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RAISIN RIVER CONSERVATION REPORT 1966

ONTARIO

TORONTO

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INTRODUCTION

The Conservation Authorities Act, passed in 1946, was based on three mises: (1) that since water is the most important of the renewable natural sources, the most logical area on which to co-ordinate c nservation work is a tershed or group of watersheds; (2) that the initiative must come from the local ople; and (3) that if the local people establish a Conservation Authority and are epared to carry out a program of conservation, they can receive considerable sistance from the Ontario Government in the form of technical advice and grants.

With the advent of this concept of personal and community responsibi-ty in conservation, the Conservation Authorities movement was born, and the llingness of our people to undertake conservation in this way is indicated by the ct that in the past 20 years 36 Authorities have been established, with a total mbership of 541 municipalities and an area of 25,798 square miles. The population thin watersheds on which Authorities have been established is estimated to be pproximately 4,427,000 or over 73 per cent of the total population of the Province.

The first step in establishing a Conservation Authority is undertaken y the municipalities wholly or partly within a watershed. Two such municipalities ust first by resolution petition the Government to call a meeting for the purpose f ascertaining whether or not an Authority should be established. Two-thirds of he number of representatives which all the municipalities in the watershed are ntitled to appoint must be present to form a quorum. If two-thirds of those resent vote in favour of establishing an Authority, a resolution is forwarded to he Government. The Authority is then established by Order-in-Council and, under he Act, becomes a body corporate, including, as members, representatives from all he municipalities in the watershed.

The Townships of Roxborough, Cornwall and Charlottenburg petitioned the Minister in June, 1963, to call a meeting to determine whether or not an Authority should be established for the watersheds of the Raisin River and the adjacent streams. All seven municipalities to be affected sent representatives to the meeting held on July 23, 1963, in the Council Chambers, City of Cornwall. The vote for the establishment resolution was unanimous and the Raisin River Conservation Authority came into being by Order-in-Council, October 10, 1963. The first meeting of the new Authority was held on January 20, 1964.

While some Authorities were brought into being because of flooding within their areas, all were aware of the necessity of carrying out such supplementary measures as improved methods of land use, reforestation, proper woodlot management, investigation of underground water supplies, wildlife studies and development of recreational facilities. But the Authorities are not equipped to carry out the extensive investigations that would indicate where such work should be done. Consequently the Conservation Authorities Branch of the Department of Energy and Resources Management undertakes to carry out the preliminary investigations as a service to the Authorities; to appraise, by means of surveys and reports, the conservation needs of each watershed, and to submit to the Authority a detailed report outlining the conservation measures that should be implemented.

Surveys may include work in five general fields: Land, Forest, Water, Wildlife, Recreation. The scope of the studies made in each of these subjects varies with the condition and needs of the area under survey.

Before the survey is commenced in the field, all such contributing data as maps, old records, photographs, unpublished reports and other useful sources are thoroughly explored and the pertinent information recorded. Field observations are marked on aerial photographs of the area. While the survey is in progress similar data are gathered locally, and agricultural representatives, zone foresters, municipal clerks, other officials and private citizens are interviewed for additional material.

The results of these conservation surveys together with the recommendations based upon them are set down in the reports presented to the Authorities and intended to serve them as a guide in their work. The carrying out of any scheme is not the work of the Conservation Authorities Branch, because it is not an operating branch, although it stands by to interpret the report and give advice and assistance in carrying out the plans recommended in the report.

The Authority itself must assume responsibility for initiating the schemes which it considers most urgent; it must also make the approaches to government departments or other bodies from which it hopes to get assistance. If, for example, an Authority undertakes a scheme having to do with land use, it must seek assistance from the Department of Agriculture; if the scheme involves a forestry or wildlife problem, then branches of the Department of Lands and Forests are consulted. In the case of flood control, however, as the only provincial department engaged in hydraulic surveys is the Conservation Authorities Branch, whose staff is not large

ɔugh to carry through to completion the engineering works of several Authorities, e Authority must engage a consulting engineer to do the final engineering and signing and to carry the work through the construction stage. Similarly, when an thority undertakes a scheme which has to do with recreation, it may have to employ n specially trained in this field.

As the work being done by Conservation Authorities is a new approach the conservation problem in that the responsibility of carrying it out is left ıtirely in the hands of the Authority concerned, much direction and assistance from ıe Conservation Authorities Branch have been necessary. In the case of 27 of the ıthorities, including the Raisin River, a member of the staff of the Department of ıergy and Resources Management has been assigned to work in the watershed.

A comprehensive conservation survey of the Raisin River was carried ut by land, forest, water and wildlife field crews in the summer of 1964. The esults of these studies and of further work done by the technical staff in the ranch office are included in this report.

A.S.L. BARNES

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RECOMMENDATIONS

STATED OR IMPLIED IN THIS REPORT

That the Authority encourage the elimination of grazing from local woodlots and an increase in woodlot fencing. (Page 30)

That the Authority implement all reasonable means of improving the stocking and regeneration of local woodlots. (Page 30)

That the Authority encourage the return of scrublands to more productive uses by clearing for agriculture by reforestation or by excavation of wet areas for ponds. (Page 31)

That the Authority encourage greater care in the management of private reforestation and natural woodlands and the use of the best methods for controlling insects and diseases. (Page 33)

That the Authority support the certification of Tree Farms, particularly if they represent economic units, as demonstrations of good private forestry practices. (Page 34)

That the Authority support the formation of 4-H Forestry and Conservation Clubs. (Page 36)

That the Authority establish a program of systematic purchasing of the 35,997 acres recommended in this report for incorporation into an Authority Forest. (Page 39)

That the Authority provide a private lands assistance program designed to increase the reforestation of small idle or marginal areas outside of the recommended Authority Forest, in the manner stated in this report. (Page 44)

That the Authority encourage research into local forestry problems. (Page 44)

That the Authority encourage conservation education. (Page 44)

That the Authority encourage the planting and management of windbreaks and shelterbelts in those areas where their use is applicable. (Page 61)

12. That the Authority develop a precipitation network within the river basin and consider the installation of a recording rain gauge. (Page 68)

13. That the Authority discourage unnecessary swampland clearing and drainage. (Page 68)

14. That the Authority install a recording type water level gauge to replace the existing manual gauge at Williamstown. (Page 70)

15. That the Authority encourage the cheese and milk processing plants to operate and maintain their waste disposal systems properly. (Page 75)

16. That the Authority establish fill regulations to prevent sanitary landfill operations with 100 feet of any ditch or watercourse. (Page 75)

17. That the Authority continue to report to the Ontario Water Resources Commission any situations which may impair the quality of the ground or surface waters. (Page 75)

18. That the Authority inform the pollution regulation offenders of Section 27 of the Ontario Water Resources Commission Act. (Page 75)

19. That the Authority carry out minor channel clearing and dredging at various locations indicated to reduce the possibility of ice jamming and consequent flooding. (Page 77)

20. That the Authority give consideration to the construction of several low weirs as an aid toward solving its low flow, pollution abatement and recreation problems. (Page 79)

21. That the Authority urge the City of Cornwall to restrict the use of the flood plain land along the South Raisin River between Brookdale Avenue downstream to Highway 401. This land should be zoned for recreational and agricultural uses only. (Page 80)

22. That the Authority acquire the pond north-west of Cornwall Centre, have it tested and perhaps stocked experimentally. (Page 83)

That the Authority encourage the construction of farm ponds as a means of water conservation. (Page 86)

That the Authority consider the creation of community recreation areas in conjunction with the series of low weirs recommended in this report. (Page 87)

CHAPTER 1

EARLY DEVELOPMENT OF THE AREA

Physical evidence of events before recorded history in the Raisin watershed lies in the glacial and marine deposits of the watershed. The n ridges paralleling the St. Lawrence and the mounds of boulders throughout ea were both formed and laid down by the last glaciation (Wisconsin) as it south-westerly through Eastern Ontario. The post-glacial Champlain Sea which ed left a number of records, including bones of a white whale buried beneath 11. Men working at a site on the south side of 6th Street in Cornwall in 1868 red the whale bones 14 feet below the surface while they were digging for blue or bricks.

The Raisin River system and adjacent streams in a great part ined the pattern of settlement by pioneers arriving in the Glengarry-Stormont Direct access to a water source, either the lakefront or a stream, was a consideration for the settler. A 1792 survey map showing the early settled has all the worked lots running from either the lake or river back to a sion line.

The first white settlers to enter the region in any number were Empire Loyalists who fled from the State of New York in 1784. There were two among the Loyalists, the German Palatines (originally refugees from Palatine, y) who settled in Dundas and Osnabruck, and the Scottish (originally from rry, Scotland) who took land in Glengarry and Cornwall. The numbers of sh settlers were increased by later migrations directly from Scotland in 1786, 1794 and 1803-4. Because of its colour and marshy origin, the Raisin was as the Black River by Scottish settlers and reference sources made use of both until very recently.

The Loyalist soldiers, when disbanded in 1784, were ordered to take families to New Johnstown, now Cornwall, which had been surveyed some two or years before. At the Government store they drew lots for their lands. ns received 2,000 acres and sometimes more if they had large families; nants 500 acres and privates 200 acres with provisions in the back concessions eir children when they became of age.

Most of the U.E.L. settlers had been in America only a few years when volution broke out. Both the men and women had, however, experienced the

rigours of pioneer life in the backwoods. They had suffered great losses in the Revolutionary War and had come to the Canadian frontier with willing hands, determined to get ahead here. They took their government provisions, one cow for two families, an axe and other necessary tools and equipment, and set out for their plots. Their early farm yields were only sufficiently large to supply the immediate needs of their families, but within a relatively few years, they had increased their crop harvests and had produce for sale.

A crop failure in 1787 caused great privation and even starvation in "the hungry year", 1788-89, but a successful crop the following year helped the settlers over their first major setback. In 1801, 100 cleared acres in the Eastern Districts sold for 600 pounds.

Mrs. Simcoe, wife of the Lieutenant Governor of Upper Canada, visited Cornwall on June 26, 1792, and described it in her diary as "...a settlement four miles from Coll. Gray's. There are about 15 houses and some neat gardens in them", she added.

The output for a sample farm in the district in 1804 was "1-2 tons of hay per acre, 12 bushels of wheat for one, a good many peas, eleven cows and nine other cattle". This settler had about 100 acres of which 80 were cleared, 27 in meadow and in addition, 30 acres cleared on another lot. His land was priced at $8 per acre.

By 1790, the district had its first school. One of the best secondary schools in Canada during the first part of the 1800's was established by John Strachan at Cornwall.

Peace and quiet in the Upper Canada frontier from 1783-1812 helped the settlers to get well established. By the time the War of 1812 broke out, the Eastern Districts were sufficiently productive to be considered important supply areas, not only for farm products, wheat and cattle, but also for other such supplies as potash which sold at $300 per ton during the War.

The export trade towards Montreal, from Kingston and other river centres, began in 1794. The St. Lawrence provided easy access to a trade connection with Montreal and, until 1882, most of the produce from Glengarry and area was shipped by water to Montreal or on the Grand Trunk Railway from Lancaster at the mouth of the Raisin. In 1882, the Ottawa-Montreal railway was built and Priest's Mills, better known today as Alexandria, just outside the north-east boundary of the watershed, became the centre of trade.

From the opening of the Eastern Districts, wheat was the first and in farm crop. Through the years the settlers tried various secondary industries supplement their farming income. The asheries were early the major side industry d, in 1862, 32,845 barrels of potash and 10,176 barrels of pearl ash (refined tash) were produced. Thirty cords of wood were burned to produce one ton of ashes d from this, one-sixth ton of potash was made. Beech and maple were the most dely used logs, though elm and ash gave the best ashes. Domestic ashes, bought r 12 cents a pound, were also used. Martintown, Williamstown, St. Andrews and rnwall all had at least one ashery. There was one just downstream from the grist ll in Martintown and another north of the road where the main branch of the Raisin osses the Harrisons Corner-Lunenburg Road.

The earliest settlers were taught by the Indians how to make maple rup and the Eastern District pioneers had by the 1890's developed the production maple syrup into a 600,000 gallon a year industry. Through the years, however, oduction has fallen off and, by 1940, only 20,000 gallons were being produced. en the discovery, in World War II, of how to produce paper from hardwood, resulted the removal of most of the bush, and has caused the near extinction of the maple gar industry along the Raisin.

Oats was by far the most important of the coarse grains sown by the rly Ontario settlers, mainly because it was considered essential for the keeping horses but in such Scottish districts as Glengarry they formed a staple of human et. About 1870, two townships in Glengarry County shipped approximately 200,000 shels of oats to New England.

The lumber industry was another important interest of the watershed ttlers - and perhaps the one that most interfered with their farming. Historians d reporters from the region have often stated their belief that the evils of the tempt to combine lumbering and agriculture were more apparent in the Eastern strict than in any other part of Eastern Upper Canada. One such reporter, writing the Cornwall Observer in 1843 remarked that "...if the farmers of the Eastern strict (Glengarry, Stormont and Dundas counties) in general and more particularly ose of Highland Scotch descent would pay but a little more attention to agriculture d a proportionately less attention to the speculative undertakings of the lumber siness, many a good farm would be released from the death grasp of a mortgage".

Great quantities of high grade timber, especially white pine, were oated and shipped to Montreal for ship building. The making of staves for casks

was an important industry within the area. It called for slabs of white oak five feet long and one-half inches thick. One thousand staves brought a price of 100 pounds in England.

Early survey reports describe the timber cover in Glengarry and Stormont Counties as a mixture of hardwood and pine on rolling or level land, with hemlock and balsam intermixed and, at intervals, in the hollows, cedar and tamarack swamp. The land was much encumbered with stones.

The flat lands around the Raisin in Glengarry County fell into the section of Ontario soils that required artificial drainage to make them worth working. Thus much of these lands were still swamp and bush until the 1860's, farming operations being confined to higher places.

Though marsh and swamp areas were rather dominant on the whole watershed when settlers first arrived, they were slowly drained over the years to increase the cultivated acreage, and today the area is greatly changed from the state found by the pioneers. Lists of mill sites noted in early survey reports offer a means of comparing the water system known to the settlers and that found now in the Raisin watershed. In 1792, surveyor Chewitt noted the following mills:

"Cornwall - Lot No. 4, 3rd Concession, - a Sawmill belonging to Michael Coughner.

Lot No. 6, south side of the River aux Raisins, a Grist mill belonging to John Link, generally is worked over the whole of the year.

Charlottenburgh - Lot No. 14, on the north side of the River aux Raisins, Saw and Grist mill belonging to Sir John Johnson.

On the Indian Land middle branch of the River aux Raisins about seven or eight miles from the River St. Lawrence is a good mill place (Probably - Martintown)."

An 1862 source maps out the following sites:

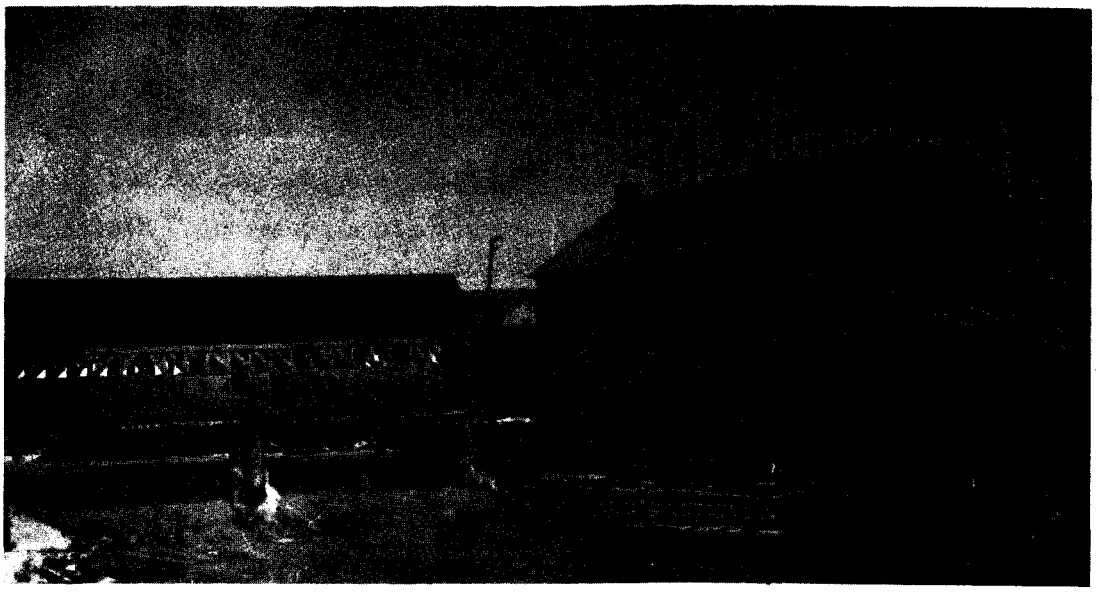
Charlottenburgh - Lot 5, 2nd S.R.R. Concession, south side of the Raisin, a grist mill.

Lot 6, 2nd S.R.R. Concession, south side of the Raisin, a sawmill.

Lot 14, 1st S.R.R. Concession, south side of the Raisin, a sawmill.

Lot 43, S.R.R. Concession, south side of the Raisin, a grist mill.

At South Lancaster, a sawmill on the east side of the mouth of the Raisin River. At Williamstown, on the east side of the river, west of John Street, a grist mill; on the west side of the river, a sawmill. At Martintown, a grist mill on the east side of the river, south of Dundas Street; a sawmill on the west side of the river, south of Dundas Street; a carding mill on the west side of the river, south of Dundas Street.



Covered bridge, dam and grist mill in operation in Martintown during the early part of this century.

The remains of the above dam and mill as they exist today.

xborough - Lot 1, 1st Concession, north side of the river, grist mill.
Lot 1, 1st Concession, north side of the river, sawmill.
Lot 2, 1st Concession, north side of the river, sawmill.
Lot 3, 1st Concession, south side of the river, sawmill.

rnwall - Lot 33, 5th Concession, on lake or pond now a swamp, sawmill.
Lot 1, 7th Concession, east side of the river, sawmill.
Lot 1, 7th Concession, west side of the river, sawmill.
Lot 4, 6th Concession, south side of the river, mills.

nabruck - Lot 4, 4th Concession, south side of the river, sawmill.
Lot 7, 6th Concession, west side of the river, sawmill.
Lot 6, 5th Concession, west side of the river, sawmill.

Some of these sites are completely dry year round now; others never e more than an intermittent flow even in the spring season. None could support a ll. This serious destruction of a good water storage and flow system is the sult of years of deforestation and swamp drainage without consideration to the ng-range consequences.

Dairying, the main farm industry the watershed has supported this ntury, began on a small scale but continued to grow as the quality of the soil and e grain crops declined through the years.

By 1850, the St. Lawrence counties produced cheese in fairly large antities, partly to counter the failure of the wheat crop and partly influenced by e infiltration of Americans acquainted with cheese-making processes. In 1850, per Canada manufactured 2,292,600 pounds, of which Glengarry County contributed ,586. During the 1850's there was little increase in production due both to fective competition from the higher quality American imports and to high wheat ices. When prices were comparable, the extra work necessary in the dairy industry compared to wheat-growing generally left dairying a secondary endeavour. Where irying was a major interest, butter rather than cheese was the important product. ss work was required to manufacture butter and, furthermore, the profitable ising of swine created a demand for buttermilk rather than whey.

The ending of the Reciprocity Treaty in 1866, by cutting off the pply of the more favoured American cheese, reversed the trend of the dairy dustry. The Board of Agriculture of Upper Canada remarked early in 1867 that neese factories are now springing up in nearly every section of the country so pidly that it is difficult to keep track of all the new institutions".

So many people rushed into the new industry without knowing a thing about it that for a few years poor quality threatened Canadians with the loss of their recently gained export market for cheese. The necessity for improvements was soon realized and, partly by adoption of improved manufacturing devices from the United States but mainly through the educational efforts of associations such as the Canadian Dairyman's Association, the Ontario Dairyman's Association and their successors, a steady raising of standards was shown for Ontario cheese.

As quality went up, so did the size of the market, both locally and in England. In 1879-80, no less than 40,368,678 pounds were shipped overseas from Ontario.

As the cheese output was increasing, the quality and quantity of butter production was going downhill. Farmers engrossed in wheat, stock and cheese interests, spent little effort in butter making.

Though Ontario butter in general had a poor reputation, Eastern Ontario butter held a deservedly high one. At the end of the American Civil War, it sold at 50 cents a pound in Boston and New York under the labels, "Orange County" [N.Y.] or "Vermont" butter. At the same time, ordinary Ontario butter was excluded from the U.S. by the four cents per pound duty.

Raw milk dairying began to be important in the vicinity of urban centres in 1880. At first it was secondary to wheat growing and cheese making but, because the complete milk dairying enterprise could be carried on by a family with no dependence on hired hands, it began to grow.

The shift from wheat growing to dairying or to mixed farming contributed to the improvement of agricultural practices. Farmers began to acquire more and better cattle and to take better care of them, with the result that the land received more manure and a greater acreage in pasture was laid down.

A review of the experiences and endeavours of the past occupants of the watershed, and of their use and misuse of the land and water supplies, is important in understanding, analyzing and finding solutions to the present water and land use problems in the Raisin River area. From details of the past abundant flow in the water system as compared with the facts of the present shortage, some idea can be formed of the scope of these problems.

CHAPTER 2

GEOGRAPHY AND SOILS

Introduction

The Raisin River Conservation Authority consists of the watershed of ıe three branches of the Raisin River and the watersheds of several small streams Lowing into the St. Lawrence River. It is bounded by the Hoople Creek watershed on ıe south-west, the South Nation watershed on the north-west, the Riviere au Baudet ıtershed on the north, and the St. Lawrence River on the south.

The Authority covers an area of 261 square miles. One city, Cornwall, ; within its boundaries and many small hamlets and villages dot the countryside. ıe Authority covers the south-west half of Charlottenburg Township and the south-ɜst corner of Kenyon Township in Glengarry County, Cornwall Township, the southern ırt of Roxborough Township and part of the eastern section of Osnabruck Township in ;ormont County.

Several small streams to the south of the Raisin River watershed flow .rectly into the St. Lawrence River and have their source in the poorly drained ınd of the Lancaster Flats.

The watershed of the Raisin River is oblong in shape with a length of ' miles and average width of approximately 8 miles. It has a drainage area of .7 square miles. The river has its sources in the drumlinoid ridges and drumlins ' the Glengarry Till Plain which covers the northern parts of the Authority Area.

The headwaters of the main branch are located in the Townships of ›xborough, Cornwall and Osnabruck at an approximate elevation of 325 feet above ɜa level. The river flows south-westerly as far as the community of Dixon. It ıen turns and flows south-easterly through North Lunenburg and then north-easterly › Martintown. From Martintown it flows in a general easterly direction to Williams-›wn and then to its outlet on the St. Lawrence at Lancaster at elevation 154 feet ›ove sea level. The total drop from the source to its mouth is approximately 171 ɜet, in a distance of 44 miles for an average gradient of about 3.89 feet per mile.

The Raisin River has two main tributaries, the South Raisin and the ›rth Raisin. The south branch has its headwaters at the town of Long Sault. It .ows easterly through the northern section of the city of Cornwall and continues to ›s confluence with the main branch at the community of Glendale. The headwaters ·e at an elevation of approximately 250 feet above sea level and the river empties

into the main branch at an elevation of 154 feet above sea level. The total drop of 96 feet in a distance of 20.5 miles gives an average gradient of about 4.69 feet per mile.

The relatively short North Raisin has its headwaters in the Township of Roxborough in the vicinity of Monckland at an elevation of approximately 325 feet above sea level. It flows south to McMillan Corners and then south-easterly through Sandfield Mills to meet the main branch at Martintown at an elevation of 181 feet above sea level. The total drop from the source to its mouth, approximately 144 feet, in a distance of 16 miles, gives an average gradient of about 9.0 feet per mile.

2. Physiography*

A knowledge of the landscape (called the physiography) is necessary for understanding the development of our soils and the problems of soil and land use. Land features of most of the northern part of this continent were formed by great continental glaciers that covered the land with thick layers of ice. These great ice sheets advanced over Canada at least four times in the past million years, which, geologically speaking, is a rather short time.

These glaciers emanated from the north-east. Climatic changes caused them to move across the face of the land and recede again. Each advance and recession took thousands of years. Between them, the climate was warm, probably even warmer than now. The last glacier, commonly called the Wisconsin, moved across Ontario some 10 to 15 thousand years ago. It was mostly responsible for our present landscape.

The Champlain Sea, which appeared after the recession of the Wisconsin Glacier, covered all of the lowland between the St. Lawrence and Ottawa Rivers. The land in this area was uplifted in stages and, according to researchers, the last dry land in Eastern Ontario emerged about 4,000 years ago.

The glaciers acted as huge scrapers, pushing, scraping and gouging the bedrock. Rock materials were piled up, ground up and shifted about. The material resulting from this grinding and scraping is called TILL. Till is a heterogeneous mixture of rock particles and stones, sand and clay. A great deal of the north and central regions of the Raisin Conservation Authority is covered by a large till plain called the Glengarry Till Plain. It is an area of low relief forming the

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* Chapman, L.J. and Putman, D.F. "The Physiography of Southern Ontario", University of Toronto Press, 1951.

MUNICIPALITIES

FIG. I

rainage divide between the Ottawa and St. Lawrence basins. The topography is undu-
ating to rolling, consisting of long drumlinoid ridges and a few well-formed drum-
ins together with intervening clay flats and swamps. The Raisin River is one of the
ivers which drains southward to the St. Lawrence River. The level of the land is
elatively constant with the result that the headwaters f.ow sluggishly between
idges before emptying into a master stream.

The till is loamy and contains a high proportion of limestone with a
ixture of materials derived from Precambrian rocks to the north and from the Nepean
andstone to the east. The depth of the till is seldom over 100 feet, with 25 feet
f depth being common over most of the area.

The outstanding characteristic of this type of till is its stoniness.
lmost all fields are either bordered by stone fences or dotted with rockpiles.
reas of boulders appear on crests of ridges and drumlins arising from the action of
ne waves of the Champlain Sea. A great deal of labour is necessary to clear the
and for cultivation. A large amount of the pasture is rough and uncleared.
umerous bars of sand and gravel were also created by the action of the waves.

The soil is very young in this part of the Authority. Even where the
rainage is good, the soil profile is shallow and has an abundance of free car-
onates. In those areas where the land is relatively flat and drainage is poor or
mperfect, poor soils exist which may contain muck and peat.

Between advances, the glacier melted. One can only imagine the fan-
astic amounts of water released, to flow as glacial rivers or to form lakes and
onds. The till materials ground out by the ice were released and transported great
istances. Water action sorted some of the material, depositing it in bars and
eltas or dumping it into lakes where it settled to the bottom.

Soil material, sorted and deposited by the moving water is called
glacio-fluvial" (glacio for ice action, and fluvial for water-moved). Such
aterials, often sandy or gravelly in nature, were deposited or washed aside by
lacial rivers, flowing either under the ice or away from the edge of the melting
ce.

Till materials carried by the streams into glacial lakes often
ettled to the bottom of these lakes. If the water in the lakes was quiet, this
aterial settled in layers. Such soil material is referred to as "lacustrine". It
s usually clay materials and often exhibits the layering, called "varving" that
ook place at the time of deposition.

In the south-east corner of the Raisin River Conservation Authority is an area of lowland in which the till plain has been buried under water-laid deposits, leaving exposed only the stony crests of a few drumlins and ridges. These water-laid materials range from clay to very fine sand. This section is known as the Lancaster Flats.

The land in this area is quite flat with the result that drainage is imperfect or poor and the streams flow slowly.

The glacier, as it pushed forward, often piled up great quantities of materials in ridges. Such ridges are called MORAINES. There are no areas in the Raisin River Conservation Authority which could be classed as true moraines. This area is better classified as a till plain. Because of the lack of moraines, the position of the ice front during the recession is indefinite and it has been assumed that it is at right angles to the long axes of the drumlins.

In many parts of Central and Eastern Ontario, a common landscape feature is low, oval, regularly-shaped hills. These hills, shaped like the inverted bowl of a spoon, are called DRUMLINS. They may also be called "sowbacks" or "whalebacks".

Drumlins are formed by glacial movements in areas of till material, probably by the glacier overriding obstructions. Drumlins are usually about one mile long, up to one-third mile wide and up to 75 feet high. They are commonly found in groups, called fields, with their long axes all running in the same direction. There are a great number of drumlins in the south-eastern section of the Authority with their long axes running almost parallel to the St. Lawrence River. A few drumlins are also found in the western part of the Authority. The long axes of these drumlins, however, run in a more north to south direction. The difference in direction of the axes between the two groups of drumlins is due to the movement of the ice in different directions.

3. Soil Surveys

After the deposition of soil material many factors were involved in its development into the many soils we have in Ontario. Kind of parent material, topography and drainage were several important influences. Soils developed from the same parent material may be quite similar, or they may differ because of the influence of topography or drainage. Two soils may be similar except for the texture of the topsoil.

Soils are identified and described by examining them in cross-section. soil cross-section, cut from the surface to the parent material, is called a ROFILE. The profile is made up of several layers, or horizons - the topsoil is alled the "A" horizon, the subsoil is the "B" horizon and the parent material the C" horizon.

A detailed examination of the soil profile is the basis of soil identification and description. A detailed knowledge of the soil is necessary for many urposes, - agriculture and farm planning, building, correct land use and resource ventory.

The Canada Department of Agriculture, and the Soil Science epartment of the Ontario Agricultural College, co-operate in carrying out soil urveys in Ontario. Soils are examined in detail, described and mapped. This is enerally done on a county basis. Soils are given names, usually of the municipality location where they were first identified.

A group of soils developed from the same type of bedrock and parent aterial and having similar horizons except for the texture of the surface horizons s called a "soil series". A predominant series in the Raisin Authority is the mer series. Soils within the series, differing only in topsoil textures, e.g. oam, sandy loam, etc., are called "soil types".

Drainage conditions during soil development may give rise to slightly fferent soils, even though they may have developed from the same parent material. or example, Eamer loam has developed under good drainage, Matilda loam has developed imperfectly drained sites and Lyons loam on poorly drained sites. When soil eries develop from the same parent material but differ because of drainage conditions, the group of these soil series is called a "catena".

4. Summary of the Classification of the Major Soils in the Raisin Area

TABLE I

CLASSIFICATION OF SOILS

Glacial Origin of Parent Material	Soil Series	Type
Glacial till	Eamer	loam
	Grenville	loam
	Matilda	loam
Outwash material (glacio-fluvial)	Castor	silt loam, fine sandy loam
	L'Achigan	fine sandy loam
Outwash underlain by Lacustrine	Allendale	sandy loam
Lacustrine	North Gower	clay loam
	Osgoode	loam, silt loam
Deltaic sands and silts	Bainsville	silt loam
Organic	Muck	

Eamer - a well drained loam. The topography is strongly undulating to rolling and, as a result, requires careful management to prevent erosion. Boulders which hinder cultivation may be present in some areas. General farm crops are most common on this soil. It is well supplied with lime and is fairly well supplied with other plant nutrients. Phosphorous is the only element which should be added in large quantities. This soil covers 32.3 per cent of the Authority.

Grenville - a well drained loam or bouldery loam. The topography is undulating to slightly rolling and requires only normal good management practices. Stones are common and in some areas boulders are found which hinder cultivation. The supply of nutrients and lime is medium. General farming and dairying are the most common types of agricultural operation on Grenville soils. Organic matter, nitrogen, phosphorous and potash are the main fertility needs. This soil group covers 15.8 per cent of the Authority.

Matilda - an imperfectly drained loam. The topography is undulating. This soil is fairly well supplied with nutrients and lime and is used mostly for semi-permanent pasture and hay production. Artificial drainage is of considerable value, provided that the number of stones does not make drainage impractical. This soil covers 2.2 per cent of the Authority.

stor - an imperfectly drained silt loam, very fine sandy loam or very fine sandy am, shallow phase. The topography is smooth and very gently sloping. Dairying is ıe major type of farming on this soil. Organic matter, lime and commercial ferti- .zers are generally necessary to attain maximum yields of crops. Good management ıs to be practised on this soil to prevent gully erosion in drainage channels when ırface runoff occurs. This soil covers 3.1 per cent of the Authority.

'Achigan - an imperfectly drained fine sandy loam. In topography, it is gently loping to level. It is low in both natural fertility and organic matter levels. ecause of this, and of its drainage condition, this soil is of low value for agri- ılture and is best used for trees.

llendale - is a poorly drained soil, sandy loam in texture with topography that is evel to gently rolling. A coarse sandy overburden overlies clay at depths varying rom 6 inches to 36 inches. In some spots the poor drainage has given rise to an ccumulation of organic matter. Artificial drainage is difficult; hence this soil s best used for trees or when cleared, for permanent pasture.

orth Gower - a poorly drained clay or clay loam. The topography is level to depres- :ional. Very few stones are present. The organic matter content is medium to high ınd it is well supplied with minerals. General farming and dairying are the most :ommon farm operations practised. Many areas are being used for permanent pasture. Where open ditches and tile drains have been installed, other crops are also grown. This soil covers 12.0 per cent of the area of the Authority.

)sgoode - a poorly drained silt loam or silty clay loam. The topography on which this soil is found is level to depressional. Pasture is the most common crop on this soil. The fertility level is medium but the restricted drainage is a limiting factor. No stones are present to hinder drainage operations. This soil covers 2.3 per cent of the area of the Authority.

Bainsville - a silt loam that is poorly drained, with level surface topography. It is stonefree, with the overburden overlying clay. Bainsville soils in this area have been mostly cleared and are used for general farm crops. Crop production can be increased with artificial drainage, but installation of tile drains is often difficult and open ditches may be best.

Muck - very poorly drained semi-decomposed vegetation material. It is usually 10 to 18 inches deep and is of no use for agriculture unless cleared and drained. This is not, in most cases, economical. The natural vegetation is elm, tamarack and cedar and is used mostly for fuel. Muck covers 14.3 per cent of the Authority.

The following table shows the different soils in the Raisin River Conservation Authority and the percentage of each soil present.

TABLE II

DISTRIBUTION OF SOILS

Well drained		Poorly drained	
Eamer - loam	32.3%	North Gower - clay loam	12.0%
Grenville - loam	15.8%	Bainsville - silt loam	3.3%
Kars - gravelly sandy loam	1.8%	Osgoode - loam and silt loam	2.3%
Wolford - clay loam	1.5%	Allendale - sandy loam	2.0%
Uplands - sand and sandy loam	0.5%	Marionville - fine sandy loam	1.1%
		Granby - sand and sandy loam	0.8%
		Lyons - loam	0.6%
		Osnabruck - clay loam	0.1%
Imperfectly drained		**Very poorly drained**	
Castor - very fine sandy loam	3.1%	Belmeade - muck	1.2%
Matilda - loam	2.2%	Muck	14.3%
L'Achigan - fine sandy loam	2.0%	**Variable**	
Mountain - sandy loam	1.4%		
Morrisburg - clay loam	1.1%	Farmington - loam	0.1%
Rubicon - sand and sandy loam	0.5%		

5. Conservation Surveys

During the summer of 1960, land use and soil resource problems were examined as part of the conservation survey.

The basis of the land use surveys was topographic maps and aerial photographs. The former were on a scale of 1:50,000, the latter 1 inch to 1320 feet.

Information on soils in the watershed was obtained from the soil survey reports and maps of the Counties of Glengarry and Stormont. Existing use of the land for urban development, woodland, cultivated crops and pasture was noted.

CHAPTER 3

USE AND MANAGEMENT OF AGRICULTURAL AND FOREST LAND

Present Use

Only about 57 per cent of the land in the Raisin River Conservation ıority is under cultivation. The remaining 43 per cent is either non-tillable ause of poor drainage or shallow soil or is rocky outcrop or woodland.

General Agriculture

The agriculture of the Raisin Authority is not diversified to any ent. Most of the farms are of a general nature, but with the main emphasis on rying. Beef raising is a secondary source of income but it is relatively nportant. Hogs and egg production are also used to some extent to supplement income.

The crops grown in the area are generally those which suggest dairy- and mixed agriculture. Specialized crops are not grown to any extent. Small ins occupy 11 per cent of the Authority area and hay and fodder occupy 18 per t. Cash crops, such as vegetables, fruit and potatoes are grown on only 0.1 per t of the land. Wheat is also grown on only 0.1 per cent of the land.

The 1961 Census of Canada reported 74 per cent of the farms in the sin Conservation Authority as being commercial farms selling products valued at e than $1,200. The remaining 26 per cent of the farms are classified as those ch do not have an income of more than $1,200 per year.

The breakdown of production of the commercial farms in the Authority a according to the values of products sold is as follows:

Dairy	60.9%
Beef	16.6%
Eggs	8.3%
Hogs	5.5%
Grain field crops	0.7%
Other field crops	1.3%
Fruits and vegetables	1.6%
Horses, sheep	0.6%
Fowl	2.8%
Other products - wool, forest products, etc.	1.7%

Wheat was grown on only 2.5 per cent of the commercial farms in the ıority area. Oats were grown on 11 per cent of the land in the Authority but on per cent of the commercial farms and hay was grown on only 18 per cent of the d but on 73 per cent of the commercial farms. Horses and ponies were raised on

45 per cent of the farms, pigs on 41 per cent, chickens on 46 per cent. Only 89 per cent of the commercial farms in the Authority area have one or more tractors.

More than 17 per cent of all farm operators reported working more than 100 days away from the farm. Off-the-farm work includes construction (8 per cent), truck or bus drivers (4 per cent) and industrial labour (5 per cent).

Types of Commercial Farms
(by major use)

Dairy	87.0%
Cattle, hogs, horses, etc.	8.0%
Poultry	3.4%
Small grains	0.2%
Field crops	0.3%
Fruits and vegetables, forestry	0.7%
Other specialized crops	0.4%

Average Size of Farms

Up to 69 acres	11.3%
70 - 129 acres	37.5%
130 - 179 acres	18.0%
180 - 240 acres	18.8%
240 - 559 acres	12.4%
Over 560 acres	2.0%

Total Capital Value of Farms

Under $10,000	20.8%
$10,000 - $15,000	22.1%
$15,000 - $25,000	32.9%
$25,000 - $50,000	21.2%
Over $50,000	3.0%

Values of Products Sold from Commercial Farms

Over $25,000	0.6%
$15,000 - $25,000	2.3%
$10,000 - $15,000	5.3%
$ 5,000 - $10,000	23.7%
$ 3,750 - $ 5,000	14.7%
$ 2,500 - $ 3,750	23.5%
$ 1,200 - $ 2,500	29.9%

3. Future Trends

The area within the Raisin River Conservation Authority will remain agricultural. Several changes will probably take place. These include the evolvement of larger farms due to the consolidation of several small farms. These farms will be centred along the roads where much of the arable land seems to lie. The areas that are non-tillable will probably return to forest. Dairying will remain as the primary source of income.

Specialized crops will not be grown to any extent because of the problems of drainage. It would not be very feasible to drain the muck areas because

· the high cost and the shallow depth of the muck. The farmland will have to be ınaged carefully to prevent severe soil erosion and water loss.

Land Capability

It is important that a farmer know the capability of his soil to ·oduce crops, just as he must know the capability of his tractor or of his live- ;ock. His soil is the basis of his whole farm operation and his income. Used with)od judgement, it can produce indefinitely at high levels; used poorly, the soil .ll deteriorate quickly.

Good land management requires a good knowledge of the soil. County)ils maps are an inventory of the type and distribution of soils in the county. ıch information is basic to developing good soil management programs.

Given the information in the soil report and from a conservation ırvey, plus close observation of crop response to treatment of the soil, we have ıch of the basic information needed to manage or advise in the management of any ınd area. In order to organize all of the facts known about a given land area, a ınd classification system has been developed. Originally devised by the United ;ates Department of Agriculture, the system has been revised somewhat by the soil :ientists of the Ontario Agricultural College to suit Ontario conditions. The /stem of classification helps to organize significant information on given soils)r crop use. It is called a land capability classification, the term "capability" ɛlating to the degree of hazards and limitations in managing the land.

Land classification is based on the soils surveys. It includes such ıctors as topography, slope, drainage and flood hazard, presence of stones and ·osion susceptibility. It is designed to help landowners interpret soils maps and) make possible broad generalizations based on soil potential, use limitations and ınagement problems.

Eight Capability Classes

The system places all land into one of two divisions - land suited ıd land not suited to cultivation. Each division contains four capability classes. ıese classes are distinguished from each other by the degree of permanent limita- .ons - that is, risks involved in their use. The basis of difference between .asses is their permanent physical features. These features limit land use or ıpose danger of erosion or other damage to the soil.

A SOILS SUITED TO CULTIVATION

Soils in these first four classes are suited for cultivation.

Class I - Soils have few limitations to restrict their use.

Soils in this class are suited to a wide range of plants and may be used safely for cultivated crops, pasture, range, woodland and wildlife. The soils are nearly level, and erosion hazard either by wind or water is low. They are generally deep, well drained and easily worked. They hold water well and either are fairly well supplied with plant nutrients or are highly responsive to fertilizer. The soils are productive and suited to intensive cropping.

Soils in Class I that are used for crops need only the ordinary management practices to maintain productivity - both soil fertility and soil structure. Such practices may include the use of one or more of the following: fertilizers, cover and green manure crops and crop rotations.

Class II - Soils in Class II have some limitations that reduce the range of crops or require moderate conservation practices.

These soils may be used for cultivated crops as well as pasture, range, and woodland. They may have some minor use limitations that require some conservation practices. These limitations may include gentle slopes, moderate susceptibility to wind or water erosion, somewhat unfavourable soil structure and workability, wetness correctable by drainage, or less than ideal depth of soil.

The farm operator has somewhat less latitude in the choice of crops and management practices in soils of this class as compared to Class I. Special management practices may include soil-conserving cropping systems, water control devices such as vegetated waterways or more attention to crop rotations.

Class III - Soils in Class III are subject to a number of cultural limitations. Limitations on soils in this class may restrict the amount and type of cultivation or the choice of crops.

Limitations in Class III land may result from the effects of one or more of the following:

(1) Moderately steep slopes,

(2) Considerable susceptibility to water or wind erosion,

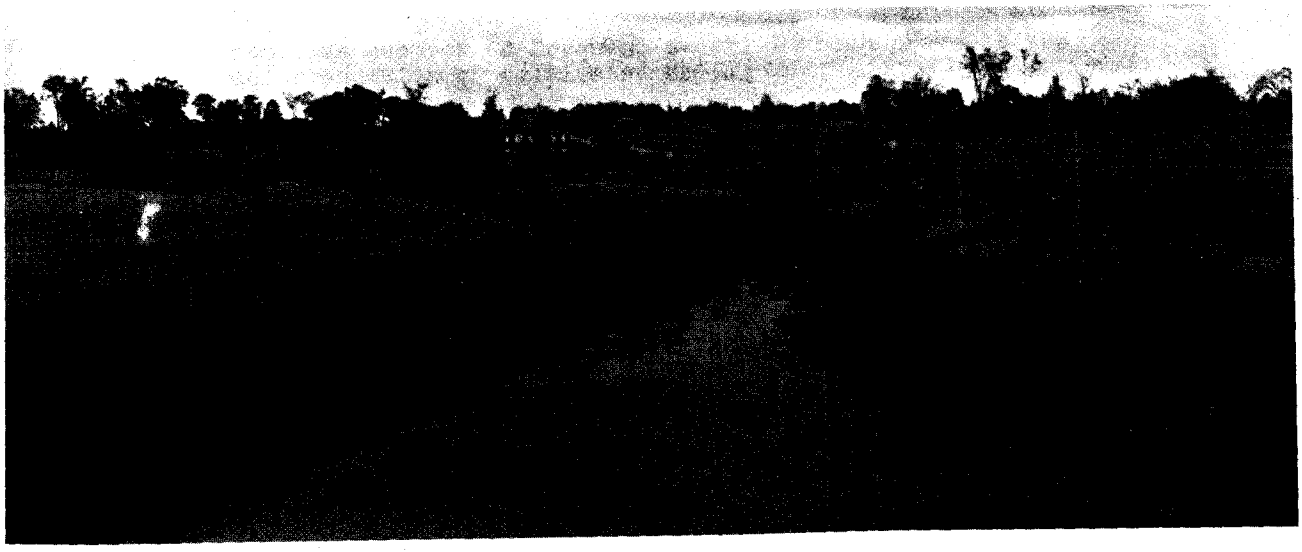
(3) Slow permeability of the subsoil and generally imperfect drainage,

(4) Rather shallow depths to bedrock,

(5) Rather low moisture-holding capacity.

Class III land requires cropping systems that provide adequate soil cover. Management measures needed are longer rotations including sod crops, contouring and strip-cropping, grassed waterways and artificial drainage.

This land along the South Raisin River is flood vulnerable and should be zoned for use as recreational or agricultural land only.



Class IV - Soils in Class IV have severe limitations that restrict the choice of crops and require very careful management.

Use of these soils for cultivated crops is limited as a result of the effects of one or more permanent features such as:

(1) Steep slopes,

(2) Severe susceptibility to water and wind erosion,

(3) Shallow soils,

(4) Low moisture-holding capacity,

(5) Excessive wetness with continuing poor drainage.

Class IV soils may be cultivated occasionally with great care. When cultivated, very careful management measures must be used to see that the soil is not depleted by erosion. They should be kept in permanent grass cover most of the time.

B LAND LIMITED IN USE - GENERALLY UNSUITED TO CULTIVATION

The soils in the last four classes are not generally suited to cultivation but should be kept in permanent cover.

Class V - The soils in Class V have little or no erosion hazard but do have other limitations of such nature that it is impractical to remove them for normal tillage of cultivated crops. They are nearly level but are often wet and frequently overflowed by streams (bottomlands). They may be stony or have a combination of these limitations.

Examples of Class V land are:

(1) Bottomlands subject to frequent overflow which prevents the normal production of cultivated crops,

(2) Level or nearly level, stony or very rocky soils,

(3) Ponded areas where drainage for cultivated crops is not feasible, but where soils are suitable for grass or trees.

Because of these limitations, cultivation of common crops is not feasible, but pastures can often be improved and benefits from their good management can be expected.

Class VI - Soils in Class VI have severe limitations that make them unsuited to cultivation and limit their use largely to pasture, woodland or wildlife cover.

Soils in Class VI have continuing limitations that cannot be corrected such as:

(1) Steep slopes,

(2) Severe erosion hazards,

(3) Effects of past erosion,

(4) Stoniness,

(5) Excessive wetness or overflow,

(6) Low moisture-holding capacity.

Generally speaking, lands in this class should be used for permanent pasture or for woodlots. Pasture use should be adjusted to carrying capacity or season.

Class VII - Soils in Class VII have very severe limitations that make them unsuited to any cultivation and that restrict their use to limited forestry or wildlife. These soils may be very steep, severely eroded, swampy or shallow with rock outcrops.

Class VII lands may have many limitations for pasture or forestry. Generally speaking they should be in permanent forest cover. Some lands may be used for limited grazing and they may also have value for recreation or as wildlife habitat.

Class VIII - Soils in Class VIII have limitations that preclude their use for any commercial plant production and restrict their use to recreation, wildlife or water supply, or aesthetic purposes.

Such lands as very rocky areas, sand beaches, badlands or undrainable marshes are included in this class. Such lands are best suited for watershed protection or for recreation and sometimes wildlife.

5. Land Management Problems

Many factors contribute to the problems met in the management of soil. Some are physical problems of the land, others are economic or social. This report is concerned, however, with the physical problems of soil management.

In Ontario the major problems in soil management are those of drainage, fertility and erosion. On any one farm or on any given piece of land, one problem may predominate. There is often a combination of all three.

(a) Drainage

Of the different problems in soil management, one of the greatest is the safe disposal of excess water. Uncontrolled runoff can cause erosion. As much water as possible should be allowed to soak into the ground.

Excess moisture may be on the land surface or within the soil itself. On most land it is necessary to get rid of both. Adequately drained land is necessary for good farm management.

(1) Surface drainage

To remove excess water safely from the surface of the soil may require special measures. These measures may include grassed waterways, diversion ditches and protective devices along streambanks. There are many places in the

Raisin area where grassed waterways and other surface water disposal systems are needed. These may include ditches on farm fields or improved ditches and culverts along township and county roads.

(2) Internal drainage

A system of tile drainage is often used tc remove excess internal soil moisture. Tile drainage of wet soils is a major contribution to soil conservation. Some of the most productive soil in Ontario is productive only because it has been tile-drained. Drainage allows increased yields of crops in low wet areas and permits slopes where serious erosion is likely to occur to be planted to more appropriate crops. The controlled removal of excess water from fields can be an aid in combating soil erosion.

Tile-drained fields permit increased yields of crops of better quality. The growing season can be longer by reason of earlier planting. With drainage, more flexible crop rotations and management practices are available.

(3) Drainage conditions of watershed soils

Approximately 52 per cent of the soils in the Raisin Conservation Authority are well drained, 10 per cent imperfectly drained, 22 per cent poorly drained and 16 per cent very poorly drained.

The two most common soils of the area, Eamer and Grenville, are well drained. There are several imperfectly drained soils which would benefit from underdrainage providing that the cost does not make the project uneconomical. Poorly drained soils occupy a great deal of area in this Authority. Of these poorly drained soils, North Gower is the most common. Very poorly drained soils also occupy a great area. These soils are usually found in the hollows between the drumlinoid ridges and drumlins. These areas are almost impossible to drain and should be left in their natural state.

(b) Fertility

Soil fertility is the ability of any soil to supply the nutrients necessary for plant growth. Maintenance of soil fertility is one of the major problems in soil management.

Some soils are naturally fertile, others less so. Differences in soil fertility may be inherent in the soil itself or they may be related to past management practices. Soils that have suffered from erosion may have lost the more fertile topsoil. Such practices as the use of manure and crop rotations will have an influence on soil fertility.

Differences in the productive capacity of various soils are commonly recognized by the farmer on the basis of his experience and the crop responses. It should be noted here that soil fertility is not necessarily the same as soil productivity. An otherwise fertile soil may be limited by drainage conditions or other factors that lessen production.

It is difficult to measure whether or not soil fertility is being maintained. It might be assumed that if crop yields do not decrease, soil fertility is being maintained. However, the use of improved varieties of crops, better tillage methods and different planting methods may well maintain or increase yields without increase in soil fertility. Maintaining soil fertility is more than the application of fertilizer to the soil. It includes as well the maintenance of adequate organic matter, liming of acid soils and protecting the soils against erosion. Organic matter levels may be sustained or increased by the use of green manure crops, by application of barnyard manures or by working crop residues into the soil. Plenty of organic matter (humus) in the soil improves soil structure and makes better use of commercial fertilizers.

Soils should be tested before a commercial fertilizer is applied. Soil tests are a guide to the farmers in deciding the fertility needs of the soil. These needs and requirements may vary with past soil treatment and with the crop to be grown.

Most of the soils within the Raisin River Conservation Authority require addition of fertilizers for best crop responses. The sandy soils such as Kars and Rubicon should have fertilizers added as they do not have the inherent fertility of clays and clay loams. On most of the soils in the Authority, moderate applications of fertilizer combined with good management practices should provide good crop returns.

(c) Erosion

Soil erosion has been an agricultural problem ever since man began to till the soil. In some parts of the world erosion has damaged or completely destroyed great areas of land from an agricultural standpoint. Fortunately, in Ontario our soils are not generally subject to serious erosion, although many small areas are to be found on which erosion has caused much damage.

Soil erosion may be defined as the "movement of soil particles from one place to another by wind or by water". In Ontario, serious wind erosion is not usually widespread. There is no wind erosion, to any extent, in the Raisin River

onservation Authority. Most soils under certain conditions are subject to erosion y water runoff. Water runoff not only removes soil from the fields but has more idespread effects such as the pollution of streams, silting of ditches and reservoirs and clogging of drainage systems.

The most direct and perhaps most serious effect of erosion is loss of opsoil. Such erosion may be spectacular in the form of gullies; mostly, it occurs radually as sheet erosion. Topsoil contains most of the easily available plant utrients and valuable organic matter. Its loss reduces crop yield and hence the wner's profits. The loss of water from soil by surface runoff is the cause of soil rosion and is serious in itself - on many areas it can be more serious than rosion. Cultivation practices which decrease the possibility of soil erosion also ecrease excessive water runoff. This is particularly important during the summer onths when lack of moisture may be a limiting factor in crop yield. The more rainall that can be absorbed into the soils in dry seasons, the greater amount will be vailable for plant growth.

Much of the soil lost from the land eventually finds its way into tream courses and rivers. Many otherwise clear streams are polluted by soil wash. uch pollution, while not a health hazard, does affect fishing conditions in the treams; in some streams it can be a limiting factor. Silt blankets the stream beds nd destroys many organisms that live there and provide fish food.

Most of the soils found in the watershed are subject to erosion nless carefully managed. There are some areas of Grenville and Eamer soils where pecial precautions should be taken during cultivation as these soils are classified s erosion susceptible. There is some evidence of erosion along ridges and the teeper slopes, and in the bouldery phases of Grenville and Eamer soils, and these oils should not be cultivated in such situations. Even grazing should be carefully anaged, particularly in dry seasons. Grenville and Eamer soils show some evidence s well of rill and small ditch erosion on the sloping area.

Under natural conditions, soil is covered with vegetation which etards runoff and slows down erosion. When land is cleared for cultivation, the atural protective cover of vegetation is removed or reduced. Cultivation may hange the structure of the soil and reduce organic matter. Such changes may easily roduce a less productive soil in a short time.

Since soils must be cultivated for crop production, it is important o carefully fit the crop or the cultivation practice to the type of land being

used. Cultivation methods which use protective measures as close as reasonably possible to those used by nature give maximum soil protection and allow a minimum of runoff and erosion.

Of the several factors and practices affecting the susceptibility to erosion of any piece of land, the most important are the physical characteristics of the land itself. Soil texture and the length and amount of slope influence the amount of erosion that may take place. Along with this are the amount and time of rainfall and the cultural practices used on the land. The steeper the slope, the more rapid the runoff can be.

The type and pattern of rainfall affect erosion. Intense rains often lasting but a short time can cause serious erosion of unprotected land. Heavy spring rains when the surface of the soil is soft but the subsoil still frozen can be particularly damaging.

Vegetative cover, whether provided by trees or by grass or decayed plant matter on the soil surface, breaks the force of the rainfall and there is little or no runoff. Rainfall on clean cultivated land stirs up the unprotected soil and may cause serious erosion. Good sod cover will absorb rain rapidly and little runoff will occur. Grain crops will give the soil partial protection, row crops very little. Cultivating up and down the slope, soil left bare over winter and planting row crops on sloping land all contribute to water runoff and erosion.

6. Regional Forest Conditions

In Hills' classification the Raisin River Conservation Authority is located in the Kemptville Site District which is the eastern part of the Lakes Simcoe - Rideau Site Region.* This district is described as a plain of limestone and sandstone bedrock, covered shallowly to deeply with siliceous and low-base sand, low-base silt and moderate to high lime clay and loam. The Authority's soils are characterized by their stoniness containing a high proportion of limestone.

The prevailing forest association within the site region is broad-leaved, with beech, sugar maple and hemlock on normal fresh sites and oak and hickory on warmer fresh sites. Oak and ash are common on hot dry sites, sugar maple, oak and ash on normal dry sites and white pine, elm and ash on cold dry sites. Wet sites are commonly populated by hemlock, yellow birch, or spruce and white cedar.

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* Hills, G.A. A Ready Reference to the Description of the Land of Ontario and its Productivity. Division of Research, Ontario Department of Lands and Forests. Maple, Ontario. 1959.

The classification in Rowe's Forest Regions of Canada* includes this area in the Upper St. Lawrence Section of the Great Lakes - St. Lawrence Forest Region. In addition to the major cover types, Rowe mentions the local occurrence of red ash, wire or gray birch, rock elm, blue beech, butternut, cottonwood and slippery elm. Poorly drained depressions frequently carry a hardwood swamp type in which black ash is prominent. During survey, silver maple was found more as a major constituent of swamp areas in farm woodlots.

In addition to the usual representation of hemlock, white pine, white spruce, black spruce and white cedar, the conifers in the watershed include red spruce, but as a rarity.

One of the chief physiographic influences is the Glengarry Till Plain which exhibits a typical rolling relief and large areas whose outstanding feature is their stoniness. Maintaining a large permanent forest on these areas will be an important part in the Authority's overall program, since much of this region corresponds to the 43 per cent of the Authority that is considered untillable. This stoniness, however, will likely decrease the possibility of reforesting mechanically.

7. Forest Survey Methods

For the detailed forest survey of the Raisin River Conservation Authority, aerial photographs, each covering about 1,000 acres, were provided to the forestry party. Mapping in the field was done directly on these photographs.

Each area of woodland, scrubland, swamp and rough land was visited and described as to acreage, cover type, presence of grazing, reproduction and average diameter at breast height. Each woodlot was classified as hardwood, coniferous or mixed. The term "hardwood" is used to denote all broad-leaved trees regardless of their physical hardness. A woodlot in which 80 per cent or more of the trees are hardwoods is called a hardwood stand; one in which 80 per cent or more of the trees are conifers is called a coniferous stand, and all other stands are classed as mixedwood.

Plantations were likewise examined and records made of method of planting, approximate age, care, damage and survival.

Land suitable for reforestation was mapped.

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* Rowe, J.S. Forest Regions of Canada. Department of Northern Affairs and National Resources, Canada. 1959.

8. Forest Cover Types

The term "forest cover type" refers to those combinations of tree species now occupying the ground, with no implication as to whether these types are temporary or permanent. A slightly modified form of the system drawn up by the Society of American Foresters was used on the survey of the Raisin River Conservation Authority so that the system would adequately describe the cover types common to the watershed.

During the survey of 1964, 25 cover types were identified, but over half of these were scarcely more than traces, considering the acreage they occupied. Of the cover types that occupied significant acreages, at least 62 per cent were associated with moist to wet areas.

The following cover types were observed:

Type Number	Name
4	Aspen
6	Paper birch
7	Gray birch-red maple
9	White pine
10	White pine-hemlock
11	Hemlock
12	Sugar maple-beech-yellow birch
13	Sugar maple-basswood
14	Sugar maple
15	Yellow birch
21	White spruce-balsam fir-paper birch
22	Balsam fir
23	Black spruce
24	White cedar
25	Tamarack
26	Black ash-white elm-red maple
45	Bur oak
51	Red oak-basswood-white ash
52	Red oak
57	Beech-sugar maple
58	Beech
59	Ash-hickory
60	Silver maple-white elm
60a	White elm
88	Willow

Nine of these types made up over 92 per cent of the Authority's standing woodland. They are described in detail as follows:

FOREST COVER TYPES BY TOWNSHIPS

PERCENTAGE BY TOWNSHIP

1965

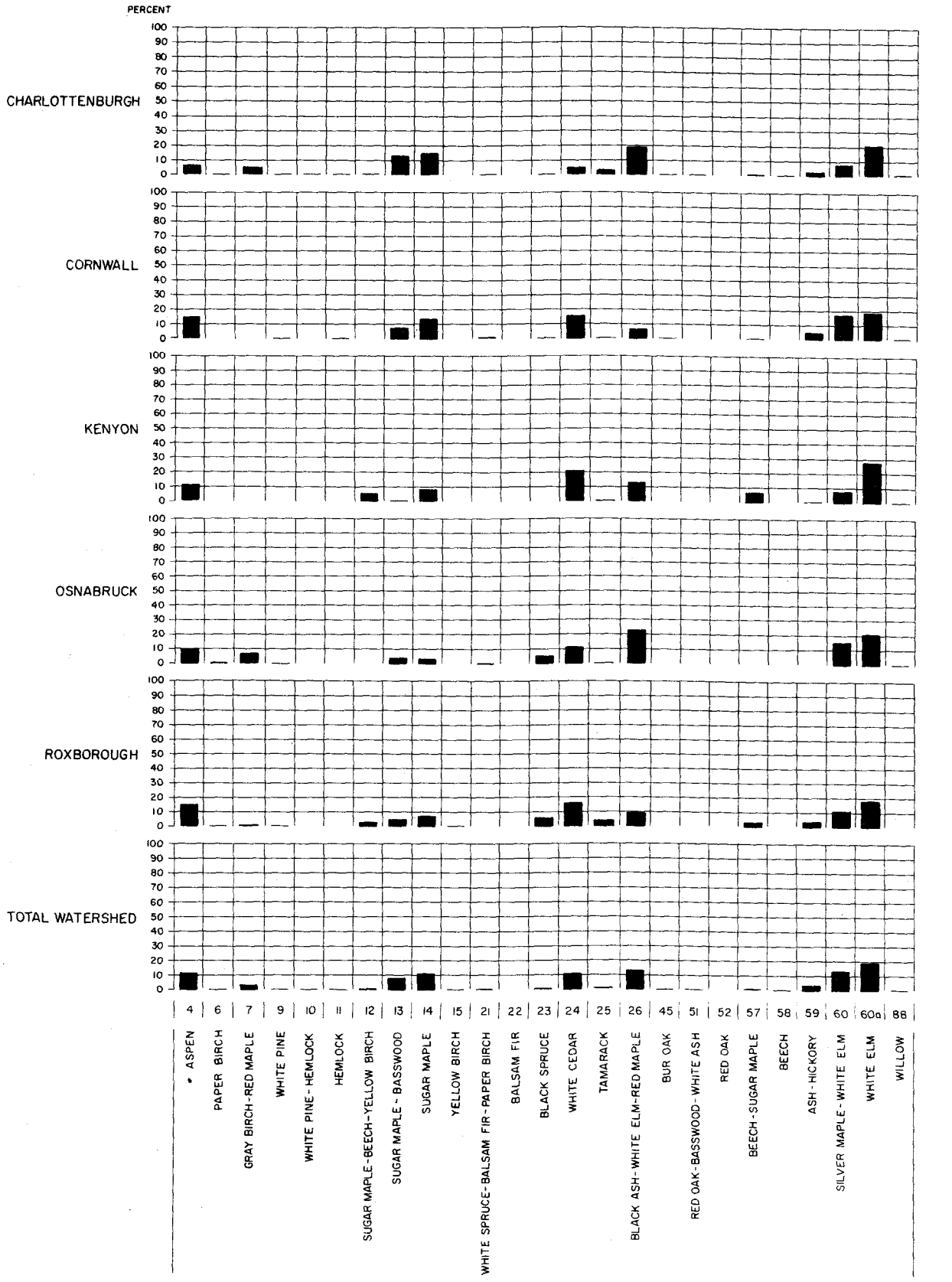

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FIG. 2

Type 4 - Aspen, occupies 11.8 per cent of the woodland area, mainly in Cornwall Township. Trembling aspen commonly functions as a pioneer type coming in after clear-cut operations, over-grazing or fire. It is a frequent invasion species on abandoned fields and pastures, a characteristic worthy of special interest on the part of the property owners in the Raisin River Conservation Authority.

Though it avoids the wettest swamps it does grow on soils that are wet throughout a good part of the year. Within the Authority, therefore, aspen is frequently associated with wet conditions although it may occur on droughty soils as well.

Aspen's associates may be large-toothed aspen, red cherry, white elm, paper birch and balsam poplar, the latter sometimes forming pure stands on moist sites. An understory of dogwood or of spruce and balsam fir on the wet sites, or of tolerant hardwoods on drier sites, is frequently present.

Poplar woodlots, if they have insufficiently well-stocked secondary constituents of more useful tree species, can be used as nurse crops for better species such as white spruce and white pine. These can be planted under the old canopy to the benefit of the stand. In the case of white pine, this method of stand improvement and replenishment will discourage white pine weevil activity without inhibiting normal height growth of white pine, so long as a level of 55 per cent of normal light intensity can be maintained in the stand.

The removal of up to 60 per cent of the overstory to favour white spruce is also a proven method of stand improvement.*

Type 7 - Gray birch-red maple, occupies 2.7 per cent of the woodland area. It is a more significant cover type in Nova Scotia, New Brunswick, and Southern Quebec, where it occupies greater acreages. However, it does penetrate into Eastern Ontario. It occupies a wide variety of sites from sand plains to heavy-soiled uplands and wet margins of streams and ponds. This type originates on abandoned farm lands and in cut-over white pine areas on the lighter class of soils. Gray birch is short-lived, disappearing in less than 60 years as more permanent species such as white pine or several hardwood types take over.

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* (1) Steneker, G.A. Results of a 1936 regulation cutting to favour white spruce in a 50 year old white spruce-aspen stand in Manitoba: Forest Research Division, Canada Department of Forestry, Publication No. 1005, 1963.

(2) Logan, K.T. Forest Research Division, Department of Northern Affairs and Natural Resources, Technical Notes No. 82, 1952.

Type 13 - Sugar maple-basswood, occupies 7.8 per cent of the woodland area. It is a type that appears on rich upland loamy soils. Its occurrence is spotty because of agricultural clearing, since most of the sites on which this type originally occurred were suitable for agricultural production. It may occur as a transition between sugar maple-beech-yellow birch and northern red oak.

Type 14 - Sugar maple, occupies 11.5 per cent of the woodland area. Sugar maple is either pure or predominant, with yellow birch, white ash, beech, northern red oak and white oak occurring as associates. It sometimes owes its vigour to cultural practices favouring maple syrup production, and it also may appear in small patches. Its original distribution was mainly on good sites for agriculture and it has, therefore, received considerable pressure during clearing operations.

Type 24 - White cedar, occupies 10.2 per cent of the woodland area. It is a type that occurs on the muck soils of swamps where drainage is slow. However, it does not occur in strongly acid swamps or stagnant bogs because water movement is necessary for the maintenance of the cedar. Under these conditions its common associates are black ash, white elm, tamarack, red maple, yellow birch, hemlock, white pine and white birch. It is a characteristic type on seepage areas.

Where lime is plentiful, white cedar may extend to droughty upland slopes, where it tends to form pure stands. It also occurs on the shallow soils of limestone uplands.

Type 26 - Black ash-white elm-red maple, occupies 12.8 per cent of the woodland area. It occurs on moist to wet muck or shallow peat soils and is found in swamps, gullies and small depressions of slow drainage or in elongated areas along small sluggish streams. It frequently grades into a white cedar type on the wetter sites. Balsam poplar, yellow birch and some white pine, tamarack, white cedar and basswood are found as stand constituents.

Type 59 - Ash-hickory, occupies 3.2 per cent of the woodland area. This is a type found throughout the deciduous forest on poorly drained soils. It may occur on any cut-over area. The predominant species are white ash, hickory and white elm.

Type 60 - Silver maple-white elm, covers 13.1 per cent of the woodland area. Its closely related type, 60a, white elm, occupies an additional 19.2 per cent, so that combined these two forest types occupy a major part of the watershed's woodlands. They occur on stream bottoms and on swampy depressions where the

land is too wet for agriculture unless underdrained. These two types often represent the left-over stands after settlement, since they were too difficult to clear because of the wet conditions. They may spread out into slightly drier sites on adjacent pastures as well.

Red spruce (Picea rubra) was nowhere abundant enough to form a major constituent in any stand but was identified occasionally as a minor species. It is more abundant across the St. Lawrence River in the U.S.A., but in Ontario it has usually been considered a rarity confined mainly to the south-eastern corner of the Province. For some years it was known to occur as a few specimens near Carnarvon in Haliburton but other identifications have since been reported.

9. Condition of Woodlands

Woodland in the watershed covers 40,921 acres, which is 24.5 per cent of the total area of the Authority.

The survey of 1964 showed that 78 per cent of the Raisin River Conservation Authority's woodland was hardwood, 13 per cent mixedwood and nine per cent coniferous. Of this forest cover, by far the greatest acreage is in the four to ten inch d.b.h. class, (56.3 per cent). This is the first age class at which woodland exhibits merchantability, especially for pulpwood or posts. Scarcely any of the coniferous segment of the Authority's forest cover is larger than the four to ten inch d.b.h. class (0.3 per cent of total woodland) and very little of the mixedwood (1.9 per cent). The remainder of the coniferous woodland (3.6 per cent) and of the mixedwoods (1.8 per cent) averages under four inches d.b.h., and therefore should be classed as regeneration.

The low volumes of coniferous stock in the older age classes may be attributed partly to the predominance of white cedar in the coniferous component of the Authority's woodlands. This cedar is probably in great demand as post material when it grows into the four to ten inch d.b.h. class and is therefore harvested as soon as possible.

Although 18.1 per cent of the woodland is hardwood in the 10 to 18 inch d.b.h. class, from which some sawlog material can be obtained, only 3.5 per cent is hardwood over 18 inches in average diameter, that age class where the presence of sawlog material is more consistent.

It should be remembered that there are few restrictions as to the species desired locally for pulpwood, thus presenting the property owner with a chance for a quick return when woodlots are at a relatively early age. Unless

careful management is used, therefore, profitable sawlog material may become scarcer, since the present tendency is to clear-cut for pulpwood. During the survey, over 2,200 acres were found to have been cut-over within recent years.

The grazing of woodlots is a matter of some concern to the Authority. It is common in 38 per cent of the Authority's woodland. This is a practice that is most detrimental to desirable shade and root tolerant species of trees such as maple, basswood and ash, since they are also the most palatable to cattle. In the case of the Raisin River Conservation Authority, only 20 per cent of the major forest types are of a tolerant nature. This indicates that cattle grazing is also affecting the remainder of the major forest types, which are mainly intermediate in tolerance and therefore do not produce a thick layer of forest tree seedlings. Consequently, cattle damage will tend to have a more serious effect on such forest types as the elm and silver maple combinations. Normally these stands are found properly stocked but regenerating poorly.

Since these same types are often on wet sites and therefore less desirable to cattle, the damage being done in this forest segment indicates the grazing pressure and need for pasture improvement as well as woodlot fencing.

Just over half (55.2 per cent) of the Authority's woodlots are fenced and the Authority should make every effort to improve this situation. In some other Authorities fewer woodlots may be fenced but the overall effect of woodlot grazing has been lessened because of a tendency to fence livestock in closer to farmsteads and feedlots for convenience and, therefore, away from the wooded section of each farm.

However, in the Raisin River Conservation Authority, much of the area grazed is of a lower agricultural capability, pastures tend to be close to woodlots, and the importance of woodlot fencing is greater.

Further indication of the forest deterioration by constant grazing is the existence of over 3,000 acres of wooded pasture. These are areas supporting natural meadows that are heavily grazed and containing low density stands, often composed of a few large open grown trees with wide spreading crowns. Very often, these were originally woodlots that gradually reverted to this type of cover naturally because of continued grazing.

Stocking also represents a woodlot problem in the Authority, as 61.3 per cent of the forest cover is either understocked or poorly stocked. This condition indicates a need for a type of woodlot management that promotes increased

WOODLAND CONDITIONS BY TOWNSHIPS

PERCENTAGE BY TOWNSHIP
1965

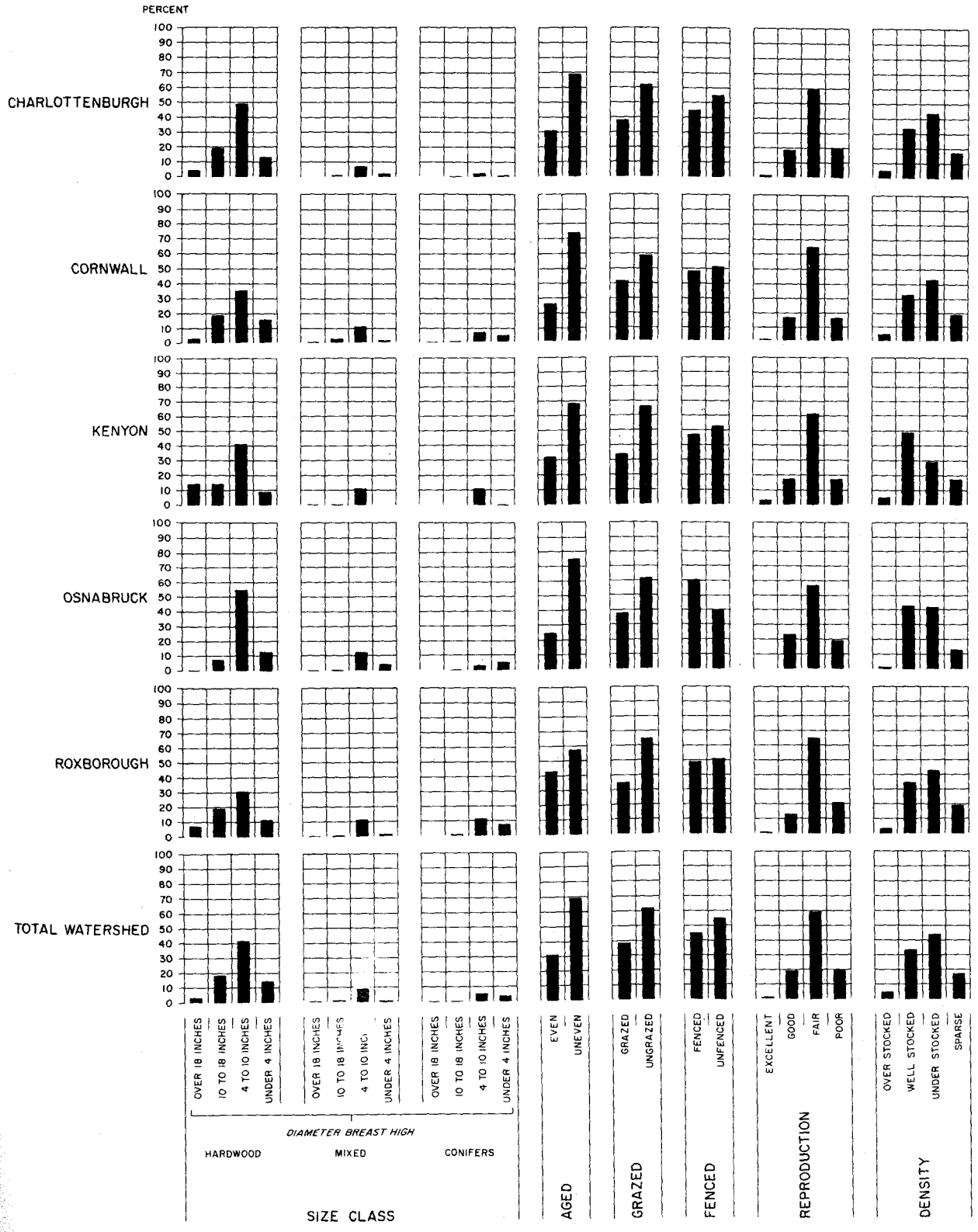

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FIG. 3

natural regeneration of desirable tree species or deliberate reforestation of existing low stocked woodlots, either by underplanting or interplanting.

10. Scrublands

Areas covered with shrubs or tree species that will never attain commercial size occupy 14,568 acres within the Authority. This represents about 24 per cent of the uncleared area of the Authority. Over half of the scrubland acreage (57.3 per cent) consists of dry scrub in which some of the common species are hawthorn, wild apple and sumac, common constituents of scrublands of southern agricultural Ontario. The remaining 42.7 per cent is wet scrub, where willow and dogwood are the chief species.

Prickly ash (Xanthoxylum americanum) is also a feature of some of the Authority's dry scrubland. In some areas it virtually covers whole fields and it is also found frequently in sparsely stocked wooded areas. This nuisance provides an added reason for maintaining normal stocking in woodlots, either by employing proper management practices or by reforesting where necessary.

Prickly ash is an upright much-branched prickly shrub which often spreads to form dense impenetrable thickets that can grow to a height of 10 feet or more. Like hawthorn it can invade an area after abandonment or mistreatment and in a short period of years can render invaded lands worthless or difficult even to reforest.

If areas experiencing invasion by scrub cover cannot feasibly be returned to agriculture, they should be reforested either by incorporating them into the Authority Forest or by subsidizing the reforestation of such areas by private individuals. The success of such ventures depends on the density of the cover. Reforestation can compete successfully against dry scrub if it is planted when openings still exist in the stand, but at a state of complete covering the inhibition of planted trees is considerable and may produce failures.

Wet scrubland can often be returned to better agricultural use through improved drainage systems or other measures to eliminate this form of cover. Where restoration for agriculture is not feasible, wet scrubland can either be reforested or used as a pond site.

TABLE III

DISTRIBUTION OF SCRUBLANDS

Township	Dry Scrub	Wet Scrub	Total
Charlottenburgh	2,127	1,755	3,882
Cornwall	3,398	4,549	7,947
Kenyon	46	39	85
Osnabruck	55	614	669
Roxborough	593	1,392	1,985
Total	6,219	8,349	14,568

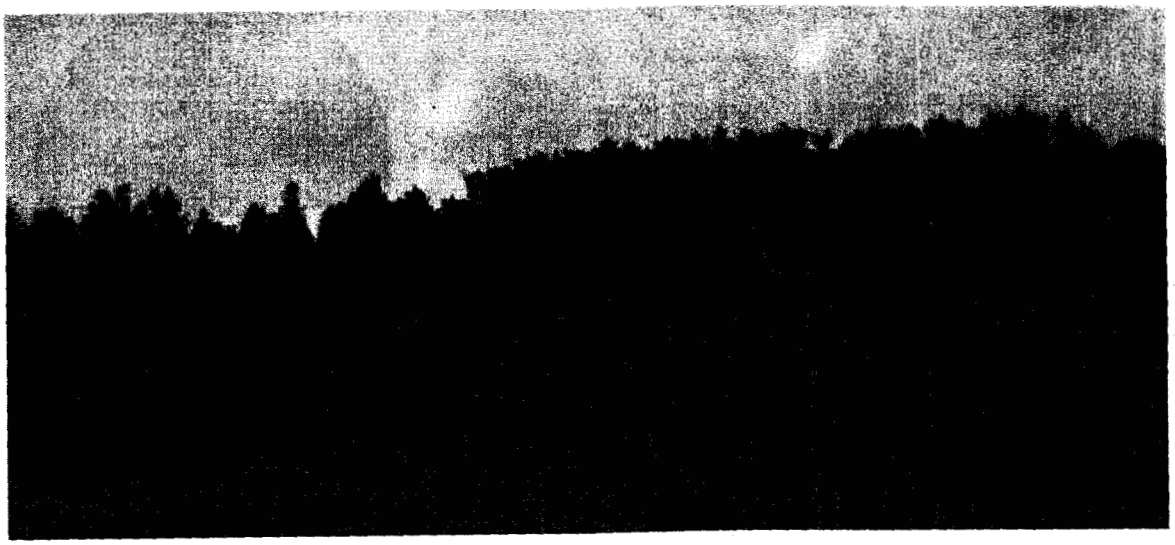
11. Present Private Planting

A total of 249 acres of private plantation have been established on the Raisin River Conservation Authority, representing 28 separate plantations. Plantation size ranges from two to 22 acres, the average area being just under nine acres. It could be said that reforestation within the Authority on the part of private individuals has been lethargic. In other areas, the interest in reforestation has increased within the last 10 to 15 years, particularly with the greater popularity of Christmas tree culture. In the Raisin area it is true that over half of the private reforestation is between one to 10 years of age, but it represents only a total of 136 acres, not a large area for a region that exhibits a considerable acreage of open marginal land. There has also been little increase in the average size of the area planted by each individual in the last 10 years as compared to the earlier period.

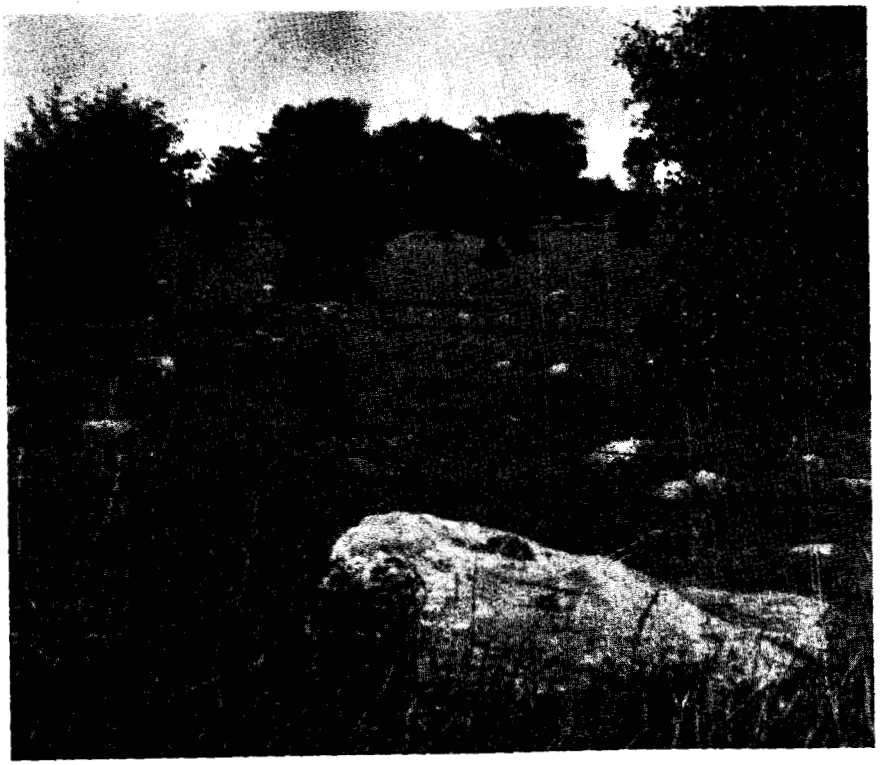
There has been no particular local desire to grow Christmas trees, since only 24 per cent of the Scotch pine, the species favoured for this form of culture, is in the age class from which Christmas trees are harvested. Even these do not exhibit the care and quality required for the market.

Mixtures of coniferous species such as Scotch pine, white pine, Jack pine and red pine have been tried, but the larger plantations have favoured the use of single species, mainly red pine or white spruce. During the survey one mixed plantation was found to contain some planted hardwoods.

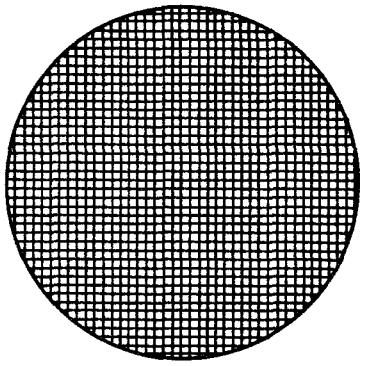
It can be said that the location of private plantations indicates a local desire to replenish woodlots, filling in the open spaces of the present



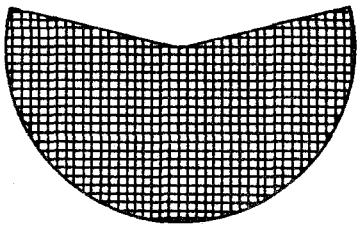
Wet scrub areas can be rehabilitated through reforestation.



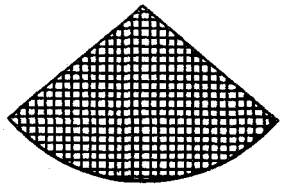
Poor pastures partially covered with scrub should be reforested. Note the shaping of these hawthorns by grazing cattle.



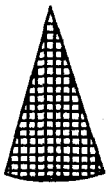
TOTAL AREA OF WATERSHED
167,040 Acres
100%



OPEN LAND
105,982 Acres
63.4%



WOODLAND AND PLANTATION
(INCLUDING WOODED PASTURE AND CUTOVER)
46,480 Acres
27.7%



SCRUBLAND
14,568 Acres
8.9%

RAISIN RIVER

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LAND CLASSIFICATION
TOTAL WATERSHED

FIG. 4

ral woodlot pattern or in extending the edges of natural woodlots, since 80 per of the local plantations take this form. Only four of the plantations ined during the survey would qualify as a form of shelterbelt.

The care of private plantations is generally lacking. This means these plantations can be a risky investment, since high timber quality is one he main aims of reforestation and low quality plantations simply do not produce necessary returns.

During the survey, over 30 per cent of the older plantations were nd to be in need of thinning or pruning. Both of these practices serve to rove timber quality and, since most of the private plantations within the hority are small, this practice is within the capability of any property owner perform himself during the off season.

Immediate post-planting care is also a necessary plantation manage- t practice and between 20 and 25 per cent of the plantations observed needed this pe of care. Five plantations needed replacement planting because of poor seedling rvival and three needed grass and weed control.

Like any other crop, trees continue to need attention through their rious stages of development. The methods of maintenance should include periodic spection, regular periods of pruning, systematic thinning, the replenishment of lled areas and areas of poor tree development and treatment for insect or disease tbreaks.

This latter point is one of importance in the Raisin River Conserva- ion Authority because it appears that the growing of white pine is favoured by roperty owners, as indicated by the presence of white pine in pure stands or as a ajor stand constituent in 50 per cent of the private plantations examined. Four of hese plantations were experiencing damage by the white pine weevil and three were ffected by white pine blister rust.

Demonstration Woodlots and Tree Farms

An early effort to promote good woodlot management was made by the rtment of Lands and Forests when it established a number of demonstration wood- . These were areas of private woodland on which owners agreed to follow cribed methods of woodlot management and to permit access to the area by inter- d persons.

The original aim of many of these was to improve regeneration and to strate the various management practices needed to improve woodlots. These were

to be done by the individual property owners concerned. Unfortunately, and for many reasons, some of these management practices have gradually fallen into disuse, although the original efforts did produce worthwhile results.

Since 1952, a movement has been under way to recognize well-managed forest properties as Certified Tree Farms. This work has been done by the Canadian Forestry Association with the sponsorship of several organizations interested in better forestry. In 1953, this association formed a National Tree Farm Committee to recognize with a suitable sign and certificate those owners who agree to maintain their land for growing forest crops and protect the land adequately, agree that cutting practices will be satisfactory to ensure future forest crops and permit inspection by Committee foresters.

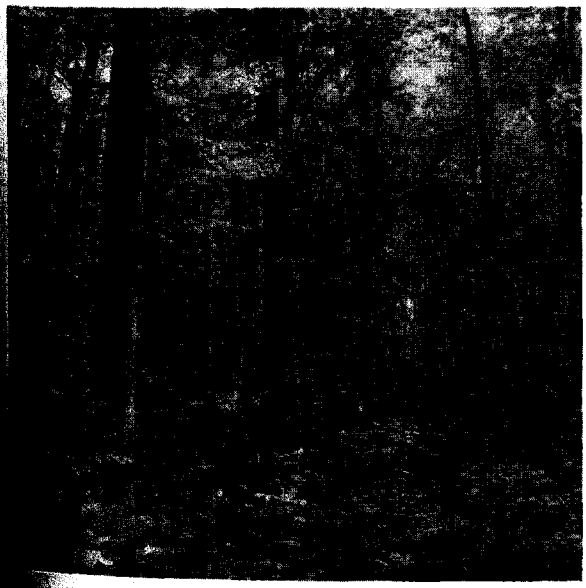
This movement should be of interest to the Raisin River Conservation Authority because it has been particularly active in Glengarry County. Though the chief concentration is outside the Authority in Kenyon and more particularly in Lochiel Township, the Authority does contain all of the certified tree farms in Charlottenburgh Township (4) and two of those pending certification. In Stormont County the four tree farms already certified are outside the Authority area but one that is pending is within the Authority, in Cornwall Township, north of Harrisons Corners. These tree farms range from 13 to 40 acres in size. For practical purposes they can serve as useful demonstrations and produce some supplemented income but they do not represent a sufficiently large area from which a reasonable income can be made by the property owner, should his aim be to live entirely off his woodlot operation.

J.L. Mennill, in an article written for the Ontario Forestry Association pointed out that in order to make a reasonable family income in tree farming ($7,808), at least 600 acres of growing stock was required, consisting of six age classes. The article also suggested that the farm would have to be well stocked like a plantation, having a productive capacity of one cord per acre per year.

In more irregular natural forests of Northern Ontario, experienced professional foresters have estimated that an area of at least 1,400 acres of productive forest per family would be required to derive a reasonable family income. In addition, it would be a considerable advantage if the property were close to an assured market, such as a kraft paper mill, and had a system of access roads. Extra income might be derived from any recreation potential existing in the form of a lake on the property or slopes suitable for skiing.

Openings in gray birch stands can be planted to desirable conifers that will grow into sawlog material.

The best trees in each hardwood stand should be left to grow into the higher quality timber products such as veneer.



Natural regeneration, as shown here, should always be maintained on the forest floor.

For the owner who has only a small property and wishes to make the of its limited production, it is just as necessary to concentrate on the growth gh quality diversified woodlot products in order to derive the maximum profit. per use based on short term profits does not provide maximum benefits and can t in decertification by the Committee. This has already occurred once in arry County, because clear cutting indicated a lack of intent to maintain the ot in perpetuity.

Implementation of the program is usually at the discretion of local sion foresters either in government or industry. The Tree Farm Movement is fore really a promotional effort to arouse and maintain interest in proper ot management.

County Forests

Many counties have established forests under agreement with the io Government. Enabling legislation for the establishment of county forests assed as early as 1911, but was not put into effect until the establishment of lendrie Forest in Simcoe County in 1922. The work is done at present under the Act of 1960 and the Forestry Act of 1952. These Acts provide for the purchase nds and for their management under agreement between the County and the Ontario nment.

Sections of the Stormont and Glengarry County Forest in the Raisin Conservation Authority amount to over 525 acres, more than double the acreage ivate plantation. The county properties represent a much greater concentration rest acreage than the scattered small private areas. The county forest rties in the Authority are to be found east of Gravel Hill, between Martintown t. Raphael West and north of Summerstown Station.

Although these properties contain some naturally forested sections, do exhibit a feature that should be of considerable interest to local property s, the use of reforestation to make areas covered with various forms of scrub h more productive.

Forest Conservation Measures in Other Areas

(a) Tree-Cutting By-Laws

Under the Trees Conservation Act of 1946 and its successor the Trees (R.S.O. 1960), 23 counties have passed by-laws to restrict and regulate the ing of trees. Stormont County and Glengarry County have not passed any such

by-laws.

These by-laws do not interfere with the right of the owner to cut material for his own domestic use, but specify certain diameters below which trees may not be cut for sale. Such diameter limits are only an elementary step to prevent indiscriminate slashing of woodlots, but where these by-laws have been enforced rigidly they have proved of considerable benefit. There will, however, usually be fast growing trees above the diameter limit which are increasing rapidly in value and should be left for future cutting. There will also be poorly formed or diseased trees below the limit which should be removed.

Better than a rigid diameter limit is the marking of trees for cutting according to their condition. Professional advice on such marking is available through the Zone Forester, special extension foresters or through private professional foresters whose location can be obtained from the zone office.

(b) Municipal Forests

Several municipalities other than counties have established forests which are eligible for assistance from the Department of Lands and Forests. These are being used for such purposes as screening residential areas from factory areas, for protecting reservoir lands and for revenue production. Charlottenburgh Township has two forest properties that are just out of the Authority, west of St. Raphael West and south of Glenroy.

(c) 4-H Clubs

These clubs are organized by the Ontario Department of Agriculture assisted by the Department of Lands and Forests and must be sponsored by an organization interested in the improvement of woodland and reforestation.

Members must be between 12 and 21 years of age and each member undertakes a project such as marking a half acre plot of woodland for thinning or reforesting a quarter acre of land. For this purpose the Department of Agriculture furnishes $3.00 per member and the sponsoring organization $1.50. Winners may enter the Provincial Inter-Forestry-Club competition.

It is recommended that the Authority co-operate with provincial departments concerned in fostering forestry work in 4-H clubs within its bounds, since it is evident that a great deal of the region should be converted to a well-managed farm-forest economy.

(d) The Department of Woodlot Management of Macdonald College

The work accomplished by this department is within two hours driving

.stance of almost anywhere in the Authority, and is therefore a point of almost
ıique interest for property owners who wish to observe the result of recent
›restry research specifically directed at the farm woodlot.

Of particular interest are the following studies recently carried
ıt:

(1) Woodland improvement

Woodland improvement operations, controlled by tree marking in
lvance of cutting, have been performed at the college. The demonstrations are
·aded for use by owners in keeping with their income levels.

These include a strip-cut designed to demonstrate the silvicultural
·eatment necessary for farm owners who would otherwise clear-cut from time to time
·r quick profits rather than ration their work properly until a second crop grows
› in cut strips.

The second demonstration in this category is aimed at middle income
mmercial woodlot owners who may be more conservative in their operations but
vertheless still cut severely. This is a diameter limit cut utilizing trees
·om 11" to 16" d.b.h. depending on their vigour. Vigorous trees are left to reach
e upper limit of the diameter class before cutting.

The third demonstration illustrates a recommended harvesting practice
r woodlot owners who can afford to invest in their forests and to build them up
r future high-quality timber production. This demonstration employs a single-tree
lection or partial cutting system that promotes the growth of a high-quality,
ade-tolerant forest cover where cutting least disturbs the established species.

(2) Maple research

These experiments were designed to improve the management of maple
odlots for syrup production. A sophisticated system of plastic drop lines is
tablished throughout the woodlot and collection is done by means of a vacuum
mp.

Paraformaldehyde pellets in tap holes are used in conjunction with
e pipe line systems to control fungal and bacterial action in the process of
tracting sap and afterwards, when infection of trees can occur from the tap holes.

Tests on various other aspects on sap production are also being
formed and it is expected that work on the control of rodent damage to pipe lines
l be done in the future.

These experiments and frequent tours and discussions are designed to improve the future of the maple products industry.

(3) Other research

Other fields of forestry research into which this department of Macdonald College is probing include:

(i) Winter injury to native Canadian and exotic species,

(ii) Several forms of plantation management such as Christmas tree production, white pine blister rust control and knot-free timber in red pine,

(iii) Wetlands planting,

(iv) Hybrid poplar planting,

(v) Hybrid larch fertilization,

(vi) Hardwood plantations.

CHAPTER 4

FOREST CONSERVATION MEASURES REQUIRED

Authority Forest

It is evident that a consolidation of forest properties into more ıomic units is needed in the Authority to provide a sounder base for forest ıgement practices. In addition there are cleared areas too stony for cultivation ;hat have experienced considerable invasion of scrub cover that should be ›rested to more desirable tree species. A general pattern of proximity of wood- l to stream systems indicates a need for careful logging control to prevent ;ion and siltation. However, no significant erosion along the river system ›er has been observed, except in some areas where stream-bank damage has been ;ed by cattle. It is suggested that adequate erosion control in forested areas generally be achieved through careful forest management. The susceptibility to ;ion of some of the soils in the Authority (e.g. Eamer) has been noted in the l section.

In addition, much of the natural forest acreage in the Authority is .eed of the type of management that will prevent wasteful exploitation and pro- for the production of more diversified products such as pulpwood, sawlogs and er.

Consequently, an Authority Forest has been mapped showing those ·erties most in need of acquisition for the establishment of permanent public st areas. These are described according to the townships in which they are ted. The total area recommended is 35,997 acres, or just over 22 per cent of total Authority area.

(a) Roxborough Township

The recommended Authority Forest areas in this township are in the waters region of three of the major tributaries of the Raisin River system. The recommended, 7,606 acres, consists of two main sections, a series of land ks in the Gravel Hill - Monckland Station area and a fairly solid block at the age of McMillan Corners and immediately west of it.

A third of the forest of the first section consists of large areas of red fields that have shallow soils in need of reforestation. There are also ral large areas of wet scrubland that should be made more productive through

reforestation. The remainder consists of natural woodlots mainly on wet or moist sites that are in need of more careful management.

The major portion of the second section also consists of mainly wet to moist site woodlots and some wet scrubland. Again, 30 per cent of the area consists of open fields and meadows that should be reforested. Included also are just over 200 acres of wooded pasture. It is suggested that these are lands of too low a potential for pasture improvement and should therefore be returned to forest cover.

(b) Kenyon Township

Only a small part of this township lies within the Authority. The properties in the township recommended for acquisition for Authority Forest purposes adjoin the areas recommended in Roxborough Township. A total of 658 acres is recommended for purchase, of which 57 per cent is forested and 39 per cent is open land that should be reforested.

(c) Osnabruck Township

Almost 70 per cent of the area recommended for incorporation into the Authority Forest in this township is woodland of some type. It consists of two main blocks of land adjacent to the upper reaches of the Raisin River, including one source water area west of Bunker Hill.

There are some clear sections in these blocks and at least two of them contain small fields exhibiting a desirable agricultural capability but at present being operated in units too small to be economic. These could be kept in agricultural production by consolidation into larger units and either resale or leasing.

(d) Cornwall Township

A feature of the Authority Forest recommendations in this township are the extensive areas of organic soils and the stony and bouldery phases of the Grenville Soil Series, that are now forest covered. These are in an irregularly shaped block of properties stretching from Northfield Station to McMillan Corners, Bonville, Sandfield Mills and St. Andrews.

Although some small areas of reasonably good agricultural capability exist in this section of the township, their chief limitations in many cases are the stony soils. It is therefore suggested that the small size of individual properties coupled with the amount of natural forest and the agricultural limitations, warrant

return of the open areas (24 per cent of the total) to forest cover rather than ther clearing.

Similar conditions of large areas of natural forest cover and stony ls limiting the degree of agriculture feasible to the small farm units that are sent exist in the lower block recommended for incorporation into the Authority est in this township. This area forms an almost solid block of over 9,000 acres etching from east of Lunenburg almost to Grant Corners.

In addition, over 2,000 acres of wet scrubland, and 1,700 acres of scrubland, are also present in the areas recommended, which should be reforested soon as possible for land rehabilitation purposes.

As in the previous township the better agricultural parts of the as are to be found on either side of road systems and these could be reorganized returned to agriculture.

Within the sections recommended are areas that have experienced ion development of rural dwellings and farm buildings. To avoid unnecessary cost dislocation of residents, these small holdings would be excluded from the ority purchases.

Such holdings in Cornwall Township are:

(1) along the east side of the St. Andrews-Bonville road,

(2) along the north side of the road between Concessions V and VI east of the St. Andrews-Eamer road,

(3) along the north side of the road between Concessions VII and VIII west of Bonville, and

(4) along the north side of the road between Concession II R 4 and Concession III R 5.

(e) Charlottenburgh Township

The 5,053 acres recommended for use as an Authority Forest in this ship is situated in four small blocks. The first adjoins the eastern end of the e block recommended for the northern region of Cornwall Township and joins it to Kenyon Township block.

The second is a series of properties east of Martintown close to the Raphael road, characterized by the irregularly rolling and bouldery Eamer soils are prone to erosion. Over half of this series of properties is forest covered. remaining clear sections that require reforestation are mainly centred in lots 21 of Concession VII, an area of over 570 acres.

Two additional areas recommended for Authority Forest acquisition are centred around Cashionglen and Glenbrook Station. Reforestation is necessary in the Cashionglen area but the Glenbrook block is mainly forested with wet site woodlots.

In review, it can be seen that the recommended Authority Forest is designed to function as a means of forest consolidation in order to create units that will lend themselves to better forest management and production. Because the existing woodlots in the recommended areas are frequently adjoining streams and swamps, the management methods used should include techniques to control sedimentation.

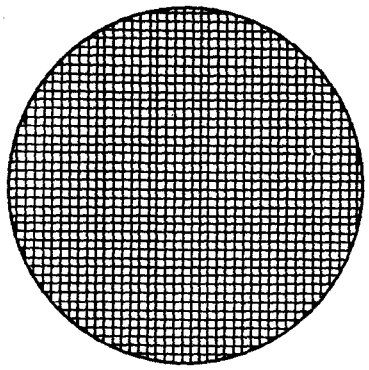
In addition, 17 per cent of the recommended acreage consists of scrublands in need of rehabilitation through the establishment of more productive cover. As well, there are cleared sections, having stony and bouldery soils and often exhibiting an irregular relief, that do not lend themselves to economic farm units, that should be reforested, including areas of the Eamer soil series that are susceptible to erosion.

TABLE IV

RAISIN RIVER CONSERVATION AUTHORITY
RECOMMENDED AUTHORITY FOREST IN ACRES

Township	Woodland	Wooded Pasture	Open	Wet Scrub	Dry Scrub	Total
Osnabruck	1,188		417	85	12	1,702
Roxborough	3,358	211	2,569	1,065	403	7,606
Cornwall	11,075	660	5,299	2,174	1,750	20,958
Kenyon	379	5	259	11	24	678
Charlottenburgh	2,744	78	1,598	229	404	5,053
Totals	18,744	954	10,142	3,564	2,593	35,997

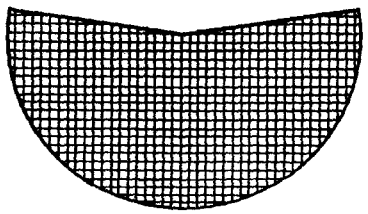
The Larose Forest in the neighbouring United Counties of Prescott and Russell provides an example of a managed agreement forest on a large scale and in a consolidated block form. Land was first acquired for this forest in 1928, so it is possible to get some idea of progress on its operation to date, as well as some projections as to its future worth.



TOTAL AREA OF
RECOMMENDED
AUTHORITY FOREST

35,997 Acres

100%

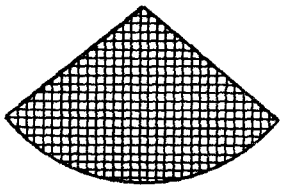


WOODLAND AND PLANTATION

(INCLUDING WOODED PASTURE AND CUTOVER)

19,698 Acres

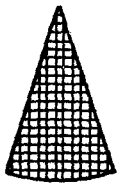
54.8%



OPEN LAND

10,142 Acres

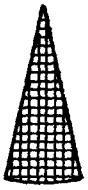
28.1%



WET SCRUB

3,564 Acres

10.0%



DRY SCRUB

2,593 Acres

7.1%

RAISIN RIVER

CONSERVATION AUTHORITIES BRANCH Dep't. E.&R.M. DMc 1966.

LAND CLASSIFICATION
RECOMMENDED AUTHORITY FOREST

FIG. 5

Reports on its management indicate, that annual expenditures set an easing trend for 33 years but have begun falling off since that time. Lower mates for future spending are explained by the omission of planting costs after), and a shift towards stumpage sales and lower costs anticipated for protection road building.

To date, the greatest expenditures have been for planting, operaal staff, roads and fire-guards and woods operations. Lesser expenditures have necessary for protection, fencing, equipment and buildings.

By the year 2,000, it is estimated that the forest will be worth 00,000, based on stumpage values of standing timber and products removed up to time, with 45 per cent of the revenue at that time having been derived from nings. These values are generally considered conservative as, historically, st product values have been increasing at about two per cent annually. Future es are also more likely to be based on a greater diversity and quality of ucts such as veneer and sawlogs, which should provide a total possible contrion to the community in income from harvesting, trucking and processing of five s the value of the raw material given above.

Private Lands Improvement Programs

Even in better farming areas in Ontario there are small tracts which, any number of conditions, are in need of return to tree cover. Such conditions mall islands of poor or rocky soils, areas of poor drainage or small areas cut from the rest of the property by drainage ditches, old gravel pits, small or ow areas of steep topography such as eskers, steep pitches and banks, are all ons for the use of a limited acreage for reforestation. Often such areas, gh providing some shelter or erosion control, may contribute little to the idual farm, but when joined to others in a systematic fashion may, combined, orm a more useful function for the community as a whole. Reforestation of long ow ridges and banks are examples of this type of function. In addition, in the in River Conservation Authority, many small areas of scrubland or wooded pasture in present woodlots and might better be reforested and included with the wood-

These areas have often not been privately reforested heretofore use the owner had some minor use for the area, because he was discouraged by the period between planting and harvest of a forest crop or, more commonly, simply use of inertia on his part.

It is suggested that a reforestation of private lands assistance program should be given serious consideration by the Authority, particularly in Charlottenburgh Township. Recent examination of the agricultural potential of this township indicates that the capability for agricultural production from Martintown southward is reasonably high. However, the township also contains the second largest total area of scrubland (3,882 acres) and wooded pasture (1,142 acres), 7.5 per cent of the total area of the township in the Authority, indicating possible lethargy on the part of some property owners in preventing the invasion of unwanted species and in maintaining the full agricultural productivity of which the area is capable. These areas are mainly alongside the present woodlots.

The Authority therefore should consider assistance in improving these areas by reforestation or, where suitable, by restoration as improved pasture. The areas most suitable for application of such a program are indicated on the map as private land improvement areas.

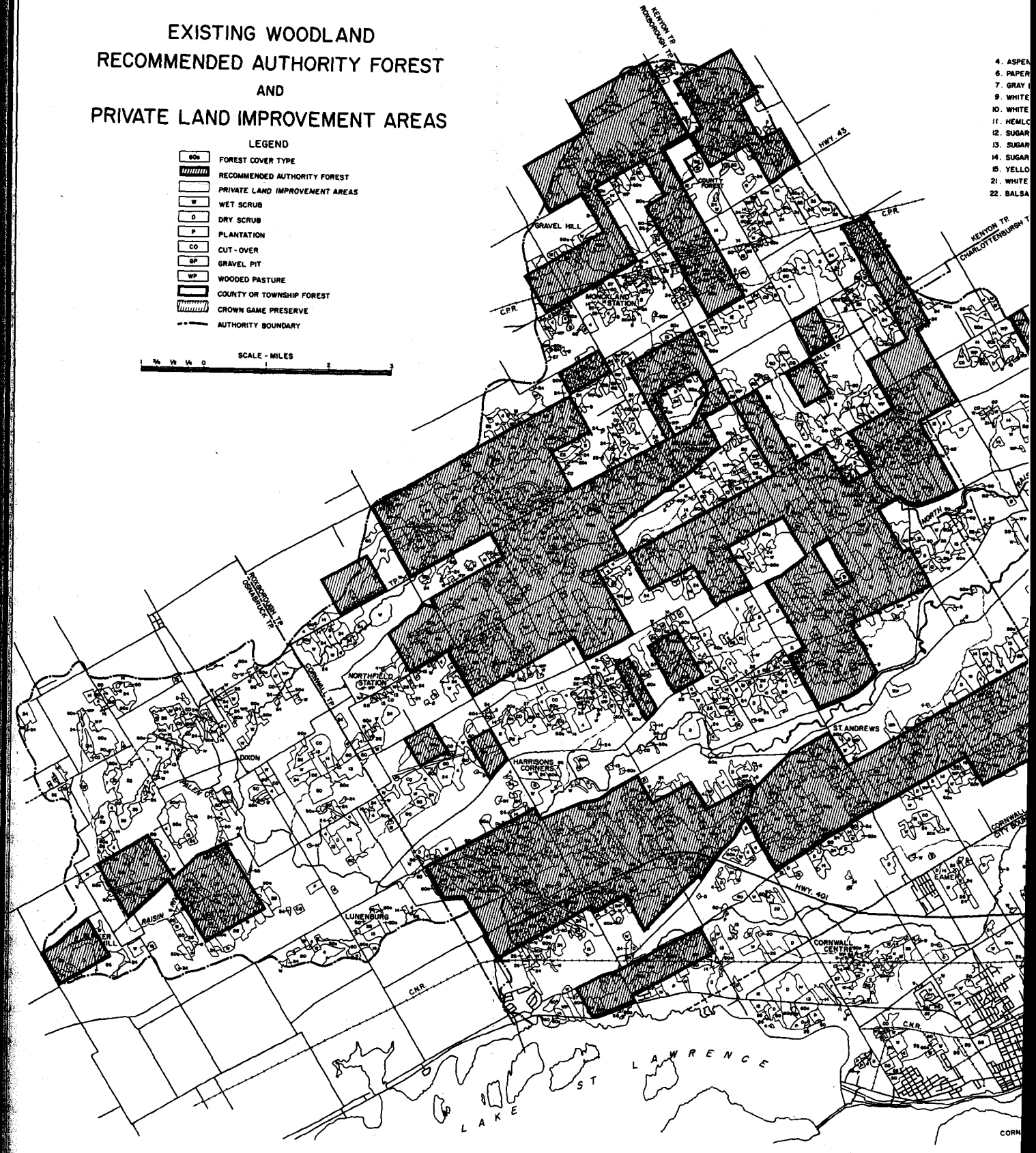
3. Forest Research

Detailed scientific research is the task of universities or government departments with greater research facilities than are available to a conservation authority. Large-scale application of proven methods is the task of private owners or of the Department of Lands and Forests in managing authority forests. Between these two extremes, however, there are many possibilities for small-scale investigations which are urgently needed and which the Authority might encourage on its own land or on private land under agreement. Determination of the best planting methods on difficult sites such as valley slopes, comparison of growth in different plantation mixtures, investigation of the value and cost of cultivation in plantations and the actual improvement in woodlots following thinning or other treatment are all projects which would guide the people of the watershed in managing their own plantations and woodlots. The Authority should encourage such investigations and co-operate with the Department in carrying them out.

4. The Authority and Conservation Education

Many agencies at present do, or can, engage in conservation education. The Authority can supply opportunities and materials to encourage and enlarge these activities. Wall maps, literature, conservation pictures and conservation lectures supplied to the schools will help to give geography, history and conservation practices a local significance. Building up a library of slides on local

EXISTING WOODLAND
RECOMMENDED AUTHORITY FOREST
AND
PRIVATE LAND IMPROVEMENT AREAS



FOREST COVER TYPES

	23. BLACK SPRUCE
	24. WHITE CEDAR
ED MAPLE	25. TAMARACK
	26. BLACK ASH - WHITE ELM - RED MAPLE
EMLOCK	45. BUR OAK
	51. RED OAK - BASSWOOD - WHITE ASH
BEECH - YELLOW BIRCH	52. RED OAK
BASSWOOD	57. BEECH - SUGAR MAPLE
	58. BEECH
	59. ASH - HICKORY
BALSAM FIR - PAPER BIRCH	60. SILVER MAPLE - WHITE ELM
	60a. WHITE ELM
	86. WILLOW

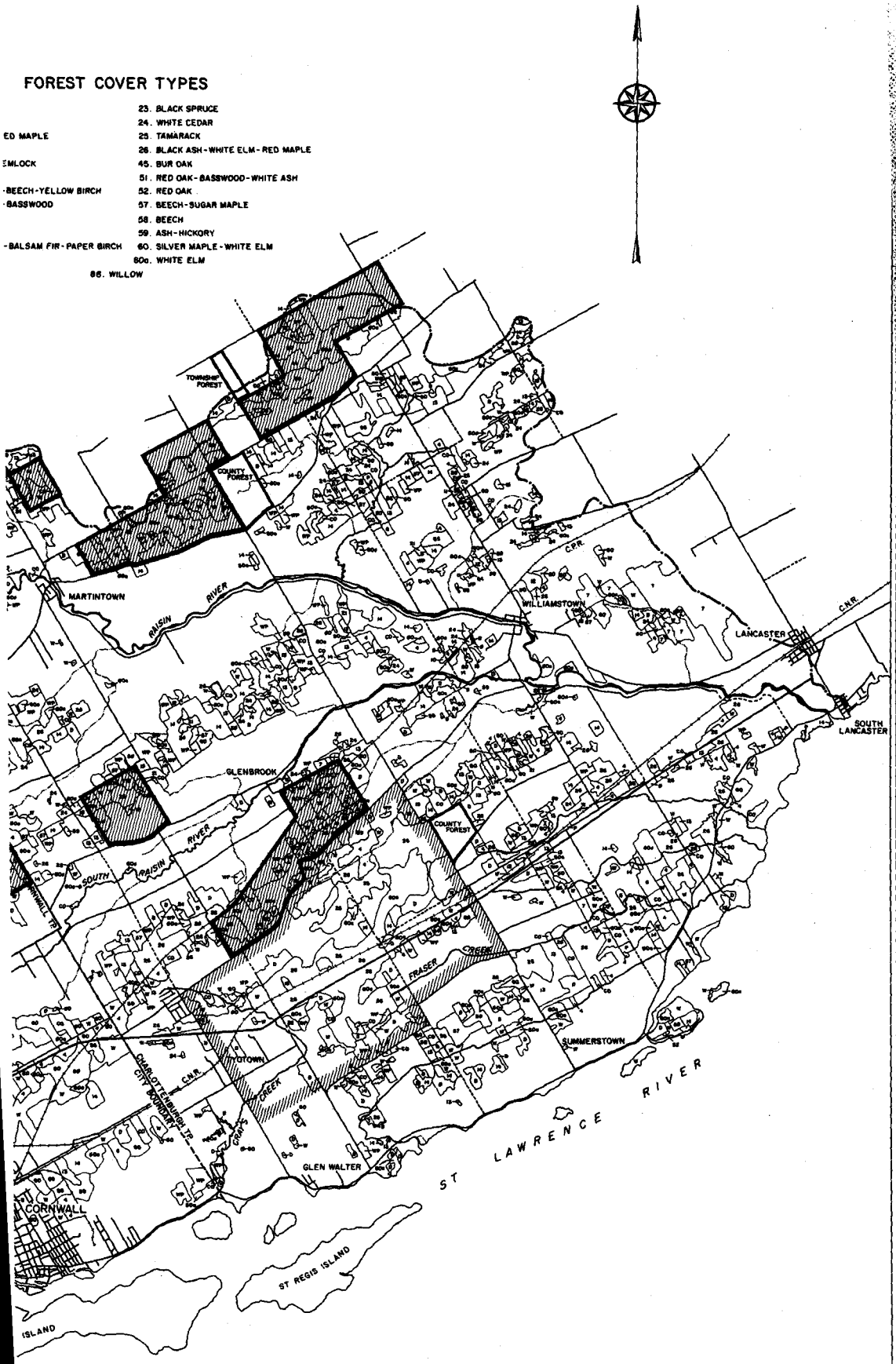


FIG.6

CONSERVATION AUTHORITIES BRANCH, Dept. E.B.R.M., W.J.C. 1966

ervation problems and accomplishments would be of great assistance to speakers. ıization of public meetings and contact with individuals and groups such as farm ıs will gain support for both private and public conservation efforts. Land-'s should be encouraged to make greater use of the services available from the ervation Authority and from officers of the Department of Lands and Forests and)epartment of Agriculture.

The most effective educational activity is actual participation in or observation of conservation projects. Tree-planting days, group visits to managed woodlots and conducted tours over a well organized conservation trail all be sponsored by the Conservation Authority. These activities would all late individual action on forest conservation measures, such as those described e following chapter, which cannot be carried out directly by the Authority.

The Forest and Livestock

The grazing of woodlots is still one of the greatest causes of wood-depreciation on the farm today. This method of livestock husbandry produces atic and continuous loss of regeneration and eventually can leave the mineral of the woodlot itself completely exposed.

The lack of repaired fences and the loss of proper pasture due to er conditions are reasons often given for using woodlots as pasture. However, not uncommon to find woodlots deliberately used as an integral part of a e rotation system, with cattle fenced into parts of them.

The economic fallacy of grazing the farm woodlot has been proved in ısin where, over a five-year observation period in Richland County, it was shown unimproved pasture will produce over five times as much (dry matter) feed as und and improved grass-legume pasture will produce over 11 times as much feed. und pasturage is considered by agricultural leaders to be only half as good in nutrition as proper pasture. This is because of the lowered food value of s grown in shade, plus the added factor of weeds which are usually prolific in pastures. Even in the open park-like stands in the Rocky Mountain regions, g experiments have proved that acceptable gains are made by livestock in areas from spring to early summer only. After this period livestock tend to early all of this weight gain if left on the wooded range.

Field observations in Ontario indicate that cattle prefer the more ically desirable species such as maple, basswood and elm, whereas the

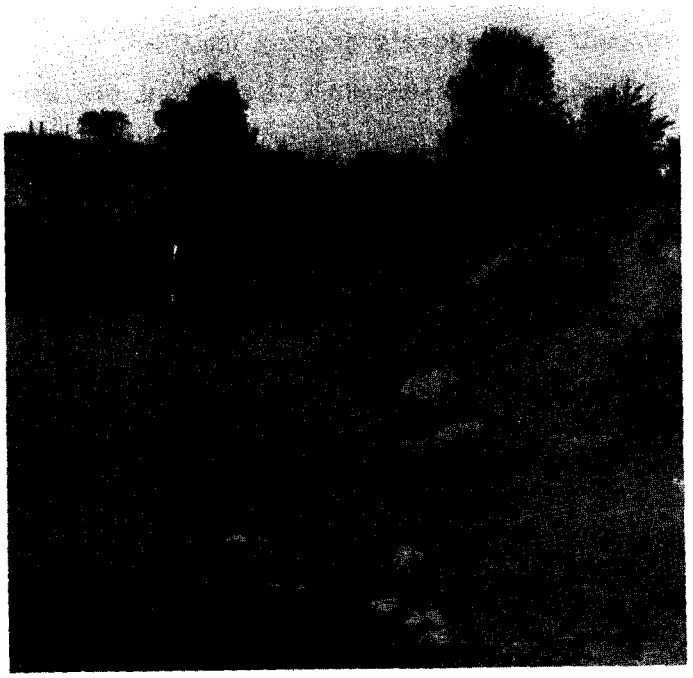
undesirable species such as ironwood, dogwood and hawthorn are grazed only as a last resort. This preference changes not only the quantity but the quality of the reproduction and so the succeeding stand.

Reproduction also suffers through the effects of grazing animals on forest soil. Compaction by livestock, particularly on clay soils, makes seedling survival and growth difficult. It also breaks up the protective litter layer, exposing the mineral soil to drying and thereby reducing germination. Consumption of the vegetation within reach reduces the volume of new litter available to keep the soil open and porous and in a highly absorptive state. Thus water relations are changed, adversely affecting the rate of tree growth and natural regeneration.

Cattle break down young trees to graze on them or to brush off flies. This has a particularly damaging effect in young pine plantations. Sheep interfere with pine seedling growth by nipping the buds. Hogs can ruin either natural or planted woodland by grazing and scuffing the roots. This allows fungal infection as well.

There are, of course, secondary benefits to the livestock from access to wooded areas. Those include shade, shelter from severe weather, protection from "face flies" and "shipping fever" causes, and quiet seclusion for the delivery of their young. The better condition of stock enjoying these facilities is a real economic gain to the farmer. However, this gain can be secured by fencing off a small corner of the woodlot or by developing groves or shelterbelts of fast-growing trees. The remaining woodlot is thus left to continue production, unimpaired by grazing.

Damage resulting from needless grazing varies according to the size of the woodlot and the number of animals grazed in it. However, regardless of either of these conditions, continued grazing virtually ruins a woodlot, since it removes the whole succeeding stand whose growth is needed to replace the older trees as they die or are removed. Though the total growth period of a woodlot is beyond the lifetime span of the property owner, making it difficult for him to appreciate his loss through grazing, the loss remains, often in the hands of the owner's heirs. A woodland is doomed where conditions persist which will not permit natural regeneration. After a time, with no new growth to replace larger trees which die of natural causes, the canopy begins to open up. Sunlight then can dry out the soil, weeds and grasses gain a foothold and a sod begins to form. In general, tree seeds which germinate cannot compete with an established grass cover. As these



Eroding stream banks should be planted to shrub species, and livestock should be kept away from them.

Woodlot grazing destroys regeneration, compacts the soil and aids erosion. It should be discouraged.

itions progress, the stand becomes open and park-like and eventually the trees ppear, leaving a rough, weedy pasture which cannot be improved without great iculty.

Woodland grazing affects more than the growth of trees. Soil erosion he woodland increases as the absorptive capacity and mechanical protection rded the soil by the litter are reduced. The open canopy exposes the soil to erosive force of rain and compacted soil forces overland movement of water. stock tend to follow trails in the woodland and these often become centres of ous erosion. Thus continued grazing increases surface runoff and soil erosion.

During studies of watershed management problems at the Coweeta ologic Laboratory at Asheville, North Carolina in 1952, some interesting facets his problem were observed.* To begin with, it was found that continued woodlot ing will eventually give a forest stand a park-like appearance with no ground and the effect of an empty space between the ground and the first limb layer grazing cattle cannot reach.

With fewer stems offering the obstruction to movement, the litter is a away to accumulate in ravines and ungrazed patches of subvegetation. Areas have been trampled show exposed soils for many months of the year. The sity and permeability of the soil is reduced as well as infiltration, so that eased overland storm runoff produces sheet erosion which increases progressively.

During the early years of woodlot grazing silt may not reach anent streamflow channels because it is caught by the litter in depressions and ies, allowing water to eventually percolate into the soil.

However, during the Coweeta experiments, a high intensity storm in inth year of experimentation produced large volumes of overland flow that ed out the litter dams and carried eroded sediment directly to the stream els, causing a subsequent jump in stream turbidity. Eventually a continuous of bare soil developed from the storm runoff source areas to the permanent m channel.

These observations indicated that if downstream municipalities needed water derived from grazed watershed areas, filtration treatment would be needed

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hnson, E.A. Effect of Farm Woodland Grazing on Watershed Values in the uthern Appalachian Mountains. Journal of Forestry, Volume 52, No. 6, June 54.

to make it usable. Under the conditions of these experiments it was indicated that one acre of improved pasture would provide more cow days of grazing than 100 acres of woodland, and that the woodlot grazing did not cause the livestock to thrive, nor was there sufficient profit to balance against the extensive land damage.

The case against woodland grazing is summed up by the United States Department of Agriculture Yearbook on Soil for 1957:

> "Investigators also agree on the low quality of the forage usually produced under hardwoods. Forage volumes are very low, except in open stands...and even there they seldom exceed 500 pounds an acre. Cattle thus reap little benefit, except shade and exercise from grazing a hardwood forest - and the farmer ends up with a poorer woodlot for timber production and watershed protection."

From the public point of view, therefore, the practice should be discouraged. It has been seen that woodland grazing contributes to soil erosion and increased water runoff, which in turn lower the yield of the land as well as adding to the flood hazard. The quantity as well as the quality of wood products reaching the market is reduced and the poor pasture results in increased costs per cow. These losses affect not only the individual but also the community as a whole. The Authority therefore is justified in carrying out a vigorous campaign of education in woodland improvement and also in offering direct assistance to woodlot owners. It is recommended that the Authority, through discussions with woodlot owners, should develop a program which will help eliminate the practice of woodland grazing.

6. Woodlot Management

A common problem in the Raisin River Conservation Authority is solid blocks of woodlot concentrated in the centre sections of concessions between strips of higher capability agricultural land. Because the ownership pattern fragments this woodland and combines small portions of it with areas of better farm land, it is not possible to add this woodland to the Authority Forest.

Conditions of this sort can be observed north and east of the Bunker Hill area and in most of Charlottenburgh Township. To date there has been little tendency by property owners to preserve woodlots in a well managed state. Rather the trend has been toward woodlot liquidation when quick sources of income are needed.

The problem of woodlot grazing and its effect on local woodlots has been discussed. In addition to the 38 per cent of the woodland which is regenerating unsatisfactorily from this cause, there is another 41.6 per cent requiring improved regeneration for various reasons.

The slashing of woodlots adjacent to streams causes bank erosion, sedimentation and obstructions in the channel.

Widespread clear cutting is leaving heavy slash that obstructs the regrowth of desirable species.

A typical young hardwood stand in the watershed. Such stands should be managed to maintain growing stock at all times, particularly during harvesting for pulpwood.

(a) Forest Regeneration

Recent studies of Eastern Ontario under the provisions of ARDA
:ate that, although there are areas within the Authority where the capability
:orest growth is good, there are some limiting factors such as excessive lime,
;sive stoniness, excessive wetness, relatively impermeable soils and, in one
.on of the Authority west of Martintown, bedrock close enough to the surface to
)it the root growth of trees. Since re-establishment of cover is difficult on
: areas once they have been denuded, it is important that care be taken to
.ain the present growing stock.

One factor controlling regeneration is light, particularly in the
of desirable hardwoods such as hard maple, silver maple and yellow birch and
'ers such as white spruce and white pine. Although the tolerance to light by
idual species varies, quantities of seedlings will germinate in from 10 to 25
ent of full light. Subsequently, as the seedlings grow, the provision of more
through such means as the cutting of strips or openings is needed to maintain
growth through the provision of about 45 to 55 per cent of full light. Clear-
ngs are not necessarily called for, since research in both Canada and the
d States indicates that heavier exploitation increases the amount of intolerant
es in the ensuing stand, particularly the tolerant hardwoods such as aspen.
erous reproduction is often more satisfactory on partial-cut swamps, but care
oe taken to avoid wind damage or to salvage wind-thrown trees.

Mechanical logging serves as a means of increasing regeneration
se it spreads cone bearing slash during skidding operations. Mechanical
:ication is also often needed to improve seedbed conditions, mix the litter in
nineral soil and cover tree seed properly to increase the success of germina-

Although heavy litter inhibits germination because the first shoots
cannot penetrate through the layer of litter or because the rootlets dry out
penetration is possible, it is also true that this same litter is a necessary
l control of erosion. This is because of its capacity to absorb water, deter
and protect the surface soil from the impact of rain, thereby preventing
ng and clogging of soil pores. This allows free water entry into the under-
soil. Improper scarification, therefore, can cause soil losses. Buffer zones
carified litter near waterways and streams are also necessary and scarifica-
nd cutting should be done in good seed years to ensure the regrowth of

desirable regeneration as quickly as possible to maintain the necessary litter and the soil condition.

(b) Use of Woodlot Thinnings

Thinning of woodlots is an important measure to encourage more rapid growth of the better trees and to salvage the value of small trees which would be lost through natural mortality.

In other authorities, there are often marketing problems for small material, but no such limitation exists on the Raisin River Conservation Authority due to an excellent market for pulpwood. Recent research on the use of wood chips from thinnings has revealed other possibilities. Though local pulp and paper industries use chips in quantity, this material can also be used by local farmers for cattle bedding purposes, chicken litter and barnyard fill during periods when the other more traditional materials are not available. These can be subsequently spread on fields to increase the humus content of the soil, and can be made from any species of wood, and tops and branches can be utilized. Tests have also shown that no danger to livestock is likely to occur through using this form of bedding.

In 1958 tests on the absorptive ability of wood chips were done in Minnesota because it was felt that changes in agriculture had reduced the amount of straw available for bedding. These tests showed that although straw and corn stalks were at the upper end of the absorptive scale, such materials as ground corn cobs, sawdust and planer shavings showed no advantages over wood chips. Greater quantities of chips were required to absorb as well as straw.

A ready market for small products can be a detriment to the area if it leads to indiscriminate clear-cutting of immature woodlots. However it can be a great advantage if used to encourage well planned thinnings.

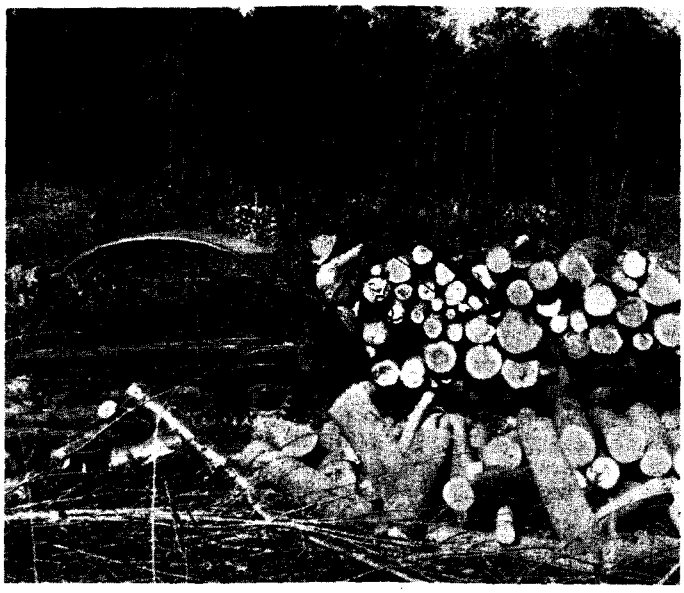
7. The Agricultural Rehabilitation and Development Act

The Agricultural Rehabilitation and Development Act of 1961 enabled the establishment of a Federal-Provincial program of alternate land use, soil and water conservation, rural development and research, aimed primarily at alleviating the serious national problem of low income in rural areas. It is administered by the Canada Department of Forestry.

Under ARDA, it is the responsibility of the provinces to initiate projects and programs, implement them, and pay approximately one-half the costs involved. The federal government, in addition to sharing costs, establishes in consultation with the provinces the main objectives of the program and its operati

Dense stands of prickly ash are a serious problem on some abandoned pastures, and should be reforested.

Poor aspen stands should be gradually converted to higher quality forest, through careful cutting and planting.



echanized operations can be used to improve forest ilization and seedbed preparation for future regener- ion.

cy and criteria under which programs are initiated. The Federal ARDA nistration functions as a clearing house for information, both technical and ral, and works toward improving co-ordination of all agencies concerned with l, social and economic development and resource use.

Each province has established a provincial ARDA office to administer provincial program and maintain working relations with the federal ARDA nistration. In Ontario the provincial ARDA office is a branch of the Department griculture.

The first approved forestry scheme in Ontario under the terms of this vas submitted by a conservation authority. Other authorities have also made use RDA funds for the implementation of forestry schemes. In most cases, these ies were proposed to get additional financing in order to speed up the purchase ind for forestry purposes.

It is suggested that one section of the Act that could be of .cular interest to the Raisin River Conservation Authority is Part 2 of the .d General Agreement between the federal government and the province. This is rned with land use and farm adjustment. Sections of this part cover approved cts or programs designed for such operations as the following:

(1) the acquisition of farmland of low capability for agricultural use for conversion to a more effective use such as permanent forage or pasture, forest, recreation, wildlife management or conservation reserve;

(2) the acquisition of non-economic farms for the purpose of effecting farm enlargement or consolidation, or for conversion to a more effective use...;

(3) the acquisition of non-economic woodlot holdings for the purpose of effecting woodlot enlargement or consolidation;

(4) the regrouping and basic improvement of properties acquired under the latter two sections, for the purpose of establishing economic farms or woodlots suitable for private ownership or operation.

Forest Fire Protection

The average person does not realize the seriousness of damage caused e in the woodlot. Though he may know that young growth and small trees are l by surface fires, he does not realize the extent of the less obvious damage is the destruction of humus, which itself preserves the condition and water- ing capacity of the soil. When the humus and ground cover are destroyed the d dry winds remove the moisture required for tree growth and plant nutrients stroyed. The heat of the fire also injures the growing tissue inside the bark

of older trees which are not actually burned, exposing the wood to attack by insects and fungi. Even though through time the wounds may be completely healed, the damage shows up as defects when the tree is cut for lumber.

The first step in fire control is fire prevention, and the best assurance of prevention is an enlightened public opinion which will make every member of the rural community conscious of the seriousness of the fire damage and of his duty as a citizen to do all he can to prevent it. The farmer can prevent most fires in farm woodlots if he exercises the same care that he does around his home and buildings. It is particularly necessary to exercise such care in areas which have been cut recently, since the accumulation of slash creates a serious fire hazard. Close utilization of tops and the scattering of slash so that it lies close to the moist ground and rots faster will help to reduce this danger.

From the evidence collected in the northern United States, where conditions most nearly approximate those of rural Southern Ontario, it is apparent that the most effective fire protective systems are those set up under the following conditions:

(a) Where the system is organized under the direction and control of the state forester and the wardens in each township are appointed by him on the recommendation of the local council.

(b) Where wardens paid an annual retainer are actual residents in the locality. Usually they are farmers who have had practical instruction in fighting fire. They have the power to call out other local residents to help in fire-fighting, and maintain a store of fire-fighting tools on their premises.

(c) Where the warden is assisted in his work by all members of the community. That is, his address and telephone number are known to everyone and fires are reported to him immediately.

(d) Where designated members of the community know that they are likely to be called on to fight fire and are paid so much per hour for the time they are so employed.

(e) Where every resident is thoroughly fire-conscious and realizes that loss of timber by fire is a loss to the whole community, and considers it his duty to prevent, report and fight fire.

(f) Where fires for burning brush and rubbish may be set only after a permit has been obtained from the local fire-warden.

It is recommended that the Raisin River Authority set up a committee termine the best method of providing fire protection for public and private , through the co-operation of the Department of Lands and Forests, for the ction of woodlands in the Authority area.

Protection from Insects and Disease

In projects such as the public and private reforestation recommended he Raisin River, careful consideration should be given to the prevention of eaks of insects or tree diseases, and adequate arrangements made for the iate application of control measures when these become necessary. While it is ossible to predict accurately the course insects or disease may take under the changing conditions of a newly forested area, there are a number of fundamental iples which, if applied, will greatly lessen their destructiveness.

Large areas of one kind of tree present ideal conditions for an out- of insects or fungus disease. Mixing species in the plantation or separating ecies in small blocks tends to slow the spread of outbreaks until natural es bring them under control or direct control measures can be applied.

It is important to plant only the species of trees suitable to the nd existing growing conditions. Healthy vigorous trees are certainly more ant to attack than weak, struggling ones.

Over-mature and dead trees should be removed from the existing stands, se harbour bark beetles and wood-boring insects which may become excessively nt and attack healthy adjacent trees. Fungus infections may likewise spread uch sources.

Care should be exercised to prevent ground fires. Even light ground are frequently followed by severe outbreaks of bark-beetles and wood-boring s and fungus infection at the base of the tree.

It is essential that an inspection be made each year so that any al increase in insects or disease may be noted and control measures initiated the outbreak becomes serious. Prompt action may reduce control measures to a atively easy task and confine damage to a small area.

a) Some Important Insect Pests

The white pine weevil is a notably damaging agent on white pine. As sect prefers to work in full sunshine, the growth of white pine in mixed or under a light canopy of such tree species as aspen should be considered, r to provide shade for the young trees in their early stages. This is a

simple means of reducing this insect's activity in valuable plantations. Another suggested cultural method of weevil control is the maintenance of high density crops, so that injured trees will tend to straighten more quickly. Recent research work in the weevil control field indicates that such methods of control, though useful, make it necessary for the grower to expect slower growth in his plantation. In some cases, therefore, the control may inhibit growth almost as much as the infestation.

A control of the number of egg-laying adults of this species can be effected by "leader clipping". Infested leaders are removed and burned before the adult insects develop. Though this method can be costly when compared to chemical control, it can be particularly useful to the property owner who prefers to invest his own time, rather than the cost of men and materials, in plantation culture.

At present chemical control is considered the most effective for the amount invested. Chemical sprays are used on the leaders and foliage at the proper time of the year. Granular insecticide can be used on the ground litter where the adults hibernate, and the newer systemic insecticides are also a possibility, although the latter require careful use due to the danger they represent to the person applying them. A recent report from the United States Forest Service provides a number of useful guidelines for white pine weevil control. It also advises the careful consideration of the variables concerned such as weather, equipment and the many types of chemical available. These influence the success of control and the degree of danger to other organisms.*

The growth of the Christmas tree industry has brought increased attention to bear on the damage done by the Root-Collar Weevil, the Northern Pine Weevil, and the Pales Weevil. The former can be controlled by applying insecticides around the base of infected trees. After cutting, the rows of stumps should be cut even with the ground and chemicals applied before replanting.

The European Pine Sawfly occurs, mainly in small numbers but widely spread throughout the watershed. The owners of Scotch pine plantations, particularly those with a Christmas tree acreage, should consider the use of the "virus" method of control rather than insecticide, since it is a biotic control and does not have a detrimental effect on other forms of life. With this method, a small residual insect population infected with the virus remains in the stand. From these infected

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* Marty, Robert and Mott, D. Gordon. Evaluating and Scheduling White-Pine Weevil Control in the North-east: U.S. Forest Service Research Paper NE-19, 1964. Northeastern Forest Experiment Station, Upper Darby, P.A., U.S.A.

ısects, the virus spreads to new outbreaks, thereby producing a longer-lasting
›ntrol. Information regarding arrangements for the use of this method can be
›tained from the Zone Forester of the Department of Lands and Forests at Kemptville.

Leaf-feeding insects may kill conifers by one complete defoliation
d hardwoods by defoliation for three years in succession. However, even partial
foliation may so weaken trees that they will be attacked by other enemies.

This serves to illustrate that frequent inspection by property owners
r such leaf-feeding insects is desirable. It is this kind of attack that is most
ccessfully controlled through spraying. In order to keep control methods effective
d up to date, owners should keep informed on insect controls through the Zone
:rester, since investigations of forest insects are constantly under way.

(b) Tree Diseases

The chief diseases of the hardwoods are the various trunk, butt and
›t rots and chronic stem cankers, which are all endemic and may cause serious
ıage under aggravating conditions. Woodlots in the Raisin area present very
'erse conditions with respect to the incidence of these diseases, a circumstance
ch is usually related to their past history. A sanitary condition should be
ntained to obviate loss on account of decay.

The wood rots are commonly thought of as diseases of mature and over-
ure timber, but experience has shown that infection may occur at a very early age.
hardwood sprouts the stem may be infected from the parent stump. In older trees
ection is chiefly through wounds, either of the root or trunk, which may be
sed by fire, trampling by animals, insects, meteorological agencies, or by
elessness or accident in felling and other woods operations.

For many reasons "cleanings" in the reproduction are desirable,
:cially where the woods have been heavily cut. Besides favouring the valuable
:ies, those stems which are of seedling origin should be favoured over stump
›uts which are more liable to decay.

In harvest cuttings, which should recur at frequent intervals, the
:issible volume allotted should include trees in which incipient decay is
overed and so far as possible those which have become a poor risk through injury
ther circumstances.

The Dutch elm disease, which causes rapid wilting and death to all
ve elm trees and most introduced species, has caused great concern ever since
first discovery in Canada in 1944. It appeared first in Quebec, then at Windsor

somewhat later and has subsequently spread over a large part of Southern Ontario. It may attack single trees or destroy whole woodlots. Evidence of the disease was frequently found on the watershed during the survey period.

Control is achieved by elimination of diseased trees and material, by meticulous sanitation and by spraying healthy trees to prevent attack by the elm bark beetles which carry the disease. For valuable trees in parks and along streets, costs of control are well within reason.

Some control of Dutch elm disease has been accomplished in cities in Canada and the United States by the spraying of insecticides at considerable expense on elms on city streets to control the beetles. Recently the City of Milwaukee, Wisconsin, has attempted large-scale inoculation of elms with a systemic chemical called bidrin that is still in the experimental stage. Tests over an eight-year period have shown effective control of the disease-carrying insects without harm to other organisms, provided that suitable safety precautions are taken. The cost of using this chemical has been competitive with the cost of using the more common insecticides by spraying. Bidrin is now receiving some use in Ontario for Dutch elm disease control. It requires the use of specially trained and licensed technicians because of the danger that careless use of the chemical could cause the loss of human life.

At present the use of acceptable insecticides on trees living in a forested condition, is either difficult or impossible. In a woodlot, therefore, careful sanitation is the only means of gaining any control over the disease's spread. That this has not been done on the woodlots of the Raisin River watershed is evidenced by repeated observations, during the survey, of logging operations for elm that have removed the bottom logs of felled trees, leaving the tops intact. This material has become an ideal breeding ground for the beetles. Consequently the spread of the disease has been aided through such logging methods.

To ensure that meticulous sanitation is done, property owners wishing to sell their standing elm timber should incorporate clauses into their cutting contract, providing for slash sanitation measures plus any other treatment that is deemed necessary to prevent spread of the disease. The Authority should recognize that, unless it uses a strong educational program to combat this disease, elm will soon cease to be a major component of the watershed's existing wooded areas.

Though no detailed survey of the incidence of various diseases was made on the Raisin River Conservation Authority, a notation of obvious occurrences

Dutch elm disease and white pine blister rust was made during the normal woodlot mination. In all cases disease occurrences were in isolated form, usually in ll woodlots. A total of 13 cases of Dutch elm disease and 12 cases of white pine ster rust were observed in natural woodlots, in addition to the three plantations cted by blister rust which were noted earlier in this report.

In most cases blister rust occurrences were in the central portion of watershed. Dutch elm disease at present appears to be concentrated within or cent to the City of Cornwall and between the lower reaches of the South Raisin r and the shores of Lake St. Lawrence.

Windbreaks and Shelterbelts

In many cases natural hedgerows have been left in the farming areas he Raisin River Conservation Authority, especially in those areas where the itional farm layout has produced small fields. Often the position of natural lots is still effective in reducing wind severity. However, exposed areas can ound, since often the better fields are to be found at higher elevations, where exist in the hedgerow pattern or where these have been removed altogether during reation of larger fields. It is also possible that in some parts of the rity this trend of hedgerow removal could accelerate due to the increased sis on large scale corn production, which is often adapted to a large field rn of cultivation.

The Authority should promote the establishment of shelterbelts on ed hills near pastures and farmsteads, since much of the local agriculture has estock base, particularly in dairying.

When proper species are used and windbreaks are correctly placed the s are almost entirely beneficial. The effects may be direct or indirect, but her case are the result of reduction in wind velocity. The effects of wind- on crops and cultivated fields may be listed as follows:

a) Direct Effects

(1) Wind damage and lodging in small grains and corn is reduced or eliminated.

(2) Snow and the resultant moisture are more evenly distributed over fields, particularly on the higher spots where they are required most.

(3) Wind erosion of the soil is minimized.

b) Indirect Effects

(1) Moisture loss by evaporation is reduced.

(2) Temperatures in the field are raised; this may prevent frost damage, accelerate growth and even lengthen the growing season slightly.

(3) Erosion of the soil by water may be reduced by its more even distribution when released from snow.

The benefits of windbreaks to buildings in reducing heat loss in winter have been shown to be considerable. Experiments conducted in the United States proved that a house loses more than twice as much heat with a wind of 20 m.p.h. as with one of 5 m.p.h., and a windbreak can easily reduce wind velocities in this proportion. Used in this way it can often be made to form an effective background for the house and protection for farm buildings. Another advantage of windbreaks is that they provide shelter and runways for insectivorous birds and other small animals.

Recent literature from the British Isles, where shelterbelts in agricultural areas are being stressed, indicates that their value has been proved as regards the health and efficiency of farm livestock. American and Russian sources estimate that a withdrawal of five per cent of cultivated ground for shelterbelts results in an increase of output of 20 per cent on the sheltered land. British farmers are apparently willing to spend considerable sums in planting and caring for their windbreaks in order to achieve these advantages.

Belts of trees consisting of one or two rows are usually called windbreaks, and with more than two rows, shelterbelts. In Southern Ontario windbreaks as a rule give sufficient protection except where wind erosion of soil on rolling land is severe. Here shelterbelts may be required. On level land, windbreaks may nearly always be established along existing fence lines, but on rolling land consideration should be given to the contour of the land. The prevailing winds in Southern Ontario are generally from the west, so that the greatest protection will be derived from windbreaks on the west side; but the placement of windbreaks on the other three sides as well should be considered.

Both the height of the trees and the wind velocity influence the effective range of a windbreak. An average windbreak will reduce the ground velocity of a 20-mile wind 10 per cent or more for a distance of about 30 times the height of the trees. About one-fourth of this effect will be felt on the windward side of the windbreak and three-fourths on the leeward side. For example, if the trees are 40 feet high, the total effective range with a 20-mile wind will be 30 x 4 or 1,200 feet; 300 feet of which will be on the windward side and 900 feet on the leeward side. The wind velocity is reduced by half at a distance of 500 feet. Thi

:ans that with such a windbreak, wind velocity is reduced for almost the entire
ngth of a 40-acre field.

A few years ago European alder gained considerable popularity as a
ndbreak tree because it is a nitrogen-fixer like the legumes and does not rob the
il to the same extent as non-nitrogen-fixing species. At the present time stock
hard to obtain.

One consideration that should be kept in mind is that under certain
·cumstances windbreaks may cause air stagnation, which may increase temperature
moisture conditions to a dangerous degree in summer or increase frost damage in
ing and fall on small areas, particularly in hollows. Where this is likely to
ur, windbreaks should be planted so as to guide the flow of air past such spots.
re these conditions develop after the windbreaks are established they may be
ieved by judicious opening up of the windbreaks.

On the Raisin River watershed, many types of windbreak and shelter-
. have been grown as the woodlots of the area have been cleared away for
culture. There are cases where a trend of woodlot location on the watershed, on
rear boundary line, has resulted in insufficient overall protection from wind,
buildings and fields have been left exposed as a result of great spaces in this
lot pattern. Therefore, the increased use of windbreaks and shelterbelts is
l.

In the case of shelterbelts, one of the important features of their
;ement is the control of the density of the tree stand itself. The results of
t Russian shelterbelt research* are of considerable interest. These studies
ated that thick forest belts (134 feet wide), through which wind could not pass,
ded maximum wind reduction only in the shelterbelts themselves and in their
iate lee and was felt some distance above the ground. Maximum distance at
ground level effect was felt was at about 39 to 40 times the average height of
ıelterbelt.

As the shelterbelts were thinned, the point of maximum wind reduction
farther outward into lee fields, the maximum horizontal effect of wind reduc-
engthened and was felt closer to the ground, coming down to about six feet
ground level.

ɾlik, A. Selected Russian Articles on Forest Meteorology: Meteorological
ıslations No. 11, Canada Department of Transport.

The amount of thinning had an important bearing on wind effects. Moderate thinning with a shelterbelt about 13 yards wide and allowing moderate wind passage through its trees gave useful wind protection to a distance of five times the tree height in its lee area, and some protection for a distance of 46 times the tree height. Further thinning to a point where the same width of shelterbelt was easily passable by wind gave maximum wind reduction from a point six to eight times average tree height in its lee to another point at ground level over 50 times the average tree height from the shelterbelt. However, this severe thinning produced higher wind velocities in the immediate lee of the shelterbelt.

If belts of woodland are parallel to the prevailing wind, beneficial shelter effects are minimized. The above studies also indicated that in cases of long narrow fields between such shelterbelts, wind velocities will increase. This will also occur in cases of gaps in shelterbelt systems, to the point that the wind velocity in the gaps will be greater than it is over open land. For this reason gaps in forestbelt systems should be planned so that they do not form long straight corridors.

The use of windbreaks and shelterbelts in a largely agricultural area requires that the spacing of tree species and methods of management be designed to fit the type of agriculture being employed. The species of trees used must also be adapted to the site. For livestock farming, initial plantings of fast-growing trees, followed by the planting of slower-growing but sturdier varieties in the spaces left, is a useful plan. It is sometimes found that animals tend to gather in the immediate lee of such shelter, thereby concentrating their manure too much in one spot. Pruning the bottom 6 to 8 feet of the windbreak will force the livestock to scatter more over the field, and yet will still provide the necessary shelter.*

In areas where "cash cropping", particularly for vegetables on muck-lands, is important, the planting of primary windbreaks on field borders and secondary windbreaks within the field is important to prevent the lifting of whole crops by wind.†

In Michigan, muckland farmers discovered some years ago that black willow, the common windbreak species used up to that time, provided the wrong kind of protection. It lost its lower branches and developed into a large tree with hi

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* Farm and Country. U.K., 1960.

† Geiger, R. Climate Near the Ground.

anches that gave little ground protection. It also competed for nutrients and ter from a large area on either side of the windbreak. Experiments over four owing seasons by the Lapeer Soil Conservation District determined that arctic llow and medium purple willow were the best plants for providing a complete inter- diate wind-breaking effect. The latter, because of its narrow and upright growth rm, which leaves little space between plants at their bases and thereby reduces passage through the windbreak, is considered slightly the better plant. At sent, primary windbreaks of trees such as Austrian, Scotch and white pine at imum distances of 40 rods have been recommended for some time in Michigan. Inter- iate windbreaks of shrubby species are being employed between the primaries on ck farms at about 150 to 200 feet spacing.*

Recently, valuable work has been done and useful information obtained the Ontario Agricultural College regarding wind and snow effects on farm buildings er varying conditions of wind direction and building location. These experiments e been performed using a specially constructed water flume that provides a means accurately simulating certain conditions in miniature and observing them at first l. Efforts are now being made to obtain similar observations regarding the ect placement and design of windbreaks under varying topographical conditions.

One authority has recently begun a special experimental program to mpt alleviation of wind erosion conditions in South-western Ontario.

Through observations made in the flume, it was deduced that although ary windbreaks were a necessity, intermediate windbreaks of a lower growing species were equally important. These were to be planted across the field ern and against the traditional direction of cultivation in this particular case. nting program of suitable shrub species that can be controlled by normal vation methods is to be implemented on the basis of the flume observations.

Experience has shown that windbreaks are an asset to any farm, that adverse effects if any are local and easily remedied, and that in many areas are essential to the control of soil erosion by wind. It is therefore mended that the Authority encourage in every way the establishment of windbreaks ivate owners.

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rnal of Soil and Water Conservation, Soil Conservation Society of America, ., 1962.

11. Snow Fences

In the climate of Southern Ontario snow drifting may cause much inconvenience and sometimes hardship. Control can be readily effected by means of windbreaks and is dependent on proper placing with reference to lanes of travel and topographic features.

Where space is limited or land valuable, lath or board fences are frequently used, but the annual cost of erection, removal and maintenance of these can be eliminated by using trees as permanent windbreaks or shelterbelts.

The object of a snow fence is to mechanically reduce wind velocity near the ground in such a manner as to cause a drift to form where it will be least harmful. The reduction in velocity creates two pools of relatively calm air, a small one on the windward side and a much larger one on the leeward side, and it is here that drifts form, leaving the area farther to the leeward free of drifts and comparatively free of snow. As winds become stronger the wind reduction and the width of the calm pool on the leeward side will increase and the centre will tend to move farther away from the windbreak.

A wide belt of trees which will accumulate a large drift of snow on its windward side may be planted right to the edge of the road, the windward edge extending back a distance equal to three or four times the height of the trees, and generally at least 100 feet.

In some places the snow-trap type of windbreak is effectively used. It is composed of one or more rows of trees close to the road with a wide opening to windward and then a single row of trees. The single row arrests the first force of the wind and the snow is deposited in the opening. This has the advantage of requiring fewer trees than the shelterbelt and leaving the ground between open for cultivation in the summer.

Poor placement of windbreaks may accentuate drifting conditions. A single row of trees, unless it is a dense coniferous type, is seldom dense enough to completely stop winter wind and may create drifts. Any prejudice which may exist against windbreaks for protection against drifting snow on roads arises from such poor or poorly placed windbreaks. If a windbreak has openings in it or if it ends abruptly, streamer drifts will form. Windbreaks should be kept dense and tapered down at the ends by using progressively smaller species of trees and shrubs to prevent the formation of streamer drifts.

Trees are being used successfully as snow fences in Ontario by the partment of Highways, by railways and by a number of counties. Every encouragement should be given to the establishment of such snow fences in place of the removable type of lath fence now in use.

CHAPTER 5

WATER PROBLEMS

1. General

The critical water problems on the Raisin River watershed are low summer flows and pollution which are prevalent in all three branches of the river. Minor localized problems of flooding and erosion also occur at several points on the watershed.

2. Low Flows and Water Usage

Over the past few decades, local residents have often expressed concern over the low summer flows in the river during the summer months. This condition was quite evident during the summer of 1964, during which many tributaries of the Raisin River dried up completely and flow in the river at Williamstown dropped to a low of 0.1 cubic feet per second.

This condition was due mainly to two factors:

(1) Much below normal precipitation during the past decade has reduced the runoff.

(2) Extensive stripping of forest cover and draining of swamps have allowed the water to run off the land swiftly rather than allowing it to percolate to ground water and then flow to the river gradually.

Lack of sufficient streamflow results in insufficient water supply for stock watering, recreation, and fish life. As the flow decreases the quality usually decreases since there is not enough dilution water available to flush the wastes from the channel.

The wells in the area have apparently not experienced the same lowering of ground water levels that has occurred in many parts of Southern Ontario. Many wells have a history of going dry during the periods of low rainfall. The situation could probably best be improved by deepening the wells.

The major industry located along the river is cheese making. So far these factories have not experienced a serious water shortage except for waste disposal. As more urban development and services extend throughout the country, modern conveniences, such as indoor plumbing, are becoming more common. Electric pumps have replaced hand pumps and gasoline pumps are almost non-existent in the area. These conveniences have greatly increased the daily consumption of water

lthough no drastic shortages have occurred there is a general need for conservation f water during the summer months. About 50 per cent of the people augment their ater supply by the use of cisterns.

. Pollution

The effects of pollution are many and varied and usually go unnoted ıtil it is too late. Fish die, community health is threatened, and the aesthetic ıalities of the stream are impaired.

In general, the Raisin River is in fair to good condition with regard pollution. Within the watershed there are many isolated areas of pollution and ny different causes of pollution. The site and smell of any of these isolated eas of pollution make the whole stream suspect and thus act as deterrent to use of r part of the stream.

The causes, effects, and possible solutions to the problems of lution are discussed more fully in Chapter 7.

Flooding

As far as can be ascertained from long time residents, the Raisin er periodically overflows its banks, benefiting the farmer in some cases, and sing minor damage or inconvenience in other cases. Much organic matter from the ips and stream bed is deposited on the flood plain during the spring floods. organic matter serves to enrich the soil after the water has drained away. In cases, it takes so long for the water to drain off these lands that the area is ered virtually useless for cultivation during that particular growing season. reaches of the river have been dredged and straightened in an attempt to ove drainage. This results in improved drainage locally, but it aggravates the l problem in the lower reaches of the stream.

There have been developments within the flood plain during the years help to point out the fact that the flood plain belongs to the river and must e encroached upon by man. Some examples of this are the flooding of the tly developed subdivision on the South Branch at Pitt Street in Cornwall, and nual flooding around the elementary schools in St. Andrews.

Although floods occur in the Raisin River mainly during the spring ts, flooding can also occur through other seasons of the year due to intense ll. Very little accurate history was available on this type of flooding in the ut it was reported that within recent years a summer storm did cause the river od the street at the bridge in Martintown.

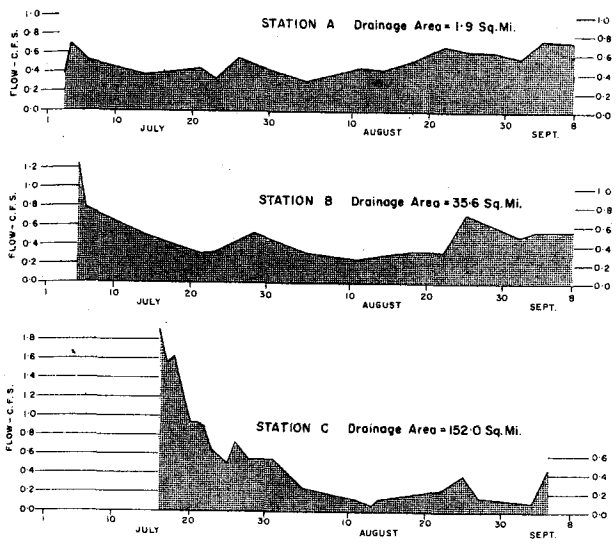
5. Erosion

Very little stream-bank erosion was noted along the banks of the river except where cattle come to water. This lack of stream-bank erosion is due to the low stream gradients and large channel section with a resulting low velocity of flow.

Sheet erosion occurs on the bare fields in the spring, but is relatively minor on most soils due to the flat slopes. Sheet erosion has increased over the years as a result of forest stripping. Good crop rotation practices will help stabilize the soil and alleviate sheet erosion problems.

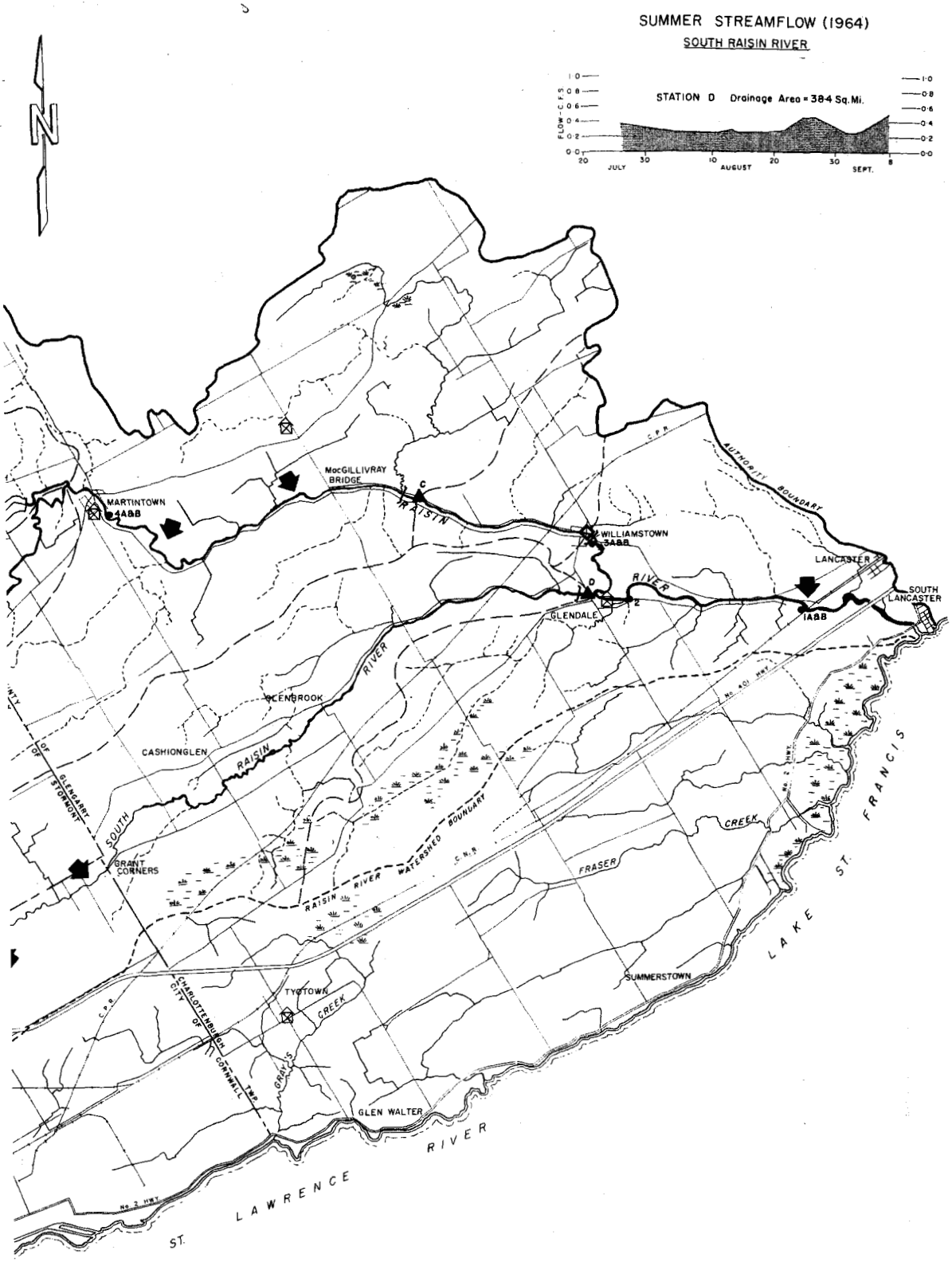
SUMMER STREAMFLOW (1964)

MAIN RAISIN RIVER



LEGEND

- AREAS SUBJECT TO SPRING FLOODING
- CHEESE FACTORY OR MILK PLANT
- RESERVOIR SITE INVESTIGATED
- POSSIBLE WEIR LOCATION
- TEMPORARY LOW FLOW GAUGE (1964)
- POLLUTION SAMPLING STATION
- MANUAL STREAM GAUGE (DEPT. OF NORTHERN AFFAIRS & NATIONAL RESOURCES) WATER RESOURCES BRANCH
- INTERNAL DRAINAGE BOUNDARY



SURFACE WATER RESOURCES

SCALE — MILES

1 1/2 0 1 2 3

CONSERVATION AUTHORITIES BRANCH — Dept. E.&R.M. — Wm.M. — 1965

FIG.7

CHAPTER 6

HYDROLOGY

1. General

Hydrology is that branch of physical geography which is concerned with the origin, distribution, and properties of the waters of the earth. The circulation of water in its various forms from the seas to the atmosphere, to the ground, and back to the seas again is known as the hydrologic cycle.

The activities of man are greatly affected by this movement of water, particularly that portion of the cycle between the incidence of precipitation over land areas and the subsequent discharge of water through stream channels or its direct return to the atmosphere by evapotranspiration. For a proper assessment of water problems, and an accurate determination of the ratio of runoff to precipitation, a knowledge of this phase of the cycle and the factors affecting it are essential.

2. Climatic Characteristics

The climatic factors affecting runoff are extremely variable but with sufficient and accurate observed data recorded over a long period of years these factors can be evaluated for an area with a reasonable degree of confidence. Observed data recorded daily will keep one informed as to existing ground and runoff conditions and, with weather forecasts, the people in the area may be alerted when a potential danger exists. Unfortunately there are no observation stations on the Raisin River watershed.

The more important climatic factors which influence the rate and volume of runoff are the amount and intensity of rainfall, amount of snow and ice accumulation, temperature, and direction and velocity of the wind. The closest station with a long period of record is that of Morrisburg which has data recorded since 1916. These records indicate that the mean annual total precipitation for the area is 37.9 inches, of which 29.3 inches comes as rain and the equivalent of 8.6 inches in the form of snow. (One inch of water is taken as the approximate equivalent of 10 inches of newly fallen snow.)

Thus for an average winter 86 inches of snow falls in the area and, with an average winter temperature of 20°F. from December through March, most of it will remain.

Although there are no meteorological observations being taken in the Raisin watershed itself there are first class stations nearby which can be used in

future when a longer period of record is available from them. There is a station in Cornwall and one in Apple Hill. These weather records and particularly the rainfall observations should be supplemented with observations made at strategic points within the watershed and, if possible, at least one recording rain gauge should be installed in the area. Interested parties should be sought out to make records and maintain these gauges.

2. Physical Characteristics

Precipitation is the source of all runoff but the proportion of the precipitation and the rate at which it runs off an area is influenced to a great extent by the physical characteristics of the area. Unlike the climatic factors, the physical factors affecting runoff remain fixed or change slowly, except where rapid urbanization takes place. However, the factors are many and so interrelated that it is difficult to determine the effect of any one on the runoff. The principle physical factors of the drainage basin to be considered are:

(a) Location and orientation.

(b) Size and shape.

(c) Configuration of drainage routes and their gradients.

(d) Natural or artificial storage - lakes, ponds, swamps.

(e) Soils and topography.

(f) Extent and type of land use.

In the easterly and northerly parts of the drainage basin, many swamps are present. These swamps act as natural retardation basins and tend to reduce flood peaks downstream and improve the summer flows. Water stored in these swampy areas has been shown to be the main source of flow during the summer months.

Unfortunately, many of these swamps have been artificially drained to be used for agriculture but have proved unsuitable for this purpose. This drainage eliminated any effect they may have had as reservoirs and, as a result, summer flows in the river have decreased. An attempt should be made to discourage unwise swampland clearing and drainage in the watershed.

Due to a large portion of the area being overlain with impermeable clay deposits and much of this area having been stripped of tree cover, very little precipitation can percolate to ground water. This results in high spring runoff and decreased summer flows from ground water.

Another important physical factor is the slope of the stream channel or gradients which have a direct influence on the discharge capacity of the channel

ANNUAL PRECIPITATION AND SUMMER RAINFALL
(MORRISBURG GAUGE)

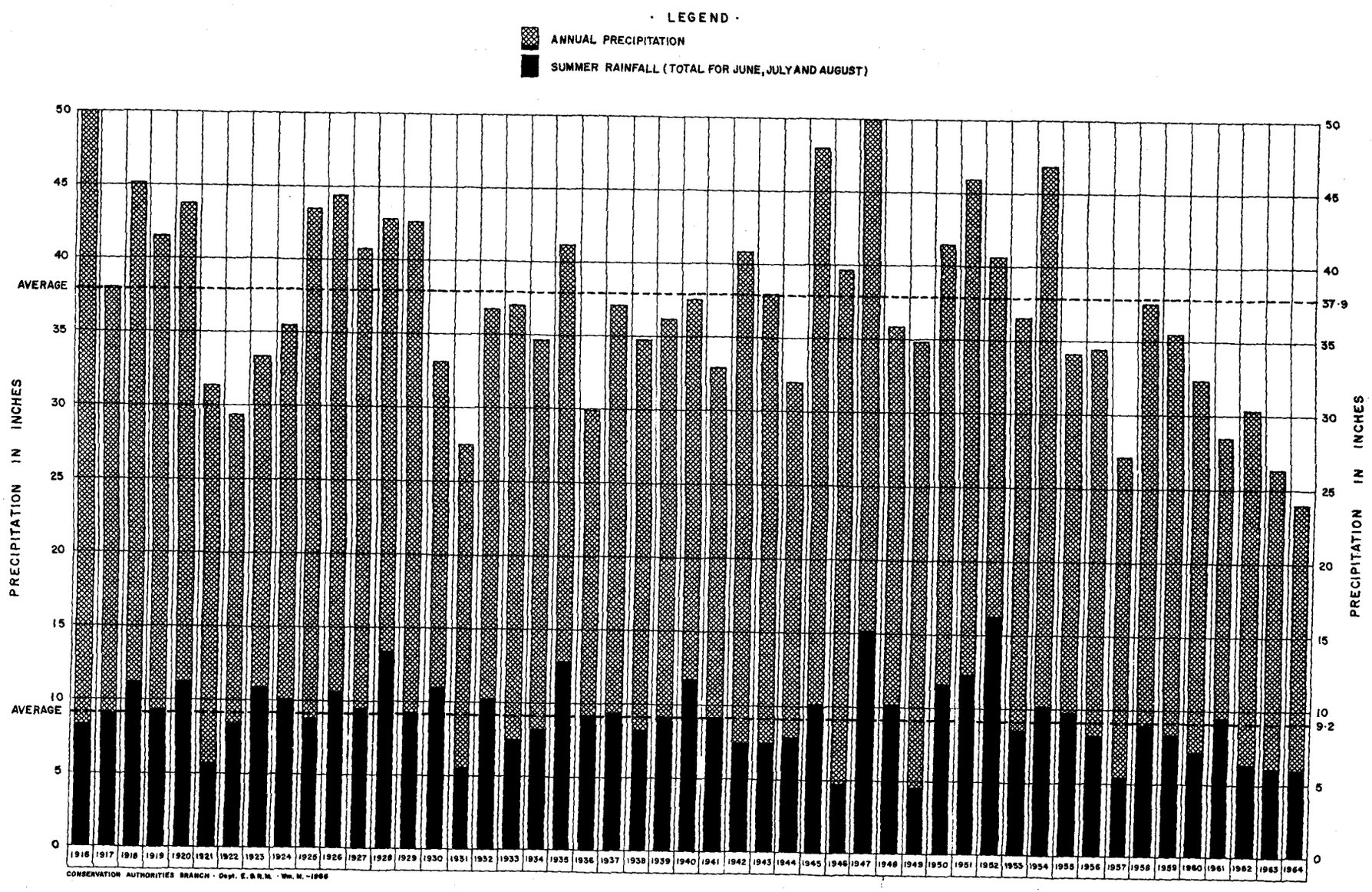
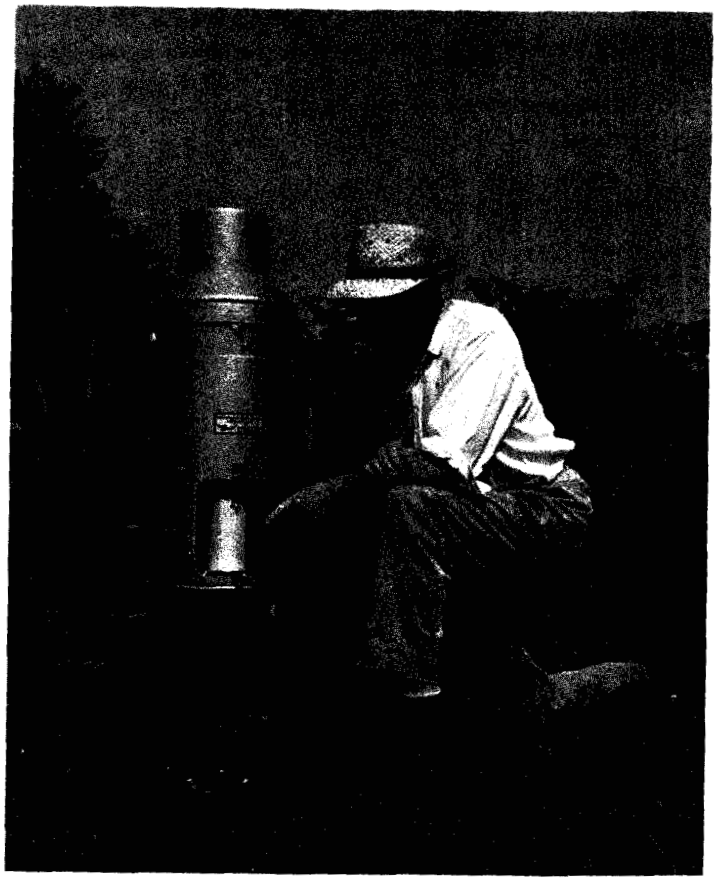
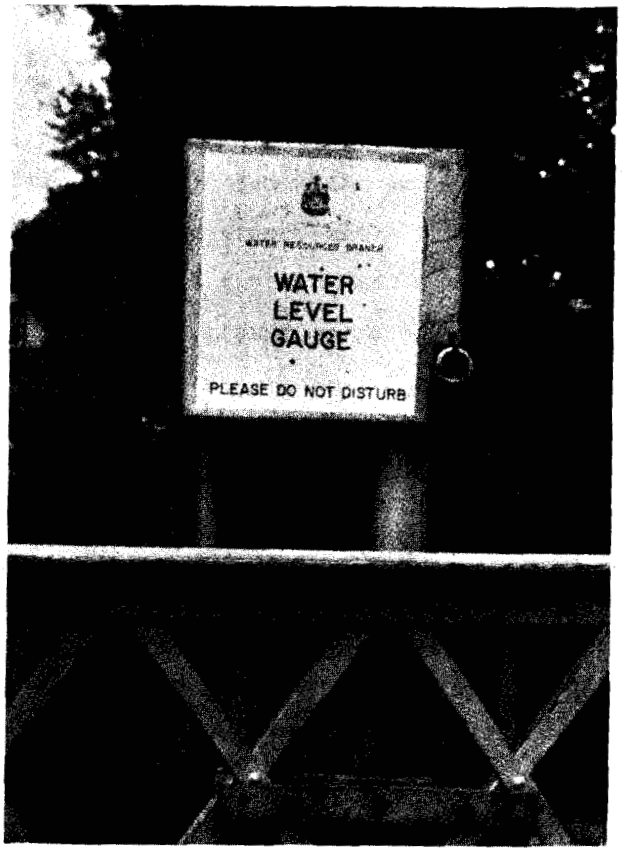


FIG.8

FIG.8



Recording gauge for measuring precipitation. Rainfall amounts are recorded on weekly charts.



Hydrometric gauge used for measuring streamflow at Williamstown.

If two streams have otherwise similar physical characteristics but different gradients, the stream with the steeper gradient will have the greater discharge capacity.

The Raisin River has a gradient of about three to four feet per mile throughout most of its length, as can be seen from the accompanying water level profile (Figure 9). This is a flat gradient in comparison to many of the rivers in Southern Ontario which have average gradients of 20 feet or more per mile. The mild slope of the Raisin reduces its capacity and increases its susceptibility to ice jams, thus causing flooding for several days at a time.

The slope of the terrain over which runoff must pass to reach the stream channels is also an important physical characteristic and is usually referred to as the "lateral slope". Although vegetation partially impedes surface flow and increases the opportunity for infiltration, the slope of the land is significant in determining the rate at which runoff reaches the tributary water courses. The lateral slopes of the Raisin may be described as gentle slopes and the resultant runoff is thus slow in comparison to areas with steep slopes. Gentle lateral slopes help reduce the probability of flash floods since the water takes a longer time to reach the river channel.

It may be said in conclusion that the physical characteristics of this basin discourage flash flooding but on the other hand make it susceptible to ice jamming and prolonged flooding during spring break-up.

3. Streamflow

Streamflow is simply the amount of water flowing in the stream. It consists of surface flow and ground-water flow which enter the channel throughout its length. Surface flow is that portion of the precipitation which reaches the channel by flowing over the ground surface. This is intermittent depending on the precipitation and temperature.

Ground-water flow is that portion of the precipitation that enters the soil and by various underground routes reaches the stream. Ground-water flow may be nil, intermittent or continuous depending on the elevation of the stream with respect to the elevation of the water table. During the dry summer periods, water which was stored in the swamps at the headwaters is released from storage and becomes streamflow. As this streamflow progresses downstream, it has been observed that the quantity becomes less and less. This is a result of two factors, (1) evaporation from the water surface and (2) infiltration to the ground water which,

through a large portion of the stream, is below the river elevation. This conclusion is illustrated by flows measured at various points on the stream during the summer of 1964 and these are shown in Figure 7 together with the location of the flow gauges.

To establish reliable solutions for many water conservation problems, accurate flow measurements are necessary for a considerable period (10-15 years). Regular observations of streamflow have been recorded at the Williamstown gauge on the Raisin River from November, 1960, to the present. (See Figure 10) The gauge located at the traffic bridge in Williamstown is the manual type and observations are taken twice daily. For more accurate data, a recording type gauge should be installed. The maximum and minimum mean daily discharges recorded so far are as follows:

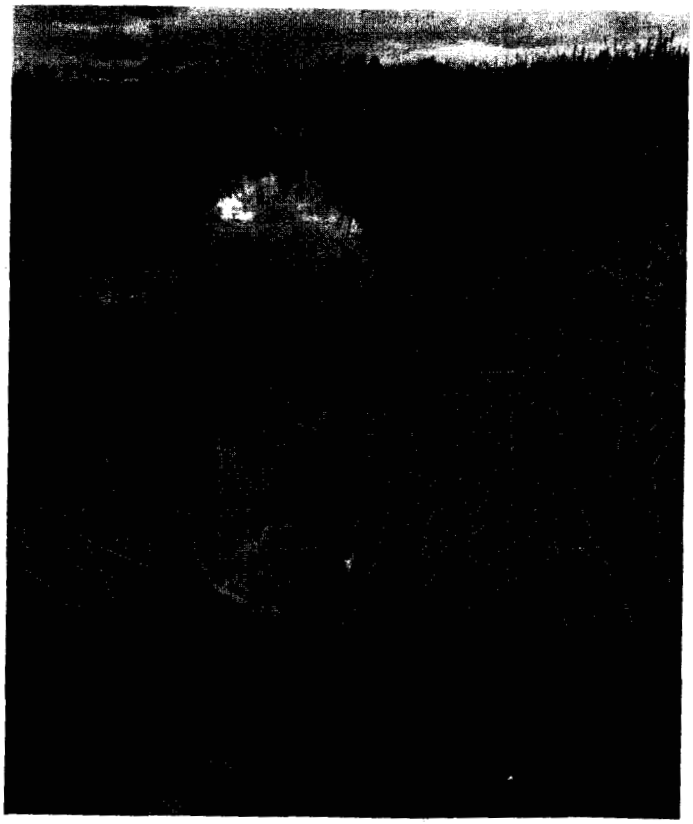
TABLE V

DISCHARGE - c.f.s.

Maximum	Minimum
4640 1 April 1963	0.1 4-7 Sept. 1964

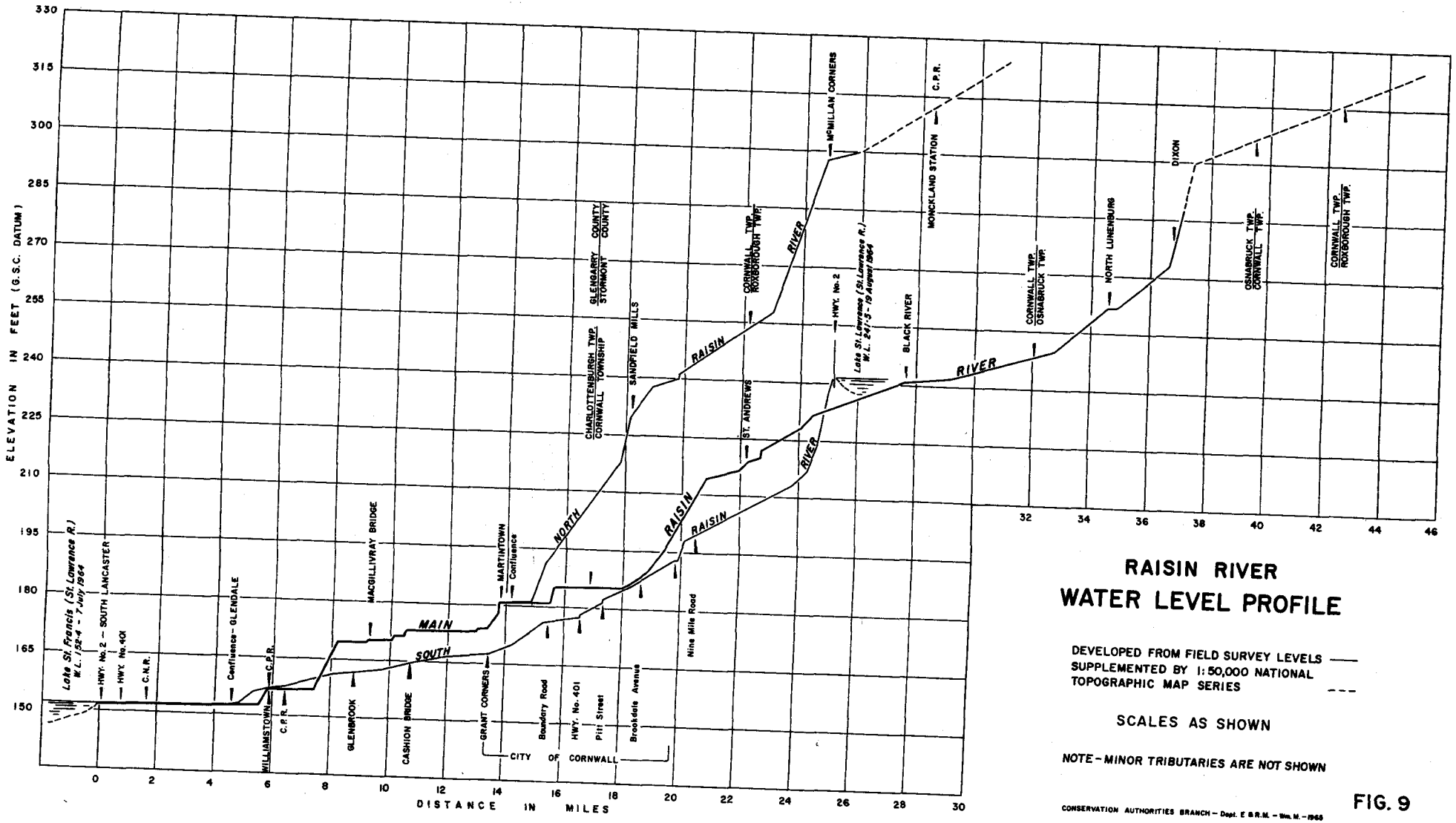
The highest water elevation that could be recalled by the local citizens was pointed out on the bridge at Williamstown. From this it was estimated that the corresponding high flow was about 6,000 c.f.s. It was not known when this occurred but it was some time during the last 20 years.

It was generally agreed that the least flow remembered by local citizens occurred during the summer of 1964 and it is evident that this was approximately 0.1 c.f.s. recorded from the 4th to the 7th of September, 1964.



A V-notch weir used temporarily during the summer of 1964 to measure flow from the peat bog on the north-western edge of the watershed.

A trapezoidal weir used to measure streamflow during the dry summer period. This weir was situated about one mile downstream of MacGillivray Bridge during the summer of 1964.



RAISIN RIVER
WATER LEVEL PROFILE

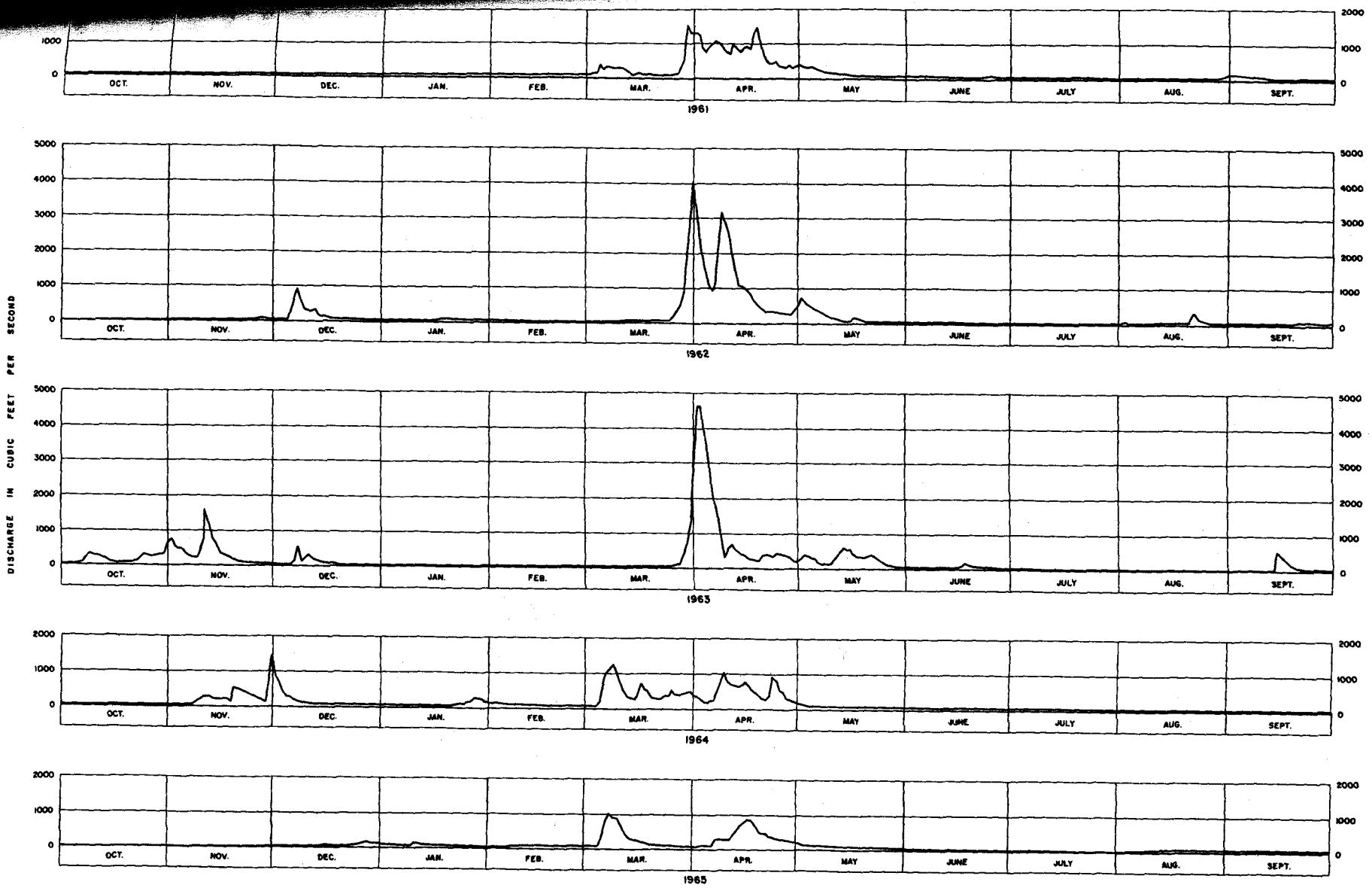
DEVELOPED FROM FIELD SURVEY LEVELS ——
SUPPLEMENTED BY 1:50,000 NATIONAL TOPOGRAPHIC MAP SERIES - - -

SCALES AS SHOWN

NOTE - MINOR TRIBUTARIES ARE NOT SHOWN

CONSERVATION AUTHORITIES BRANCH — Dept. E.B.R.M. — Wm. M. — 1965

FIG. 9



RAISIN RIVER

HYDROGRAPHS

WILLIAMSTOWN GAUGE – DRAINAGE AREA 154 SQ. MILES

Mean daily flows plotted from Dep't. of Northern Affairs and National Resources, Water Resources Branch Records.

CONSERVATION AUTHORITIES BRANCH, DEP'T. E.&R.M., L.R.L. 1966

FIG. 10

FIG. 10

CHAPTER 7

POLLUTION

1. General Information

Pollution is considered to be anything that may impair the quality of the water of any well, lake, river, pond, spring, stream, reservoir, or other water or watercourse. It includes discharge of material of any kind to the water or depositing such material on the bank or shore of the water supply. It is not restricted to depositing those materials or quantities which may be injurious to health, but also includes those which might interfere with aquatic life, recreation, or any normal use of water.

Upon reaching the earth's surface, water dissolves or carries in suspension organic residues of plant and animal life from the upper layers of the soil. If the water flows through peat bogs, swamps, or otherwise encounters much decomposing animal or vegetable matter, this change in water condition is often quite significant. This is true in the Raisin River.

The water of the stream, with its natural additions, is considered to e in its natural state and ready to support natural aquatic life. The bacterial nd other microscopic animal and plant life present will supply food for the successive life stages of protozoa, rotifera, molluscs, and insect larvae. All of these ay eventually supply the requirements for the support of major fish species.

Normal stream life is possible only when the flora and fauna, both in ıe water and on the bed of the stream, are well balanced. The many forms of ıuatic life, from the smallest bacteria to the largest fishes, distribute themselves a stream in accordance with the environment. If this normal stream life is upset the introduction of excessive wastes, adverse environmental conditions will sult, and the stream will be unable to serve its true function.

One of the greatest hazards of water pollution is the risk of disease a community. Polluted water may contain pathogenic organisms which are hard to ɔect. Coliform organisms, although not dangerous themselves, accompany the pathoıs and are easily detected. For this reason, one of the standards of water quality based on the coliform count. The Ontario Water Resources Commission recommends t no more than 2400 coliforms per 100 millilitres be tolerated in surface waters.

Pollution is of concern not only as a health hazard but also as an nt affecting the possible usage of water facilities. Foul smelling and objection-

able looking water not only offends our sensibilities and our aesthetic and recreational enjoyment of the out-of-doors, but is usually completely devoid of desirable species of fish and wildlife. People are spending more and more time on recreation and if benefits are to be reaped from the growing interest in outdoor recreation, natural facilities and sites must be conserved and protected from pollution.

The Conservation Authorities in Ontario are co-operating closely with the O.W.R.C. in combatting pollution. They collect water samples for testing by the Commission and investigate and report sources of pollution. As a part of this co-operative effort a system of weekly stream sampling was established as part of the regular watershed survey during the summer of 1964. The findings of this stream sampling are reported in the following sections.

2. Sources

Most of the major sources of pollution of the Raisin River have been and are continuing to be investigated by the O.W.R.C. The major source of pollution has been found to be dumping of cheese wastes into the river. Poor sanitary landfill operations, private garbage dumps, overflowing septic tanks, and combined sewers probably account for most of the secondary sources of pollution.

Sanitary landfill operations in the city of Cornwall were found to be unsatisfactory. Organic wastes were observed oozing from the landfill directly into the watercourse. Little or no flow occurs near this landfill in the summer but a heavy rainfall could carry these pollutants downstream.

Many citizens along the river have been using the river bank as a convenient garbage dump. This is not only unsightly but also unsanitary, because the garbage eventually washes into the stream and adds to the pollution load.

It was observed that many systems of sewage disposal were being employed on properties along the river bank. Some property owners were discharging human sewage directly into the stream, others dumped it as the overflow from their septic tanks and still others, as in Martintown, were illegally combining their sewage disposal with the town's storm sewers.

The pollution problem is mainly confined to the river water but, in the area around Bonville, several wells were reported to be polluted by seepage from the cheese factory there.

3. B.O.D., Coliform, D.O. Tests and Streamflow

Samples were taken from the river at various locations during the

This drainage ditch at Lunenburg receives a heavy pollution load making it unsightly, unsanitary and foul smelling.

This garbage dump on the stream bank is one of many which contribute to pollution of the Raisin River.

period June 3 to September 8, 1965. The locations of the major sampling points are shown in Figure 7. Testing of the water samples was done in the chemical and bacteriological laboratories of the Ontario Water Resources Commission.

The most useful indicator of organic pollution (apart from coliform bacteria and other bacteria more harmful to human health) is the relation of the dissolved oxygen in the stream to the dissolved oxygen required to stabilize the wastes in it. This is commonly measured by the Biochemical Oxygen Demand, (usually known as the B.O.D.) determined wholly by the availability of the material in the water and as a bacterial food by the amount of oxygen utilized by the bacteria during its oxidation. The "five-day B.O.D." at 20° centigrade is the commonly accepted standard of measurement of oxygen demand.

One of the objectives of the O.W.R.C. for surface waters is a maximum B.O.D. of 4 p.p.m. The B.O.D. and coliform counts exceeded the limits in many instances, particularly at locations just downstream from the cheese factories.

A test for dissolved oxygen (D.O.) in the water, reveals the amount of oxygen available to satisfy the B.O.D. The absence of oxygen will result in anaerobic conditions, with foul smelling water and large quantities of fungi developing. Unfortunately the ability of water to hold oxygen in solution is small, ranging from 14.6 p.p.m. at 32° F. to 7.6 p.p.m. at 86° F. Therefore, conditions are aggravated in polluted streams in summer when bacterial action takes place faster and the dissolved oxygen is low. Oxygen contents are sometimes expressed as per cent saturation and values below 40 per cent are considered to be indicative of poor quality water.

High free ammonia contents are indicative of organically enriched water and in 1964 were particularly prevalent downstream from the cheese plant at Martintown and the milk plant at Glendale.

The amount of nitrates and phosphates which enter the river from chemical fertilizing in agricultural operations is not known but it may be considerable. The phosphates which are present are probably largely a residue from cleaning compounds used in cheese and milk plants.

Analysis for nitrogen in its various forms is a reliable indicator of the presence of pollution in a stream. High values of free ammonia and total Kjeldahl* are an indication that the stream is freshly polluted, while the presence

*Kjeldahl values are derived by the conversion of as much organic matter in water as possible to ammonia, plus any free ammonia in the water. They do not include nitrates or nitrites.

of nitrates and nitrites indicate that pollution has already occured at some earlier stage and has been almost completely oxidized. In unpolluted waters the amount of ammonia and ammonium compounds (chiefly ammonium carbonate) is usually very small.

From the standpoint of aesthetics, large amounts of suspended solids are objectionable, whereas for domestic or industrial purposes dissolved solids are objectionable. Neither of these types of solids were considered excessive for surface waters in the Raisin except perhaps in the immediate vicinity of waste outfalls.

The following table gives an indication of some of the extreme values encountered at sampling points downstream from the major sources of pollution during the survey period of 1964:

TABLE VI

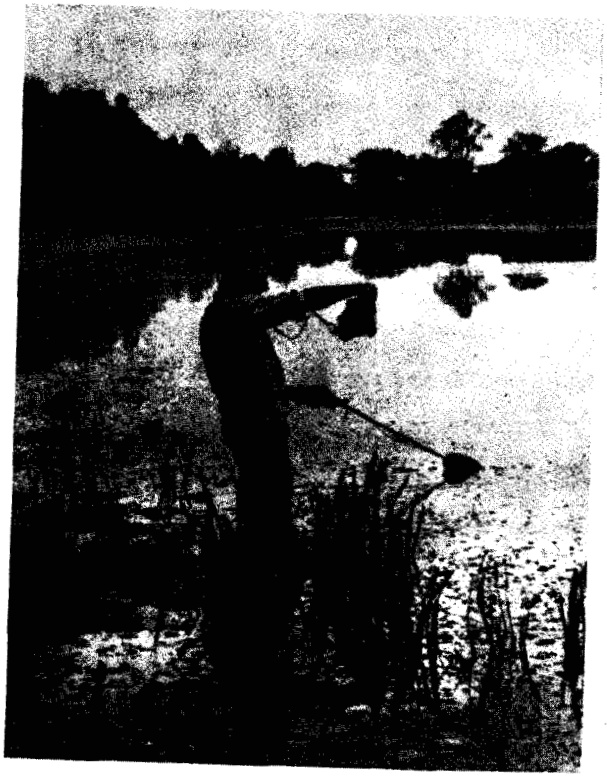
POLLUTION SAMPLES

	Sample Results	O.W.R.C. Objective
5-Day B.O.D.	310 p.p.m.	4 p.p.m.
Dissolved Oxygen	0.5 p.p.m.	4 p.p.m.
Total Kjeldahl	42 p.p.m.	--
Free Ammonia	4.6 p.p.m.	--
Nitrite	0.3 p.p.m.	--
Nitrate	0.8 p.p.m.	--
Total Phosphorus	20.0 p.p.m.	--
Soluble Phosphorus	15.0 p.p.m.	--
Total Solids	672 p.p.m.	--
Suspended Solids	101 p.p.m.	--
Dissolved Solids	604 p.p.m.	--
Coliform Bacteria per 100 Ml.	68,000,000 m.p.n.	2400 m.p.n.
Colour	250 Hazen Units	15 Hazen Units

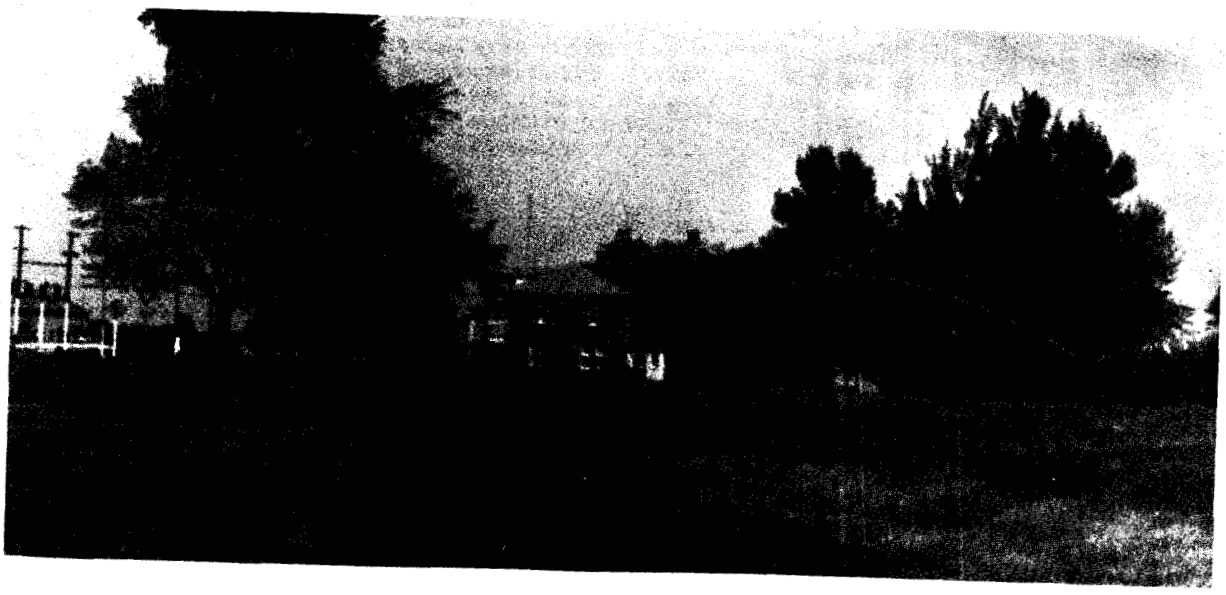
It should be noted that during the 1964 survey streamflow was very low and offered little dilution to the pollution load discharged to the stream. This serves as an explanation for some of the extreme values noted in the table above.

4. Inspections

In 1964, all cheese and milk processing plants in the area were inspected by O.W.R.C. and recommendations were made to each one on the proper disposal of its wastes. In most cases, the recommendation was to employ a system of spray irrigation for waste disposal, thus making use of these wastes as a fertilizer. In some instances, this system was not considered feasible due to the lack of sufficient available pasture land adjacent to the plant.



Measuring the amount of dissolved oxygen in the water.



Spray irrigation — an effective means of waste disposal.

During the summer of 1965, the O.W.R.C. noted that many improvements had been implemented by the cheese factory owners. No evidence of wastes being discharged directly to the river was noted except at Lunenburg, where wastes were being discharged to the ditch on the north side of the town. This same condition was noted in October, 1965, when inspected by a member of our field staff.

5. Recommendations

In order to maintain sanitary conditions in the river, more concern must be given to the proper and efficient disposal of wastes.

Cheese and milk processing plants should install adequate spray irrigation facilities for all their industrial wastes and should be encouraged to operate and maintain these properly.

Sanitary landfill operations, if properly controlled, are an effective means of waste disposal. In the future, it is recommended that no dumping be allowed within 100 feet of any ditch or watercourse. The same regulation should be applied to both municipal and private garbage dumps near river banks.

Septic tanks should overflow into a tile weeping bed and should not be allowed to enter any watercourse such as a stream or storm sewer.

All possible sources of pollution should be kept under continual inspection and persons responsible for polluting watercourses should be made aware of Section 27 of the Ontario Water Resources Commission Act which states:

> "Every municipality or person that discharges or deposits ... any material of any kind into or in any well, lake, river, pond, spring, stream, reservoir, or other water or watercourse or on any shore or bank thereof or into or in any place that may impair the quality of the water of any well, lake, river, pond, spring, stream, reservoir, or other water or watercourse is guilty of an offense and on summary conviction is liable to a fine of not more than $1,000 or to imprisonment for a term of not more than one year, or to both."

The only other solution to the pollution problem is that of providing dilution flow. This method is expensive and schemes to provide any major relief by this method cannot be economically justified. The physical controls which would be needed to provide dilution flow are discussed in Chapter 8. The removable weirs which are recommended there would be of some help but their effect would be limited and local.

CHAPTER 8

PHYSICAL AND REGULATORY CONTROLS

1. Introduction

The Raisin River, like many small rivers in Southern Ontario, experiences a period of very low to nil flow during the summer months and high flows and water wastage during the spring. In order to gain a more or less stable condition on the watercourses, water must be conserved in the spring when there is an excess and released later when the natural flow is deficient.

There are many important advantages to be gained from good summer flows. Streams with extremely low flows and those which dry up entirely are a health menace to the communities through which they pass. A good flow will flush out the channel and provide a good environment for fish and wildlife, as well as a source of water for farms and villages.

With these factors in mind, a preliminary investigation of the watershed was undertaken. The purpose of the survey was to find some means of alleviating low summer flows and providing flood protection during the spring. Four types of physical controls were investigated: (a) reservoirs, (b) channel improvements, (c) diversions, (d) removable weirs.

2. Reservoirs

In order to justify the high expenditures for reservoirs, it is usually necessary to make them multi-purpose in nature. The reservoir must satisfy any or all of the following:

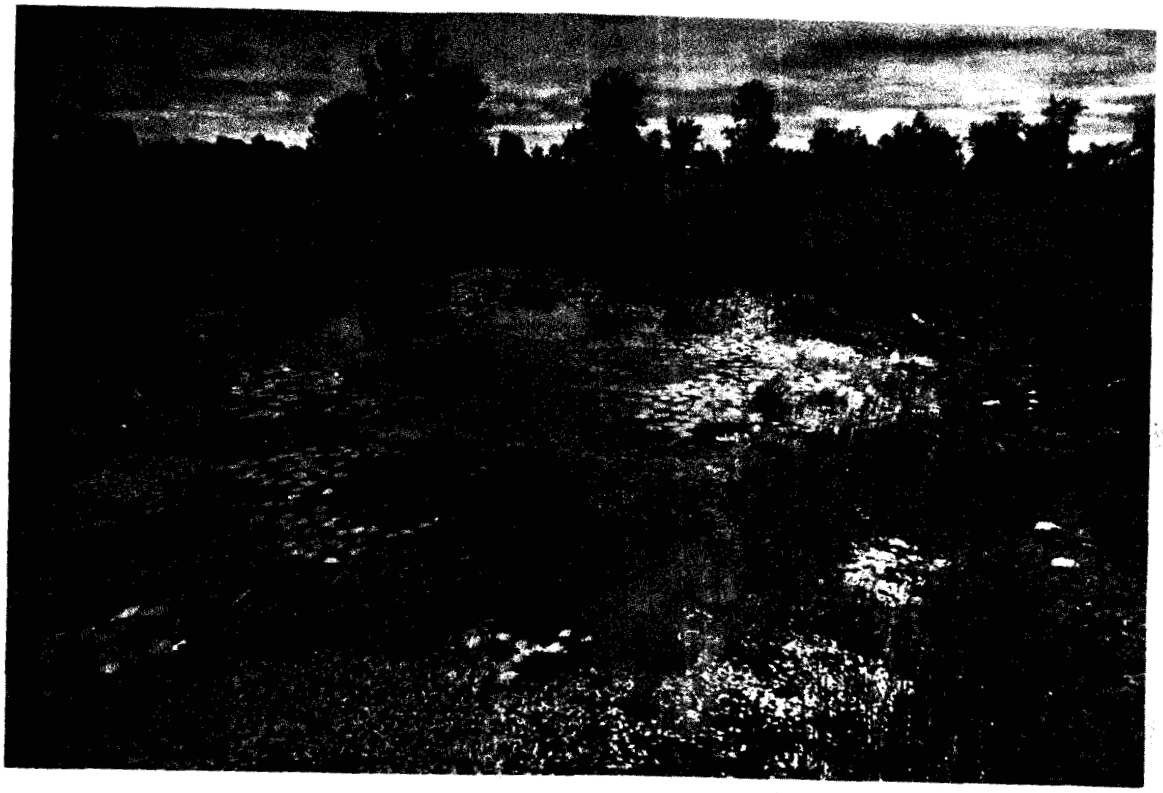
(a) protect an area from flooding,

(b) store enough spring runoff to maintain good summer flows,

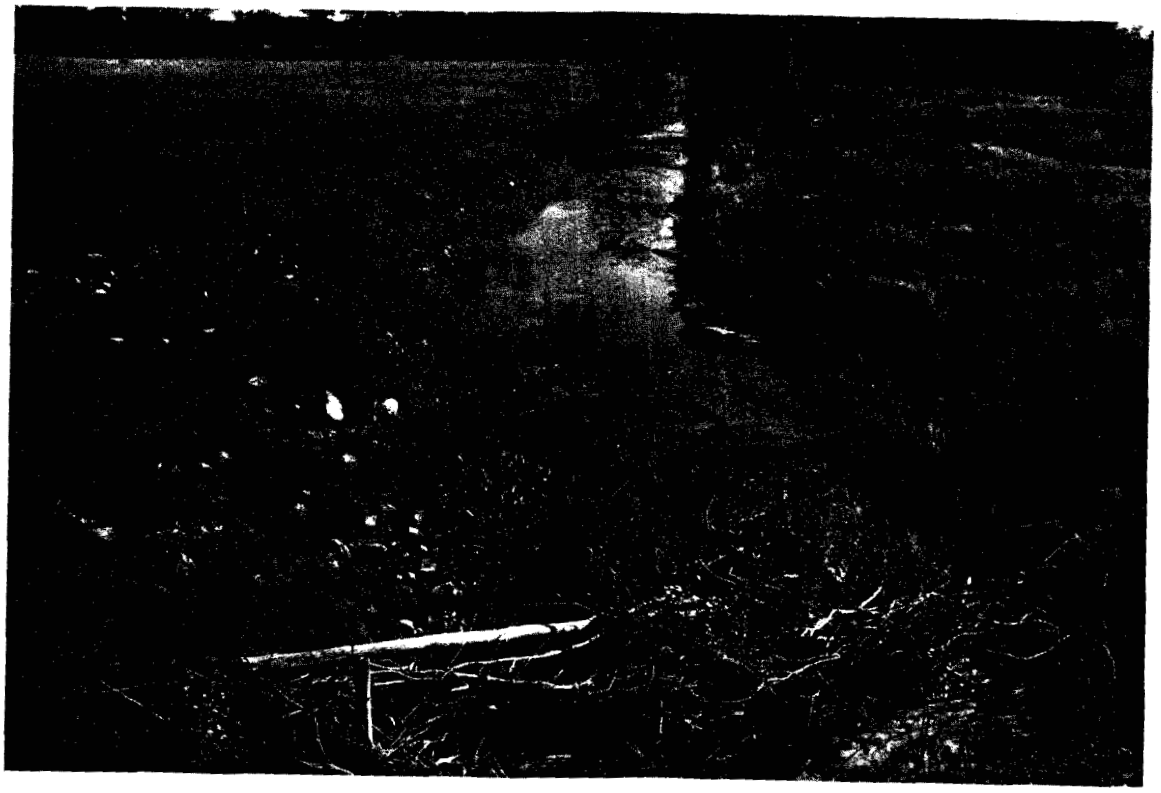
(c) provide water supply and fire protection for communities,

(d) be usable as a recreation area.

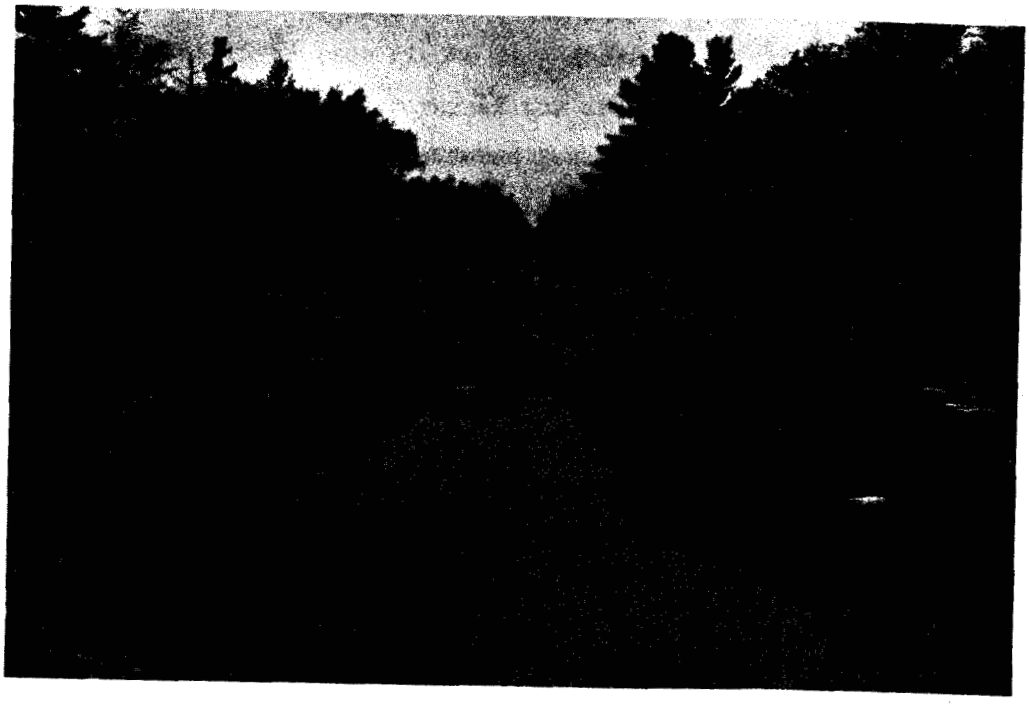
In considering storage reservoirs for physical control of water, two limitations must be borne in mind. First, the physical conditions of the watershed must be such that reservoirs can be constructed of sufficient size to store flood waters and maintain enough storage for summer flows. For flood protection, reservoirs should be relatively close to the area to be protected since their effect diminishes rapidly with distance upstream from the trouble area. Secondly, the cost of such reservoirs must be reasonable and less than the benefits which will result from their construction.



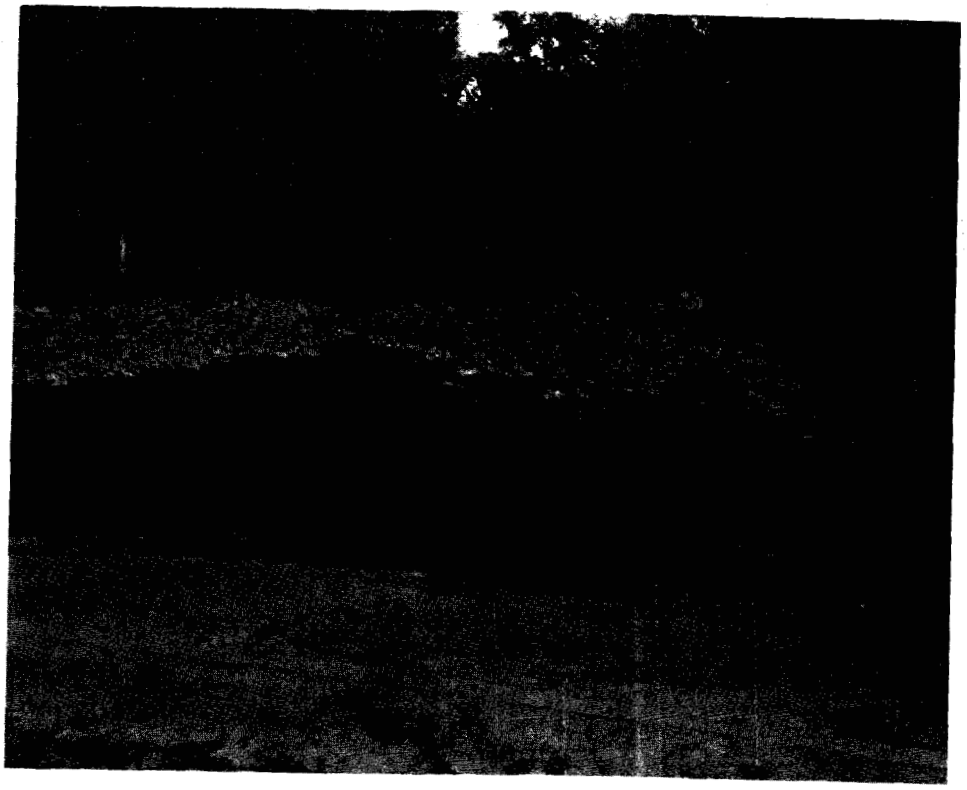
Very dense weed growth along the South Raisin River is a major obstruction to flow in the stream.



Roots and stumps of fallen trees clog the channel at several places along its length.



This small island is located at the downstream end of a long flat stretch of river. Ice jamming here in the spring causes widespread agricultural flooding upstream. Removal of this barrier is recommended.



Clearing of this channel downstream from the bridge at Martintown would increase the channel capacity.

From an examination of topographic maps, seven possible sites were located along the river (see Figure 7). These were inspected on site and levels were taken to check the topography of the areas. Due to the flatness of the watershed, none of the sites was considered feasible and it was felt that protection could probably be obtained more economically in other ways.

3. Channel Improvements

Preliminary surveys were carried out in several areas to determine the degree of protection that might be provided by straightening and improving the channel through the potential flood areas. At present, the number of inhabitants to be protected is few and the property values involved probably would not warrant the construction of any major channel improvements. Consideration should be given to minor channel clearing and dredging at various trouble spots such as those shown in the illustrations. These channel obstructions are conducive to ice jamming and consequent flooding and should therefore be removed.

4. Diversions

Since the creation of Lake St. Lawrence on the St. Lawrence Seaway, there have been many local suggestions for the diversion of water from this lake to the Raisin River. Any such proposal would, of course, involve the interests of the Seaway Authority and the power commissions involved and would require permission from the International Joint Commission since Lake St. Lawrence is international water.

The studies described below deal only with the engineering considerations which would be involved in these suggested diversions and carry no implication as to the possibility of their acceptance by the various bodies concerned.

(a) Lunenburg Diversion

One suggestion has been for the diversion of water from this lake to the Main Raisin River near Lunenburg. From a study of the extent of pollution on the river, it was decided that a dilution flow of approximately 15 cubic feet per second would be needed to improve the aesthetic and wildlife potential of the river.

Two schemes were investigated and are described below. Both schemes follow the same route across country from the bay at Hoople's Creek to a point on the Main Raisin River about three-quarters of a mile north-east of Lunenburg (see Figure 11).

(1) Open channel scheme

This scheme consists of a channel 7.8 miles long with a grade of 0.284 feet per mile or 0.00492 per cent. It would have a bottom width of 20 feet and side slopes 1½:1. The average depth of the cut would be approximately 16 feet, and with the inclusion of berms to offset bank erosion would have an average top width of 60 feet. At the height of land south of Lunenburg, the maximum cut would be approximately 32 feet deep and 106 feet wide.

The cross-country ditch would be approximately 2.6 miles long and would meet the Main Raisin at an elevation of approximately 237.5 feet above sea level. Since the existing river bed is at elevation 248.0 and the river slope is only about 2.0 feet per mile, the river bed would need to be excavated 10.5 feet at the confluence with the ditch, and the excavation continued along the river for another 5.2 miles at a slope of 0.284 feet per mile. At the confluence a drop inlet would be necessary to bring the flow from upstream down to the new channel level.

It is estimated that the required excavation for this scheme would be approximately 620,000 cubic yards. It would also be necessary to construct three township road culverts, one major highway culvert (Highway 401) and one railway culvert (C.N.R.) and provide protection for a gas pipeline. A control structure would be required at the Lake St. Lawrence end to regulate the flow.

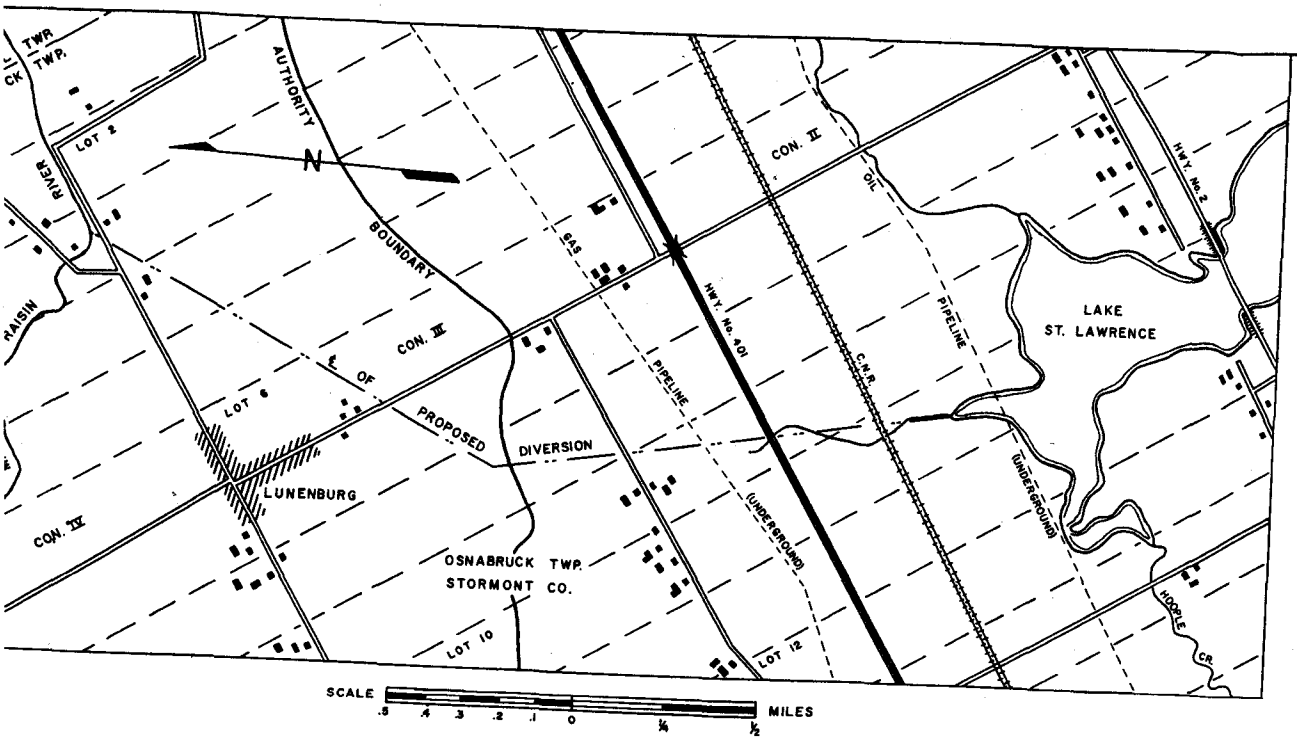
At an estimate of 55¢ per cubic yard for excavation, this project would cost approximately $800,000 including land acquisition and bridge construction costs.

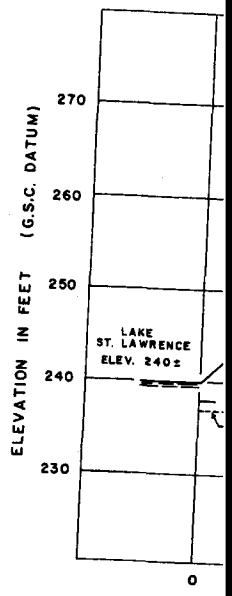
(2) Ditch and pumping scheme

This scheme involves the construction of an open channel from Lake St. Lawrence to a pumphouse on the south side of Highway 401. The open channel would have a 20-foot bottom width with 1½:1 side slopes and a bottom elevation of 237 feet above sea level.

At Highway 401, a pump would lift approximately 15 c.f.s. or 8,100,000 gallons per day over the height of land through a 36-inch pressure conduit. The conduit would be approximately 6,000 feet long, and would discharge into an outlet ditch. The outlet ditch would be two feet deep with 2:1 side slopes and a bottom width of five feet.

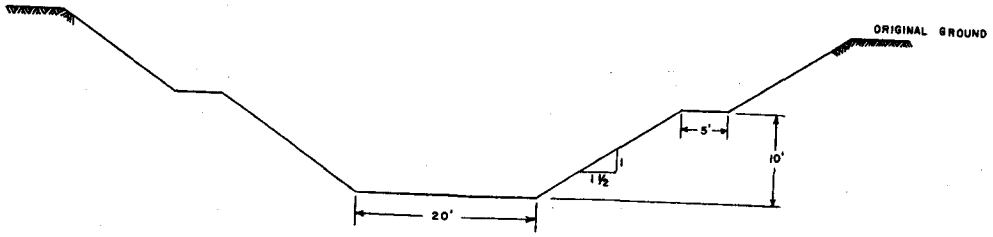
The estimated capital outlay for this system including land acquisition, excavation, pipe, pumping machinery and structures is $400,000. The estimated annual operating cost is $15,000.



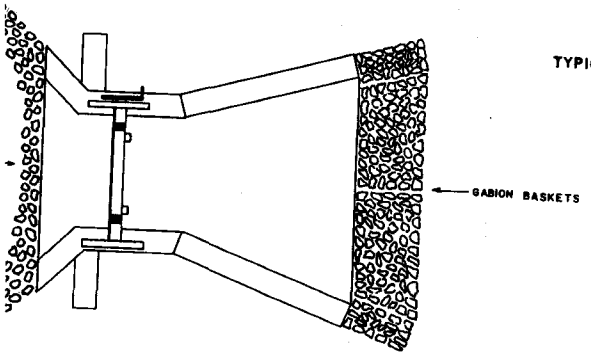


LOCATION OF PROPOSED DIVERSION

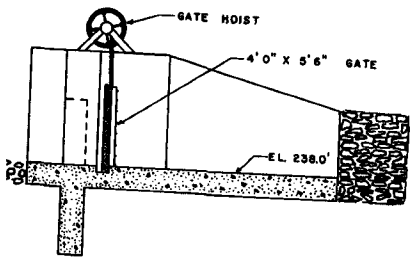
DIVERSION SCHEME (a)
(OPEN CHANNEL)



TYPICAL CHANNEL SECTION

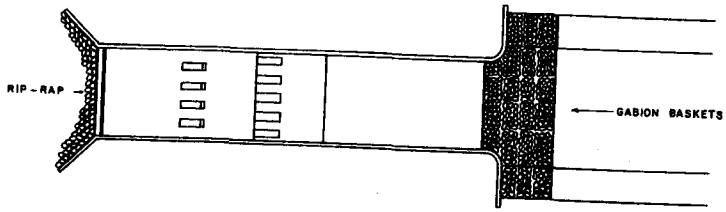


PLAN OF INLET STRUCTURE

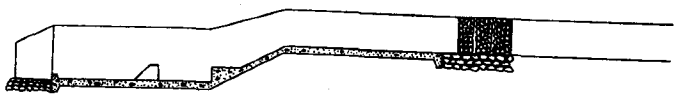


CROSS-SECTION OF INLET STRUCTURE

SCALE 1" = 8'

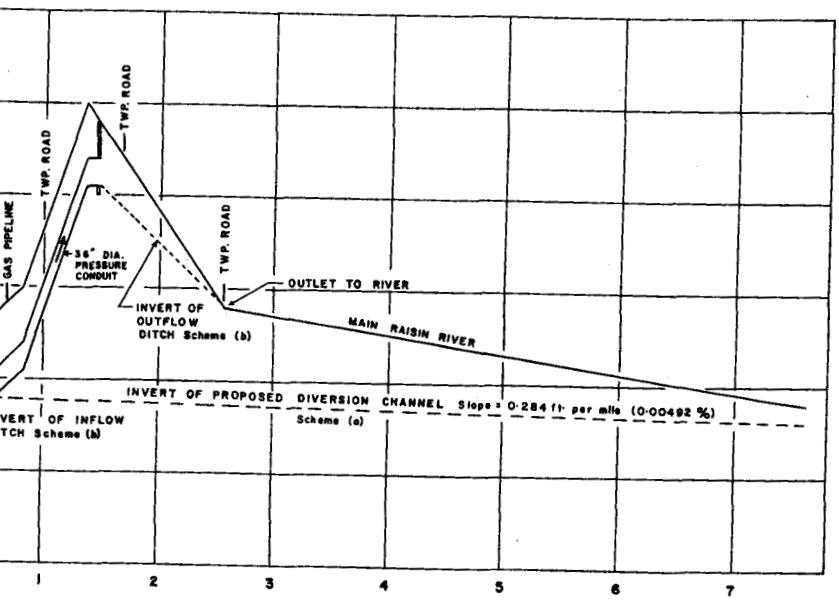


PLAN OF OUTLET DROP STRUCTURE



CROSS-SECTION OF OUTLET DROP STRUCTURE

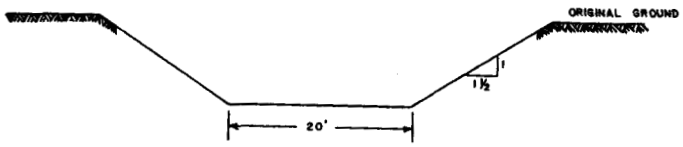
NOT TO SCALE



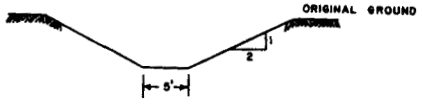
DISTANCE IN MILES

PROFILE OF PROPOSED DIVERSION

DIVERSION SCHEME (b)
(PUMPING)



TYPICAL INLET CHANNEL SECTION



TYPICAL OUTLET CHANNEL SECTION

RAISIN RIVER CONSERVATION AUTHORITY

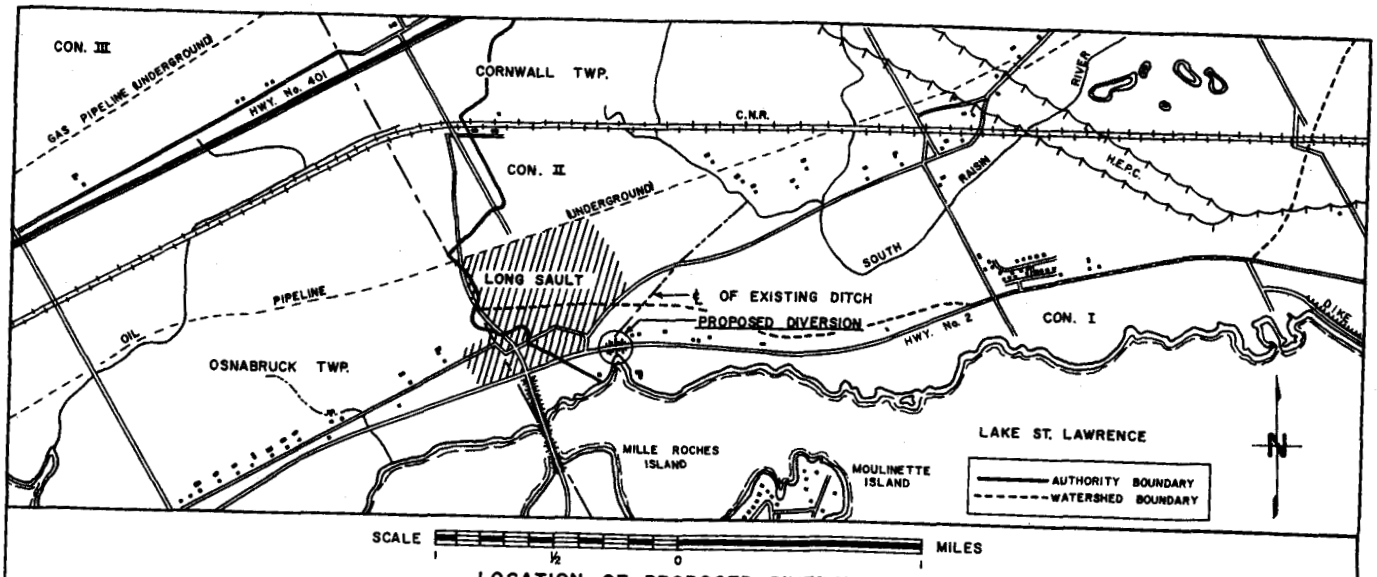
LUNENBURG DIVERSION

SCHEMES (a) & (b)

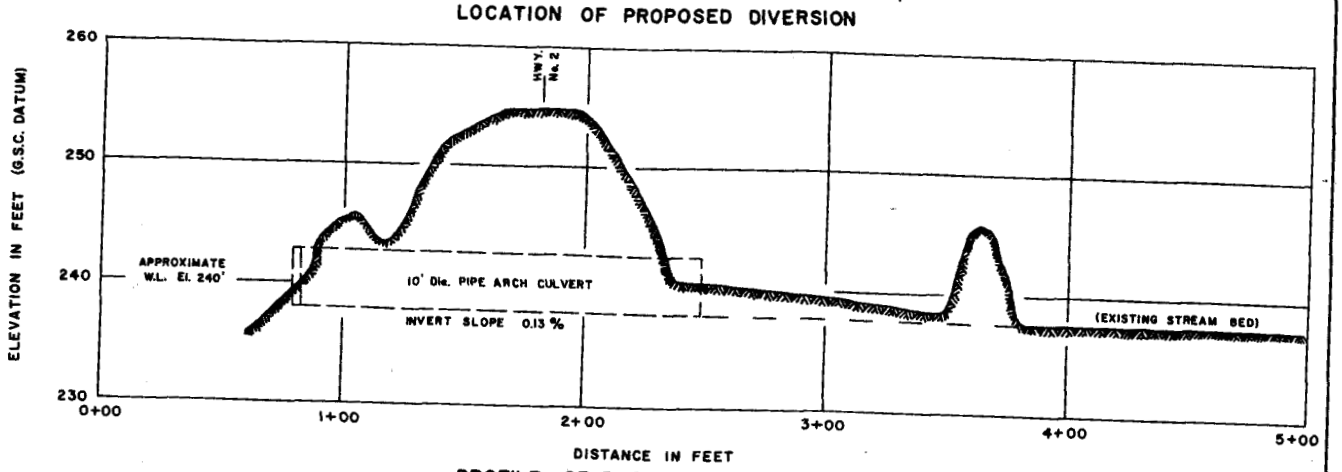
SCALES AS SHOWN

CONSERVATION AUTHORITIES BRANCH Dep't. E.B.R.M. J.MacP. 1965

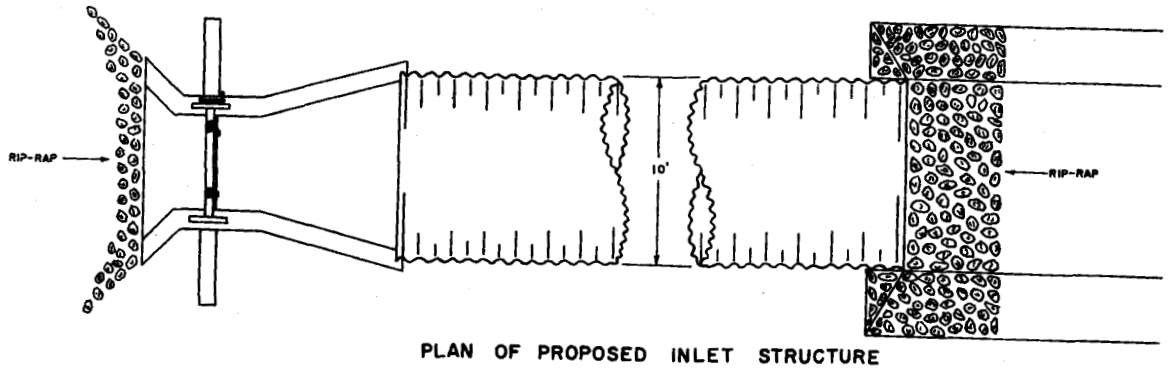
FIG. II



LOCATION OF PROPOSED DIVERSION

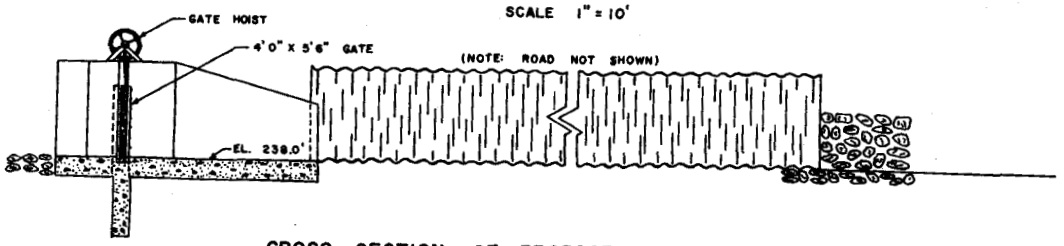


PROFILE OF PROPOSED DIVERSION



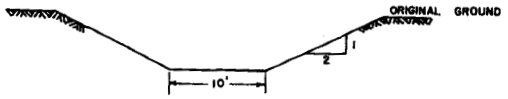
PLAN OF PROPOSED INLET STRUCTURE

SCALE 1" = 10'



CROSS-SECTION OF PROPOSED INLET STRUCTURE

SCALE 1" = 10'



TYPICAL CHANNEL SECTION

SCALE 1" = 20'

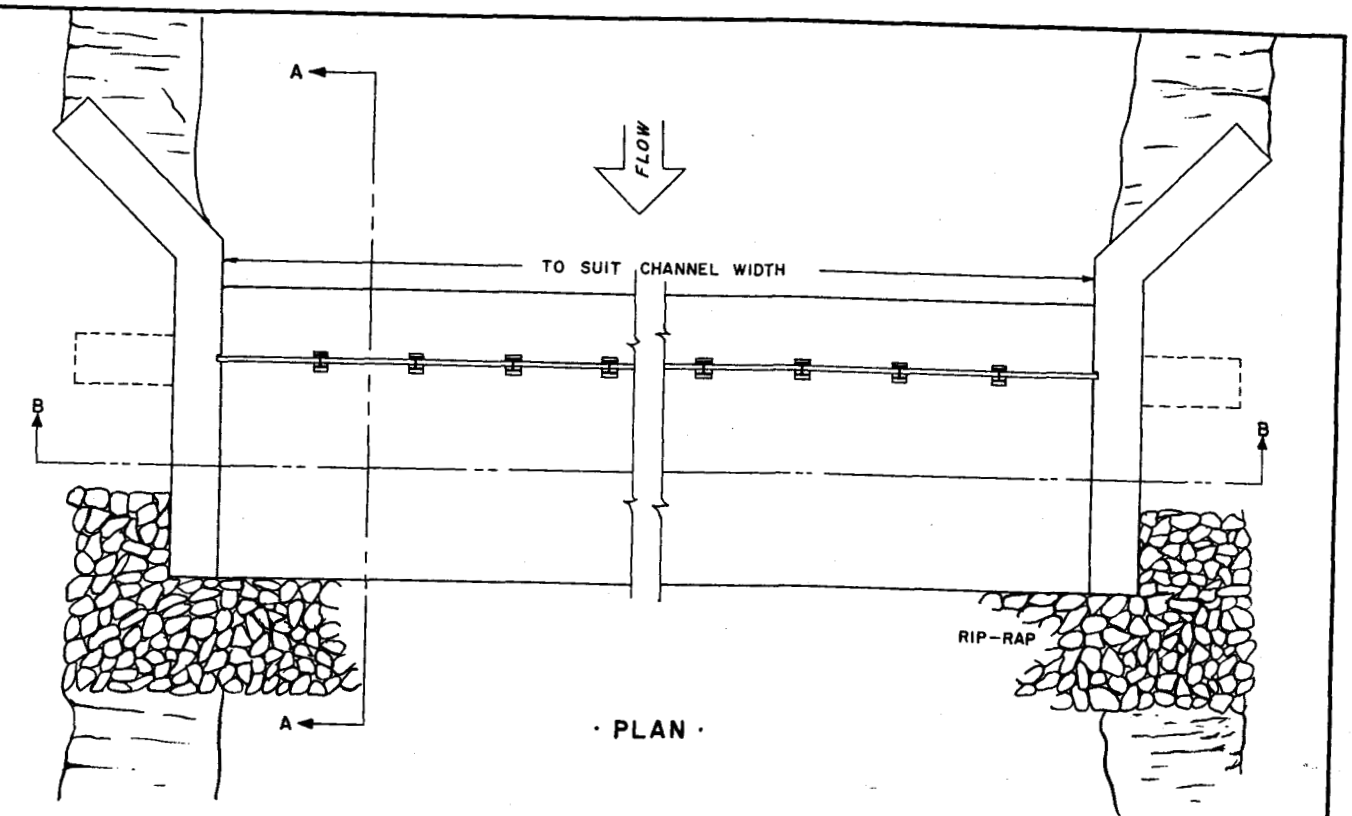
RAISIN RIVER CONSERVATION AUTHORITY

LONG SAULT DIVERSION

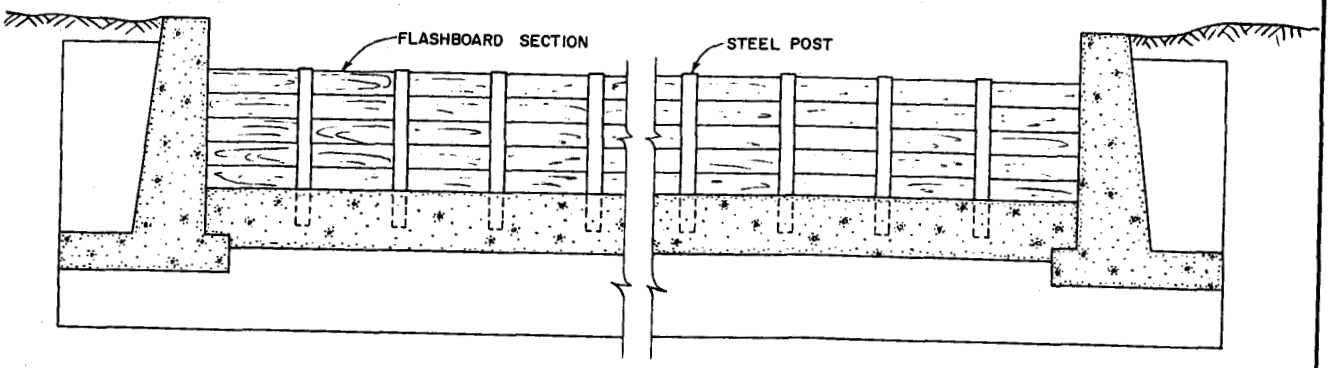
SCALES AS SHOWN

CONSERVATION AUTHORITIES BRANCH Dep't E. & R.M. J. MacP. 1965

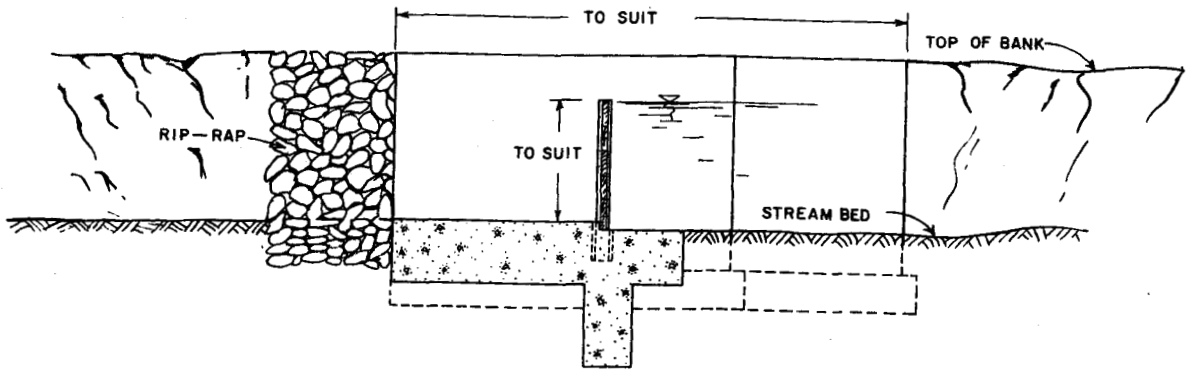
FIG. 12



· PLAN ·



· SECTION B-B ·



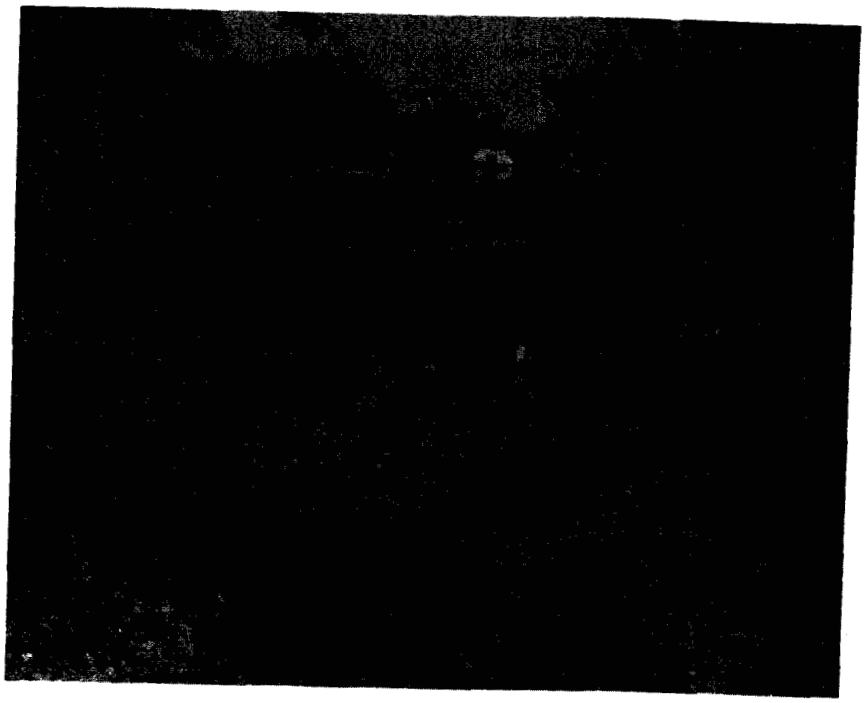
· SECTION A-A ·

TYPICAL LOW WEIR

SCALE 4 0 4 8 FEET

CONSERVATION AUTHORITIES BRANCH — Dept. E & R.M — Wm.M. 1966

FIG. 13



Installation of a low weir downstream from the bridge at Williamstown would make this site more attractive for recreation and fish life.

This natural rock shelf about one-half mile downstream of MacGillivray Bridge would be a suitable location for a low weir.

It should also be noted that any diversion along this route would involve land outside the present limits of the Authority.

(b) Long Sault Diversion

In order to improve the stream potential of the South Raisin River, water could be diverted from Lake St. Lawrence to the headwaters of the South Raisin at Long Sault. A flow of 10 c.f.s. would be required and this diversion would involve the construction of a small inlet structure and a culvert under Highway 2 at Long Sault.

The total cost of this diversion would be approximately $15,000.

As with the other schemes, any diversion of water under this scheme would require the permission of the International Joint Commission.

5. Removable Weirs

A series of removable weirs could be constructed at appropriate spots along the river. These weirs would create deeper pools and thus, generally improve the conditions of the stream for recreation, pollution abatement and stream life development.

With this type of weir the sections are put in place in the early summer to maintain a basin for swimming, boating and fishing as well as conserving water for fire protection and dilution flows. The sections are removed in the fall in order not to impede the high spring flows. Similarly, sections would be removed during any sudden summer storm that threatened to cause flooding.

Some suggested locations for these weirs are shown on the watershed map (Figure 7). The cost of these structures varies with the height, length and soil conditions but is generally in the range of $3,000 to $10,000. A typical low weir is shown in Figure 13.

It is recommended that the Authority give consideration to this type of weir as an aid toward the solution of its low flow, pollution abatement and recreational problems.

6. Legislative and Regulatory Controls

In the past, much land development has progressed without due regard to the flood potential of the adjacent rivers. Each river has its flood plain or land flooded during periods of high flows. This land belongs to the river and should not be occupied by man. In order to prevent damage and suffering due to floods, the use of the areas along the river must be adjusted to work in harmony

rather than in conflict with the nature of the flood plain.

One method which can be used to make this adjustment is "flood plain zoning". There are two approaches to establishing control of the flood plain lands:

First, the Conservation Authority, under Section 20 of The Conservation Authorities Act, can establish regulations:

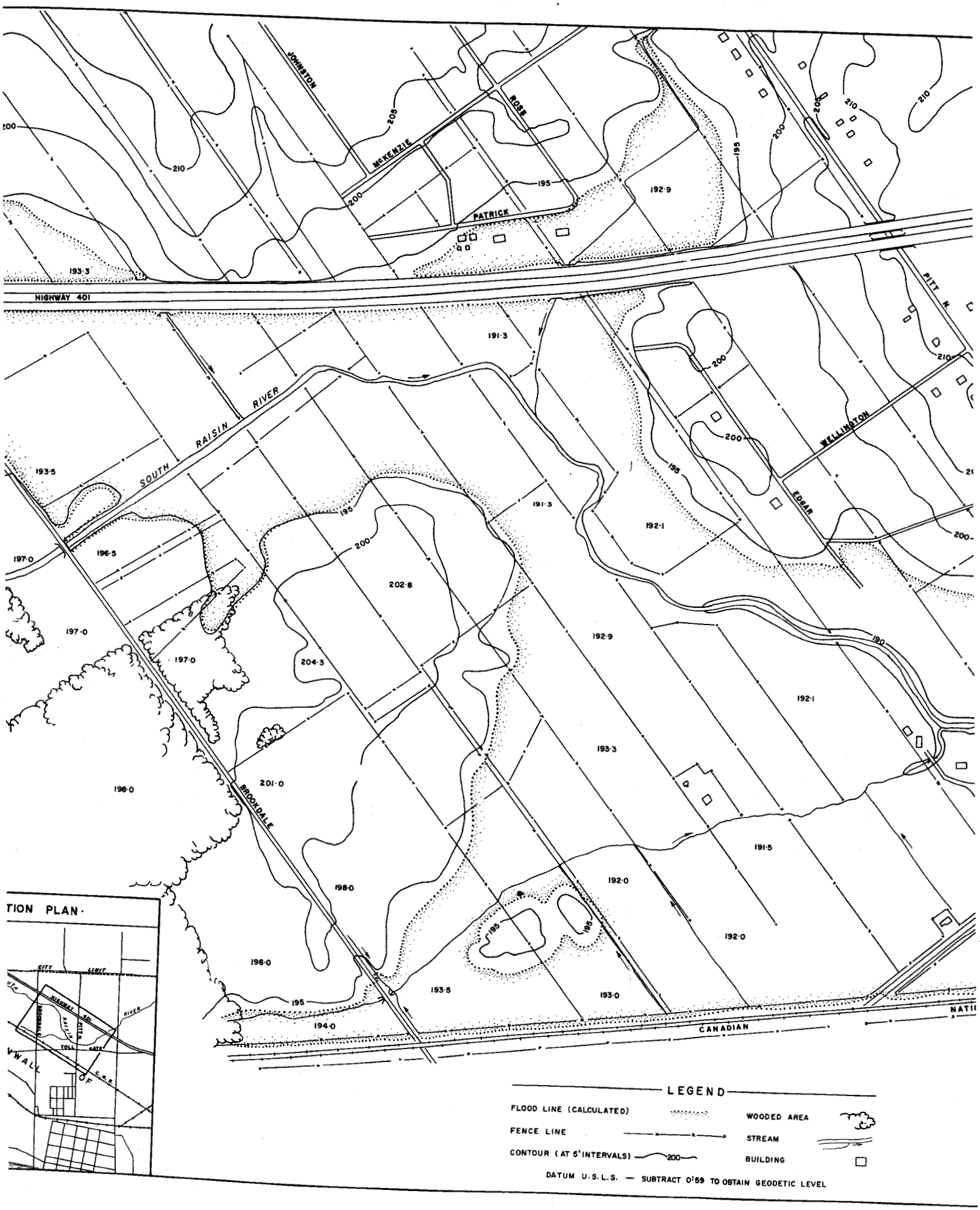
> "prohibiting or regulating the construction of any building or structure in or on a pond or swamp or in any area below the high-water mark of a lake, river, creek or stream;
>
> prohibiting or regulating the placing or dumping of fill of any kind in any defined part of the area over which the authority has jurisdiction in which in the opinion of the authority the control of flooding or pollution or the conservation of land may be affected by the placing or dumping of fill."

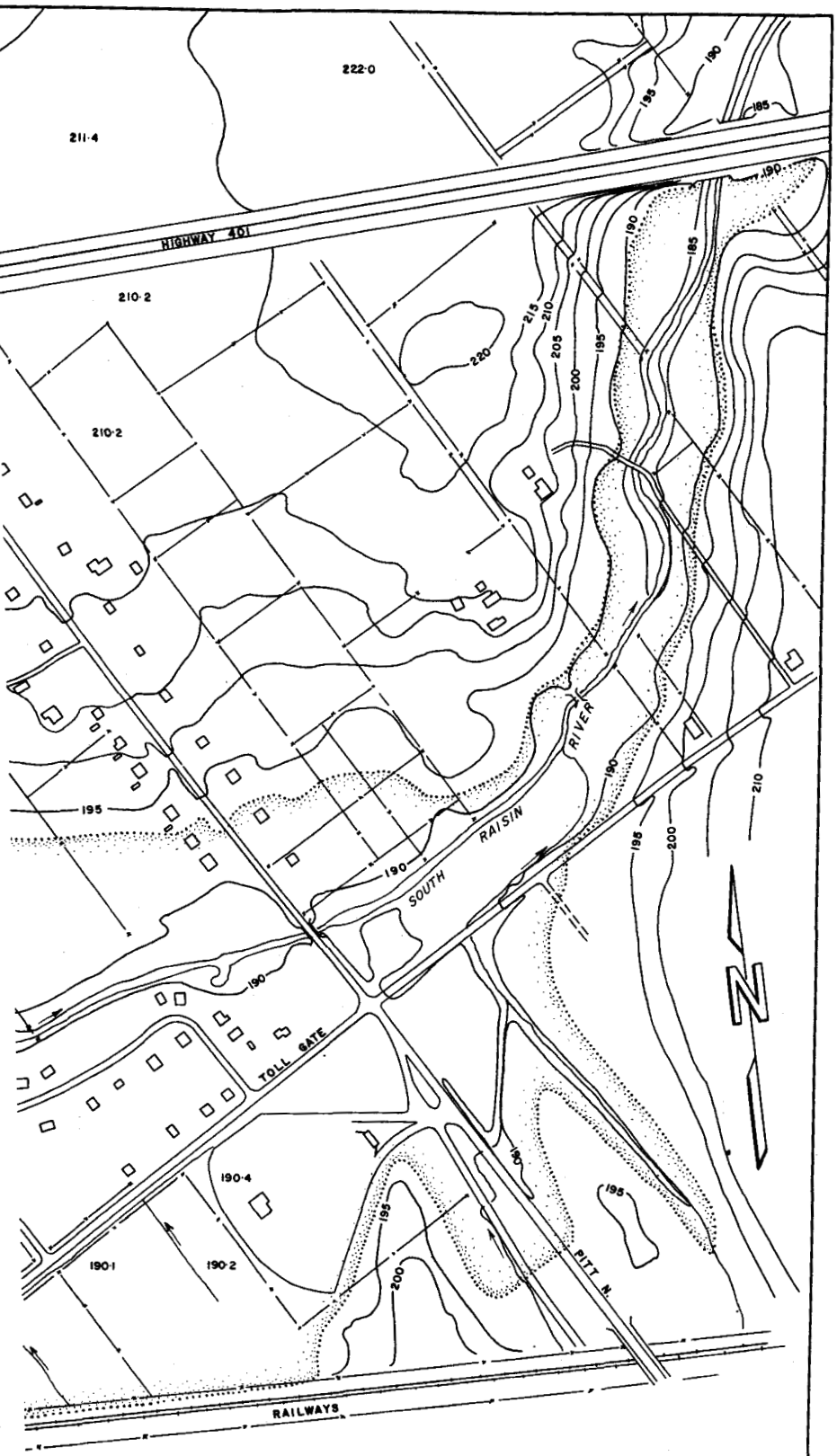
Second, the Authority can solicit the co-operation of all the member municipalities to pass, under Section 30 of The Planning Act, by-laws designating flood plain lands and restricting the use of these lands.

Although development has been slow within most of the watershed, now is the time that consideration should be given to the zoning of flood plain land. It is better to prevent residential and industrial development in the flood plain than to be faced with the task of clean-up, repair and future protection of flood plain developments.

At the present time, it is felt that the only area in need of immediate flood plain zoning is that land along the South Raisin River between Brookdale Avenue and the river culvert at Highway 401 in the City of Cornwall. Since no streamflow records are available for this region, the expected flood flow was estimated from a study of the drainage basin hydrology. This investigation gave a flow rate of 3,200 cubic feet per second and, considering this flow figure, the flood plain was outlined as shown in Figure 14. This area should be restricted to recreation and agricultural uses only.

In the near future, and before any further development is allowed, the flood plain should be outlined for all areas within the City of Cornwall. As the need arises, other areas throughout the watershed should also be examined closely before any development along the river is allowed.


JOHNSTON
MCKENZIE
ROSE
PATRICK
HIGHWAY 401
SOUTH RAISIN RIVER
WELLINGTON
EDGAR
PITT N
BROOKDALE
CANADIAN
TION PLAN
CITY LIMIT
HIGHWAY 401
RAISIN RIVER
TOLL GATE
LEGEND
FLOOD LINE (CALCULATED)
FENCE LINE
CONTOUR (AT 5' INTERVALS)
WOODED AREA
STREAM
BUILDING
DATUM U.S.L.S. — SUBTRACT 0'59 TO OBTAIN GEODETIC LEVEL



RAISIN RIVER CONSERVATION AUTHORITY

FLOOD PLAIN LAND

SOUTH RAISIN RIVER IN CORNWALL

SCALE-FEET

200 100 0 200 400 600 800

CONSERVATION AUTHORITIES BRANCH—Dept. E.&R.M.—Wm.M.-1966

FIG. 14

CHAPTER 9

PONDS

1. Value of Farm Ponds

Most farms in South-eastern Ontario would benefit greatly from an increase in their water supply. Many in fact suffer each year because they are subject to actual water shortages.

Today, with increased use of water for irrigation, spraying, livestock and domestic uses, supplies once satisfactory are proving inadequate or actually diminishing. Changes in land use have promoted rapid surface runoff; vegetation and forest cover areas which once induced infiltration and inhibited runoff have been reduced; many swamps and low areas which were particularly valuable in retaining water have been drained. This general loss of infiltration has resulted in high streamflows in the spring and at periods of excessive rainfall, with an inadequate supply through the rest of the year.

The average annual precipitation over the Raisin River watershed is more than 37 inches. This would provide an ample amount of water for farming needs if the precipitation could be stored in periods of excess to provide a supply when it is needed later in the year.

The most direct way in which the individual farmer can help to overcome his own seasonal deficiency of water and, at the same time, help in regulating streamflow, is by constructing a pond on his farm.

The basic purpose of most farm ponds is to provide water to meet the needs of livestock and domestic consumption. These are by no means the only benefits to be gained. The pond provides a ready source of water for fire protection and for irrigation, as well as recreation facilities and aesthetic values. Swimming, skating, fishing and even boating can be made possible for the farmer and his family by a properly constructed and managed farm pond. Also, with a little landscaping, a pond can be a most attractive and pleasing addition to the farm community.

The construction of a small pond can yield another benefit by establishing a suitable habitat for wildlife. Tree and shrub growth along its banks will provide shelter for birds, animals and fish, which are valuable in the control of insects, provide game for hunting and fishing and are desirable simply because their presence does much to add interest to the countryside.

It must be realized that a single pond cannot be adapted to serve all purposes. The need of water for irrigation, for example, may make even a large pond

unfit for fish and reduce its recreational possibilities. One must, therefore, decide for what purpose the pond is needed and design it with this idea in mind.

2. Types of Farm Ponds

There are four main types of ponds in common use, classified according to the source of their water supply.

(a) Dugout Ponds

This type of pond includes those in which storage is provided by excavating below the natural level. They are best located in a low depressional area with a high water table, for their main supply is from ground water. They are also supplied by surface runoff.

A pond of this type has the advantage of being very cheap to construct and requiring no designed outlet. However, with no flow through the pond, the water grows stagnant after some time and, unless very large, is not suitable for the keeping of fish. As mentioned, such a pond depends on a high water table and if the water level falls below the bottom of the pond, it will dry up.

(b) Spring-Fed or Runoff Ponds

The primary requirement for these types of ponds is a supply of water from a spring or from intermittent runoff from a small, well-defined watershed.

This pond is then most suitable at the outlet of a small valley or draw or at the foot of a rise from which springs issue. A storage volume is created by constructing an earth dam or by a combination of excavating and damming.

Where a constant supply of water is passing into the pond, it is necessary to have a mechanical spillway as well as some sort of grassed waterway or emergency spillway to prevent damage from excessive flooding.

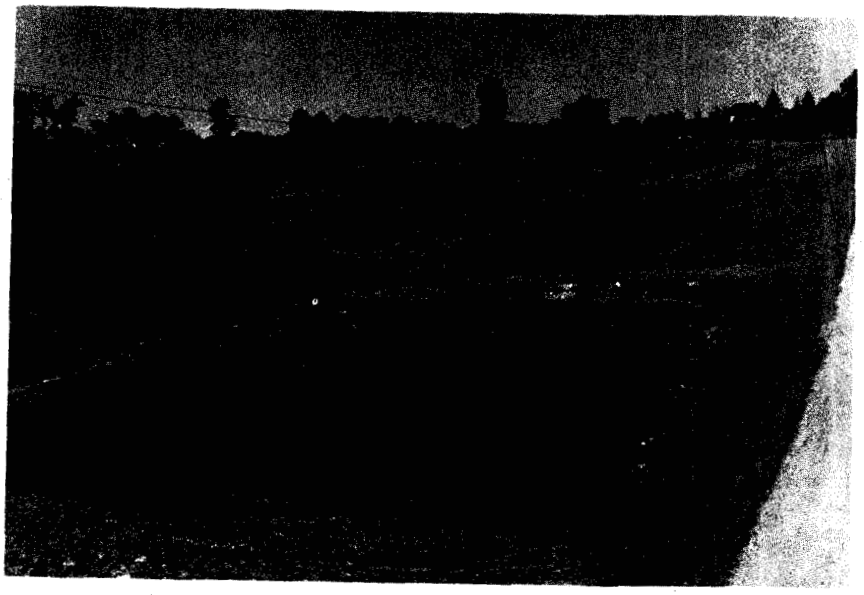
(c) By-Pass Ponds

This type of pond is constructed adjacent to a stream and it is maintained by diverting water through a pipe or ditch from the stream to the pond. Excess water is allowed to return to the stream after passing through the pond.

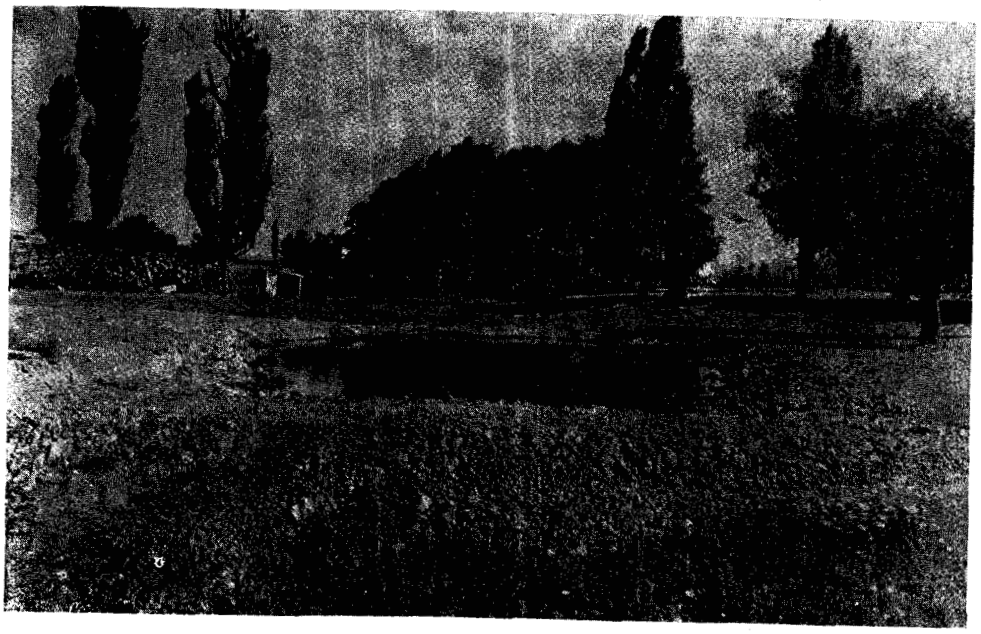
The by-pass pond has the advantage of a flow of fresh water without interfering directly with the natural flow of the stream. At periods of high flow, the water is allowed to go down the original channel and thus prevent damage to the pond by silting or by wash out.

This is an inexpensive pond to build and should be attractive to a farmer who has a small permanent creek on his property.

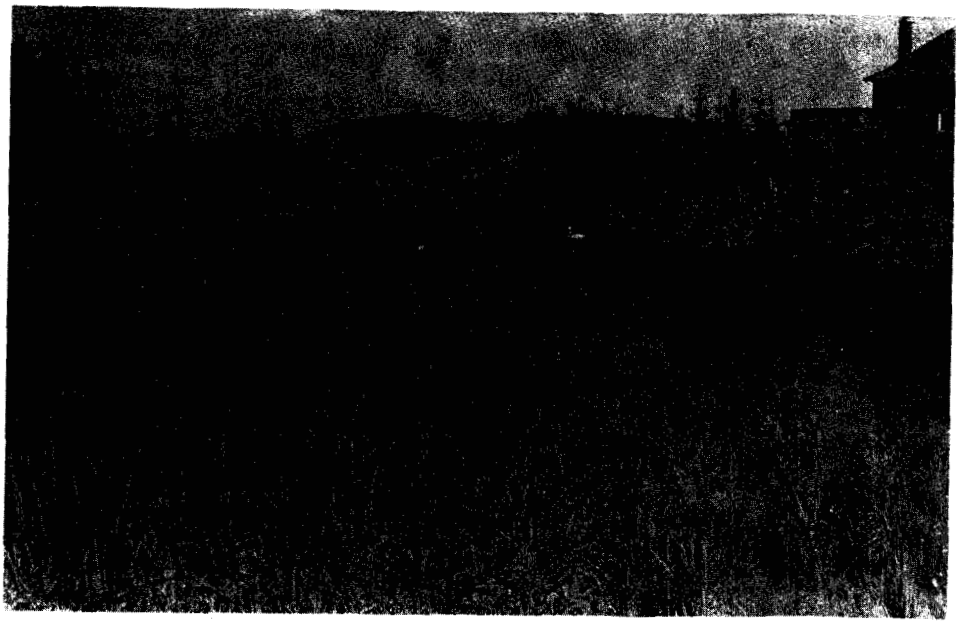
A pond excavated by the use of blasting techniques.



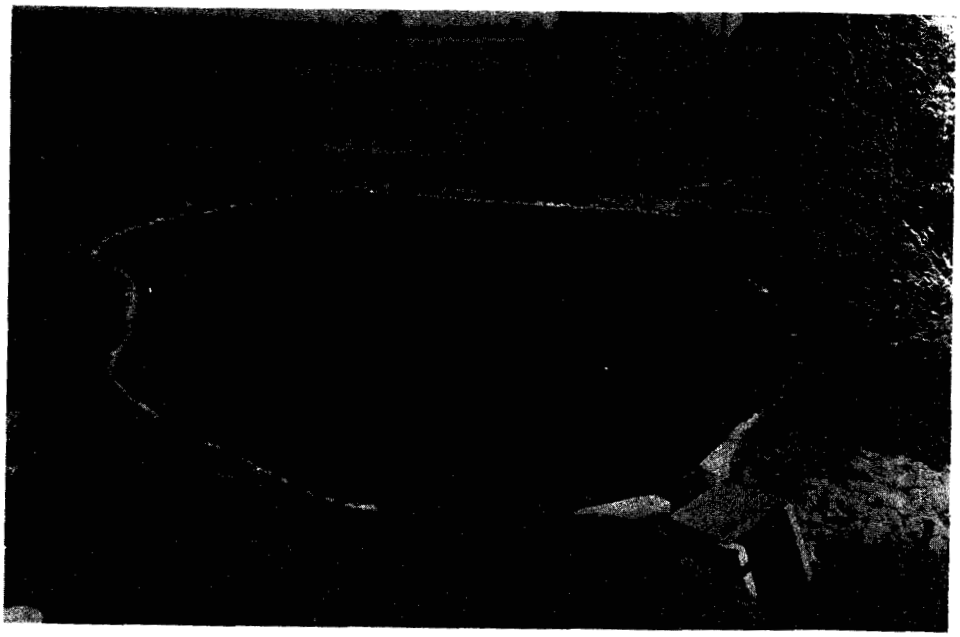
A dug-out pond suitable for irrigation, fire protection and other farm purposes.



Runoff pond under construction. Located close to farm buildings, this is ideal for fire protection and properly finished and maintained will be a valuable asset to the farm.



Impounded pond. This attractive pond is formed by a small concrete dam (not shown in the picture) crossing a permanent stream which is fed by springs in the distant hills.



By-pass pond. A well managed pond is an asset to any farm. This pond is fed from a small stream at the far-side of the pond.

Abandoned quarry north-east of Cornwall. This water should be tested to determine whether or not it would support fish life. The area could be developed for recreation.

(d) Impounded Ponds

When a small dam is placed across a permanent watercourse, a pond will be formed. The dam may be a permanent structure requiring careful design to prevent failure during high flows, or a temporary structure, placed only after the spring freshet, to maintain a summer pool. This temporary structure can also be taken out at periods of high summer flow.

The design and construction of ponds of this type will usually necessitate careful planning and be more costly. Such ponds are therefore usually maintained as community projects rather than as farm ponds.

3. Quarries and Gravel Pits

Of 51 quarries and gravel pits which were examined during the survey, 18 were found to have water in them which remained during the summer. It is estimated that there are about 20 other gravel pits which were not examined. Four of the pits which were examined and had water in them are still in use and probably would not support fish life. Of the remainder, five have water of depth greater than five feet. Of these the most important one for possible use for fish life is the one north-west of Cornwall Centre. This pond is about 10 acres in extent. It is a relatively new pond from which material was removed for the construction of the St. Lawrence Seaway. There is also a good pond in the gravel pits north of Martintown. Others will no doubt be excavated in the near future. These should be watched closely as they may well produce additional good habitat for fish or wildlife. It is recommended that the Conservation Authority should make arrangements to acquire the pond north-west of Cornwall Centre, have it tested and perhaps stocked experimentally. Some of the other ponds could be acquired and developed for wildlife. Several are already in good condition for wildfowl.

4. Management of Ponds

(a) General

The success of a farm pond does not depend only on careful planning and construction. Perhaps the more important part comes after, for only with good management can one be assured of obtaining full benefits from the investment.

Firstly, right after construction, the pond area should be fenced to protect it from livestock. Farm animals will foul the water and break down the banks of the pond, spoiling its appearance and making it unfit for other uses. If the water is to be used for livestock, a separate watering trough should be

constructed outside the fence by pipe flow from the pond.

To obtain a good supply of domestic water from the pond, a shallow well can be constructed near the pond. The intervening earth acts as a natural filter to purify the water.

The pond should not be located where it will receive ground seepage from a barnyard or from domestic sanitary facilities.

Growth of grass and shrubbery should be promoted about the margin of the pond. Vegetation will improve its appearance and also stabilize the slopes.

It is generally good practice to have separate ponds devoted to wildlife and fish and to control the aquatic plants in a fish pond.

In managing warm water ponds for fish the following points should be kept in mind.

(1) A minimum depth of 12 feet over at least 25 per cent of the pond should be planned to avoid excessive winter kill, probably the critical factor in fish survival in farm ponds in Ontario.

(2) If suckers, carp or large numbers of minnows are already present in the pond, it is usually best to destroy all fish in the pond before stocking.

(3) Since many of the species commonly recommended for introduction grow very slowly in Ontario waters, research to determine the most satisfactory species will be needed. New ponds and those in which the previous fish have been destroyed might be stocked experimentally with a combination of largemouth bass and the fathead minnow, which occurs in the watershed already.

The fertilizing of ponds for the increased growth of plankton (the smaller aquatic invertebrates) to provide food for fish should be approached with caution. Those considering the fertilizing of ponds should apply to the district biologist at Kemptville for advice.

Aquatic plants have various effects in ponds. They provide cover for the young of every species, and they may be essential for the spawning of some species. In low densities they may encourage the development of invertebrate foods for fish. A blanket of Muskgrass, Chara sp., (one of the algae) over most of the pond bottom may maintain an important cool habitat in the water in hot weather. However, the merits of aquatic vegetation may be overshadowed by more important disadvantages. Little or no photosynthesis takes place beneath a layer of ice or snow. Plant decay will reduce the oxygen content of the water and this, with the resultant liberation of carbon dioxide, ammonia and hydrogen sulphite, may kill all or part of the fish population. If there is a partial kill, it is the game fish (apart from pike) which will suffer most since they have higher water quality

requirements.

Relatively shallow ponds are more susceptible to invasion by plants, and to remain suitable they should be kept reasonably free of weeds. The presence of higher aquatic plants in large quantities significantly decreases production of phyto and rotifer plankton.* The basis of a modern fish management program is adequate production of plankton and bottom fauna, with proper control of algae and the submersed and emergent plants.

(b) Control of Aquatic Plants in Ponds

Considerable research has been carried out by the Ontario Water Resources Commission in the control of algae, particularly Cladophora, in Ontario. The Metropolitan Toronto and Region Conservation Authority has also carried out extensive research in the control of algae, the flowering submersed vegetation and emergent vegetation.

Blooms of algae on the surface of ponds are not usually a problem in Ontario. Algae in ponds are often present only for a short time and will disappear in a month or so. It is recommended that the safest method of getting rid of algae is to treat the pond with a concentration of one part per million of copper sulphate which should be dissolved in water and distributed uniformly over the pond. If there is no sign of disintegration or change in colour of the algae, then a second dosage of one part per million should be given in three or four days, and if this is not successful a third dosage should be given of the same concentration three or four days later. Under no circumstances should three parts per million of copper sulphate be applied in a single application.

The control of other submersed vegetation is a more difficult problem. A few years ago there were very few aquatic herbicides available. Sodium arsenite should not be used for this purpose, as it is dangerous from the point of view of public health. Safer compounds are now available. Endothal, Silvex, Fenac, 2-4-D, Diquat, Paraquat, Simazine and Atrazine provide a wide selection for control of most submersed weeds in farm ponds. New compounds are now frequently appearing on the market. They should be used strictly according to the directions on the labels, and never in greater concentrations. Tests with Silvex carried out by Cowell† at the rate of two parts per million gave complete control of Potamogeton

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* Hasler, E.D. and Jones, E. Demonstration of Antagonism of Large Aquatic Plants on Algae and Rotifers. Ecology, 30 (3), 1949.

† Cowell, Bruce C. The Effects of Sodium Arsenite and Silvex on the Plankton Populations in Farm Ponds. Transactions of the American Fisheries Society, October, 1965.

and Lemna and partial control of many other aquatic plants in farm ponds. Silvex also controlled the algae Hydrodictyon and Spirogyra in these tests, but it did not control Chara. Silvex in the concentrations mentioned had little effect on the zooplankton.

Of the emergent vegetation, Cattails and most other species can be killed with Dalaphon at rates of 10 to 15 pounds per acre.

It should be remembered that if there is any plan to treat aquatic vegetation with chemical herbicide and the treated water flows into any other privately owned or public waters, it is absolutely necessary to receive a permit from the Ontario Water Resources Commission.

If there is doubt as to what the species of weeds are and how they may be controlled, a fair sample of the weeds should be placed in a quart sealer which contains a five per cent solution of formaldehyde, and the sealer should be sent to the Ontario Water Resources Commission, Toronto. The Ontario Water Resources Commission can provide information as to where the recommended products can be obtained in Ontario.

5. Information and Assistance

Information on the various types of ponds is given in Publication No. 515, "Construction and Management of Farm Ponds in Ontario", Ontario Department of Agriculture.

A construction subsidy of 50 per cent up to a maximum of $500 for each pond is available from the Province of Ontario. Technical and financial assistance is available through the local offices of the Ontario Department of Agriculture.

It is recommended that the Authority encourage the use of farm ponds as a means of water conservation.

CHAPTER 10

WATER FOR RECREATION AND FISHING

1. Present Recreation Facilities

Since the development of the St. Lawrence Seaway system, many parks and campsites have been developed along the St. Lawrence River. Two of the larger sites in and around this area are Long Sault Parkway south of the town of Long Sault, and Charlottenburgh Park in Lot 3, Concession I, Charlottenburgh Township.

These sites provide swimming, boating, camping and many other recreational facilities. Many tourists are attracted to the area and often the parks are crowded by midsummer. Although very well kept, these parks suffer from air and water pollution. Foul odours from the paper mill at Cornwall are often carried into these areas making it unpleasant for campers, and fish caught in the area are reported to taste of oil discharged from passing ships. High coliform counts in the water at these parks have been reported several times in the past five years.

2. Possible Future Facilities

No major potential recreation area exists within the watershed, but several small sites could be developed in conjunction with low removable weirs on the river. Some possible weir sites are indicated on the watershed map (Figure 7).

At Martintown and Williamstown community ponds could be developed to serve not only as recreation sites, but as a good source of water supply for community fire protection.

On the South Raisin River, immediately downstream of the Canadian Pacific Railway crossing near Glendale, there is a good area for development of a picnic ground and campsite. This site has many large trees and at present is used mainly as pasture land. Easy access is provided by the South Branch Road and the area on the south side of the river could be made accessible by a low ford. The river through this reach has a gentle slope and could be deepened and enhanced by installation of a low weir. Tree screens could be established to replace the hawthorns, the stream could be stocked with fish, and the site could be used to demonstrate various types of conservation practices.

Besides providing recreation facilities for the local people, these areas would attract tourists and thus aid an otherwise lagging local economy.

3. Water and Fishing

The only aspect of fish and wildlife that was examined during the course of the survey was the condition of the various branches of the Raisin River as a habitat for fish. Examination of the quality of the water so far as pollution is concerned was carried out and the results of that survey (chiefly of the Biochemical Oxygen Demand) are discussed elsewhere in this report.

The main stream of the Raisin River received some water from the north-eastern end of the peat bog which lies east of Newington. In its upper 14 miles it is a stream with a low gradient of less than four feet per mile. In this section it has a stony bottom and cattail-covered banks. Between this section and Martintown the stream appears to contain a much larger volume of water than either the north branch or the south branch, although there is very little flow. From Martintown downstream the river widens to an average width of 35 - 40 feet, meandering, with occasional rapids, through the flat countryside towards Williamstown, where it flows over flat exposed stretches of limestone.

The south branch not only differs from the other two branches in having a very muddy bottom, but it is also overgrown with sedges, cattails, water lilies and other aquatic plants. There are, however, a few open stretches.

4. Methods of Survey

The procedure here adopted followed closely that used in previous surveys made by the Conservation Authorities Branch in other river systems. The three branches of the river and their tributaries were examined at "stations" from one mile to seven, or eight miles apart on each stream course. The erosion, vegetation, temperature and type of bottom were listed for each station. Wherever possible, the volume of flow was also calculated. At all suitable stations, collections of the aquatic insects and other invertebrates were made and, at many stations, collections of fish were also made. The collections were classified and used in zoning the various sections of the river. The nymphs of certain species of insects are confined to waters which remain cold and usually clear in summer, such as waters suitable for brook trout or brown trout. Certain species of the genus Baetis of the mayflies are the most useful for this purpose. Other species of various genera of caddisflies, in particular the genus Hydropsyche, are indicators of permanent flow or of high maximum summer water temperatures.

The South Raisin River approximately one mile upstream from Glendale. A low level weir near this location would enhance the stream and make the area suitable for recreational development.

The present criteria were developed from intensive research carried out by Dr. F. P. Ide of the Department of Zoology, University of Toronto.*

The river and its tributaries were examined at 83 stations. At 55 stations there was no flow at all. At 24 of these the stream bed was completely dry and at 31 there were only standing pools. At 28 stations there was evidence of flow, but the streams at many of these probably dried to standing pools later in the summer.

The accompanying drawing, "Permanence of Flow", shows in a general way which areas in the watershed have permanent flow in an average summer and which streams dry up completely or to standing pools. All of the water is relatively warm in summer with a single exception. At this exceptional station nymphs of the species Baetis vagans (a mayfly) were found. These are normally excellent indicators of water suitable for brook trout or brown trout, so far as temperature is concerned. This small stream is indicated on the accompanying drawing, "Permanence of Flow". The stream had a temperature of 62° F. at the time of the survey, in midsummer. However, its volume of flow was less than one tenth of a cubic foot per second and it appeared to dry up to standing pools lower down its course. No trout were found in the stream, which, however, contained at least seven species of fish. Those caught included the following:

white sucker	mud minnow
creek chub	brown bullhead
common shiner	Johnny darter
bluntnose minnow	

In view of the abundance of these species, some of which are not usually associated with trout waters, it can hardly be recommended as a suitable stream in which to introduce trout.

The order and names in the accompanying list of fish species follow those of Scott and Crossman.†

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* Ide, F.P. The Effect of Temperature on the Distribution of the Mayfly Fauna of a Stream: University of Toronto Studies, Biology 39, Ontario Fisheries Research Laboratory Publication 50, 1935. Ide, F.P. Quantitative Determination of the Insect Fauna of Rapid Water, University of Toronto Studies, Biology 47, Ontario Fisheries Research Laboratory Publication 59, 1940.

† Scott, W.B. and Crossman, E.J. A List of Ontario Fishes, Department of Fishes, Life Sciences Division, Royal Ontario Museum, Toronto, 1961.

FISH DISTRIBUTION

The following 21 species of fish were found in the river during the course of the survey.

Scientific Name	Common Name	No. of Stations Where Collected
Esocidae - pikes		
Esox lucius	northern pike	2
Umbridae - mudminnows		
Umbra limi	central mudminnow	3
Catostomidae - suckers		
Catostomus commersoni	white sucker	15
Hypentelium nigricans	northern hog sucker	1
Cyprinidae - minnows		
Couesius plumbeus	lake chub	1
Margariscus margarita	northern pearl dace	1
Notemigonus crysoleucas	golden shiner	7
Notropis cornutus	common shiner	15
Pfrille neogaea	finescale dace	1
Pimephales notatus	bluntnose minnow	14
Semotilus atromaculatus	creek chub	9
Ictaluridae - catfishes		
Ictalurus nebulosus	brown bullhead	5
Cyprinodontidae - killifishes		
Fundulus diaphanus	banded killifish	1
Centrarchidae - sunfishes		
Ambloplites rupestris	rock bass	3
Lepomis gibbosus	pumpkinseed	8
Micropterus dolomieui	smallmouth bass	1
Percidae - perches		
Etheostoma caeruleum	rainbow darter	1
Etheostoma flabellare	fantail darter	5
Etheostoma nigrum	Johnny darter	9
Percina caprodes	logperch	1
Gasterosteidae - sticklebacks		
Eucalia inconstans	brook stickleback	1

IANENCE of FLOW

1/2 0 1 2 3 MILES
SERVATION AUTHORITIES BR. Dept. E. & R.M. N.T. 1966.

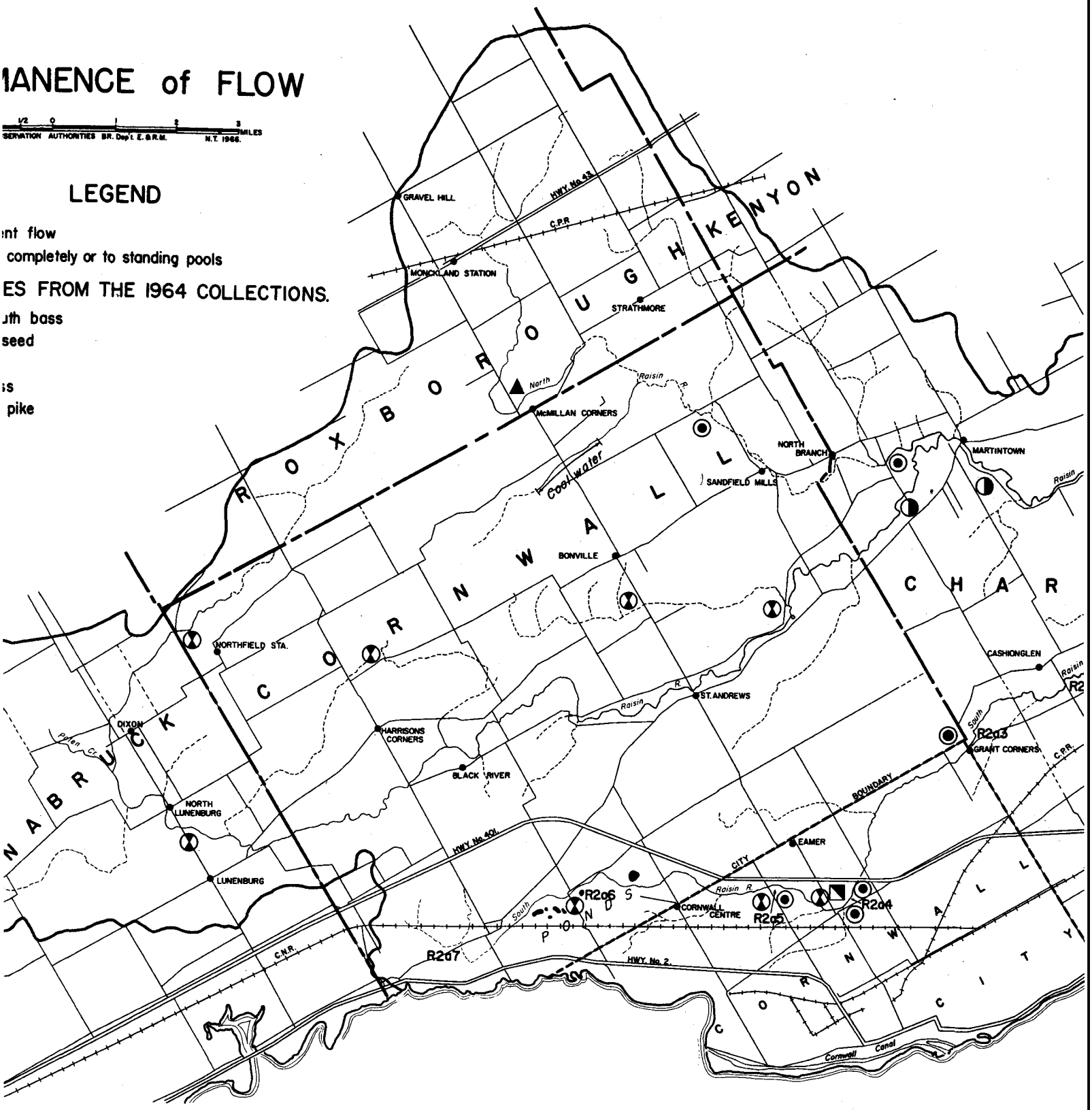
LEGEND

ınt flow
completely or to standing pools

ES FROM THE 1964 COLLECTIONS.

ıth bass
seed

ıs
pike



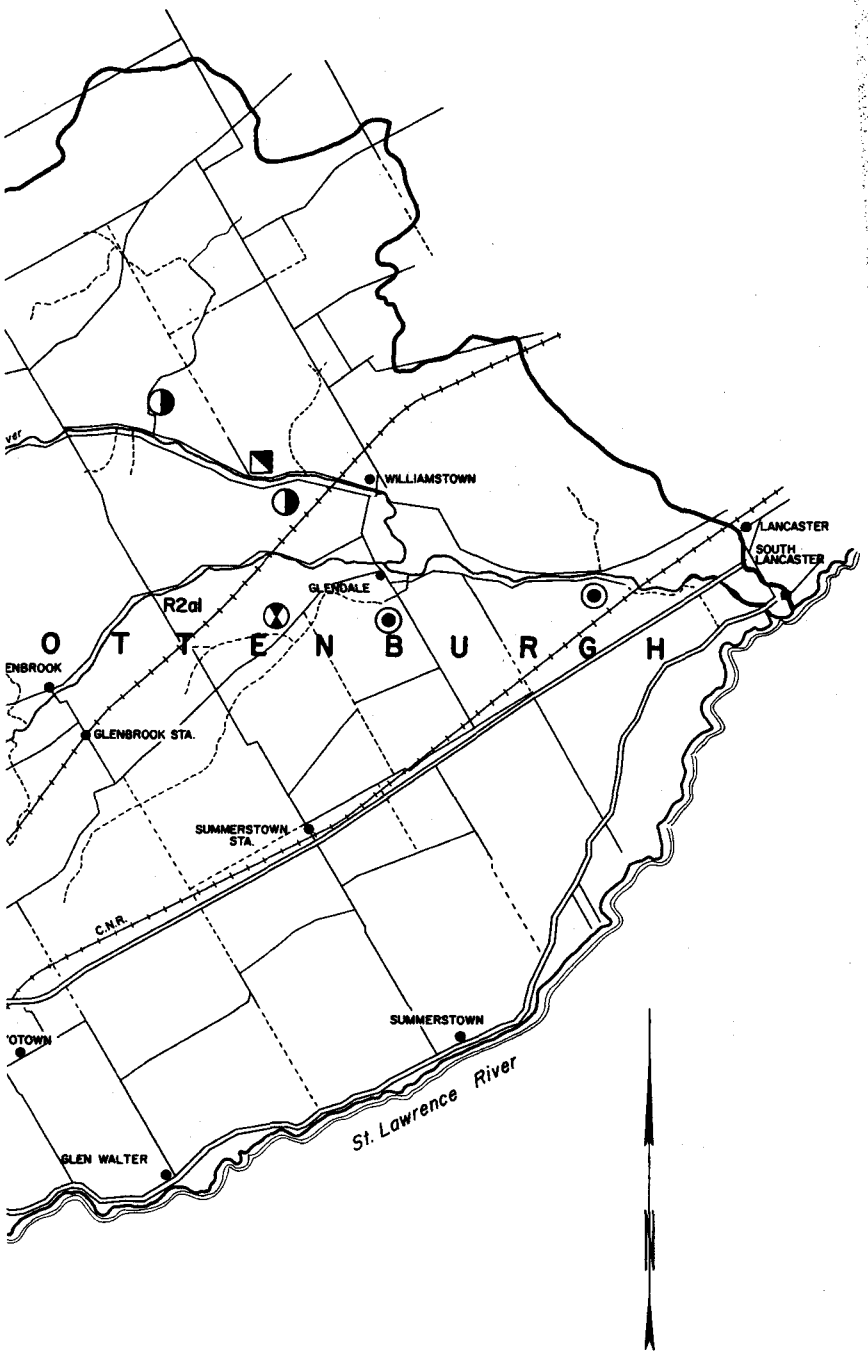

WILLIAMSTOWN
LANCASTER
SOUTH LANCASTER
GLENDALE
R2al
O T T E N B U R G H
ENBROOK
GLENBROOK STA.
SUMMERSTOWN STA.
C.N.R.
'OTOWN
SUMMERSTOWN
St. Lawrence River
GLEN WALTER

FIG. 15.

To this list must be added carp (Cyprinus carpio), which were seen at the effluent of the Kraft milk-processing plant at Glendale. Carp may be in many other stretches of the river. They are active and resourceful and are often missed in minnow seine collections even when they are known to be present in the area seined.

The wide and deep area of the river near its mouth was not examined during the survey. However the following additional species were reported to have been caught in trap nets in the river near its mouth, in 1963, by officials of the Department of Lands and Forests:

muskellunge
grass pickerel (Esox vermiculatus)
carp
largemouth bass
black crappie

There is no reason to question these additional reports, since the grass pickerel, while absent from most of Ontario, is in the centre of its known range at the mouth of the Raisin River, and the other species are all common in Lake St. Francis.

It was apparent from the complete absence of muskellunge, grass pickerel, largemouth bass and black crappie in the collections made during the course of the survey, that these species, even if they occur, are present in very small numbers in the sections of the river other than the area near the mouth where they were caught in trap nets. Seining with nets of mesh no larger than a quarter of an inch usually catches large numbers of young fish particularly since the populations of young fish are enormously greater than those of larger fish such as would be caught in trap nets. However, there is one point which should be taken into consideration. The species of fish caught by the Department of Lands and Forests, with the possible exception of the black crappie, are commonly found in very weedy and muddy waters. Such waters are very difficult to seine. This is particularly true of the south branch of the Raisin River, much of which is choked with aquatic weeds.

The lack of game fish in the Raisin River system as shown by the collections and illustrated on the map "Permanence of Flow" may appear surprising. This may be partly due to the pollution of the river from effluents from the five cheese factories which, until 1965 at least, were reducing the oxygen content of

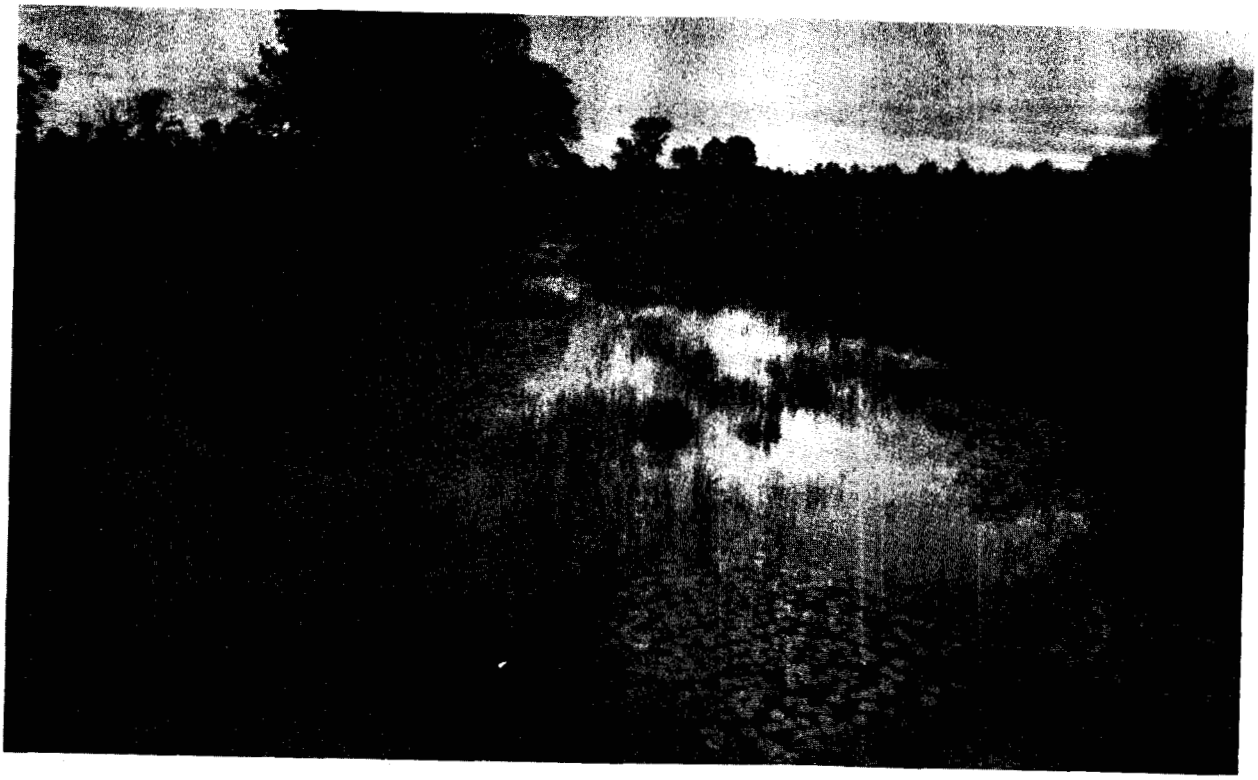
the water radically at certain points. There are, however, other factors which render the Raisin River a very unimportant river system for game fish.

The north branch may be dismissed as a significant stream for fish as it dries each summer either completely or to standing pools. The middle branch dries up to such a degree that its total flow was measured as low as 0.1 cubic feet per second at Williamstown. There are scattered pools with a depth of three to four feet, but it is mostly much shallower. Its flow, in fact, is so low that for the purposes of fish life it can almost be regarded as a series of relatively shallow separated pools. The south branch had a regular flow during the summer of 1964 of 0.4 c.f.s. But even this very low flow was virtually nullified by the fact that the stream is generally shallow, flowing with a scarcely perceptible gradient in a very wide stream bed filled with grasses and sedges, so that it resembles a lengthy field of weeds rather than a stream. It can also scarcely be considered as a habitat for game fish other than small pike. However, fish collected in the south branch in the summer of 1964 included the following 10 species, at the various stations noted here and shown on the map "Permanence of Flow".

TABLE VII

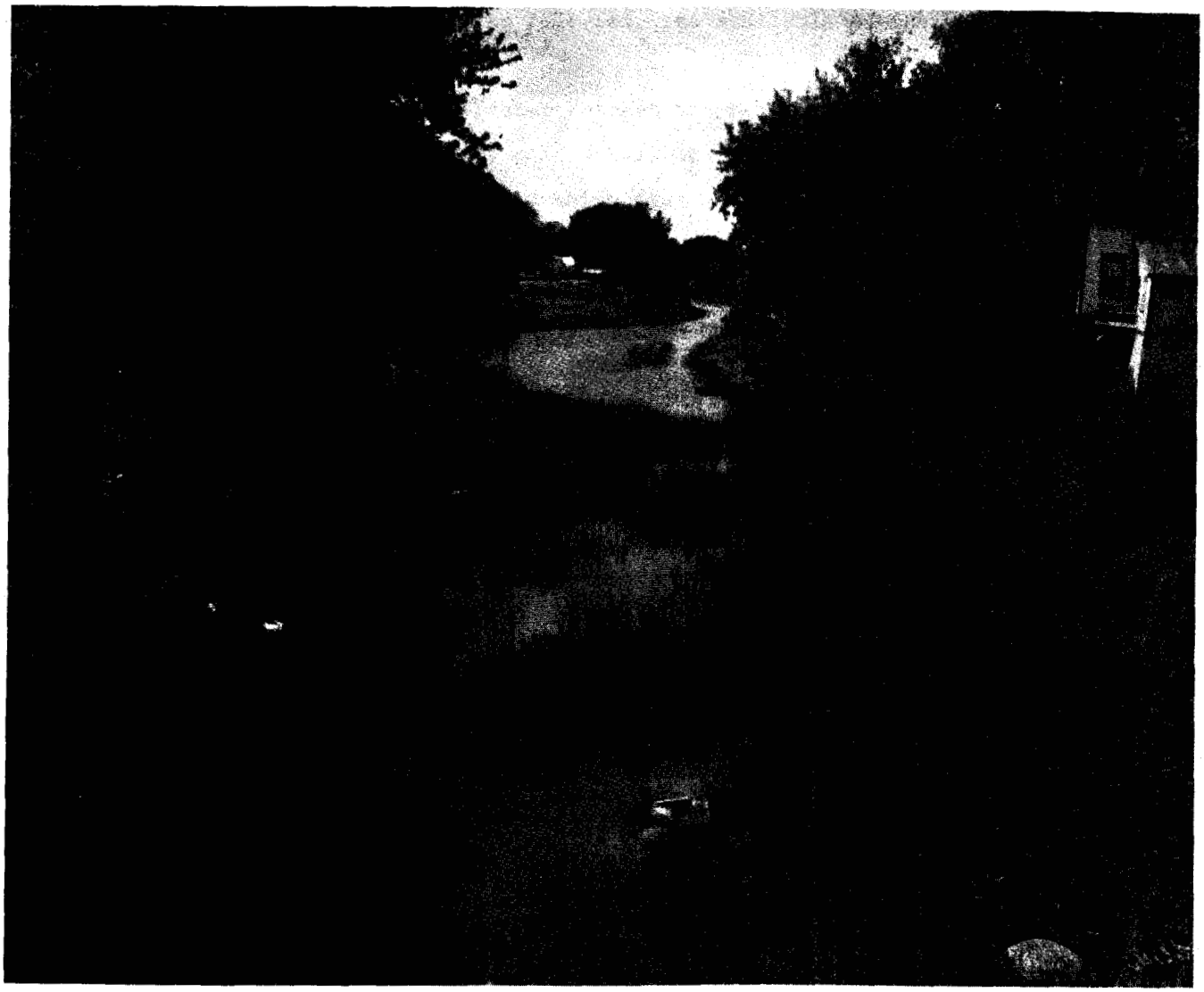
DISTRIBUTION OF FISH
IN THE SOUTH RAISIN RIVER

Fish Species	STATION NO.						
	R2a1	R2a2	R2a3	R2a4	R2a5	R2a6	R2a7
white sucker					X	X	
golden shiner	X	X		X			
common shiner	X	X	X			X	
bluntnose minnow	X	X	X	X			
creek chub						X	X
brown bullhead				X	X	X	
banded killifish					X		
rock bass				X			
pumpkinseed			X	X	X		
Johnny darter							X



A typical view of the South Raisin River showing the flat gradient and weedy channel bottom. Although this branch has a permanent flow, the wide stream bed and shallow water render it unsuitable for game fish other than small pike.

The North Raisin River at Sandfield Mills. This branch dries to standing shallow pools and is obviously unsatisfactory for game fish.



The main Raisin River at Williamstown. While this section of the river supplies fair habitat for game fish in the scattered pools, the conditions for fish would be greatly improved if a low weir were built and the water level raised in summer.

The beneficial effects which would accrue to fish life if the proposed weirs are constructed remain to be considered. During the summers the available fish habitat would be greatly increased. Due to the low flows in the various branches, there would probably be temperature gradients favourable to game fish in the impoundments. In the fall, winter and spring, however, when most if not all of the impounded water would be released, the available habitat would be very similar to what it is now.

The difference in character between the main branch and the south branch of the Raisin River has already been described. It is sufficient to say that the main branch has already pools in which bass might safely spend the winter, particularly as the pollution of the river has to a great extent been abated. Due to the extremely shallow conditions in the south branch this stream cannot be expected to harbour large bass once the stop logs in the weir or weirs have been removed. Weirs in this branch can therefore only be justified as an aid to improved recreation facilities and possibly as demonstrations in connection with other conservation measures in multiple use conservation areas.

So far as spawning areas are concerned, no enlarged areas would be available for the spawning of northern pike, muskellunge and grass pickerel, since these species spawn immediately after the ice cover has melted and before the stop logs would be in place in the weirs. However, there would be greatly increased spawning areas in June for largemouth bass in muddy areas, and possibly for smallmouth bass if shallow boxes filled with gravel were put (at a depth of one to two feet) in the impounded areas. This method has been tested in many parts of the country and has been found to be extremely successful. It might be necessary initially to stock smallmouth bass and largemouth bass in the river above some of the weirs.