet.

The mean annual total precipitation at the Yarmouth Airport is 50.52 inches. The greatest recorded rainfall during a 24-hour period is 6.79 inches. A 24-hour storm during a 50 year interval would yield about 6.24 inches of runoff, as



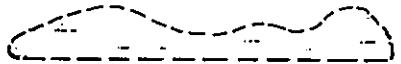
BROAD BROOK FLOODPLAIN STUDY

YARMOUTH, NOVA SCOTIA

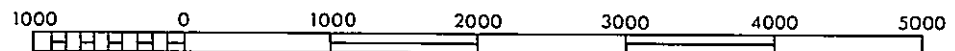
- HYDROLOGY -

LEGEND:

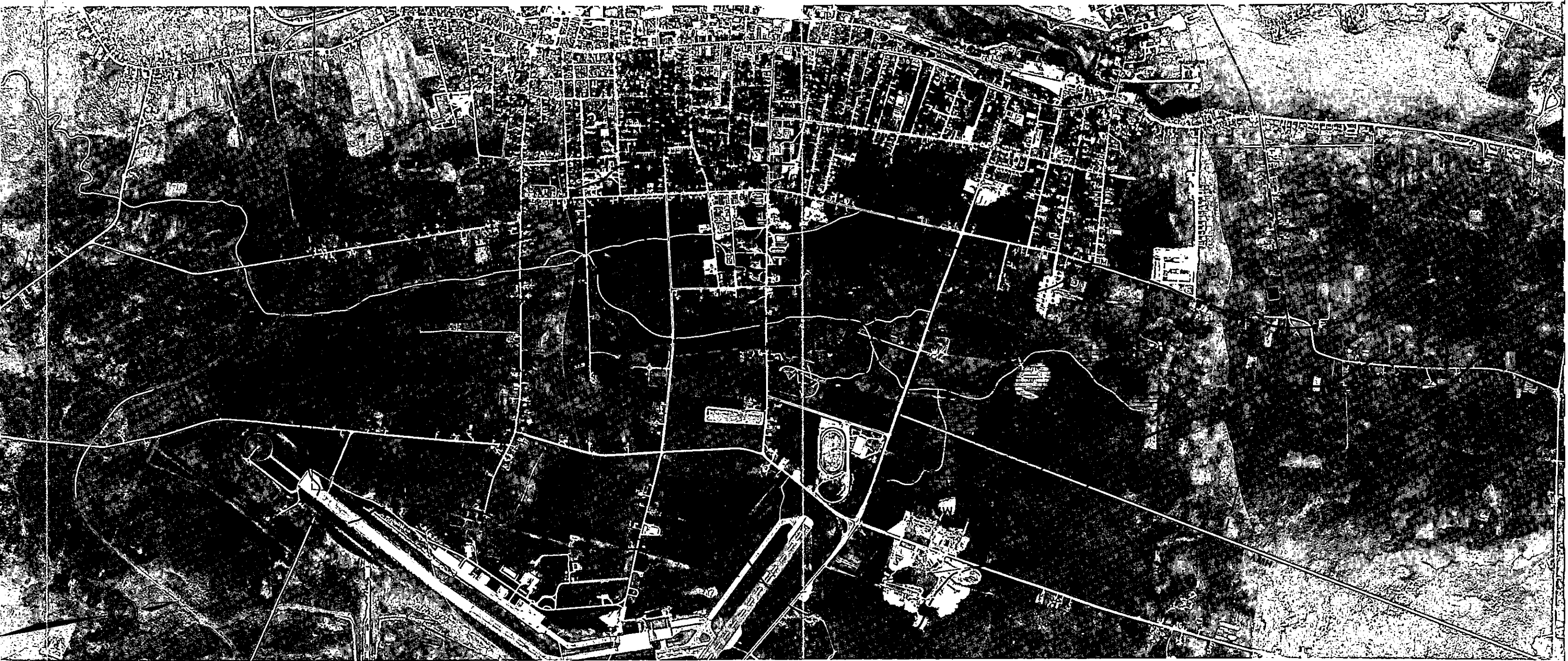
FIG. 1

WATERSHED BOUNDRY	
FLOODPLAIN BOUNDRY	
MARSH DELINEATION	

Scale 1 In. = 1320 Ft.



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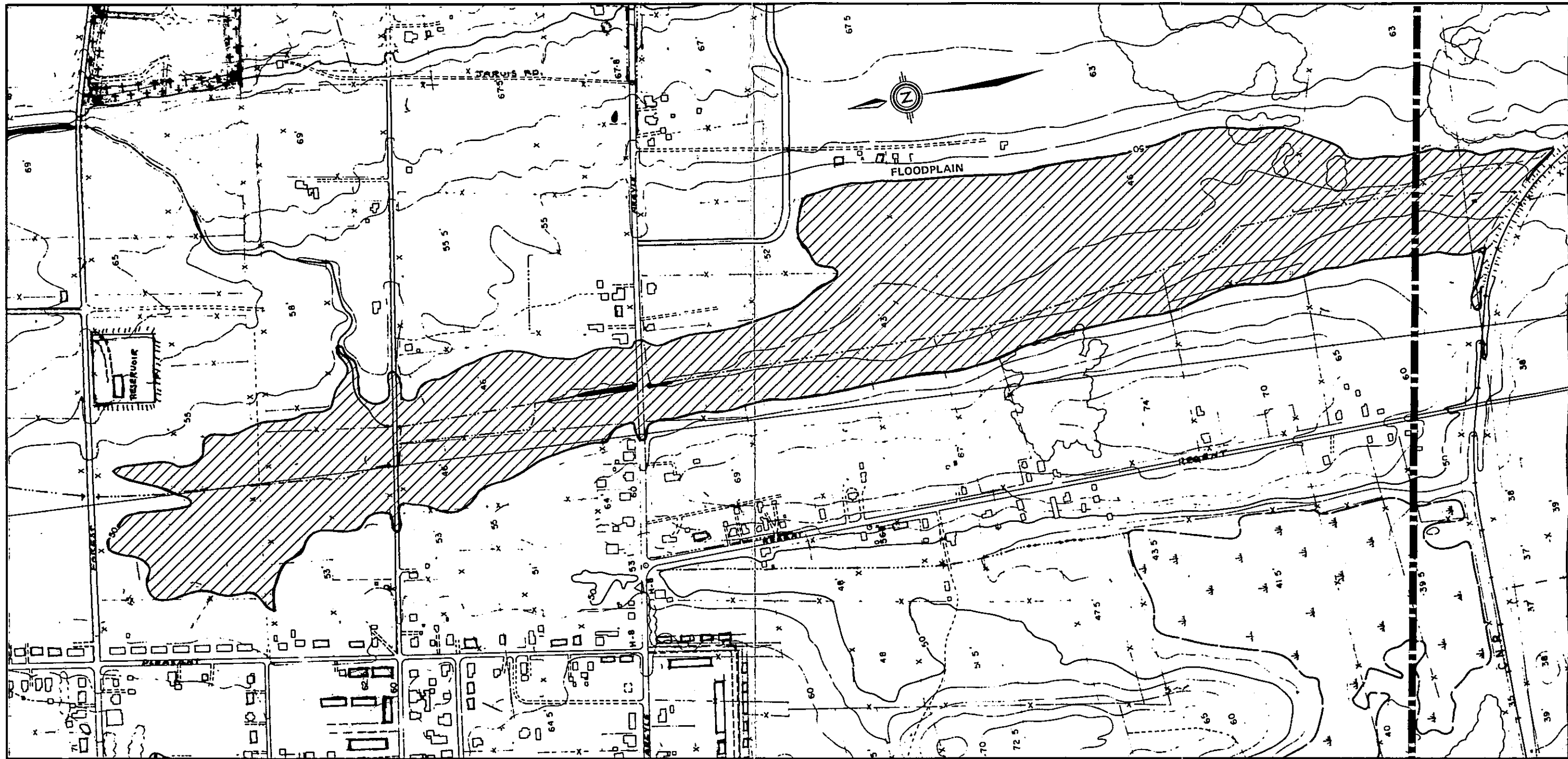
determined from long term records at the Saint John Airport and the Kentville Experimental Farm.

Figure 2 illustrates the inflow and outflow hydrographs of Broad Brook at the railroad culvert. The flow hydrograph representing the increase stream flow and reservoir capacity of the lower marshes was determined using data for unit hydrographs on eastern Nova Scotia rivers. The outflow hydrograph representing the stream flow through the culvert was determined using a standard routing procedure. With the calculated runoff of 6.24 inches at a 50 year storm the depth of the water at the culvert would reach a maximum of 42 feet which corresponds to an elevation of 52 feet. At this depth the water would begin to flow along the railroad ditch*. The water will not rise much above the 52 foot level as the discharge capacity of the ditch is quite large. During the spring runoff, water depths at the culvert increase rapidly due to ice jamming at the culvert, blocking the natural stream flow.



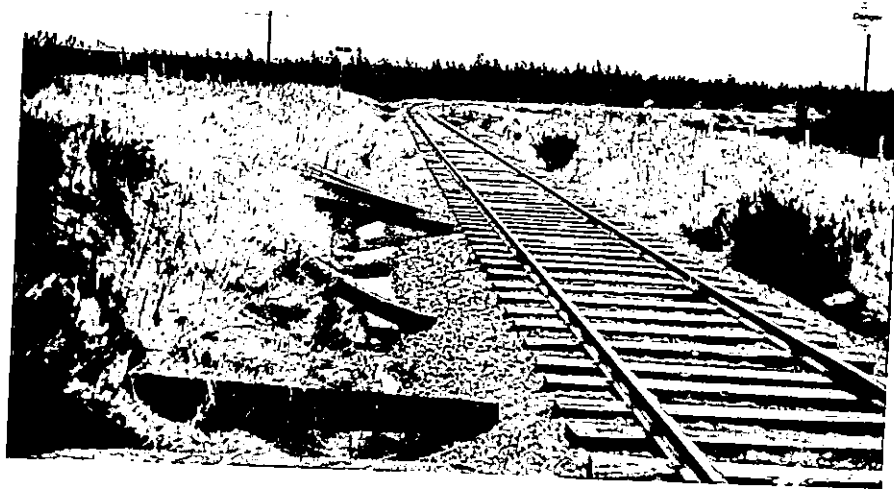
Plate #1
Culverts
beneath the CNR
crossing of
Broad Brook

*The floodplain has been mapped in Figure 1 at an elevation of 50 feet. A more precise mapping would require a further field investigation with the assistance of a survey team.



**BROAD BROOK FLOODPLAIN
YARMOUTH, NOVA SCOTIA
SCALE: 1IN. = 400 FT.
FIG. 2**

Plate #2
Railroad
Ditch



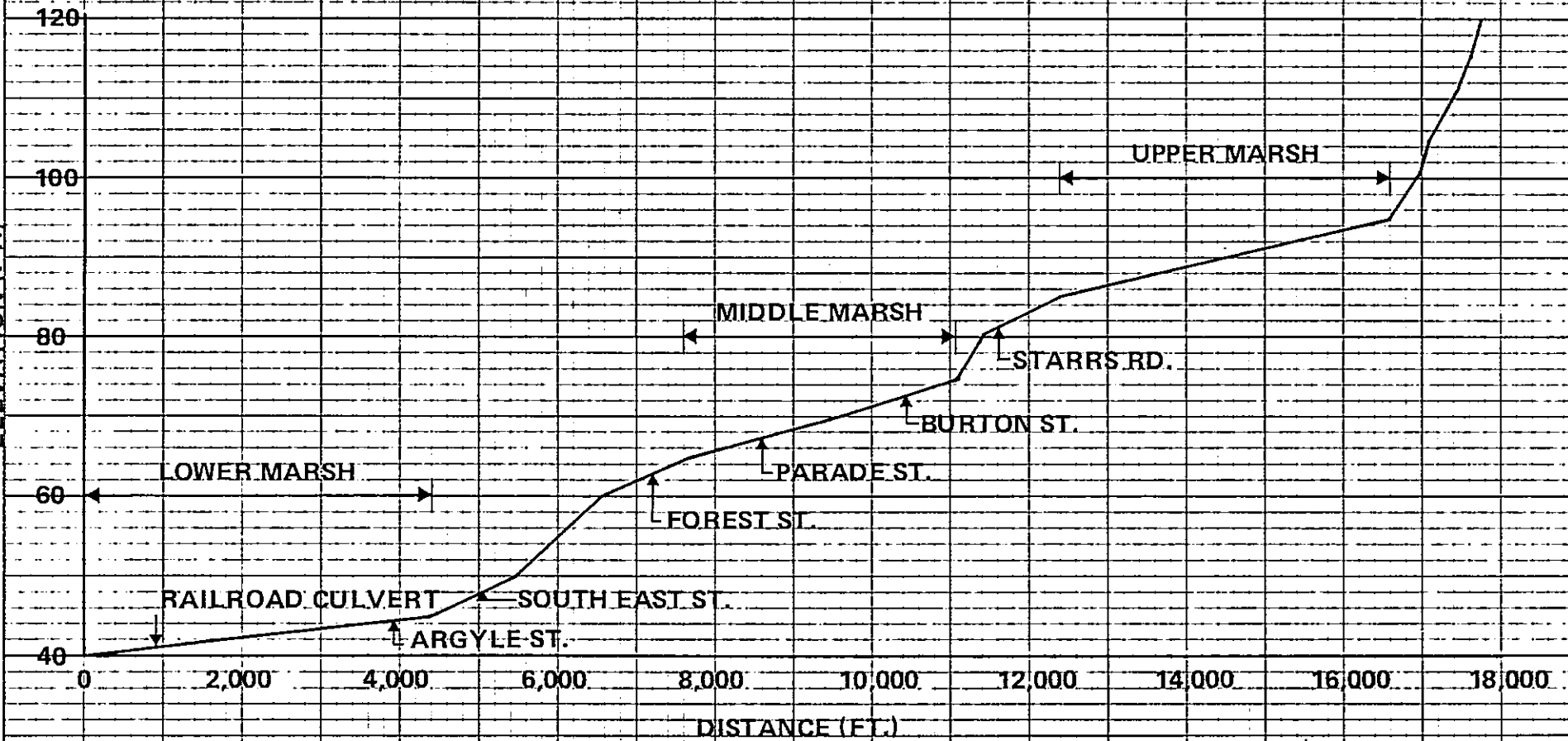
The stream profile, as shown in Figure 2, may be used to divide the brook into several sections. The distinct changes in slope are indications of natural restrictions. These restrictions together with the thin layer of top soil, have combined to create several marshy areas. The soil series that are found in the marshes are a direct result of this process.

The upper marsh is located on a horseshoe shaped plateau which opens southward. This organic deposit is the largest in size and it also has the least slope. The new constructed Route No. 101 divides the bog into two almost equal portions.

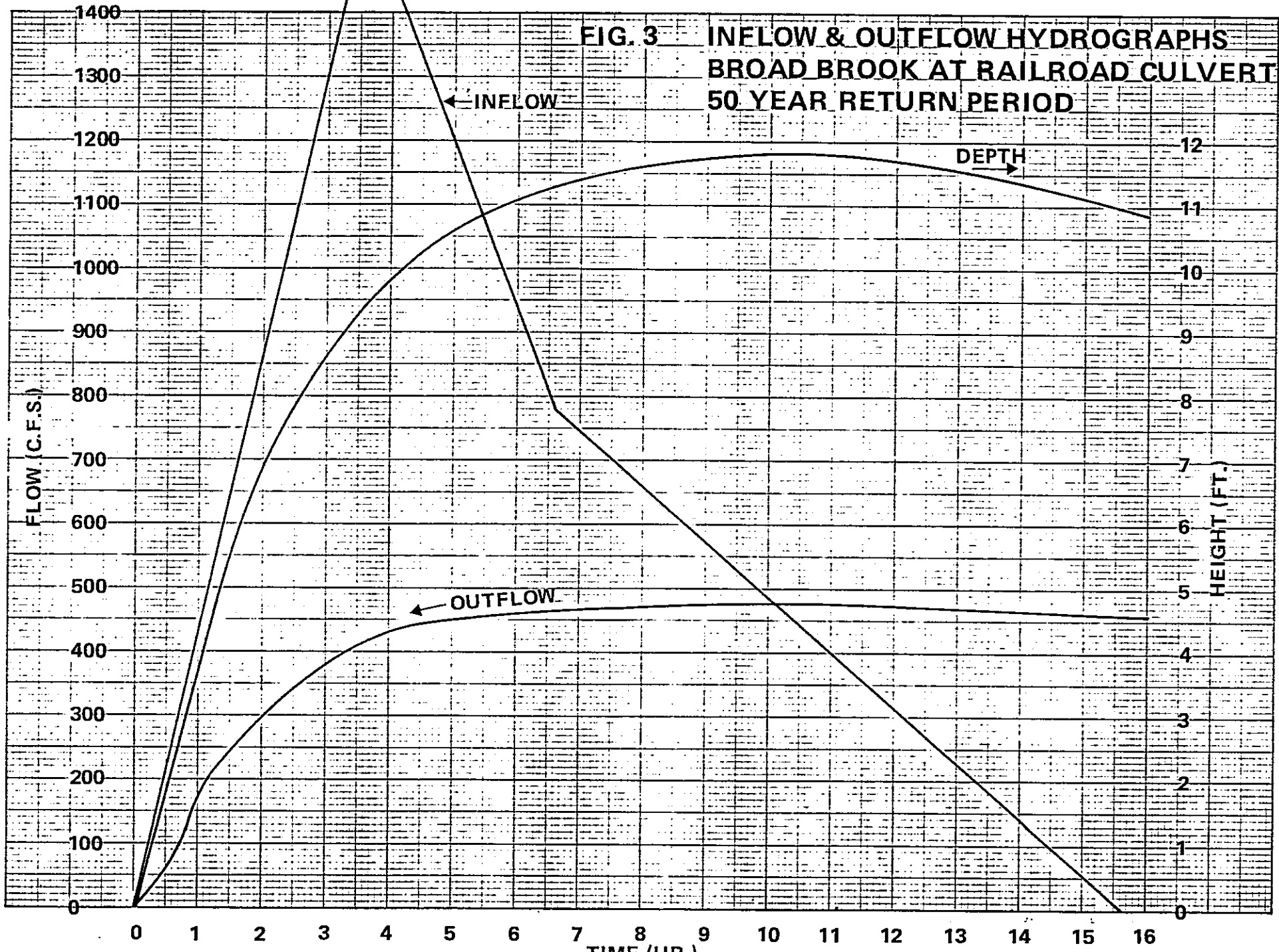
The middle marsh, which can be considered to end at Forest Street, is the smallest. This marsh is quite narrow and has a small area in comparison to the other two.

FIG. 4 BROAD BROOK STREAM PROFILE

ELEVATION (FT.)



**FIG. 3 INFLOW & OUTFLOW HYDROGRAPHS
BROAD BROOK AT RAILROAD CULVERT
50 YEAR RETURN PERIOD**



The lower marsh, which is also called the Broad Brook Floodplain, begins at South East Street and ends at the railroad culvert. The gentle slope of the brook as it traverses this marsh makes it especially susceptible to flooding.

The approximate areas and watershed sizes of each marsh are as listed below"

	<u>Approximate area of marsh (acres)</u>	<u>Watershed area above bottom of marsh (acres)</u>
Upper marsh	120	630
Middle marsh	25	880
Lower marsh	70	1570

There are two alternative hydrological solutions which would help to alleviate the flooding in the Broad Brook Floodplain:

1. Install a larger discharge structure beneath the railroad tracks.

One of the main causes of flooding on the floodplain is due to ice blockage in the railroad culverts. Ice blockage will be a problem in any discharge structure which is not open to the atmosphere.

Therefore the construction of a channel with a trestle to support the railroad is recommended as being less subject to problems with ice. An 8 foot wide channel would be more than sufficient and would significantly decrease the flooding problems.

2. Create a diversion channel.

As mentioned earlier, the flood waters tend to discharge into the organic area situated west of the floodplain once the water level has reached a sufficient height.

By upgrading and lowering this inadvertent diversion channel, the peak water levels can be lowered proportionally.

2. SURFICIAL DEPOSITS AND SOILS

2.1 Glacial Till

The predominant surficial deposit located within that segment of the Broad Brook watershed under study is a compact, lodgement (basal) till. This material is a moderately coarse-textured sandy loam and is extremely stony.

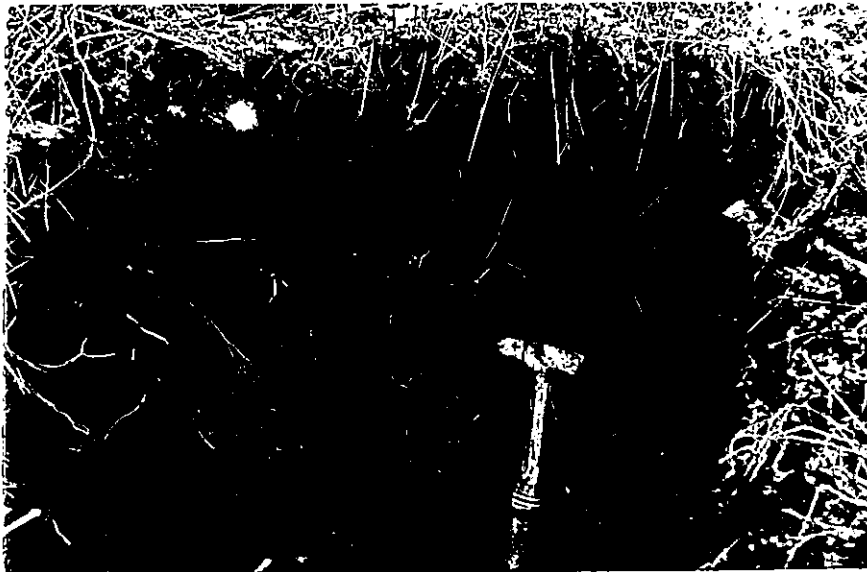


Plate #3

Soil profile
of the well-
drained Yarmouth
soil series

Since it has been derived largely from schistose bedrock, glacial erosion in the Pleistocene Epoch was substantial and a relatively thick till mantle exists (greater than 1.5 metres). This characteristic is exemplified by a drumlinized topography composed of several elongated ridges with a north-south orientation and sporadic drumlinoid mounds.

BROAD BROOK FLOODPLAIN STUDY

YARMOUTH, NOVA SCOTIA

- SOILS -

LEGEND:

FIG. 5

I) MINERAL SOILS:

A) GLACIAL TILL (YARMOUTH SOIL CATENA)

Extremely stony, sandy loam parent material

WELL TO MODERATELY
WELL DRAINED

IMPERFECTLY
DRAINED

POORLY TO VERY
POORLY DRAINED

Y (YARMOUTH SOIL
SERIES)

D (DEERFIELD
SOIL SERIES)

P (PITMAN SOIL
SERIES)

B) RECENT ALLUVIUM

RA 1 - Stratified loamy sand (medium and coarse textured) and fine gravel

RA 2 - Unstratified fine sandy loam.

II) ORGANIC SOILS:

Om - mesic organic matter.

The format used to designate organic deposit depth is as follows:

- e.g. i) .3 - .6 Om - .3 to .6 metre of mesic sedge organic matter overlying Pitman series
 ii) > 1.5 Om - greater than 1.5 metres of mesic organic matter

III) SLOPE:

Percent Slope

Simple Topography

Complex Topography

0 - 1/2 %
1/2 - 2 %
2 - 5 %
5 - 9 %
9 - 15 %

A
B
C
D
E

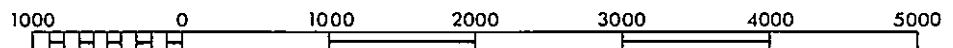
a
b
c
d
e

Note: directional arrows (↓) often accompany slope class to denote the trend of the topography

IV) LEGEND FORMAT:

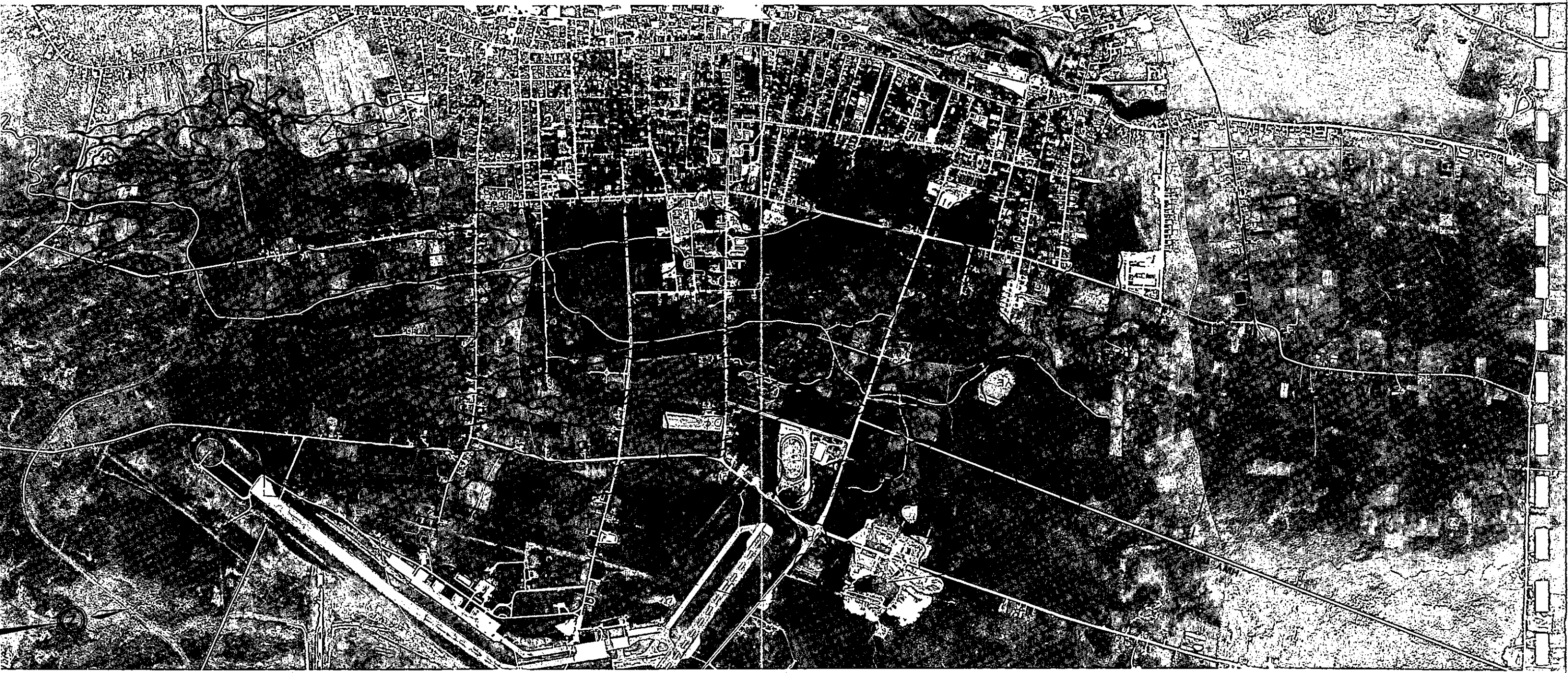
- e.g., i) single deposit: YE - Y - soil series E - slope class
 ii) double depositions: $\frac{RA2}{P}b$ - RA2 - .3 to .9 metre overburden
 P - underlying soil series
 b - slope class
 iii) triple depositions: $\frac{.30m}{\frac{RA2}{P}}b$ - .3 metre mesic organic matter on surface
 RA2 - .3 to .9 metre overburden
 P - underlying soil series
 b - slope class

Scale 1 in. = 1320 Ft.



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Consequently, the topography of the area is determined by the till mantle and is not a physiographic expression of the underlying bedrock. This glacial till comprises the parent material of the Yarmouth soil catena and its component soil series (see Soil Legend, Appendix "A").

2.2 Recent Alluvium

The soils identified as recent alluvium have been deposited since the last period of deglaciation and, in some localities, sedimentation is still actively taking place. These sediments are water-deposited and are, consequently, relatively well-sorted and stone free. Variable amounts of organic matter have been incorporated in the often stratified material.

2.3 Organic Soils

The inherent characteristics of the organic soils within the watershed are relatively consistent with the only major exception being the depth of the deposits. The degree of decomposition of all the organics examined was determined to be "mesic" (10-40% rubbed fibre content) regardless of the type of vegetation from which the soil was derived. Degree of decomposition is important in the evaluation of such properties as water holding capacity, compressibility and trafficability. The sphagnum-spruce bog immediately north of Starrs Road represents the only organic deposit within the study area derived from that type of vegetation. The majority of the

Plate #4

Dense cover of black spruce and tamarack on the organic bog along Highway No. 101 north of Starrs Road.



organic matter in the region is formed from decomposing sedge and related vegetation. The deposits vary from 30 cm. to greater than 1.5 metres in depth depending upon their position within the soil-hydrological system.

Plate #5

Sedge is the predominating type of vegetation forming organic deposits in the Broad Brook floodplain.



3. SOIL-HYDROLOGICAL SYSTEM

3.1 The Broad Brook Soil-Hydrological System

A natural soil-hydrological system is vital in maintaining existing vegetative cover and associated fauna which comprise the biotic component of the environment. These have been established and maintained by relatively constant soil moisture and ground water tables. In a floodplain, the vegetative species have adapted their rooting systems to function under high water table conditions. Consequently, any alteration of the groundwater conditions by either elevating or lowering the ground water table will have the



Plate #6

Roadbed for subdivision development has resulted in the obstruction of subsurface water movement and an elevation in the groundwater table levels.

effect of either flooding the root aeration zone or lowering the water table beyond the reach of the rooting systems, respectively. This may result in the death of the existing vegetation leaving no vegetation cover or lead to succession by less desirable vegetative species. Of particular importance in this respect are the organic deposits within the floodplain which serve as natural habitats for wildlife due to their unique vegetative cover.

Organic deposits play a significant role in the soil-hydrological system of the Broad Brook floodplain. For example, the sphagnum-spruce bog north of Starrs Road acts as a key hydrological receiving and retaining area. The large water holding capacity of the organic matter enables the bog to store much of the flow entering it from upstream during heavy rainfall events. This excess water is then budgeted out systematically, thereby reducing the magnitude of the peak storm flow. Similarly, during dry periods between rainfall events, streamflow is maintained by the same mechanism. Urban and related uses located on such a deposit would seriously hinder this natural hydrological process. In addition, a reduction in water table levels in these normally saturated organic soils would initiate rapid oxidation of the organics. This would result in subsidence of the soil surface of up to 30 cm. the first year (less in subsequent years), thereby exposing tree roots and causing extensive tree mortality.

Another inherent and equally important streamflow maintenance system within the Broad Brook watershed involves the mineral soils of the Yarmouth soil catena. Since there is only one glacial deposit in the study area and it is relatively deep to bedrock, the groundwater flow regime is very simple and predictable. The surface horizons of the sandy loam soils are permeable and have relatively high saturated hydraulic conductivity values. These properties tend to reduce flood frequency. The well drained Yarmouth soil series dominates the upland areas of the study area e.g. - drumlins and drumlinoid mounds (watertable at a depth greater than 1.8 to 2.4 metres throughout most of the year). These sites act as groundwater recharge

areas which contribute vadose water from heavy rainfalls to the intermediate and local groundwater flow systems. The groundwater is budgeted out to the poorly drained Pitman soils in the lower lying, depressional, discharge areas (watertable within 30 to 60 cm. of the surface for periods of about 8 to 10 months of the year), thereby maintaining the base flow in Broad Brook over dry periods between rainfall events. The imperfectly drained Deerfield soils are located on seepage areas at intermediate elevations (watertable within 1.0 to 1.8 metres of the surface for periods of about 8 to 10 months of the year).

3.2 Adverse Impacts of Intensive Urban Land Use on the Broad Brook Soil-Hydrological System

Certain changes in the life supporting, soil-hydrological system of the Broad Brook watershed as a result of future intensive urban development and related uses can be predicted. These include:

1. Permanent lowering of ground water table levels due to:
 - (i) drainage through footing drains around the perimeter of buildings.
 - (ii) drainage through granular backfill used to cover buried services.
 - (iii) reclamation of wet, depressional areas through artificial drainage e.g. - floodplain.
 - (iv) groundwater withdrawal from municipal supply e.g. - "drawdown cones".
2. Changes in diversity of surface vegetative cover due to:
 - (i) permanent lowering of water table levels (see 1. above).

- (ii) permanent elevation of water table levels through obstruction of subsurface water movement by road beds, etc.
 - (iii) compaction of fine textured soils over rooting systems by human or vehicular traffic.
3. Reduction of groundwater recharge (frequency and amount) due to:
- (i) storm sewer drainage.
 - (ii) reduced area of surface infiltration due to artificial impervious surfaces e.g. - asphalt pavements, roof tops.
4. Changes in the quality or quantity of surface runoff due to:
- (i) increased contaminant levels in watershed runoff (urban runoff).
 - (ii) storm sewer drainage.
5. Increased soil erosion and sediment production due to:
- (i) removal of natural vegetation covering during construction and, to a lesser degree, after construction.
6. Inappropriate or expedient exploitation of unsuitable lands for intensive and/or passive recreation e.g. - floodplain.

4. DEVELOPMENT WITHIN FLOODPLAIN BOUNDARIES

4.1 Intensive Urban Development

Having examined the potential adverse effects of intensive urban development on the watershed's soil-hydrological system, it is evident that intensive urban land uses should be avoided in areas where these impacts will be

most severe. Within the Broad Brook watershed, these areas are situated below the "flood line". Particular emphasis should be placed on the major organic deposits due to their unique and significant role in natural flood control.

Aside from these considerations, the most severe physical constraints to urban development also exist within the floodplain. High water table levels will necessitate dewatering procedures during and after below grade construction in addition to causing subsequent foundation problems. Organic soils and recent alluvium provide a

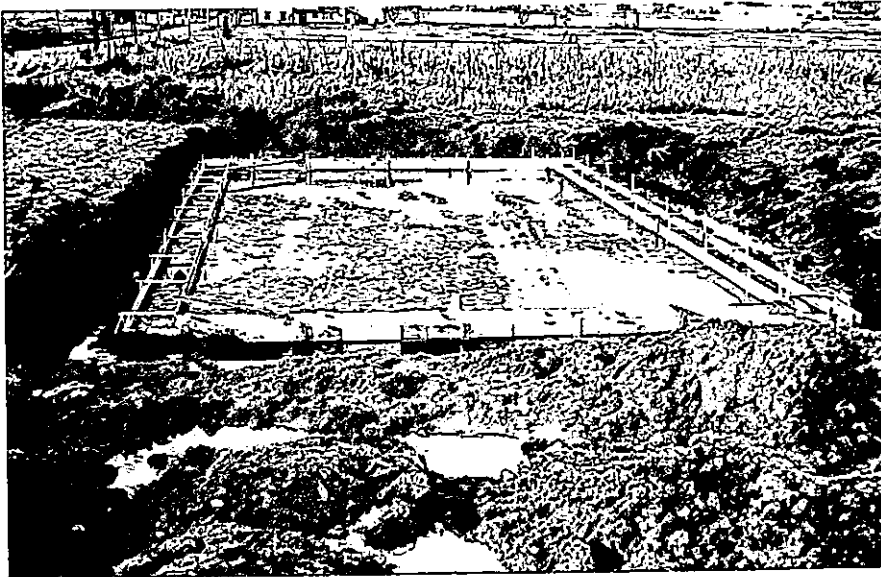


Plate #7

High water table levels have given rise to dewatering problems in this below grade foundation within the floodplain.

particularly poor construction base for foundations due to their low bearing strength. Remedial measures which involve the excavation of these materials and subsequent replacement by granular fill add significantly to construction costs. These soils are also susceptible to

frost heaving and have low trafficability properties. Finally, floodplains are considered hazard lands to intensive urban development due to the threat of inundation.



Plate #8
This row of duplex housing units along the floodplain margin is periodically under the threat of inundation.

Valley lines are often chosen as the most efficient corridors for gravity-flow conduits. However, in the Broad Brook watershed, organic deposits, alluvium, high ground watertables and the necessity of maintaining an intact soil-hydrological system all militate against floodplain location.



Plate #9

Raw sewage boils
from an
underground sewer
conduit into
the Broad Brook.

Nevertheless, intrusion of underground services into the floodplain can be minimal while still maintaining an adequate servicing pattern for those areas within the watershed suitable for urban land uses.

4.2 Recreational Development

Three major limitations restrict intensive recreational use within the floodplain boundaries. Trafficability problems will arise on the extensive organic deposits and recent alluvium. In addition, the problems associated

with excessive surface water and surface drainage due to high water tables are augmented by the flooding hazard. In areas where there is no overburden on the Pitman or Deerfield soils, stoniness is the most significant constraint to intensive recreational development.

Certain passive, stream-associated activities might be considered in an effort to maximize the recreational potential of the floodplain.

5. DEVELOPMENT IN THE BROAD BROOK WATERSHED

5.1 Intensive Urban Development

Several design requirements can be suggested with respect to the maintenance of the inherent soil-hydrological conditions in areas of projected urban development within the Broad Brook watershed.

5.1.1 Groundwater Recharge:

By locating low and moderate intensity urban land uses in those areas identified previously as groundwater recharge areas, the reduction in natural recharge caused by artificial, impervious surfaces can be minimized. However, with the recent introduction of pervious asphalt pavements which permit the infiltration of up to 200 cm. of water per hour, intensive urban development need not necessarily result in drastic reductions in groundwater recharge. Commensurate with this, residential lots located in natural recharge areas can be graded in such a manner that roof drainage can be discharged directly onto the lot rather than into the storm sewer system. Since the soils located within the natural recharge areas of the

watershed meet the criteria established for soil renovation of storm runoff, storm drainage systems could be designed to discharge into lagoons located in suitable areas. This would have the effect of maximizing groundwater recharge while exploiting an efficient and ecologically sound means of treating runoff.

5.1.2 Maintenance of Existing Groundwater Table Levels:

Reclamation of poor and imperfectly drained areas by artificial drainage should be avoided in order to maintain;

- (i) the "interflow" contribution to the Broad Brook base flow, and,
- (ii) the level of the groundwater table.

Similarly, "drawdown cones" resulting from the extraction of subsurface water for municipal supply will tend to lower the piezometric surface and the water table.

The material employed as backfill for service trenches should not obstruct the free movement of subsurface water in the vicinity of the conduit. This is particularly important in poorly drained areas where the conduit piping should have an adequate strength classification so that uniform permeability can be re-established near the conduit by reducing backfill compaction. Low infiltration piping should also be used to prevent seepage. (See Plate #9).

Drainage patterns should be preserved by implementing designs of linear facilities e.g. - streets, which allow for the maintenance of an intact microdrainage network on the development site.

5.1.3 Maintenance of Stream Baseflow:

By implementing the design recommendations pertaining to groundwater recharge and water table levels in Sections 5.1.1 and 5.1.2, base flow in the Broad Brook will be maintained after the encroachment of urban development into the watershed. In conjunction with these measures, seepage and local discharge areas, which are found largely in the Deerfield soils, should be preserved due to their significant role in sustaining stream baseflow.

The Broad Brook headwaters, of which the sphagnum bog north of Starrs Road is an integral part, must be protected from any type of development which would alter the water table levels or reduce the area's effectiveness as a natural reservoir and filtration system for surface runoff from surrounding regions.

5.2 Recreational Development

In order to maximize intensive recreational use within the Broad Brook watershed, it is apparent that the most appropriate lands lie at the periphery of the floodplain rather than generally nearby the stream. This, however, does not preclude certain passive, stream-associated activities where reasonable access exists. Consequently, to optimize both recreational and conservation potentials, intensive-use recreational facilities may be situated between developable land and conservation land areas e.g. - floodplain.

With the aesthetic qualities of the watershed in mind, and with knowledge of other areas in close proximity to Yarmouth with greater potential for active and passive recreation, a policy of conservation is recommended versus that of recreation development.

6. FLORA & FAUNA

6.1 Habitat & Species

While the Broad Brook watershed cannot be said to be "unique" it does possess certain distinctive features with respect to flora and fauna.

To the north of Starr's Road a black spruce stand, an organic bog and an open pasture provide three distinctive habitats. The pasture serves as a resting place for several species of plover during the autumn migration. The spruce stand supports a breeding population of small birds such as the Boreal Chickadee and the red-breasted Nuthatch and others, who favour a coniferous woodland. The organic bog supports Common Snipe, Greater and Lesser Yellowlegs, Plover and several species of sandpiper and dabbling ducks such as Blacks and Teal.

Between Starr's Road and Parade Street stands of alder with scattered clumps of white spruce provide a favourable habitat for various species of warbler and other birds which inhabit mixed second growth.

The Brook winds through a wet meadow area from Parade Street to Forest Street where it enters a fertile marsh area which is rich in both plant and animal life. This area is well known and is frequented by birders, botanists and other amateur naturalists as it is the only habitat of its particular sort for some distance. Here a number of rare birds have been observed and a rich variety of plants, a few of which are uncommon in the province, grow in profusion. Among these worthy of mention are skunk cabbage, cuckooplant, ragged robin and gerardia nev scotica. A further listing of bog and marsh flora are found in Appendix "B".

Regular bird inhabitants of the wet meadow-marsh area are: Pied-billed grebe, Herons and Bitterns including rare stragglers from the south and west, Dabbling ducks, rails, small waders, Bobolink Meadow Lark, Red-winged blackbird, Savannah, Sharp-tailed and Swamp sparrows. Detailed lists of residents, visitant and migrant birds are printed in Appendix "B".

In past years there were brook trout of sufficient numbers and size to justify angling but with the dwindling size of the stream it is unlikely that any but a small relict population remains. A reported small "run" of sea trout into the mouth of the brook at Kelly's Cove suggests that a "residue" of this species does exist.

Mammal population throughout the study area is sparsely distributed. Permanent residents found throughout the meadow and marsh areas are: muskrat, meadow moles, star-nosed mole, little brown bat and raccoon. In the upper reaches of the watershed permanent residents include red squirrels, flying squirrels, red-backed mouse, white footed mouse, deer mouse, jumping mouse, porcupine and snowshoe rabbits. White-tailed deer stray in to the headquarters of the watershed occasionally from adjacent areas.

6.2 Comments

The Broad Brook watershed is a combination of freshwater marsh and other semi-primitive habitats which have persisted in close proximity to a thickly settled area. It harbours a number of small birds and plants which are not found commonly elsewhere in the province.

The area is extremely fragile as determined by the soil-hydrological relations. Various unique habitats have already been severely disturbed and are threatened by future development.

With growing interest in nature and environmental values natural areas of this kind located in close proximity to urban centres are increasing in importance.

e.g. > 1.5 Om = greater than 1.5 metres of mesic organic matter (organics too deep to determine underlying mineral soil)

There was no humic or fibric organic matter mapped in the watershed since all organics examined has a 10 - 40% rubbed fibre content (mesic). All organic matter was derived from sedge vegetation with one exception; that being the bog north of Starrs Road which has been formed from sphagnum moss and related vegetation.

3. Slope

The topography of the Broad Brook watershed was expressed by assigning a slope class to each mapping unit according to the following table.

<u>PERCENT SLOPE</u>	<u>SIMPLE TOPOGRAPHY (distinguishable crests and troughs)</u>	<u>COMPLEX TOPOGRAPHY (undulating)</u>
0-1/2%	A	a
1/2 - 2%	B	b
2 - 5%	C	¢
5 - 9%	D	d
9 - 15%	E	e

NOTE: Occasionally, directional arrows accompany the slope class (↓) to denote the trend of the topography.

4. Legend Format

The following is the format used on the accompanying soils inventory map to represent the various characteristics which were determined for each mapping unit.

(a) Single Deposit

e.g. YE Y-soil series
E-slope class

(b) Double Deposition

e.g. $\frac{RA2}{P}$ b

RA2 - .3 to .9 metre overburden
P - underlying soil series
b - slope class

(c) Triple Depositions

e.g. $\frac{.3 Om}{\frac{RA2}{P}}$ b

.3 metre depth of organic matter
on surface
Om - mesic organic layer
b - slope class
RA2- .3 to .9 metre overburden
P - underlying soil series

BIRDS OF THE BROAD BROOK FLOOD PLAIN

YARMOUTH, NOVA SCOTIA

The following species of birds 100+ in all occur at different seasons or are permanent residents of the Broad Brook flood plain. These have been grouped under the following headings: Resident (all seasons), Summer Resident, Winter Resident, Migrant (passing through regularly in spring or fall) and Visitant (birds in this last category being those which occur irregularly and may vary from "common" to "rare". Birds which breed in the area are indicated by (B) after their name.

<u>Permanent Resident</u>	<u>Summer Resident</u>	<u>Winter Resident</u>
Pheasant (B)	Pied-billed Grebe (B)	Horned Lark
Gr. Black-backed Gull	Great Blue Heron	Northern Shrike
Herring Gull	American Bittern	Evening Grosbeak
Bluejay (B)	Black Duck (B)	Tree Sparrow
Raven	Kestrel	Snow Bunting
Crow (B)	Sora Rail (B)	
Boreal Chickadee (B)	Killdeer (B)	
Bl. capped Chickadee (B)	Common Snipe (B)	
Mockingbird	Spotted Sandpiper (B)	
Starling (B)	Night hawk	
Common Grackle (B)	Chimney Swift	
Cowbird (B)	Ruby thr. Hummingbird	
Goldfinch (B)	Kingfisher (B)	
Dark-eyed Junco (B)	Flicker (B)	
White-throated Sparrow (B)	E. Kingbird (B)	
Song Sparrow (B)	Alder Flycatcher (B)	
	Least Flycatcher (B)	
	Tree Swallow (B)	

Permanent Resident

Summer Resident

Winter Resident

Bank Swallow
Barn Swallow (B)
Cliff Swallow
Cat bird (B)
Robin (B)
Golden cr. Kinglet
Ruby cr. Kinglet (B)
Cedar Waxwing (B)
Red-eyed Vire (B)
Solitary Vire
Black and White Warbler (B)
Parulu Warbler (B)
Yellow Warbler (B)
Magnolia Warbler (B)
Yellow-rumped Warbler
Bl. throated green Warbler (B)
Chestnut-sided Warbler (B)
Palm Warbler (B)
Yellowthroat (B)
Redstart (B)
House Sparrow (B)
Bobolink (B)
Meadow Lark (B?)
Red-winged Blackbird (B)
Baltimore Oriole
Purple Finch (B)
Savannah Sparrow (B)
Sharp-tailed Sparrow (B)
Chipping Sparrow (B)
Swamp Sparrow (B)

Visitant

Canada Goose
Snowy Egret (Rare)
Little Blue Heron (Rare)
Green Heron (Rare)
Goshawk
Sharp-shinned Hawk
Red-tailed Hawk
Broad-winged Hawk
Rough-legged Hawk
Marsh Hawk
Common Gallinule (Rare)
Coot (Rare)
Mourning Dove
Snowy Owl (Rare)
Short-eared Owl
Saw-whet Owl
Western Kingbird (Rare)
Horned Lark
White-breasted Nuthatch
Red-breasted Nuthatch
Brown Creeper
Brown Thrasher (Rare)
Loggerhead Shrike (Rare)
Short-billed Marsh Wren (Rare)
Bohemian Waxwing (Rare)

Migrant

Ring-necked Duck
Green-winged Teal
Blue-winged Teal
Pigeon Hawk
Virginia Rail
Semi-palmated Plover
Golden Plover
Black-bellied Plover
Woodcock
Solitary Sandpiper
Willet
Greater Yellow legs
Lesser Yellow legs
Pectoral Sandpiper
Least Sandpiper
Dowitcher
Semi-palmated Sandpiper
Buff-breasted Sandpiper
Black-billed Cuckoo
Yellow-bellied Sapsucker
Phoebe
Yellow-bellied Flycatcher
Wood Pewee
Olive-sided Flycatcher
Hermit Thrush

<u>Visitant</u>	<u>Migrant</u>
Cardinal	Swainson's Thrush
Pine Grosbeak	Veery
Red poll	Eastern Bluebird
Pine Siskin	Water Pipit
Fox Sparrow	Philadelphia Vireo (Rare)
	Nashville Warbler
	Cape May Warbler
	Black-throated Blue Warbler
	Blackburnian Warbler
	Bay-breasted Warbler
	Black poll Warbler
	Oven bird
	Northern Water thrush
	Mourning Warbler
	Wilson's Warbler
	Canada Warbler
	Rusty Blackbird

BOG AND MARSH FLORA OF THE BROAD BROOK

FLOOD PLAIN

(* = species uncommon in surrounding area)

Bog Species

Pitcher Plant (Sarracenia)

Bog Orchid (Calopogon)

Bog Rosemary (Andromeda)

Bog Species (Cont'd)

Cotton grass (Eriophorum)

Wet-Land Species

Grasses, Sedges, Rushes

* Skunk Cabbage (Sumplocarpus)

Blue Iris (Iris)

* Yellow Iris (Iris)

Purple-fringed Orchis (Habernaria)

* Turtle-head (Chelone)

Bed Straw (Galium)

Forget-me-not (Myosotis)

* Gerardia Neoscotica

Emergents

Arrow-weed (Sagittaria)

Cow-lily (Nymphaea)

Cat-tail (Typha)

* Swamp Knot weed (Polygonum)

Submerged forms

Pond-weeds (Potamogeton)

Fresh-water Eel Grass (Vallisneria)

Water Crow-foot (Ranunculus)

Bladderwort (Utricularia)

References:

Centre For Resources Development, University of Guelph,
Guelph, Ontario

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Volumes 1 and 2, April, 1972.