TWELVE MILE CREEK CONSERVATION REPORT

1960

DEPARTMENT OF COMMERCE AND DEVELOPMENT

CONSERVATION BRANCH

Mount Nemo rising to an elevation of 1,000 feet is the highest point in this section of the Niagara Escarpment and commands a wide view of the plain below. The Authority has acquired this as part of its first Conservation Area.

DEPARTMENT OF COMMERCE AND DEVELOPMENT

HON. W. M. NICKLE, Q.C.
Minister

T. A. C. TYRRELL
Deputy Minister

A. H. RICHARDSON
Chief Conservation Engineer

TWELVE MILE CREEK

CONSERVATION REPORT

1960

ONTARIO

TORONTO
1960

Two hundred copies of this report have been prepared, of which this is

Number 71

Honourable W. M. Nickle, Minister,
Department of Commerce and Development,
Parliament Buildings,
Toronto, Ontario.

Honourable Sir:

I take pleasure in transmitting herewith the complete Conservation Report for Twelve-Mile Creek.

The report covers Forests, Water, Wildlife and Recreation.

Yours very truly,

A. H. Richardson
Chief Conservation Engineer

Toronto, December 21, 1960.

CONSERVATION BRANCH

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INTRODUCTION

Conservation has long been a subject of concern to the people of Ontario. This concern had to do originally with the protection of forests because of their importance as a source of revenue to the Province; but allied with this was the problem of wildlife management and the protection of source areas of rivers and streams. In Southern Ontario interest in conservation was indicated first by reforestation and woodlot management, but more recently this has broadened out to include flood and pollution control, improved land use and provision for recreation facilities.

While the progress in these activities has been steady up to the present, most of the programs heretofore were initiated by government departments. Recently, however, there has been a growing conception of personal obligation, especially where land use problems, farm ponds and small reforestation projects are concerned. On the other hand, control of flooding, summer flow and pollution, large reforestation projects, and recreation areas have come to be considered the responsibility of the community - the community in this case being the river valley.

With the advent of this new concept of personal and community responsibility in conservation, the Authorities movement was born, and the willingness of our people to undertake conservation in this way is indicated by the fact that in the last fourteen years 30 Authorities have been established, with a total membership of 438 municipalities and an area of 19,535 square miles.

The first step in establishing a Conservation Authority is undertaken by all the municipalities wholly or partly within a watershed. Two such municipalities must first by resolution petition the Government to call a meeting for the purpose of ascertaining whether or not an Authority should be established. Two-thirds of the number of representatives

which the municipalities are entitled to appoint (on a population basis) must be present to make the meeting legal. If two-thirds of those present vote in favour of establishing an Authority a resolution is forwarded to the Government. The Authority is then established by Order-in-Council and under the Act becomes a body corporate, including representatives from all the municipalities in the watershed.

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, prevention of pollution, investigation of underground water supplies, wildlife studies and recreation. But the Authorities were not equipped to carry out the extensive investigations that would indicate where such work should be done. Consequently the Conservation Branch of the Department of Commerce and Development undertook 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.

The survey work is grouped under five general headings, namely, Land, Forestry, Water, Wildlife, and Recreation. The scope of the studies made in each of these subjects varies with the condition and needs of the area under investigation. In addition to the five topics indicated above, a study of the history of the area is made. This serves as a backdrop to all the conservation problems of the watershed and compels the reader to understand the abuses of the past and the need for a diversified program in the future.

The starting point for all surveys is aerial photography. Before the survey is commenced in the field all such contributing data as maps, old records, photographs,

unpublished reports and other useful information are thoroughly explored and recorded. While the survey is in progress similar data are gathered locally, and agricultural representatives, zone foresters, municipal clerks and 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 blueprint. The carrying out of any scheme is not the work of the Conservation Branch of the Department of Commerce and Development, because it is not an operating department. Its active participation for the most part ceases when the planning is complete and the report is submitted, although it stands by to interpret the report and give advice and assistance in carrying out the plans recommended in the report. The Authority must assume responsibility for initiating the schemes which it considers most urgent; it must also make approaches to the 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 it involves a forestry or wildlife problem, then the Department of Lands and Forests is approached. In the case of flood control, however, as there is no department of the Government doing hydraulic surveys except the Conservation Branch, whose staff is not large enough to carry through the engineering works of several Authorities, the Authority must engage a consulting engineer to do the final engineering and designing and to carry the work through the construction stage. Similarly, where an Authority undertakes a scheme which has to do with recreation, it may have to employ men specially trained in this work.

As the work being done by Authorities is a new approach to the conservation problem, in that the responsibility

of carrying it out is left entirely in the hands of the Authority concerned, much directing and assistance have been necessary from the Conservation Branch and, in the case of 25 Authorities including the Twelve-Mile Creek, a member of the staff of the Department of Commerce and Development has been assigned to work in the watershed.

The Twelve-Mile Creek Conservation Authority was established by Order-in-Council on June 12, 1958, following an organization meeting which was held at the Township Hall, Trafalgar, on April 24, 1958, when nine representatives out of a total of nine attended the meeting and eight voted in favour of establishing the Authority.

As mentioned above, the Department of Commerce and Development, as a service to an Authority, undertakes to carry out a conservation survey of the valley for the guidance of the Authority, but the commencement of conservation work in the valley does not necessarily have to wait until such a survey has been made and the report presented. This has been the case with the Twelve-Mile Creek Conservation Authority, where the Mount Nemo Conservation Area has been established, and it is planned to increase the Area to 261 acres; plans have been prepared for channel improvement work at Morriston and schemes for farm pond and private reforestation assistance have been set up.

The Twelve-Mile Conservation Report has been prepared in sections, namely, Forests, Water, Wildlife, and Recreation, and the four sections are included in this volume.

- A. H. RICHARDSON

RECOMMENDATIONS

RECOMMENDATIONS

STATED OR IMPLIED IN THIS REPORT

Forest

1. That the Authority encourage private reforestation by providing a planting service at nominal cost and by offering a planting subsidy for trees privately planted. p. 25

2. That the Authority encourage landowners to convert to productive forest such parts of the 4,593 acres of scrub-land as cannot economically be restored to agricultural use. p. 17

3. That a Twelve-Mile Creek Authority Forest be established and that it be expanded through a definite program of annual additions until as much as possible of the 9,704 acres recommended has been acquired. p. 23

4. That the Authority establish woodlot improvement projects on its own properties or on private woodlots under agreements with the owners in order to demonstrate the advantages of better forestry practices. p. 26

5. That the Authority, by purchase of equipment, organization of cutting crews, or direct subsidy, encourage private owners in thinnings and improvement cuttings in their woodlots. p. 31

6. That the Authority co-operate with Halton County in the application of its woodlot fencing by-law to stimulate action toward the elimination of woodland grazing. p. 21

7. That the Authority act as co-sponsor for:

   (a) The Tree Farm Movement p. 19
   (b) Woodlot Meetings p. 20
   (c) 4-H Forestry Clubs p. 22

8. That the Authority co-operate with schools, government departments and all other groups and agencies possible to publicize the need and methods of reforestation and

woodlot management; and in particular that the Authority sponsor tours, practical demonstrations and field days for this purpose. p. 28

9. That the Authority encourage and co-operate in research to find improved methods of managing plantations and natural woodlands and publicize results which would help private woodlot owners. p. 28

10. That the Authority investigate, publicize and urge the implementation of the best methods for protecting natural woodland and plantations from:
    (a) Fire p. 38
    (b) Insects and diseases pp. 38-42

11. That the Authority encourage the establishment of windbreaks, shelterbelts and snow fences. pp. 42-46

Later

12. That the Authority have automatic recording stream gauges installed on the Creek near Zimmerman, Carlisle and Mountsberg. p. 15

13. That the Authority act to prevent further encroachment on the flood plains of the Twelve-Mile Creek and its tributaries. pp. 17-18

14. That the Authority have flood line maps made to delimit the flood-vulnerable lands within the watershed. pp. 17, 19

15. That the Authority proceed with a flood-control project at Morriston including regulation of the lake as a flood-control reservoir. pp. 19-22

That the Authority carry out demonstrations of road-bank and gully erosion control. pp. 22, 23

17. That the Authority acquire the necessary lands for the Mountsberg, Freelton and Strabane reservoirs. pp. 25-27.

18. That the Authority establish a program for community pond development, with early consideration being given to the Carlisle and Morriston sites. pp. 31-33

Wildlife

19. That landowners be encouraged to improve their land for wildlife by the elimination of grazing in woodlots, by the construction of farm ponds, by the planting of various recommended plants and by other methods described in the text. pp. 11-14

20. That the Authority request that the introduction of fish into the waters of Twelve-Mile Creek be restricted to those sections which are shown on the accompanying map to be suitable for the species concerned and which require stocking. p. 19

21. That the Authority encourage the development and management of farm fish ponds by the methods described. p. 25

Recreation

22. That the Twelve-Mile Creek Authority consider the possibilities of developing the following areas for conservation and recreation:

(1) Rattlesnake Point
(2) Calcium Pits
(3) Bronte Gorge
(4) Mount Nemo
(5) Meanders
(6) Bronte Bend

FORESTRY

CHAPTER 1

THE FOREST IN THE PAST

1. At the Time of Settlement

The settler striving to clear enough land to feed his family was too busy and too antagonistic to the forest to admire or describe it. The supplies he needed for building a simple dwelling were quite limited; and fuelwood, while important, was everywhere abundant and not worthy of special note.

However, a fairly good picture of the forest may be obtained by piecing together the scattered information which does exist. Pine and oak were noted because of their interest to the British navy and the easily cut softwoods because of their value for building purposes. In addition, the type of timber was of indirect interest as an indication of the quality of the land; pine - oak forests indicating light, easily-worked soil, and maple - beech stands suggesting richer but heavier soils.

In order to record this information prior to settlement, the early surveyors were instructed as follows:

> "Your field book is to be kept in the accompanying form, comprising the kind and quality of the soil and timber, entering each kind of timber in the order of its relative abundance."

In accordance with these instructions, the surveyors' notebooks included a running account of the composition of the forest cover along every line they ran, and thus they provide a reasonably accurate picture of the original bush in each township surveyed.

In 1792 Augustus Jones surveyed the boundary of the lands purchased from the Mississaugas (between Nelson and East Flamborough). For over 40 years thereafter surveyors were occupied periodically with surveys in the Twelve-Mile Creek area. From their field notes it is clear that they worked through a primeval forest almost unbroken except for an occasional "meadow" along a stream or a patch of windfall. The

path of one violent storm was apparent from a strip of windfall, and later small timber, which was noted on many survey lines and which impressed the early settlers as noted by Mr. J. Norrish, writing some time later (in 1889) on "The Early History of Nasagiweya".

> "This township was visited at one time by a heavy cyclone, but at what date is not known as there is no record of it that I have ever heard of, but it must have been from one hundred to one hundred and fifty years ago. It crosses the township diagonally from west to east, taking a strip about a mile wide, the middle of the strip is about Lot 23, in the 1st Concession, and crossing the line into Esquesing about Lot 8. It is said to have extended from lake to lake and took down everything in its course except an odd pine stubb."

The path of destruction would, therefore, cross the north end of the watershed near Brookville.

The narrow sand plain each side of the mouth of the creek supported a forest usually associated with more southern regions. The surveyor, Samuel Wilmot, describes this section as "Oak & pine Plaines" with sometimes a mixture of "Chesnutt". Northward, the pine and oak persisted although usually, except on shallow droughty soils, they were mixed with beech, maple and basswood, and in some places constituted only a minor part of the stand.

Some typical notes from Sherwood's survey of Nelson Township in 1819 will help us picture the timber there.

At Lot 10, Concession 3 - "mostly a tall growth of Pine"

At Lot 6, Concession 5 - "wood principally **ash** Beech & Maple except a few tall pine on the Bank of the 12 Mile Creek"

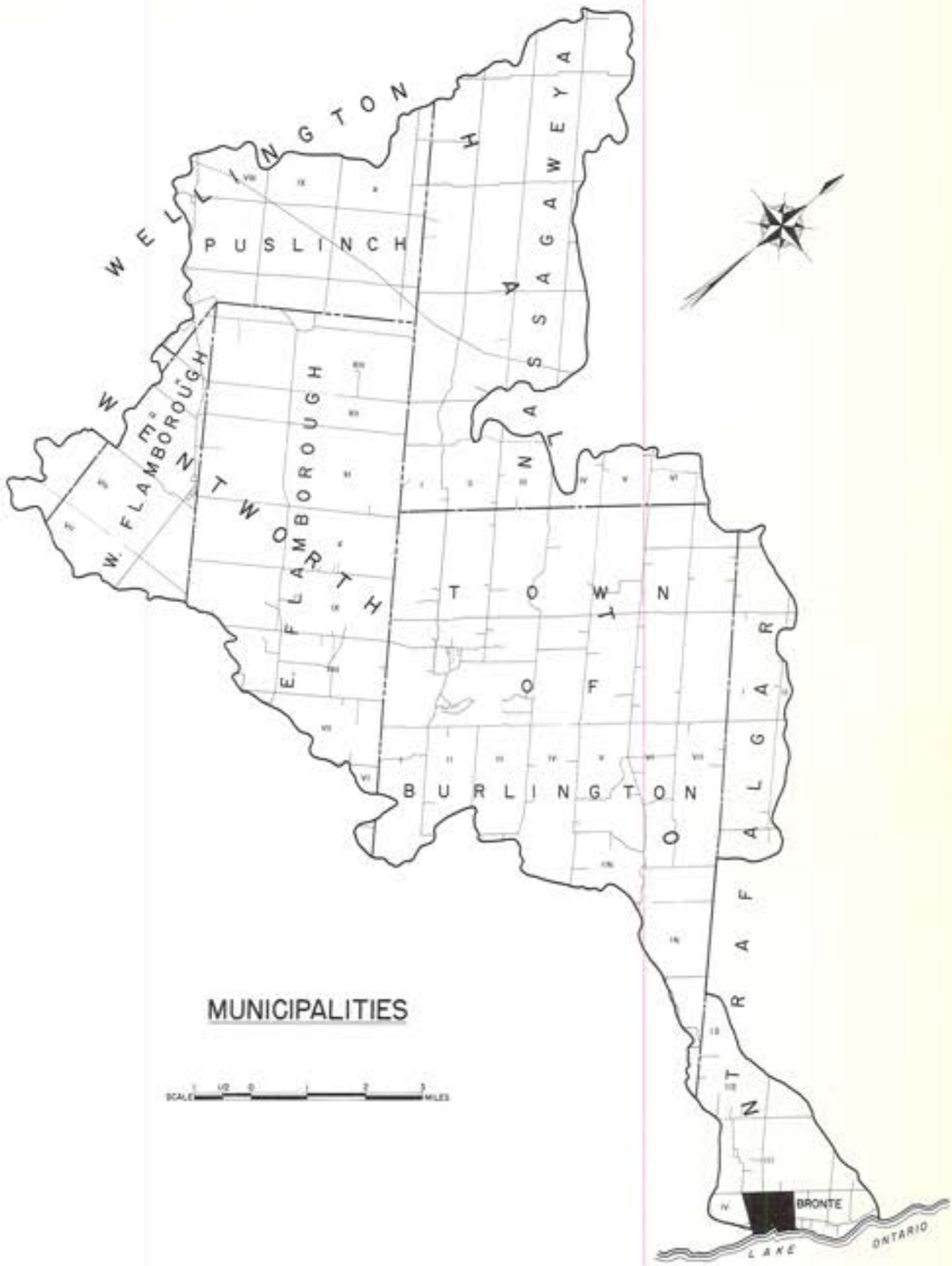
At Lot 1, Concession 7 - "heavy timbered with large White oak ash Beech Maple & Bass"

Similar notes by Gibson in Puslinch Township in 1828 on the first concession east of the Aboukir Road, record:

at Lot 27 "Heavy Beech, Maple & Basswood with a few Pines"

at Lot 32 "Large Pine, Beech, Basswood and Soft Maple, timber Thrifty"

at Lot 33 "Pine Ridge tall & Thrifty"



MUNICIPALITIES

SCALE 1 1/2 0 1 2 3 MILES

Memories of such timber passed into later accounts, and with only slight allowance for the haze of time we may appreciate Mr. Norrish's description of "Nasagiweya":

> "The mountain crossing it at the south-east end causes the land to be very uneven and very stony, some places solid rock and high precipices, but even this territory is getting to be valuable now. The timber in this part of the township was mostly pine up to the middle of the township and in some parts a little above that. In some places there was a scattering of hardwood among the pine and some very good red and white oak. In these places the pine grew very large. I knew of one tree that grew on Lot 20, in the 1st Concession, that measured two feet in diameter, ninety-five feet from the ground. This part of the township was very hard to clear up, as after they had got the timber off the pine stumps were a great obstruction, and the timber itself of very little value in the early days of settlement. But the stump and stone machines have worked wonders here, but a stranger visiting here could form but a very faint idea of the labour and expense of constructing those stump and stone fences. The hardwood consists of maple, beech, and some elm and basswood, there was also some hemlock in places, but a great part of it was destroyed before it became of any value; we had some white and black ash and a large amount of cedar swamp. In the upper end of the township there was some good rock elm, but the best of it was cut and shipped to Britain several years ago."

2. Clearing the Land

Understandably, the attitude of the early settler to the forest was almost completely hostile. The forest supplied his meagre needs for construction material and fuel, but these were small drops in a seemingly limitless sea of supply. Transportation was poor, and markets for his woodland produce extremely limited. For agriculture to develop the forest must go, and much of it was simply piled and burned. Settlement duties required a certain amount of land to be cleared before a patent could be obtained.

As a new area was opened up the better lots were naturally occupied first and the rough and swampy areas were avoided. Land was cleared first along the fronts of the farms and the woodland shrank farther and farther toward the end of the farm farthest from the road. This sequence was followed, in many cases, without reference to the quality of the soil except where it was swampy.

REMAINING WOODLAND IN PER CENT
ESTIMATED FROM CENSUS OF CANADA FIGURES

Township	1851	1861	1891	1911	1921	1931	1941	1951
Beverly	59	47	17	10	11	12	10	13
Flamborough (East & West)	57	42	15	10	8	10	9	11
Nassagaweya	62	54	27	19	21	23	19	23
Nelson	45	36	15	11	12	14	12	11
Puslinch	55	43	19	16	15	15	15	13
Trafalgar	42	31	17	5	7	8	5	6
Total	53	42	18	11	12	13	11	12

Note: The recent figures are lower than those found by actual survey, but the table shows the general trend of land clearing.

The accompanying table gives an estimate of the woodland remaining at various dates in the townships making up the Twelve-Mile Creek Watershed. Although slight irregularities appear in the table, due to incomplete information, the general trend of events is obvious. Until about 1910, the decrease in woodland was rapid. After that the small remaining area of woodland was at least tolerated, and in some cases has probably shown a slight increase. There is not as yet any evidence of a sharp increase in woodland cover such as might be brought about by a real enthusiasm for reforestation of submarginal lands.

3. Forest Products

The earliest interest in timber in Ontario was the reservation of pine and oak either by specified areas or by individual marked trees for the use of the British navy. While it seems unlikely that specific reserves were made during the settlement of the Twelve-Mile Creek Watershed, we do have later records of masts and spars produced in Wentworth and Halton Counties which probably included some of the best pine from this area.

The square timber trade commenced somewhat later than the mast trade and was carried on simultaneously with it from the eighteen-thirties. Square timber was obtained by selecting large trees, particularly white pine, and squaring the best part into one long stick. In the earliest days of the industry the timbers were squared on all four sides to a fine "proud edge", but later, when the best timber had been cut, they were squared with a rounded shoulder or "wane", and were known as "waney timber". Such methods, of course, were wasteful since the finest grained wood was sacrificed in the operation, but this was the type of material called for by the British market.

> "Often only one tree in a thousand would yield a finished 'stick' (so was the heavy square timber nonchalantly called in the trade) fit for export. A good stand might yield thirty or forty trees an

> acre for over the whole area allowance had to be made for 'wants' - the non-bearing patches of swamp, burn, etc. Today a whole township or limit (in Northern Ontario) may not have one good square stick of the quality of the square timber of another day."*

Until 1890 the Census of Canada lists all pine and oak not sawn into lumber as "square timber", and even as late as 1910 most species are listed as "square, waney or flattened".

As settlement and trade grew, sawmilling became important. It is uncertain when the peak was reached in this industry. Actually it would not be the same in all parts of the watershed. Nelson Township had three sawmills in 1817, and by 1850 the number had risen to seventeen. In that year there were four sawmills on Twelve-Mile Creek between Dundas Street and the mouth of the river at Bronte. Exports from Bronte in 1850 included:

Lumber - 1,835,000 feet

Cordwood - 2,350 cords

Additional exports from the watershed were no doubt made from Wellington Square and Port Nelson, and possibly some by way of the Burlington Canal. Some of the products travelling by this latter route are listed below.

Year	Lumber (Boards)	Staves	Ashes
1843	20,000 feet	182,613	267
1844	329,647 "	199,257	430
1850	4,794,409 "	61,200	163

The "ashes" in this list refer to potash, shipped to Britain for use in soap-making and the dyeing industry. It was extracted from the ashes of hardwood trees, 60 large maple trees producing one barrel of 650 pounds. In the early stages

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* A Hundred Years A-Fellin', written for Gillies Bros. Ltd., by Miss Charlotte Whitton.

FOREST PRODUCTS
ESTIMATED FROM CENSUS OF CANADA FIGURES
COUNTY OF HALTON

Products	Species	Unit	1870	1880	1890	1900	1910	1920	1930	1940	1950
Pulpwood		Cords			2,512	113			31	8	
Tanbark		"	520	321	125	104	2				
Lathwood		"	21		50						
Masts & Spars		Number			8	4					
Staves		M	939	1,166	121	$213	$200				
Fence Rails		Number						4,075	2,950		
Fence Posts		"			32,572	22,895	4,795	6,231	13,660		3,169
Poles		"			225		500	8	162		118
Railway Ties		"			800	400					
Piling		"				2					
Shingles		"			6,656M						
Fuel Wood		Cords	62,946	61,780	59,018	35,956	29,005	21,786	17,371	14,121	4,275
Square Timber & Logs	Ash	Cu.Ft.				100	130				
	Birch & Maple	"	215		1,200		1,000				
	Black Walnut	"			100						
	Elm	"	3,801	1,219	10,525	2,380	1,100				
	Hickory	"		237	6,040						
	Oak	"	5,870	28,855	1,986	2,378	2,300				
	Pine	"	5,023	274,088	12,532	2,157	5,810				
	Tamarack	"	9,033	4,417	1,000						
	Others	"	37,299	31,893	8,022	1,500	14,300				
Lumber	Pine	M.bd.ft.	13,585	12,175	6,496	496	276)	673	785		542
	Others	M.bd.ft.	1,436	1,870	2,360	3,042	1,418)				
Other Products		$							629	4,571*	1,790

* Includes lumber, posts and poles

M = Thousand (1,000)

FOREST PRODUCTS
ESTIMATED FROM CENSUS OF CANADA FIGURES
COUNTY OF WENTWORTH

Products	Species	Unit	1870	1880	1890	1900	1910	1920	1930	1940	1950
Pulpwood		Cords				24					
Tanbark		"	27		44	18					
Lathwood		"		25	32						
Masts & Spars		Number	35	281	39	2					
Staves		"	349M	70M	14M	$645	$112				
Fence Rails		"							1,167		
Fence Posts		"			84,169	75,352	22,370	6,029	12,448		2,990
Poles		"			90	485	484		82		2
Railway Ties		"			24,255	2,275	230	100			
Piling		"				28					
Shingles		"			893M						
Fuel Wood		Cords	92,020	91,885	57,267	63,942	19,557	18,222	16,056	13,326	3,126
Square Timber & Logs	Ash	Cu.Ft.				2,072					
	Birch & Maple	"	100	310	545	11,940					
	Black Walnut	"	13,832	2,972							
	Butternut	"	-	1,300	240						
	Elm	"	17,252	8,184	18,597	11,958					
	Hickory	"	230	200	220						
	Oak	"	23,114	87,865	13,844	2,270					
	Pine	"	16,427	59,920	11,699	3,832					
	Tamarack	"	7,400	175	1,120						
	Others	"	22,952	83,468	20,286	3,033					
Lumber	Pine	M.bd.ft.	3,823	9,979	6,118	1,044	492)	473	350		150
	Others	M.bd.ft.	307	2,588	17,492	3,524	1,705)				
Other Products		$						320	134	6,521*	35

* Includes lumber, posts and poles

M = Thousand (1,000)

of land clearing this was a source of some revenue, and without roads and factories there was no other market for these trees. However, from the 1840's on increasing amounts of lumber were needed for local building and carriage manufacture, and the potash trade was on the way out.

For later periods the Census of Canada figures for Halton and Wentworth Counties help us trace the changes in forest production and products. While the varying basis used for census returns at different periods makes exact comparison difficult, some general trends are clear from the accompanying tables. The peak production shown for many products is in 1870 or 1880. Soon after 1900 such products as tanbark, lathwood, masts, staves, shingles and piling drop from the list, and production of other products shows a sharp decline. The one product which has persisted throughout the record is fuelwood, which has dropped from a peak of 154,966 cords in 1870 to a low of 7,401 cords in 1950. This decline reflects both the decrease in available supply and the increasing competition of other fuels.

The addition in 1890 of fence posts, poles and railway ties reflects the development of the area. The introduction of wire fencing, the development of the telephone and the expansion of telegraph service all stimulated forest production at this period. The subsequent sharp decline in these products shows the rapid depletion of supplies.

The cut of walnut shown for Wentworth County in 1870 is large, although only a small part of it would come from the Twelve-Mile Creek Watershed. By the end of the century this species, together with butternut and hickory, disappears from the record. About the same time tamarack was almost wiped out by the depredations of the larch sawfly.

In 1920 no square timber is shown, and from this time on lumber production is small and is no longer separated by species.

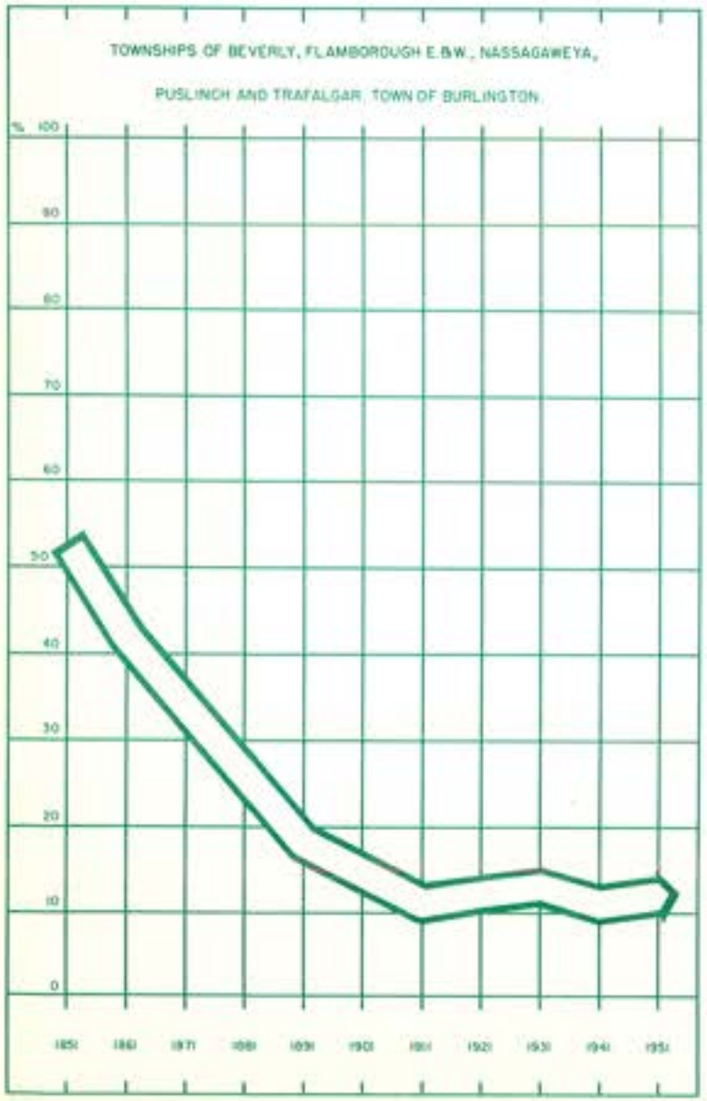
The native chestnut does not appear as a separate species in these records, but it was valued for interior trim in houses as well as for fence posts and rails. In the early years of the present century a disease, the chestnut blight, practically wiped out the species, but for years a few sprouts and the durable dead stubs of trees persisted.

Maple sugar was almost the only sugar available to the pioneers. In 1910 census records begin to list maple syrup as well, indicating the change from a pioneer necessity to a modern luxury. For the sake of comparison the table below shows these products expressed as an equivalent amount of syrup. Production in 1951 was less than one-fifth of that for the peak year of 1861.

MAPLE PRODUCTS OF HALTON & WENTWORTH COUNTIES
CALCULATED AS SYRUP
FROM CENSUS OF CANADA FIGURES

Year	Gallons
1851	9,178
1861	12,745
1871	2,775
1881	828
1891	7,194
1901	9,259
1911	10,309
1921	4,557
1931	6,568
1941	4,006
1951	2,466

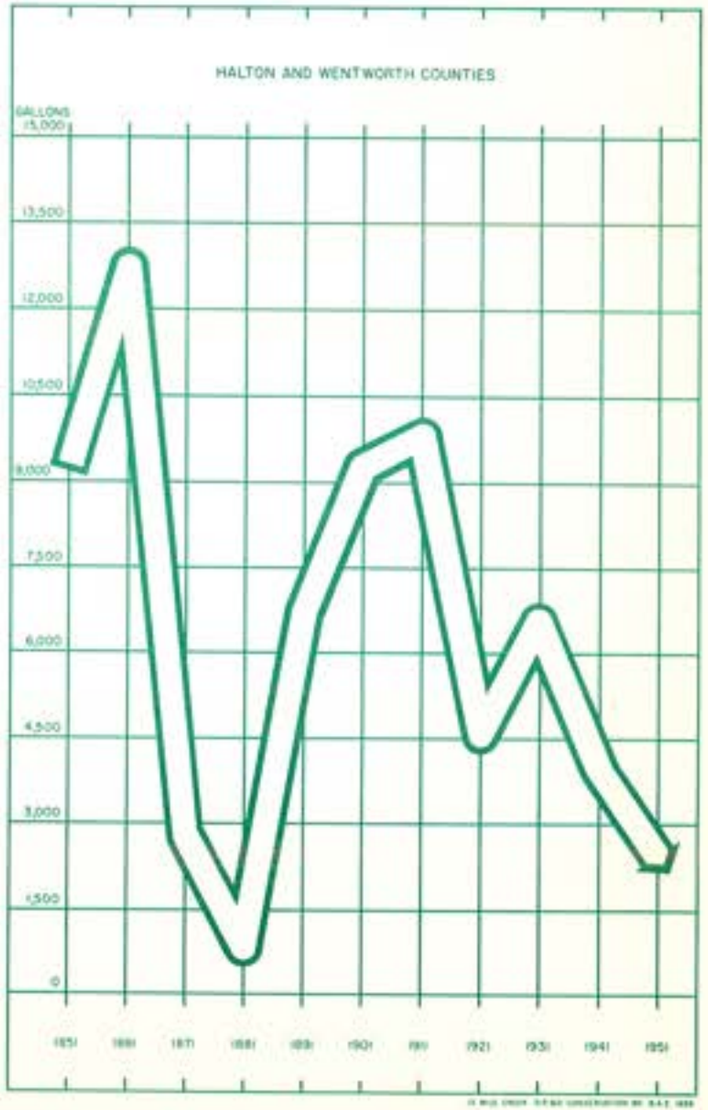
PER CENT WOODLAND



FUELWOOD PRODUCTION

MAPLE PRODUCTS

(EXPRESSED AS GALLONS OF SYRUP)



CHAPTER 2

SURVEY OF EXISTING WOODLAND

To establish a woodland conservation program, an accurate inventory of the existing woodland in the watershed and an estimate of its present condition is a basic necessity. Accordingly a detailed survey of all existing woodlands, scrublands and plantations as well as land suitable for reforestation, was carried out during the spring of 1958.

Most of the Twelve-Mile Creek Watershed lies within the Huron-Ontario Section of the Great Lakes - St. Lawrence Forest Region.* In this forest section, as a whole, the prevailing association of forest trees is dominated by sugar maple and beech and this association is described as the climax type† for the area. Occurring in this climax type are other associated species such as basswood, white elm, yellow birch, white ash, hemlock and white pine. After disturbances such as cutting or fire this climax type may be replaced for a time by poplar and white birch. On local or specialized sites such as river bottoms and swamps there occur other aggregations of trees which may bear no relation to the typical or climax forest of the area; for example, an association where white cedar is the dominant species. These distinctive local combinations of tree species are in response to very local climatic, soil, topographic and drainage features.

The Deciduous Forest Region* which occupies much of the eastern half of the United States, includes only a small part of Southern Ontario. In the Twelve-Mile Creek Watershed it extends only a few miles north of the river mouth. Here the

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* W.E.D. Halliday, A Forest Classification for Canada, 1937.

† The climax type is the one best suited to maintain itself permanently under the climatic conditions of a given area. Unless disturbed by fire, axe, or other agents it will eventually take possession and hold most of the area against the competition of other trees.

modifying influence of Lake Ontario makes possible a characteristic association containing black and white oaks, sassafras and shagbark hickory.

Although pure pine stands are not common, a scattering of white pine through the woodlots in both these forest regions is a noteworthy characteristic of the watershed.

1. Survey Methods

Aerial photographic mosaics cut into units of about 1,000 acres were provided to the forestry survey party, and mapping in the field was done directly on these mosaics. Each area of woodland was visited, mapped and described as to acreage, cover type, presence of grazing, reproduction, density and average diameter at breast height. Scrubland was also visited, mapped and described as to acreage and whether wet or dry species. Plantations were likewise examined and mapped, with records made as to species, composition, method of planting, approximate age, care, damage and survival.

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 were hardwoods was classified as a hardwood stand; one in which 80 per cent or more of the trees were conifers was classified as a coniferous stand; all other stands were classed as mixedwood.

Land suitable for reforestation and acquisition as part of an Authority forest was mapped and descriptions prepared in some detail.

2. 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 has been used on this survey so that the system will adequately describe the cover types common to the watershed. The gaps in the numerical system are due to certain cover types found in the eastern United States which do not enter Canada.

The following cover types were recorded on the Twelve-Mile Creek Watershed:

Type Number	Name
4	Aspen
4a	Poplar-oak
5	Pin cherry
6	Paper birch
8	White pine-red oak-white ash
9	White pine
10	White pine-hemlock
11	Hemlock
12	Sugar maple-beech-yellow birch
13	Sugar maple-basswood
14	Sugar maple
14a	Black cherry
15	Yellow birch
24	White cedar
26	Black ash-white elm-red maple
45	Bur oak
49	White oak-black oak-red oak
50	White 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

Since the watershed lies partly within two different forest regions, it is not surprising that twenty-six different cover types were encountered. Even with such a variety of forest types, however, over eighty-five per cent of the total woodland is contained within six cover types. A brief description of these types in the order of area occupied follows:

Type 14 - This type consists of sugar maple for the most part, with a small proportion of other species such as white elm, white ash, basswood, black cherry and hemlock. Because this type usually occurs on well-drained, fertile uplands much of its original area has been cleared to make way for agriculture. At present this type covers 26.4 per cent of the total woodland on the watershed. The majority of this type occupies the less fertile and rough uplands which are not well suited to more extensive agriculture as practised today.

Type 60 - Comprising 17.1 per cent of the woodland area. This type is predominantly silver maple and white elm, with silver maple considered to be the indicator species. Species sometimes associated with this type are red maple, cottonwood, white, black and green ash and bitternut hickory. Usual occurrence is on poorly drained soils of river bottoms and flood plains or in swampy depressions.

Type 60a - White elm is the predominant species. This type occupies 12.4 per cent of the woodland area and is very similar to the type 60, previously described, except that it may often occur on drier sites.

Elm and soft maple swamps protect the headwaters of many stream.

Seedlings chewed off each year in the grazed woodlot on the right will never produce healthy regeneration like that across the fence to the left.

Type 4 - Aspen is a pioneer type. It occurs following disturbances such as clear cutting or fire. It is often the invasion species in abandoned fields and pastures. Though it avoids the wettest sites it does grow on soils that are wet through a good part of the year, as well as on dry sites. Its associates may include large-toothed aspen, balsam poplar, red cherry and paper birch. An understory of balsam fir and spruce frequently is present. The aspen type was found to cover 11.3 per cent of the total wooded area.

Type 24 - White cedar comprises 10.6 per cent of the woodland acreage. This species is either pure or predominating in the type. Associates include balsam fir, hemlock, white elm, red maple, white birch and white pine. The type occurs on poorly drained sites with a high water table and not strongly acid, or on dry limestone uplands.

Type 57 - Beech and sugar maple pure or predominating with associate species such as red maple, hemlock, white elm, basswood, white ash and black cherry, with hornbeam a common subordinate. This is regarded as the typical association forming the climax type for the uplands of this region. Like the sugar maple type, this type was formerly quite extensive but, because it occupied the best land, its area has been greatly depleted until today it forms only 7.3 per cent of the woodland cover.

The remaining portion of the woodland on the watershed amounts to 14.6 per cent of the total and is divided between the remaining twenty cover types. A brief description of each of these types follows:

Type 4a - Poplar-oak occurs on dry ridges of shallow soil. Probably a residual type following fire in an oak-pine type.

Type 5 - Pin cherry is a pioneer type originating on clearcut or heavily burned areas.

Type 6 - Paper birch, like aspen, is a pioneer type following cutting or fire.

Type 8 - White pine-red oak-white ash occurs on moist but well-drained soils, mostly along valley slopes.

Type 9 - White pine, most common on light sandy soils.

Type 10 - White pine - hemlock, favours moister, cooler sites, ravines and north slopes.

Type 11 - Hemlock, similar to above type, but with hemlock predominant over any single associate.

Type 12 - Sugar maple - beech - yellow birch is a cover type which is close to its southern range (latitude and altitude) within this watershed, consequently it has a limited distribution.

Type 13 - Sugar maple - basswood is another cover type in which hard maple is an important component of the stand. This type is important due to the demand for basswood logs.

Type 14a - Black cherry, occurs in small patches on fertile well-drained soils; a temporary type following clear-cutting.

Type 15 - Yellow birch, a temporary type following clear-cutting or other opening up of the forest. Found in small patches. This type is important because of the demand for yellow birch logs.

Type 26 - Black ash - white elm - red maple, occupies wet muck soils in areas of slow drainage.

Type 45 - Bur oak occurs mainly in a relatively small area several miles south of Milton.

FOREST COVER TYPES

Municipality	Area (acs.)	4	6	8	9	11	12	13	14	24	26	45	49	51	52	57	59	60	60a	88
Beverly	219	23			10			6	9	45								88	38	
Burlington	5,745	236	166	6	89	117	21	300	2,402	390	12	88	31	207	51	608	104	296	511	80
E. Flamborough	3,497	445	85	8	9	22		28	588	532	109			15	2	143	10	1,001	477	
W. Flamborough	1,149	369	39		4	7		19	70	183	13					12		300	133	
Nassagaweya	4,481	412	106		18	91	23	32	1,251	363	83			2		400	2	925	749	2
Puslinch	1,537	453	4			37		8	159	327	23					45		345	114	9
Trafalgar	665	22	19	26	3			18	93		33	57	4	84		108	24	9	127	23
Total	17,293	1,960	419	40	133	274	44	411	4,572	1,840	273	145	35	308	53	1,316	140	2,964	2,149	114
Per Cent	100	11.3	2.4	0.2	0.8	1.6	0.3	2.4	26.4	10.6	1.6	0.8	0.2	1.8	0.3	7.6	0.8	17.1	12.4	0.7

Seven other types occur as traces, each constituting less than 35 acres of woodland. These are:

Type 4a - 7 acres
" 5 - 4 acres
" 10 - 30 acres
" 14a - 10 acres

Type 15 - 17 acres
" 50 - 8 acres
" 58 - 27 acres

Type 49 - White oak - black oak - red oak, found mainly in the southern portion of the watershed on well-drained soils.

Type 50 - White oak pure or predominant. Occurs on well-drained loamy soils.

Type 51 - Red oak-basswood - white ash type, occurs on well-drained soils. Associate species include red maple, sugar maple, paper birch and beech.

Type 52 - Red oak occurs as small patches among the other oak types.

Type 58 - Beech, as a pure type is created and extended by certain cutting practices.

Type 59 - Ash - hickory, is a residual type which often occurs after logging and grazing of type 60 stands.

Type 88 - Willow occurs often on flood plains and along stream edges. This is not a commercially important type.

Summary of Cover Types

(a) Originally most of the uplands of the Twelve-Mile Creek Watershed were covered by the climax type of the Great Lakes - St. Lawrence Forest Region, i.e., sugar maple and beech - sugar maple cover types. Since these types occupied the most desirable land from an agricultural viewpoint, a large proportion of them was cleared.

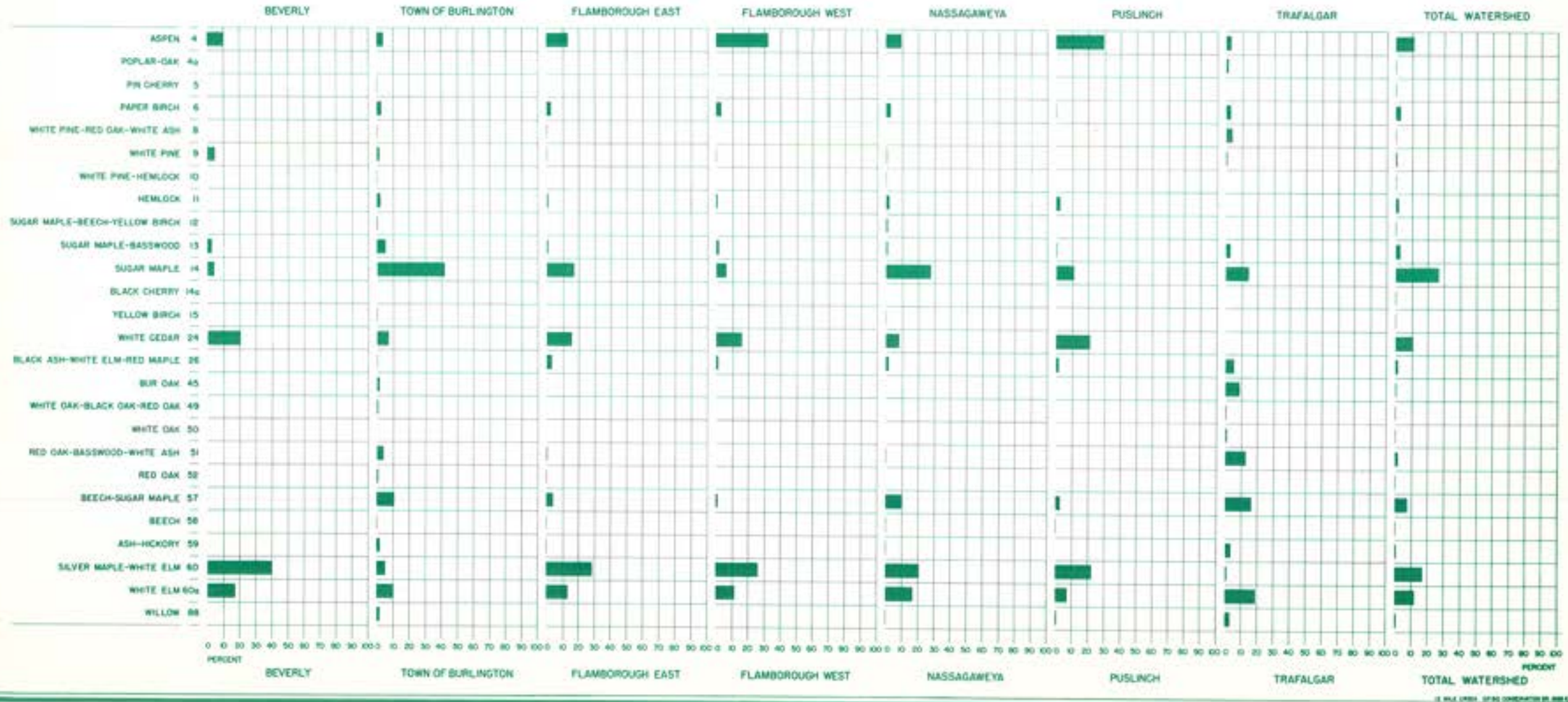
Although these and their associated types comprise almost 37 per cent of the remaining woodland they cover only eight per cent of the total area of the watershed.

(b) The presence of oak types and the abundance of hickory in the southern part of the watershed indicate that this portion may be included in the more southern Deciduous Forest Region.

FOREST COVER TYPES BY TOWNSHIPS

PERCENTAGE BY TOWNSHIP

1958



(c) Characteristic swamp cover types make up 42.4 per cent of the total woodland. This would seem to be a rather high percentage and could be considered as indicating that most of the swampy areas were not considered suitable for agriculture and thus not cleared. Elm, soft maple and cedar types produce forest crops on these natural water storage areas.

(d) Aspen and paper birch which are temporary types of low commercial value occupy 13.7 per cent of the total woodland. Much of this area could be converted to more valuable forest types.

(e) The white pine cover type, although it comprises less than one per cent of the woodland, is nevertheless significant. This desirable species occurs frequently in several cover types and could be a valuable component of many woodlots in the watershed.

3. Condition of Woodlands

Conditions revealed by the survey are shown in some detail in the accompanying tables and graphs. There are 17,293 acres of natural woodland and 326 acres of plantation in the watershed. The plantations will be dealt with in the next chapter.

The hardwood forest comprises 74.6 per cent of the total woodland, with the mixedwood and coniferous types making up 20.6 per cent and 4.8 per cent respectively. Most of the mature and merchantable timber occurs in the hardwood and mixedwood stands over 18 inches d.b.h.* and the coniferous stands between 10 and 18 inches d.b.h. There are only 137 acres (0.8 per cent) in these classifications at present. Although there is additional merchantable material in the other size classes, it is evident that the total merchantable material on the watershed is not plentiful.

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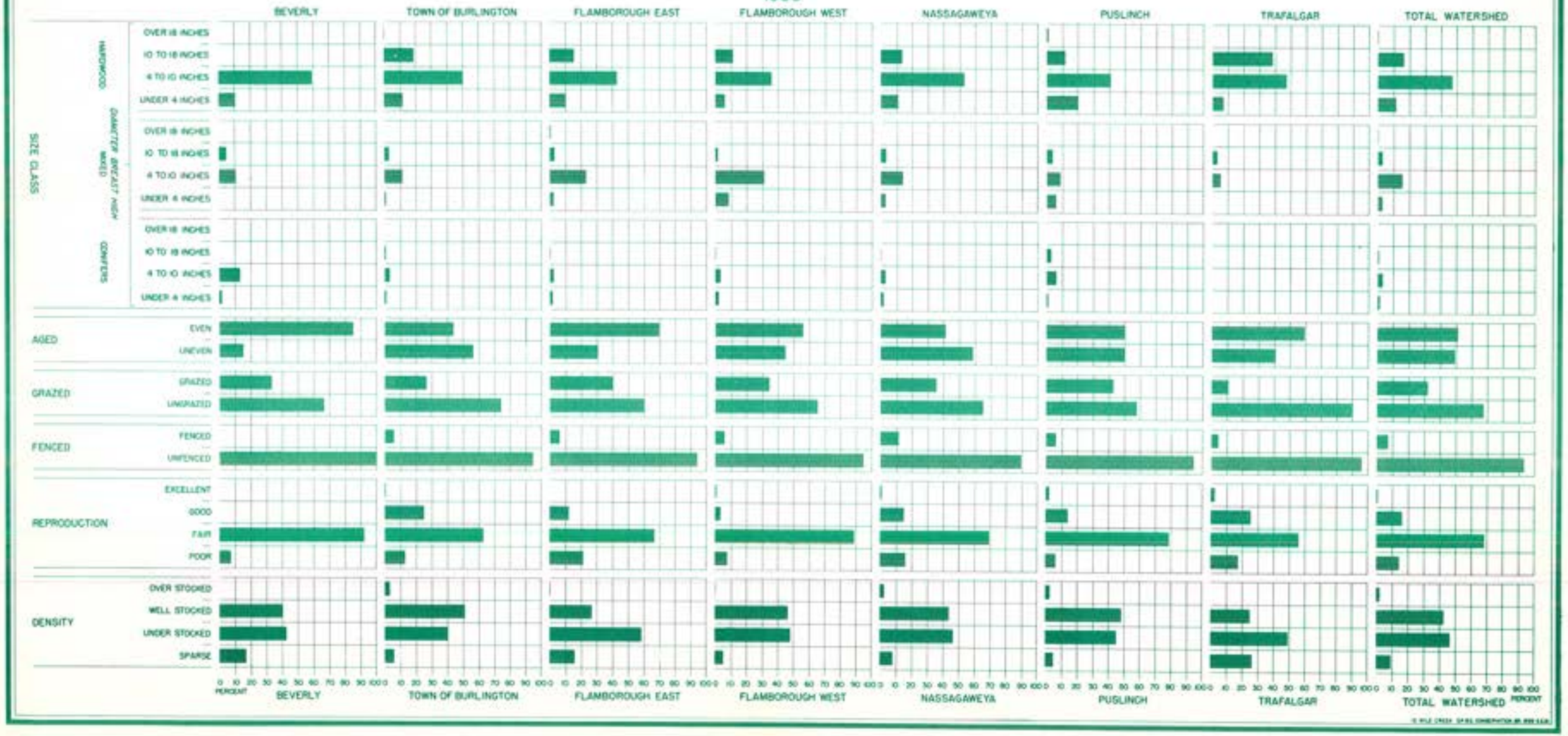
* Diameter breast height or 4½ feet above ground level.

WOODLAND CONDITIONS BY TOWNSHIPS

PERCENTAGE BY TOWNSHIP

1958



The hardwoods and mixedwoods in the 10-18-inch d.b.h. classes (18.9 per cent), and the conifers in the 4-10-inch class (3.1 per cent), will reach maturity in a relatively short time and could provide reasonable returns for good management. The remainder of the stands are young growth and will require some time to reach merchantable size. Where possible this time should be shortened by thinning cuttings.

The survey showed that the woodland is almost evenly divided between even and uneven-aged stands. The uneven-aged stands will, with proper care, provide a continuous source of revenue, since some trees will be ready for harvest every few years. The even-aged stands do not provide for a continuous harvest, but are harvested at much longer intervals. If a more or less continuous source of revenue is considered more advantageous than a larger amount of revenue at long intervals, then an uneven-aged stand is the answer. In addition, uneven-aged stands require more or less constant attention which could provide employment during the farm slack season.

Woodlot grazing does not appear to be as widespread a practice as elsewhere, with only about one-third of the woodland presently grazed. Even so this situation should be corrected and the problem will be dealt with at greater length in a later chapter.

Reproduction is not as good as it might be; however only 14.3 per cent of the woodland was found to have poor reproduction. Stand density appears to be reasonably good also with only 9.0 per cent recorded as sparsely stocked.

4. Scrublands

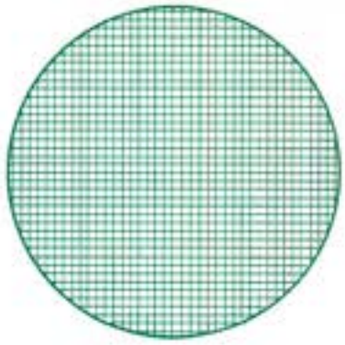
Areas which are covered with tree species which never attain commercial size are classified as scrublands. Poorly drained sites with species such as scrub willow and dogwood are

called wet scrub and dry sites with hawthorn and sumac forming the major species are called dry scrub. On this watershed there are 4,593 acres of scrubland, about evenly divided between wet and dry scrub. Much of this consists of abandoned farmland and neglected pasture.

These scrub areas represent a considerable loss to the economy of the watershed, and some effort should be made to convert these areas to a more productive state. In some cases the land could be restored to pasture or other agricultural use. Where such restoration is impractical, the areas should be returned to tree cover. A table showing the distribution of scrublands by townships may be found on the following page.

SCRUBLANDS

Municipality	Area in Watershed (Acres)	Scrub			
		Dry (Acres)	Wet (Acres)	Total (Acres)	Total % of Twp. Area
Town of Burlington	25,728	663	173	836	3.2
Beverly Twp.	1,024	24	-	24	2.3
Flamborough East Twp.	15,872	389	500	889	5.6
Flamborough West Twp.	4,864	97	260	357	7.3
Nassagaweya Twp.	15,872	942	760	1,702	10.7
Puslinch Twp.	7,808	184	491	675	8.6
Trafalgar Twp.	7,936	110	-	110	1.4
Total	79,104	2,409	2,184	4,593	5.8



TOTAL AREA OF WATERSHED
79,104 ACRES
(100 %)

OPEN LAND
56,892 ACRES
(71.9 %)

WOODLAND AND PLANTATION
17,619 ACRES
(22.3 %)

DRY SCRUB
2,409 ACRES
(3.0 %)

WET SCRUB
2,184 ACRES
(2.8 %)

TWELVE MILE CREEK D.P. & D. CONSERVATION BRANCH 1959. C.S.V.

LAND CLASSIFICATION - TOTAL WATERSHED

CHAPTER 3

FOREST CONSERVATION MEASURES IN PROGRESS

1. Private Planting

Private tree planting in the Twelve-Mile Creek Watershed was begun about 30 years ago but did not involve a very large acreage until more recently. There has been a great increase within the past ten years, with 84.6 per cent of the present plantation area established within that period. The following table shows the total area of present plantations that were established at various dates.

Present Plantations Established by:	Total Area (Acres)	Per Cent of Total
1933	4	1.3
1938	8	2.6
1943	30	9.6
1948	48	15.4
1953	139	44.6
1958	312	100.0

Approximately three-quarters of the plantations are in good condition and the remainder in somewhat poorer shape. A number of the recent plantations have had a low percentage of survival among the seedlings. This may be the result of a number of factors such as poor planting techniques, poor choice of species, or girdling by mice and rabbits.

Although only about ten per cent of the plantations have received some sort of treatment such as pruning or thinning, this should be expected since most of the plantations are too young to require such treatment yet.

Individuals and municipalities may obtain advice and assistance in reforestation and woodlot management through the Department of Lands and Forests Zone Forester at Hespeler. The

Zone Forester assists also in the establishment of Authority forests, County forests, demonstration and school plots.

2. County Forests

County forests are established and managed under an agreement between the Ontario Government and a county. Such an agreement is similar in most respects to that between a Conservation Authority and the Ontario Government which enables the establishment and management of an Authority forest. The latter type of agreement is described in some detail in Chapter 4.

There are three counties partly within the Twelve-Mile Creek Watershed and each county has at least a part of its County forest in the watershed. Four tracts of the Halton County forest, comprising approximately 230 acres, are wholly or partly within the watershed. There is also one tract from each of the Wellington and Wentworth County forests in the watershed. These cover approximately 135 acres. The total County forest area of 365 acres consists of 90 acres of coniferous plantations and 275 acres of natural woodland.

3. Tree Farms

In the past few years a movement has been under way to recognize well-managed forest properties as Certified Tree Farms. With the sponsorship of several organizations interested in better forestry, the Canadian Forestry Association in 1953 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, protect the land adequately, employ cutting practices satisfactory to ensure future forest crops, and permit inspection by Committee foresters. At present there are several Certified Tree Farms in the watershed. It is recommended that the Twelve-Mile Creek Conservation Authority give its support to this movement and to the Ontario Forestry Association.

4. Tree-Cutting By-laws

Under The Trees Conservation Act of 1946 and its successor The Trees Act (R.S.O. 1950, c.399) twenty-three counties have passed by-laws to restrict and regulate the cutting of trees. 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.

The Halton County by-law forbids the cutting for sale of cedar under seven inches stump diameter and other species under fourteen inches stump diameter.

The Wentworth County by-law established six inches as the minimum stump diameter for cedar and fourteen inches for any other species to be cut for sale.

Wellington County forbids the cutting for sale of cedars under six inches stump diameter; balsam, poplar, paper birch or ironwood under eight inches and other species under fourteen inches.

Such diameter limits are only an elementary step to prevent indiscriminate slashing of woodlands. 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 diameter 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. Many tree-cutting by-laws, including those of Halton, Wentworth and Wellington Counties, provide for the necessary variations from a strict diameter limit where the cutting is done under such supervision and in accordance with good forestry practice.

5. Meetings of Woodlot Owners

From time to time the Department of Lands and Forests holds meetings for the owners of woodlots and Christmas tree plantations to discuss the problems of woodlot and plantation management.

The Twelve-Mile Creek Conservation Authority should offer its co-operation in organizing and promoting attendance at such meetings.

6. Forest Conservation Measures in Other Areas

(a) Municipal Forests

Some municipalities other than counties have occasionally established forests for a variety of reasons. Some of these protect town water supplies and will eventually add to municipal revenues. This type of forest is also eligible for assistance from the Department of Lands and Forests.

(b) Authority Forests

The agreements for establishment and management of Authority forests are described in the next chapter. At present 15 Conservation Authorities have purchased land to be put under management as part of Authority forests. A total of 40,183 acres had been purchased as of December 31, 1958.

The primary consideration in choosing areas suitable for Authority forests is to make the best possible use of areas of low-class land. These forests may also serve to protect the headwaters of many streams.

(c) Woodlot Fencing

The practice of grazing woodlands is very detrimental to good woodland conditions but this practice is still carried on in about one-third of the woodland on the watershed. Any scheme to aid woodland owners in fencing their woods from livestock is to be recommended.

Since 1948 the County of Halton has had a program of assistance for the fencing of woodlots against grazing. To date this program has had only a very limited success, partly because of administrative difficulty but more particularly due to indifference on the part of woodlot owners. Such a program may be useful as a supplement to public education but not as a substitute for it. It is recommended that the Twelve-Mile Creek Conservation Authority promote such schemes.

(d) 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. Projects are judged annually on Achievement Day and prizes awarded. 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.

Sponsorship of these clubs would be a worthwhile project for the Authority.

CHAPTER 4

FOREST CONSERVATION MEASURES REQUIRED

The activities through which the Authority may further forest conservation fall into three broad categories. In larger areas needing reforestation or management the Authority may acquire land and manage it directly. In private planting and woodlot improvement demonstrations the Authority may co-operate with private landowners. The Authority, through public meetings, field days and publications, may educate and encourage residents of the Twelve-Mile Creek Authority to practise conservation on their own lands.

1. Twelve-Mile Creek Authority Forest

In areas such as the Twelve-Mile Creek Watershed, which are adjacent to rapidly-expanding urban centres, the production of forest products is of minor importance. The conversion of many farms into country estates has resulted in the retention of woodlots for their aesthetic value rather than their economic worth. Many woodlots are providing home sites for urban workers. The poorer parts of many farms are also left in forest cover, but little if anything is done with them. Even so there are rather extensive areas of poor land in this watershed on which the retention of existing forest cover and the reforestation of open land would be quite practical from the standpoint of watershed protection, recreation and wood production.

With this aim in mind, all the larger areas of poor land in the watershed have been examined. In general these areas are not smaller than 100 acres. The nature and distribution of this land by townships is shown in the accompanying table and map.

When large areas such as these require management or reforestation to such a degree that private owners cannot be expected to carry out the necessary changes, then an

organization such as a Conservation Authority should provide the leadership required. This is one of the most important forest conservation measures that can be undertaken by an Authority.

To facilitate the management of Authority forests, the Department of Lands and Forests will enter into an agreement with any Conservation Authority. Under this agreement, the Ontario Government will provide half of the land cost as an interest-free loan for a period of fifty years. In addition the Department of Lands and Forests agrees to establish the forest and pay the cost of such items as fencing, buildings, equipment, labour, maintenance, etc.- in short, everything connected with the management of the forest for the same period.

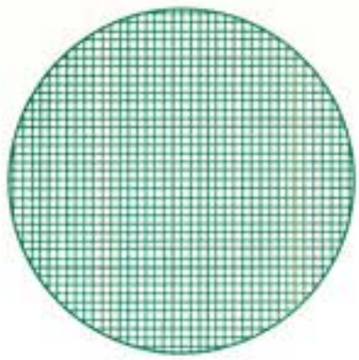
At the end of the fifty-year agreement the Authority has the privilege of exercising one of three options: First, to take the forest over from the Government and pay back one-half the cost of the land plus the cost of establishment and maintenance without interest; Second, to relinquish all claim to the forest, whereupon the Government will pay to the Conservation Authority one-half the cost of the land without interest; Third, the forest may be carried on as a joint undertaking by the Province and the Authority, each sharing half of the costs and half of the profits.

It is not expected that the Authority will acquire all of the recommended land but merely use these areas as a guide to acquisition. The formation of a properly-managed Authority forest should serve as an example for private woodland owners to follow. In some cases land recommended for acquisition as part of an Authority forest may prove to be of more value as recreation or Conservation Areas. In such cases a multiple use program may be of most value. Forestry is not necessarily the only or the most important use which can be made of the recommended areas, particularly when the high population of the surrounding area is considered.

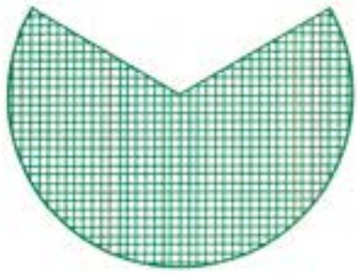
RECOMMENDED AUTHORITY FOREST

Municipality	Woodland (Acres)	Open (Acres)	Scrub (Acres)	Water (Acres)	Total (Acres)
Town of Burlington	1,872	293	99	6	2,270
Flamborough East Twp.	1,444	958	241	-	2,643
Flamborough West Twp.	396	91	52	-	539
Nassagaweya Twp.	2,108	644	466	-	3,218
Puslinch Twp.	639	184	211	-	1,034
Totals	6,459	2,170	1,069	6	9,704

TWELVE MILE CREEK



TOTAL AREA
OF
RECOMMENDED AUTHORITY FOREST
9,704 Acres
(100%)



WOODLAND
6,459 Acres
(66·5%)

OPEN LAND
2,170 Acres
(22·4%)

SCRUBLAND
1,069 Acres
(11·0%)

WATER
6 Acres
(0·1%)

TWELVE MILE CREEK D.P.& D. CONSERVATION BR. E.E.M. 1959

LAND CLASSIFICATION
RECOMMENDED AUTHORITY FOREST

The recommended areas are concentrated on the stony terminal moraine in the central portion of the watershed and in the swamps of the northern part. A minimum of land in the better classes has been included in the recommended areas. However, it was impossible to omit such land entirely when it constituted only a small portion of a lot which was composed mainly of poorer land. Where possible these small areas of better land should not be included with the area purchased.

In a few cases where lands are presently being well managed by private owners, there is no immediate need for public acquisition. However, the Authority should be alert to see that a change in circumstance does not allow these lands to fall into other hands in which their usefulness for conservation purposes might be destroyed. It is for this reason that some of these properties are included in the recommended areas.

The problem of land acquisition should be approached carefully. In most cases purchase will be arranged by direct negotiation. The Authority should also be alert to acquire tax-delinquent lands. The Authority has the power to expropriate land and is justified in doing so when an unreasonable attitude on the part of the owner stands in the way of works urgently required for the general good. However, a favourable public attitude is essential to the furtherance of conservation and such powers must be used with discretion. In some cases, if a hardship would be incurred by asking an old resident to move, some special provision such as life tenancy of the house might be arranged.

2. Private Reforestation

On many farms, even in areas of mostly good land, there are small tracts which, because of steep slopes, stoniness or poor drainage, would be better in tree cover. These small areas are not suitable for public acquisition and management, but in the interest of good land use they should be reforested if no other more valuable use can be made of them. Many of

these areas have not been reforested heretofore because the owner has some other minor use for the area, because he is discouraged by the long period between planting and harvest of a forest crop or more commonly simply because of inertia on his part.

The interest of private owners in reforestation may be fostered in several ways. Public education, such as that now carried out by the Zone Forester in the district, can be furthered by the Authority. In addition, direct assistance to private planting can be given.

Several Conservation Authorities have purchased tree-planters which supply a planting service to private owners at a nominal cost. Where rough ground makes hand planting necessary, some Authorities subsidize planting at $10 per acre if inspection shows that planting has been done carefully and the plantation is adequately protected from livestock. When labour conditions permit the Authority might itself organize crews for hand planting on these sites.

The assistance schemes carried out by other Authorities have stimulated interest in private reforestation while still ensuring the good use of the planting stock. It is recommended that the Twelve-Mile Creek Authority adopt some similar policy of assistance to private reforestation.

3. Woodlot Improvement Projects

For most persons the best lesson in conservation is field observation of specific examples of the present abuses and efforts to remedy them. Woodlots chosen as illustrations must be near good roads and should be marked with large signs giving considerable detail of conditions and improvement measures in progress. Roadside or other parking facilities should be provided so that visitors can take the full time necessary for inspection without interfering with other traffic.

The owner may suffer inconvenience from visitors, and it is possible that he may consider the whole program as experimental in nature and unproven in value. If the

Conservation Authority is able to establish demonstrations of good forest management on privately-owned woodlots, it is therefore fully justified in assuming part of the actual woodlot improvement cost as well as the cost of signs and parking facilities.

To use a private woodlot in this way for educational purposes would require a definite agreement with the owner to ensure that the proposed improvements were carried out, and that the benefits of this work would not be lost by a change of ownership or of attitude on the owner's part. In addition a detailed record of costs and returns would be necessary to show other owners that it would pay for them to adopt similar practices in their own woodlots.

Some owners may be willing to see their woodlots used for such demonstrations, but wish to be relieved of any personal participation in the project. In such cases the Authority might lease the woodlot or purchase it outright.

Two examples of woodlots suitable for such demonstrations are described here.

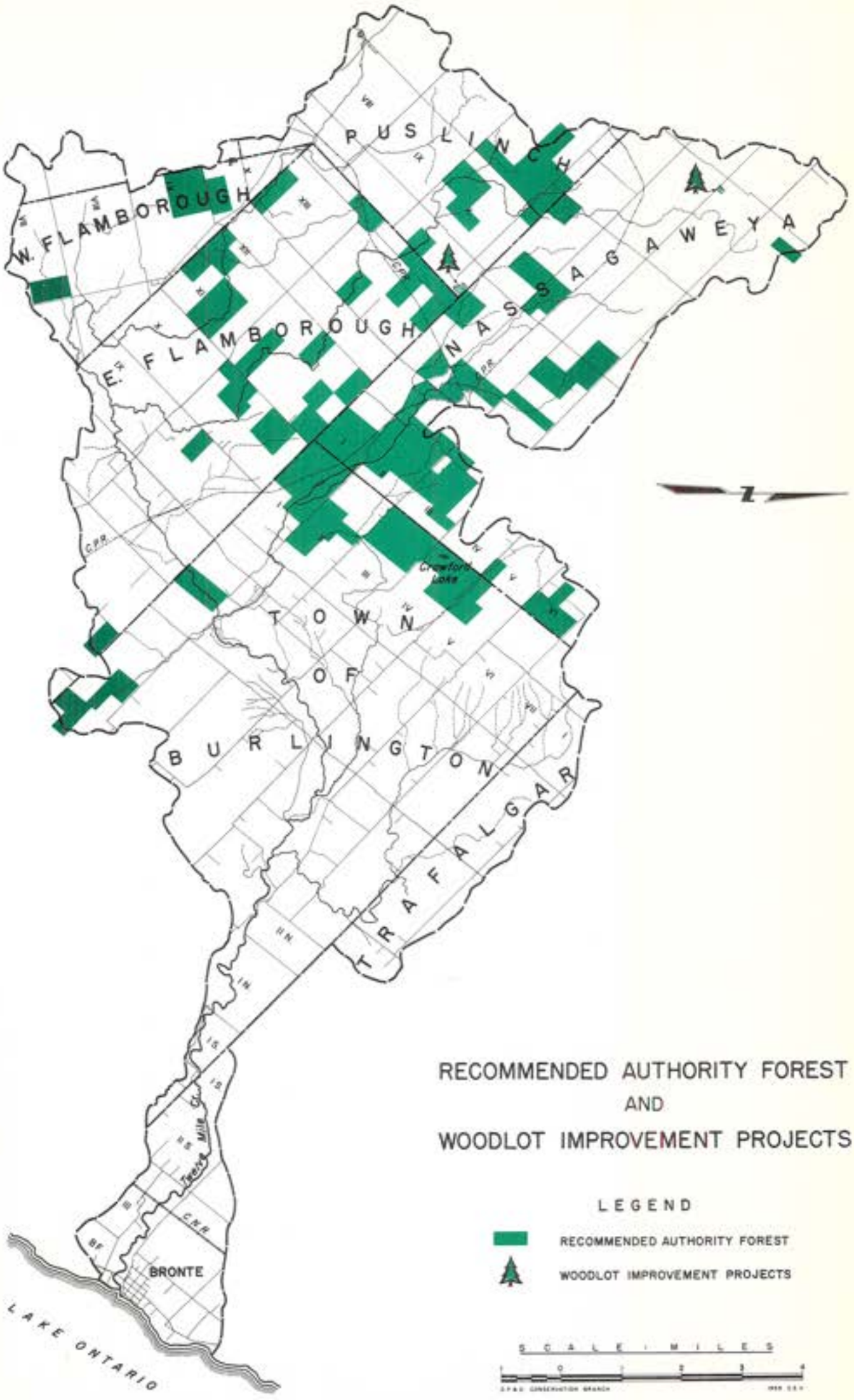
(a) Lot 37, Concession X, Puslinch
4 miles north-east of Puslinch

This sugar maple - beech stand has been heavily grazed with the result that there is almost no regeneration or advanced young growth although the larger stems are fully stocked. As a demonstration a few acres of the woodlot should be fenced to keep out livestock, and trees which are diseased, dead, or of poor form should be removed. Beech should be removed, if possible, to make room for more valuable species such as maple and the few white elm and white ash scattered through the present stand.

By improving only part of the woodlot there will be a good contrast between good and bad management of a woodlot.

(b) Lot 20, Concession III, Nassagaweya
1½ miles south-west of Darbyville

This is beech - sugar maple type of stand with a considerable quantity of hemlock and some white pine. The


PUSLINCH
W. FLAMBOROUGH
E. FLAMBOROUGH
NASSAGAWEYA
TOWN OF BURLINGTON
TRAFALGAR
Crawford Lake
Twelve Mile Cr.
BRONTE
LAKE ONTARIO
G.P.R.
C.N.R.
RECOMMENDED AUTHORITY FOREST
AND
WOODLOT IMPROVEMENT PROJECTS
LEGEND
RECOMMENDED AUTHORITY FOREST
WOODLOT IMPROVEMENT PROJECTS
SCALE - MILES
0
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woodlot has been cut over several times and the best trees have been removed. The woodlot is grazed and reproduction is not very good. For a demonstration, several acres should be fenced off to keep out livestock. In addition, dead trees as well as those of poor form should be removed. Almost all the beech should be removed. The reproduction of sugar maple and white pine should be favoured over hemlock and beech. White pine might be planted in several open spots.

4. 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 thinnings 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 of Lands and Forests in carrying them out.

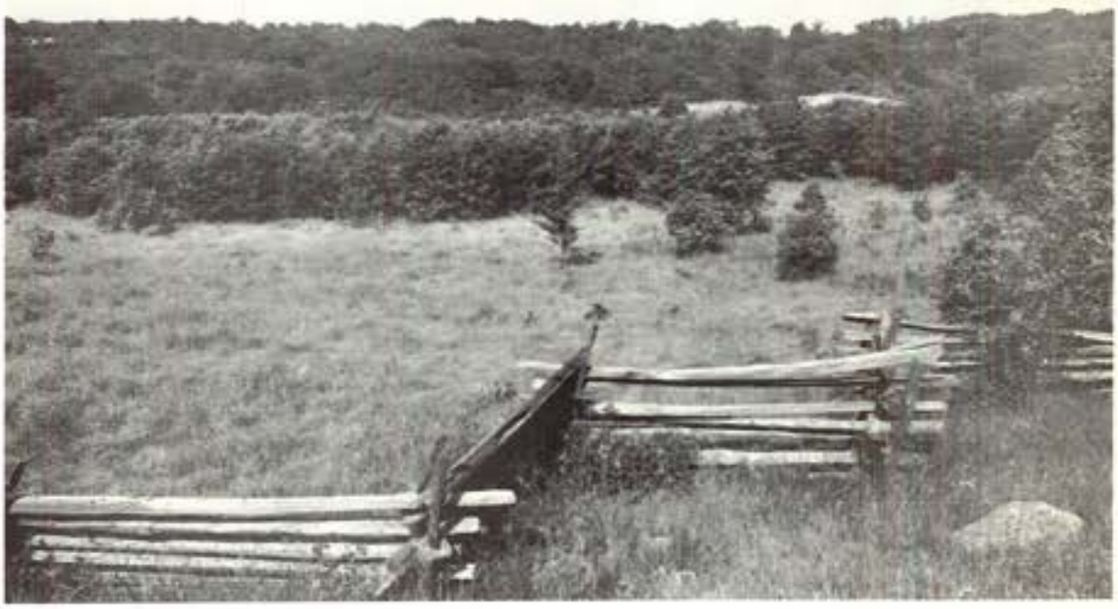
5. The Authority and Conservation Education

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 conservation problems and accomplishments would be of great assistance to speakers. Organization of public meetings and contact with individuals and groups such as farm forums will gain support for both private and public conservation efforts. Landowners should be encouraged to make greater use of the services available from the Conservation Authority and from officers of the Department of Lands and Forests and the Department of Agriculture.

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

Land too rough to be improved as pasture can be made productive by reforestation.



Hawthorn invades abandoned hillside pasture. Reforestation would return it to profitable use.

Willow scrub on neglected wet pasture. If the land cannot be improved for agriculture it should be returned to forest.

CHAPTER 5

FURTHER FOREST CONSERVATION MEASURES REQUIRED

1. Woodland Management

The present condition of the woodlands in this watershed has been described in Chapter 2. These conditions indicate that some action should be undertaken to place the woodlands on a sound management program. While experimentation is desirable to determine the best method of handling certain problems, the general principles of woodlot management have been known for years but have not been applied. A free advisory service is available from the Zone Foresters, but is not sufficiently used, and a readily understood pamphlet on the "Farm Woodlot" can be obtained from the Department of Lands and Forests.

One of the most difficult problems confronting the private owner in the management of his woodland is the utilization of the small woodland products which can be readily made and handled by the owner. These products, such as fuelwood, pulpwood, bolts, posts and poles, if properly harvested, increase the productivity of the woodlot and the gross returns per acre. The county diameter limit regulations have wisely prevented whole woodlots from going into these low-grade products through wholesale commercial slashing. Nevertheless, much material of this type could still be produced from thinnings and improvement cuttings and from limbs and tops of trees. The difficulty of marketing such low-grade material has seriously hampered owners in carrying out the needed improvement work in their woodlots. Any means which can be discovered for using small and poor-grade wood should be developed to the fullest extent. At the present time interest is increasing in the possibility of manufacturing wood chips in the woodlot by means of a portable chipper. Such chips can be used for the manufacture of pulp for paper, and as cattle bedding and chicken litter which can subsequently be spread on fields to increase the humus content of the soil.

They can be made from any species of wood, and tops and branches can be utilized. The number of pulp companies which can use hardwoods is limited at the present time and only those making kraft paper can use chips containing bark, but the demand for hardwood chips will increase and portable barkers are being developed. Every woodlot owner should consider the possibility of improving the quality of his woodlot by utilizing the low-grade material as chips or otherwise.

Owners of large woodlots might be encouraged to undertake thinnings and improvement cutting if equipment or trained crews were available at reasonable cost. The Authority should consider offering such a service. As an alternative, the Authority might offer a subsidy for each acre improved to its specifications and found satisfactory on inspection by the Authority's officers.

2. Elimination of Woodland Grazing

The Report of the Ontario Royal Commission on Forestry, 1947, contains the following statement:

> "The most widespread abuse of forests is that of utilizing them as pasturage for animals. If this practice alone could be eliminated more than half the battle to save Ontario woodlots would be won. Forestry and pasturage cannot succeed on the same piece of ground, as diametrically opposite conditions are necessary for each.
>
> "It is foolish to consider replanting millions of acres to forest unless the owners of millions of acres already under forest are convinced of the necessity and economy of caring for them in such a manner that they will be perpetuated and improved."

This is not a new theme. As early as 1908 the Ontario Legislature, in providing an exemption of one acre in ten used for forestry purposes, included a "no grazing" clause. There are a number of reasons for the widespread practice of allowing woodland grazing. The woodlot has always been considered a pasture field even though the value of woodland pasture is low compared to cleared land. The reason for its low carrying capacity is partly because grass grown in the shade is not nearly

as high in food value as that grown in full sunlight. The following statement in respect to woodland pasture has been made by leaders in agriculture: "On the whole, the opinion of the Agronomists is that, on the average, woodland pasture will produce about one-sixth the quantity of pasturage, and the quality will be about one-half as good as that of the improved pasture". Weeds are usually prolific in wooded pastures, often smothering most of the grass.

If shade is required for stock, it may be desirable to leave a portion of the woodlot in the pasture when fencing the woodlot. Another solution is to establish small groves of fast-growing hardwoods which can be fenced temporarily until the trees are sufficiently tall that browsing will not damage crown growth. Where springs or streams that supply water for the stock are situated in the woodlot access may be made to a trough near the spring and the area should be fenced to prevent trampling.

The economic fallacy of grazing woodlands is illustrated by the following examples:

(a) *The Wisconsin Agriculture Experiment Station measured the total yield per acre of the dry matter from three types of pasture over a five-year period in Richland County:

Improved pasture (grass and legume)	3,210 lbs.
Unimproved open pasture	1,453 lbs.
Woodland pasture	276 lbs.

Here the improvement of one acre of open pasture provided a gain of 1,757 pounds of feed, which is equivalent to the forage from 6.4 acres of woodland producing at the rate of 276 pounds per acre. In this case the improvement of about 6½ acres of existing open pasture would provide all the additional roughage that could be obtained from 40 acres of woodland.

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* The Case Against Cows. Wisconsin Conservation Bulletin. December 1951.

(b) *The U. S. Soil Conservation Service co-operating with the Wisconsin Agriculture Experiment Station conducted studies which showed that the daily pasture cost per cow was greater in woodland pastures. Taxes and other charges against the land, fencing, costs of establishment and acres required per cow were all considered. The study showed the relative daily pasture costs per cow on different classes of pasture to be approximately as follows:

Rotation pasture	5¢
Open permanent pasture	6¢
Improved pasture	5¢
Wooded pasture	17¢

At this rate, for a 180-day grazing season, woodland pasture cost $30.60 per cow, whereas on improved pasture the cost was $9.00. In other words, wooded pasture cost over three times as much as improved pasture.

(c) A fully timbered average maple stand, 60 years old, may yield about 4,000 board feet of saw timber per acre, net scale. Such a woodlot is virtually ruined by 20 years of heavy grazing, whereas 20 years of protection and no logging may increase the net volume to approximately 8,500 board feet per acre. The gain of 4,500 board feet is equivalent to an annual increase of 225 board feet per acre. At $28 per thousand on the stump this amounts to a mean annual gross income of $6.30 per acre over the period of utilizing only the increase in volume.

Basically the problem in grazing, as in all woodlot forestry, is the fact that a tree takes not one or two seasons but often more than the lifespan of a man before it is ready for

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* Soil Conservation Service, U. S. Department of Agriculture. Forestry Handbook (Fourth Edition) 1948. Upper Mississippi Region. Compiled and Edited by S. S. Locke, Chief, Regional Forestry Division.

harvest. This makes it difficult for many owners to understand the advantages of proper care for their woodlots or submarginal land. Examples such as those given show that good forestry practice in the woodlot will return more dollars than the scant forage value which it may produce for livestock. The Authority will find very little local or regional data on woodlands to prove these arguments on economic return, and should recommend that the appropriate agencies extend their studies in this field.

The number of cattle permitted to graze and the size of the woodlot have a direct relationship to the damage which is done. A large woodlot, of course, is not as seriously damaged by a few head of cattle as a small one. However, in most cases where grazing is permitted over a number of seasons the damage is serious.

Livestock admitted to woodland browse on the leaves and shoots of small trees and ride them down, and by scuffing the surface roots of larger trees injure them and permit entry of fungus diseases.

Field observations indicate that cattle have preference habits in grazing woodlands. Unfortunately this preference is for the more economically desirable species such as maple, basswood, elm and beech, whereas undesirable species such as hornbeam, blue beech, dogwood and hawthorn are grazed only when cattle are seriously underfed. This combination of factors, under continued grazing, changes not only the quantity but the quality of the reproduction and so the succeeding stand. The poorer hardwood species, and conifers where these occur, are favoured. The invasion of pastures by cedar and hawthorn is an illustration of this grazing preference.

Continued overgrazing affects natural reproduction both directly and indirectly; directly in so far as it affects the reproduction itself and indirectly through its effect on the soil. Livestock trampling compacts the soil, breaks up the

protective layer of litter, exposing the mineral soil to drying, and the cattle, by consuming the vegetation within reach, reduce the volume of litter naturally returned to the soil. It is this litter which keeps the soil open or porous and in a highly absorptive state. Thus water relations are changed, which adversely affects the rate of tree growth and may early eliminate seedlings which manage to make a start in the compacted soil.

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, and sunlight let in further dries out the soil. Weeds, and later grasses, which require plenty of light, gain a foothold and a sod begins to form. In general, tree seeds which germinate cannot compete with an established grass cover. As these effects of grazing progress the stand becomes open or park-like and eventually all the trees disappear.

Livestock grazing affects more than the growth of trees on the owner's land. Soil erosion in the woodland increases as the absorptive capacity and mechanical protection afforded the soil by the litter is reduced. The open canopy exposes the soil to the erosive force of rain impact and a compacted soil forces overland movement of water. Livestock tend to follow trails in the woodland and these often become centres of serious erosion. Thus continued grazing increases surface run-off and soil erosion.

Soil losses and the amount of water which ran off the land were measured at the Soil Conservation Experiment Station, La Crosse, Wisconsin. The following table* shows the results of measurements of four heavy rains recorded during the 1935 growing season on three separate watersheds having the same soil type.

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* Technical Bulletin No. 973 U. S. Department of Agriculture, Soil Conservation Service 1949.

Clear cutting in a maple bush encourages the weeds and worthless shrubs. Careful selection cutting would ensure continuous growth of valuable forest trees.

The sawmilling industry cannot thrive without an improved supply of good timber.

This windbreak protects the cropland from drying winds.

	Run-off		Soil Loss
	Inches	% of Total Precipitation	(lbs. per acre)
Watershed A (Grazed Woodlots)	1.01	12.61	1,560
Watershed B (Protected Woods)	.02	.25	20
Watershed C (Open Pasture)	.34	4.24	560

Watershed A: 2.67 acres of second growth hardwoods.
Slope 15-18 per cent.
Grazed to optimum carrying capacity.

Watershed B: 11.5 acres of second growth hardwoods.
Slope 25-50 per cent.
Neither grazed nor burned.

Watershed C: 5.85 acres cleared of second growth timber in 1932.
Slope 25-35 per cent.
Grazed to optimum carrying capacity.

Obviously continued woodland grazing is more than the private affair of the property owner. Anything which contributes to soil loss and to increased surface run-off lowers the yield capacity of the land on the one hand and adds to the flood hazard on the other. The lessened value of wood products reaching the market and the increased cost per cow on poor pasture are economic losses to the community as well as to the individual.

In spite of the studies and publicity to-date, the seriousness of the grazing problem has not yet been brought home to the person most concerned, the farm woodlot owner. It is recommended as a step in this direction that the Authority publish a simple, attractive bulletin on woodlot grazing.

3. Forest Fire Protection

The average person does not realize the seriousness of damage caused by fire in the woodlot. Though he may know that the young growth and small trees are burned by surface fires he does not realize the extent of the less obvious damage such as the destruction of humus which itself preserves the condition and

water-rotaining capacity of the soil. When the humus and ground cover are destroyed the sun and dry winds remove the moisture required for tree growth and plant nutrients are destroyed. 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 states of the 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 firewarden.

Such a system might be adapted to the more heavily wooded areas of the watershed. It is recommended that the Authority set up a committee to determine the best method of providing fire protection for both public and private lands, through the co-operation of the Department of Lands and Forests, for the protection of woodlands within the Twelve Mile Watershed.

4. Protection from Insects and Diseases

In any project, such as the public reforestation recommended for the Twelve Mile Creek Watershed, careful consideration should be given to the prevention of outbreaks of insects or tree diseases and adequate arrangements made for the immediate application of control measures when these become necessary. While it is not possible to predict accurately the course insects or disease may take under the ever-changing conditions of a newly forested area, there are a number of fundamental

principles which, if applied, will greatly lessen their destructiveness.

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

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

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

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

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

(a) Some Important Insect Pests

The White Pine Weevil has caused serious damage to plantations by attacking the leading shoots of young white pine. As this insect prefers to work in full sunshine, white pine should be grown in mixture with some other species which will shade the pine in its early years.

In recent years the European Pine Shoot Moth has increased to epidemic proportions in red and Scotch pines. Investigations are under way but no simple and effective control measures have yet been discovered. Another enemy of these species the Root-collar Weevil, has recently been reported near Angus in Simcoe County. This insect kills young trees by girding them below the ground. In the U.S.A., where this insect is better known, certain emulsions applied around the base of infested trees are said to give good control.

Leaf-feeding insects may kill conifers by one complete defoliation and hardwoods by defoliation for three years in succession. However, even partial defoliation may so weaken trees that they will be attacked by other enemies. Protection from leaf-feeding insects is therefore desirable. This is the kind of attack against which spraying is most successful.

Since investigations of forest insects are constantly under way, the owner considering insect control should always check with the Zone Forester to find the most effective methods now in use.

(b) Tree Diseases

The chief diseases of hardwoods are the various trunk, butt and root rots, and chronic stem cankers, which are all endemic and may cause serious damage under aggravating conditions. Woodlots on the Twelve-Mile Creek Watershed present very diverse conditions with respect to the incidence of these diseases, a circumstance which is usually related to their past history. Thus many containing old timber are in need of heavy preliminary salvage and sanitation cuttings as a result of mismanagement or neglect. Such cuttings should precede or be combined with cleanings and improvement cuttings, designed to improve the composition and structure of the stands. Having established a sanitary condition, normal care should maintain it and obviate loss on account of decay.

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

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

In harvest cuttings, which should recur at frequent intervals, the permissible volume alloted should include trees in which incipient decay is discovered and so far as possible those which have become a poor risk through injury or other circumstances.

The white pine blister rust is a serious enemy of that important species. It can be controlled by elimination of the currant and gooseberry bushes which spread the disease. This is economically feasible where white pine is growing on good sites, and where a considerable concentration of white pine on a small area reduces the labour involved.

The Dutch elm disease, which causes rapid wilting and death to all native elm trees and most introduced species, has caused great concern ever since the 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. A survey during the summer of 1958 in the Metropolitan Toronto area, revealed that the disease is well established there. Since the disease was introduced at Windsor and has now spread to Toronto, it follows that it must also be well established in the

Twelve-Mile Watershed. Control is achieved by elimination of diseased trees and by spraying healthy trees to prevent attack by the elm bark beetles which carry the disease. For valuable trees in parks, along streets or around houses the cost of control is well within reason. The Authority should alert its member municipalities to the danger and co-operate with them in making plans to control this disease.

5. Windbreaks and Shelterbelts

In the process of clearing land for agriculture much natural woodland, which had acted as shelterbelts, was removed. The restoration of windbreaks and shelterbelts, where necessary, is essential to a complete conservation program.

Belts of trees comprising one or two rows are usually called windbreaks; more than two rows in a belt comprises a shelterbelt. In Southern Ontario windbreaks generally give sufficient protection except where wind erosion of soil is severe in which case shelterbelts may be required.

When proper species are used and windbreaks are correctly placed, the effects are almost entirely beneficial. The effects may be direct or indirect, but in either case are the result of reduction in wind velocity. The effects of properly placed windbreaks 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 adjoining fields are raised, which 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.

On level land windbreaks may nearly always be established along existing fence lines but on rolling land, consideration should be given to the contours of the land. The prevailing winds in Southern Ontario are generally from the west; therefore the greatest protection will be derived from windbreaks on the west side of fields. However windbreaks on the other three sides should also be considered.

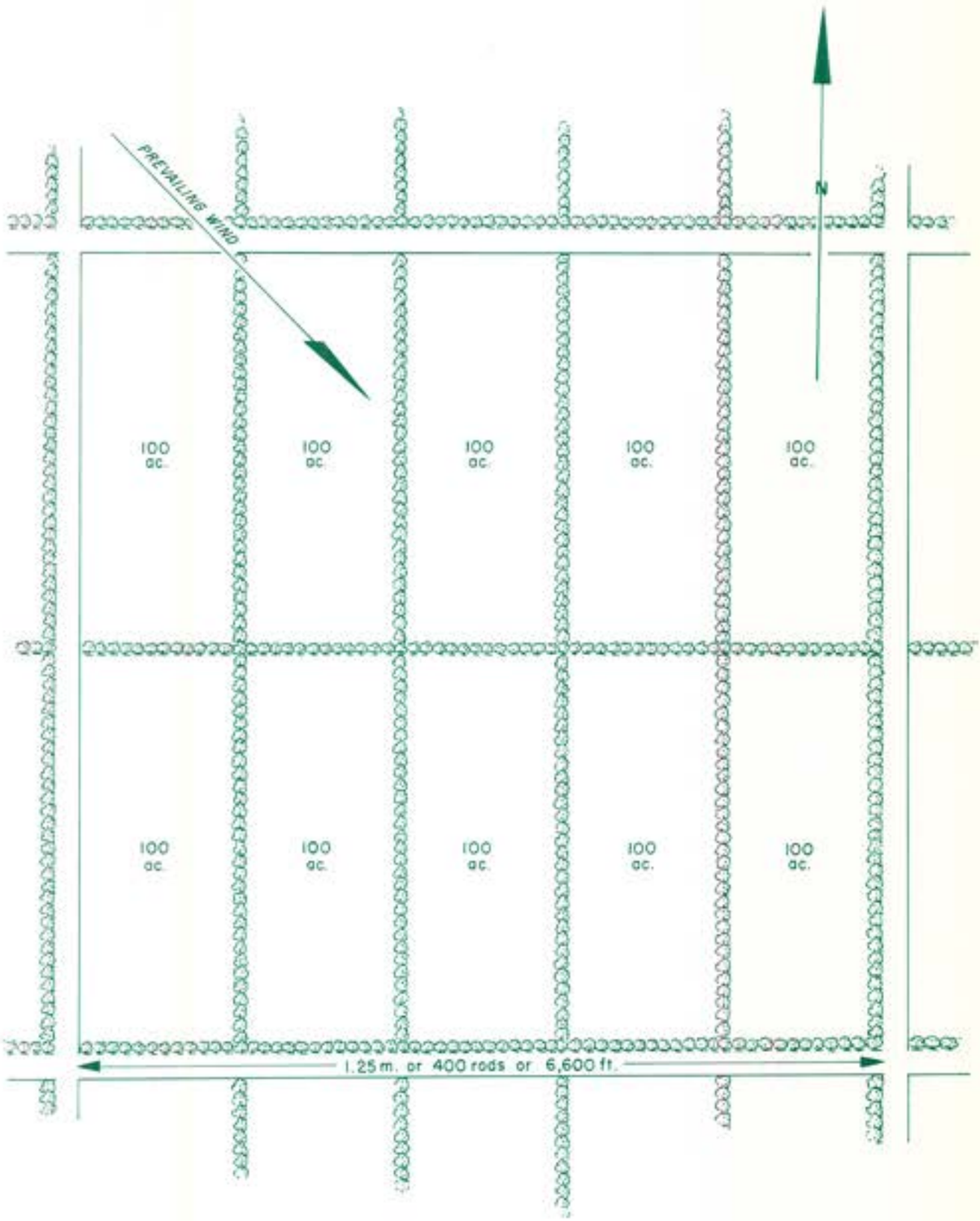
To produce the best results, the windbreaks must be adequate in design, length and numbers. The effective range of a windbreak is influenced by the height of the trees and wind velocity. An average windbreak will reduce the ground velocity of a 20 m.p.h. wind 10 per cent or more for a distance of about 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 lee side. For example, if the trees are 40 feet high the total effective range with a 20 m.p.h. wind will be 30 x 40 or 1,200 feet, 300 feet of which will be on the windward side and 900 feet on the lee side. Generally speaking, the reduction in velocity is greatest close to the windbreak and tapers out to zero farther away.

The benefit of windbreaks in reducing heat loss from buildings in winter has been shown to be considerable. Experiments conducted in the United States have shown that more than twice as much heat is lost from a house 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. In addition

WINDBREAK PLAN

for

1,000 ACRE BLOCK



This plan shows the minimum windbreak requirements for a 1,000 acre block on level land. Woodlots and plantations will replace some of this and placement will have to be adjusted according to topography and soil on rolling land.

windbreaks about buildings can add to the appearance of the property.

Another advantage of windbreaks is that they can improve wildlife habitat by providing shelter and runways for many kinds of birds and other small animals.

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

Experience has shown that windbreaks are an asset to any farm; that their adverse effects, if any, are local and easily remedied. In many areas windbreaks are essential to the control of soil erosion by wind. It is therefore recommended that the Authority encourage the establishment of windbreaks by private owners.

6. Windbreaks and Shelterbelts as Snow Fences

In the climate of Southern Ontario snow drifting may cause much inconvenience and sometimes hardship. Control can be readily affected 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 cost of erection, removal or maintenance of these can be materially reduced by using trees as permanent windbreaks or shelterbelts.

The object of a snow fence it 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 likewise create drifts.

Prejudice which may exist against windbreaks for protection against drifting snow on roads usually arises from poorly designed or poorly placed windbreaks. If a windbreak has openings in it or if it ends abruptly, streamer drifts will form. To prevent this, windbreaks should be kept dense and tapered down at the ends by using progressively smaller species of trees and shrubs. In addition, livestock should be excluded from both windbreaks and shelterbelts, since they will browse and

damage the limbs of trees and shrubs, thus reducing their effectiveness.

Trees are being used successfully as snow fences in Ontario by the Department 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 wide use.

WATER

CHAPTER 1

THE WATERSHED

The physical features of the region drained by a creek are basic to a study of water relations for that creek. Physical features rather than municipal borders fix a watershed boundary and the drainage patterns within that boundary. The boundary of the watershed will be described in this chapter; the physical features within that boundary will be described in greater detail in Chapter 2.

1. Boundaries and Area

The outline of the Twelve-Mile Creek lies in a north-westerly direction and is very irregular. (See the map of the watershed enclosed at the end of this water report). The watershed is bounded on the south-east by Lake Ontario; on the south, in part, by the watershed of Crabb's Creek and the summit of the terrain; on the west and a portion of the south limit by the watershed of Spencer Creek; on the north-west by the watersheds of Galt Creek and the Eramosa River, tributaries of the Grand River; and on the north-east by the watersheds of Sixteen-Mile and Palermo Creeks.

Its length is 22 miles. Its greatest width is 8¾ miles (near the north-westerly limit) and its narrowest width three-quarters of a mile along a 7½-mile neck which fronts on Lake Ontario; apart from this neck the average width is about 6½ miles.

The Twelve-Mile Creek Watershed has an area of 119.8 square miles. The Authority has taken in, however, two areas outside the watershed, both being along the north side of the neck. One area (1.1 square miles) lies between the watershed boundary and a 2½-mile stretch of the south-west boundary of the Township of Trafalgar. This area is part of the town of Burlington's annexation. The other is

a triangular area of 3.1 square miles fronting on Lake Ontario and lying between the easterly boundary of the Twelve-Mile Creek Watershed and the westerly boundary of the Palermo Creek Watershed. This enlargement increases the shoreline of the Authority from half a mile to 2½ miles and the area to 124.0 square miles.

Elevations in the watershed vary from about 245 feet G.S.C. at Lake Ontario to about 1,175 feet G.S.C. in the vicinity of Darbyville at the northern extremity of the watershed. The watershed lies astride the Niagara Escarpment which traverses the area in a more or less north and south line between Kilbride and Lowville.

2. Municipalities and Hamlets

Within the watershed are parts of the Townships of East Flamborough, West Flamborough, Beverly, Puslinch, Nassagaweya and Trafalgar; the town of Burlington and part of its annexation; the hamlets of Bronte, Brookville, Carlisle, Cedar Springs, Darbyville, Flamborough, Freelton, Kilbride, Lowville, Sodom, Moffat, Morriston, Mountsberg, Strabane, Zimmerman and part of Tansley which is astride the watershed boundary.

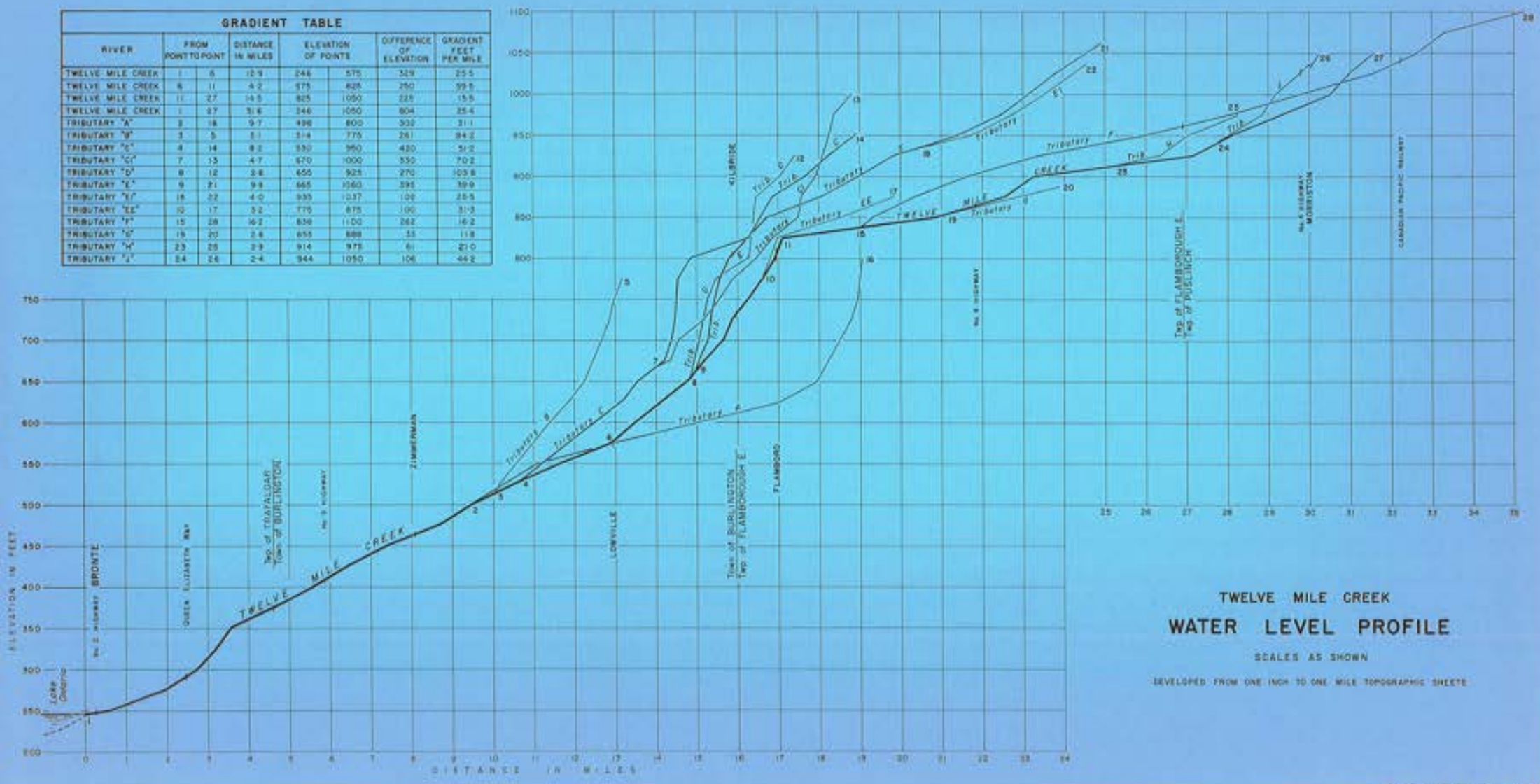
The total population within the Authority is 27,554 and the area and population of each of the municipalities in the Authority are shown in the accompanying Table 1.

3. The Creek, its Tributaries and their Gradients

The routes taken by the Twelve-Mile Creek and its tributaries and the slopes along these tributaries are shown on the map of the Twelve-Mile Creek Watershed and the water level profile. For lack of definite local names the major tributaries have been designated alphabetically on the water level profile and the watershed map. The profile data were taken from topographic maps with 25-foot contours which indicate the overall but not the minute changes.

GRADIENT TABLE

River	From Point	To Point	Distance in Miles	Elevation of Points		Difference of Elevation	Gradient Feet per Mile
TWELVE MILE CREEK	1	6	12·9	246	575	329	25·5
TWELVE MILE CREEK	6	11	4·2	575	825	250	59·5
TWELVE MILE CREEK	11	27	14·5	825	1050	225	15·5
TWELVE MILE CREEK	1	27	31·6	246	1050	804	25·4
TRIBUTARY "A"	2	18	9·7	498	800	302	31·1
TRIBUTARY "B"	3	5	3·1	514	775	261	84·2
TRIBUTARY "C"	4	14	8·2	550	960	420	51·2
TRIBUTARY "C1"	7	13	4·7	670	1000	330	70·2
TRIBUTARY "D"	8	12	2·8	655	925	270	103·8
TRIBUTARY "E"	9	21	9·8	665	1060	395	39·9
TRIBUTARY "EE"	16	22	4·0	935	1037	102	25·5
TRIBUTARY "EE"	10	17	5·2	775	875	100	31·3
TRIBUTARY "F"	15	28	16·2	838	1100	262	16·2
TRIBUTARY "G"	19	20	2·6	655	808	53	11·8
TRIBUTARY "H"	25	25	2·9	914	975	61	21·0
TRIBUTARY "J"	24	26	2·4	944	1050	106	44·2



TWELVE MILE CREEK
WATER LEVEL PROFILE

SCALES AS SHOWN

DEVELOPED FROM ONE INCH TO ONE MILE TOPOGRAPHIC SHEETS

O.F.R.C. CONSERVATION BRANCH MAY 1959

The source of the main stream of Twelve-Mile Creek is about 2 miles north-east of Morriston at an elevation of about 1,050 feet above mean sea level*. Its course is in a general south-easterly direction until it reaches the confluence with tributary "G" at a point about 2 miles west of Carlisle where it turns north-east. At about the point where the C.P.R. line crosses the creek at Flamborough, the creek begins to drop over the escarpment. At the base of the escarpment it turns south-easterly and continues in that general direction until it empties into Lake Ontario at Bronte.

From its source to Flamborough the distance is 14.5 miles and the fall is 225 feet for an average gradient of 15 feet per mile. From Flamborough to the base of the escarpment the distance is 4.2 miles and the fall about 250 feet, for an average gradient of 59.5 feet per mile. From the escarpment base to the lake the distance is 12.9 miles and the fall 329 feet for an average gradient of 25.5 feet per mile. The total distance from the source to Lake Ontario is about 31.5 miles and the fall about 800 feet.

Tributary "A" rises at an elevation of 800 feet at a point 1½ miles west of Milton and enters the main channel about 1 mile west of Zimmerman at about elevation 498 feet, after flowing 9.7 miles through a long southerly meander. Its average gradient is 31.3 feet per mile but, as over half the fall is in the first mile, the average gradient for most of the distance is only 17 feet per mile.

Tributary "B", which empties into the main stream about one mile above Zimmerman, drains about 2.6 square miles of land lying between the escarpment crest at Mount Nemo and the valley of the main stream.

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* Elevations given are based on G.S.C. datum which has been extended from mean sea level. G.S.C. signifies Geodetic Survey of Canada.

Tributary "C" which drains 14.0 square miles, flows from an elevation of 950 feet at a point 1½ miles south of Campbellville and joins the main stream 2 miles east of Lowville at an elevation of 530 feet. It has a steep average gradient for its 8.2 mile length of 51.2 feet per mile.

Tributary "D" gathers water from an area of 4.5 square miles most of which is on top of the escarpment south of Kilbride. It has an average gradient over its 2.6-mile length of 103.8 feet per mile, but half of the 270 feet of fall is at the escarpment face.

The source of tributary "E" is about a mile north-east of Moffat, at an elevation of 1,060 feet. In general, its course is south-easterly for a total distance of about 10 miles to its confluence at elevation 665 feet, with a total fall of 395 feet. In the first 8.5 miles from its source the stream drops 200 feet, with an average gradient of 23.5 feet per mile. It then begins a 1.7-mile fall to a lane of the escarpment through the north-easterly side of Kilbride and down a gorge where it joins Twelve-Mile Creek one-quarter of a mile west of Cedar Springs. The fall in this 1.7-mile reach, is 260 feet, giving an average gradient of 153 feet per mile.

Tributary "F" rises 2 miles north-east of Moffat at an elevation of 1,100 feet. It meanders in a general south-easterly direction for a distance of 16¼ miles to its confluence at elevation 840 feet. Its fall is 260 feet with an average gradient of 16 feet per mile, which is less steep than the tributaries described above.

Tributary "G" rises in the Beverly Swamp and flows in a southerly direction for a distance of 2.5 miles to join the Twelve-Mile Creek one mile south of Freelton. It has a drainage area of 4.1 square miles and a mild slope of 11.8 feet per mile.

Tributary "H" drains 2.4 square miles over a slope of 21.0 feet per mile to join the main stream one mile north of Freelton.

Tributary "J" drains an area of 3.1 square miles in the vicinity of Morriston at the most westerly part of the watershed, It flows in a general south-easterly direction for a distance of 2.5 miles to join the Twelve-Mile Creek near Puslinch Station. Some distress has been caused by the waters of this tributary as will be described along with a proposed solution later in the report.

From the above description it can be seen that the gradients of Twelve-Mile Creek and its tributaries are high with no slack water reaches. These steep streams have high velocity flows with strong erosive power. With these high gradients the lag time between an intense rainfall and the resultant run-off peak will be very short.

TABLE 1

MUNICIPALITIES OF TWELVE-MILE CREEK CONSERVATION AUTHORITY
AND THEIR POPULATION

Municipality	Total Area Sq. Miles	Area within Watershed Sq. Miles	Percent within Authority	Total * Population			Population within Authority		
				1960	1959	1950	1960	1959	1950
E. FLAMBOROUGH TWP.	43.7	24.8	57	4,114	3,942	5,809	2,345	2,247	3,311
W. FLAMBOROUGH TWP.	51.0	7.6	15	6,345	6,732	3,661	951	1,010	549
BEVERLEY TWP.	113.0	1.6	1.4	4,676	4,660	3,917	65	65	55
PUSLINCH TWP.	97.4	12.2	12	3,518	3,522	2,388	422	423	287
NASSAGAWEYA TWP.	70.1	24.8	35	2,231	2,190	1,836	781	767	643
TRAFALGAR TWP.	104.8	12.9	12.3	28,624	25,107	6,134	3,435	3,013	754
TOWN OF BURLINGTON	87.3	40.2	46	42,511	37,630	5,575	19,555	17,310	2,565
TOTAL	567.3	124.1	-	92,019	83,783	29,320	27,554	24,835	8,164

* Population figures taken from 1960 Municipal Directory.

CHAPTER 2

RUN-OFF RELATIONSHIPS

1. Streamflow

Streamflow originates primarily from prior precipitation. It consists of surface flow plus ground-water which enters the stream channel along its course and is, broadly speaking, the excess of precipitation over evapo-transpiration and deep seepage. Surface flow is that portion of rainfall, melted snow and ice which reaches the stream channels directly by flowing over the ground surface. Ground-water flow (percolation) is going on continuously and is responsible for maintaining the flow in streamsduring periods of drought. This portion of streamflow is often referred to as "base flow".

The lag of streamflow behind the precipitation producing it depends upon the physical characteristics of the watershed and the precipitation pattern. Reliable run-off relationships are required for flood-forecasting and for the design and operation of water projects. Estimates of probable flow rates during water demands are required for design of water projects to relieve drought conditions, while probable peak run-off rates have to be determined to delimit flood hazard areas and design major impounding structures for safe and efficient performance.

The factors influencing run-off are numerous, varied, and seldom independent. Some of the pertinent factors affecting run-off relationships are the basic physical characteristics of the basin as terrain slopes, watercourse gradients, degree of channelization or subsurface drainage, pondings, soil permeability, vegetation, etc.

Of these physical characteristics, degree of channelization and vegetal cover are most often altered by man, though by dint of extreme effort he may alter the others

somewhat. To date, man does not significantly alter the pattern of precipitation producing run-off.

It is the combined influence of the above-mentioned factors on streamflow which is usually desired for design purposes. The best means of obtaining the combined effect is by continuous direct gauging of streams at strategic locations. Instruments which automatically give a continuous record of flow variation are preferable to manual gauges which are seldom observed more than once or twice daily.

Unfortunately, the Twelve-Mile Creek flows have not been observed with any type of stream gauge. Consequently there are no records available with which to directly assess its run-off pattern.

Since man can alter the run-off characteristics somewhat a brief description of these characteristics as found on the Twelve-Mile Creek Watershed is given below, after which are included some sample preliminary estimates of peak flow rates.

2. Precipitation

The term "precipitation" as used in meteorology includes all forms of moisture which reach the earth - rain, snow, hail, sleet, etc. In the production of streamflow the most significant forms of precipitation are rain and snow.

From meteorological station records available for this region, which cover periods from 44 to 62 years, the average annual precipitation is 30.55 inches. This is made up of an average annual rainfall of 24.89 inches and an average annual snowfall of 56.6 inches*.

The precipitation varies widely from the "average" however, with months or years of drought and other periods of intense and excessive rain and snow. It is usually

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*10 inches of new fallen snow is taken as 1 inch water equivalent.

the non "average" precipitation conditions which give rise to water problems and which must be taken into account in designing water control works. It is likely that water problems will increase as population increases in this watershed and more basic precipitation data will be needed.

3. Terrain Slopes

In addition to the gradients of the main stream channels which were described in Chapter 1, the slopes normal to the streams are important in that they affect the rate at which water may run into or off the land toward the streams. The steeper the terrain slopes the faster water reaches the channels and rises to a peak flow with a correspondingly greater peak rate of run-off. In order to describe the slopes, the watershed has been divided into three zones which have different characteristics, viz:-

TABLE 2

TERRAIN SLOPE ZONES

Zone	Watershed Region	Square Miles	Percent of Watershed
A	Upper	53.8	44.9
B	Middle	43.8	36.6
C	Lower	22.2	18.5
	Total	119.8	100.0

A meridian through a point 1 mile west of Carlisle is the dividing line between A and B zones. Zone C is the region below the base of the escarpment.

Zone A.

In the south-easterly part of the zone, nine glacially deposited drumlins are clustered in an area of 11

square miles. They vary in height above their bases* from 25' to 100' and cover 20 per cent of the zone. The distance between the bases varies from one-quarter to 2½ miles and averages about 1 mile. In general their length is downgrade and parallel to the streams. Seventy per cent of their lateral slopes are toward streams and nearly all the others are toward relatively flat wooded land.

TABLE 3

DATA DESCRIBING NINE DRUMLINS IN ZONE A				
Item	Units	Max.	Min.	Average
Height above base	Feet	100	25	64
Length of base	Miles	2.07	.53	1.25
Width of base	Miles	0.45	0.15	0.33
Slope easterly end	Ft.per Mi.	375	83	211
" westerly end	" " "	300	94	164
Northerly Lateral slope	" " "	500	100	292†
Southerly " "	" " "	500	125	262

Outside the area of the drumlins the slopes in Zone A range from 50 to 150 feet and average 100 feet per mile.

Zone B.

The Niagara escarpment crosses this zone. The escarpment proper is broken by a steep and rugged depression about a mile wide at the narrowest place and approximately 100 feet below the adjoining summits.

The southerly part is crescent shaped with Mount Nemo at the summit and near its centre. Its westerly segment is separated by Twelve-Mile Creek which flows through a narrow gorge three-quarters of a mile north east of Flamborough. Near Cedar Springs the banks or lateral slopes to the creek are a maximum, the vertical heights being about 175 feet and 150 feet and the horizontal distances about 700 feet and 800

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* The base is the lowest unbroken contour around the drumlin.

† For lateral slopes the horizontal distances were extended either to creeks or to a lower contour in wooded land.

feet respectively for the south and north banks.

At Mount Nemo where it turns southerly, the elevation of the summit is approximately 950 feet and the base 600 feet, a slope of 350 feet in about 2,000 feet or 860 feet per mile.

The northerly part of the escarpment, which is arrow-shaped with Rattlesnake Point forming the south-easterly tip, is separated from the main escarpment by Tributary "C" of the Twelve-Mile Creek. The maximun slopes of the north-easterly and south-westerly banks are 225 feet and 175 feet vertical, to horizontal measurements of 500 feet and 700 feet respectively. On the easterly side of the arrow the terrain drops from a summit elevation of 1,025 feet to a base elevation of 650 feet in a horizontal distance of three-quarters of a mile for a slope of 500 feet per mile. At Rattlesnake Point the terrain drops 375 feet in half a mile, a slope of 750 feet per mile.

One-half mile north of Kilbride there is a saddle one mile long and three-quarters of a mile wide having several summits 50 feet above the base with slopes averaging 350 feet to the mile.

The slopes in the rest of Zone "B" range from 60 feet to 150 feet and average 105 feet per mile.

Zone C

Zone C comprises the watershed area below the base of the escarpment. In general the slopes are south-easterly toward Lake Ontario and excepting the main creek ravine walls, the terrain slopes vary from 25 feet to 100 feet per mile, averaging 60 feet per mile. From Zimmerman to Bronte the Twelve-Mile Creek ravine is about 100 feet deep and its walls have an average slope of about 100 feet vertical to 150 feet horizontal.

4. Soil Permeabilities

Other factors being equal, run-off rates vary with the degree of permeability of soils which may be roughly grouped into three classes as shown in the following table:

TABLE 4

SOIL PERMEABILITIES

Permability Class	Per Cent of Watershed
Permeable: Sands, gravels, moraines and some limestone plains	70%
Semi-Permeable: Imperfectly drained soils and some clay lands	20%
Almost Impervious: Poorly drained soils, tight clay lands, urban areas	10%

These percentages were derived from generalized physiographic maps and are only approximate.

5. Drainage Channelization

If a soil is well drained and open it will have capacity to absorb large volumes of precipitation and thereby reduce the amount of precipitation which runs off causing erosion and flooding. It can be seen that tile drainage can help reduce run-off and flooding by gradually emptying the soil reservoir between rains, which provides storage for the next rainfall. On the other hand, drainage improvements by open ditching methods, while relieving crop drowning, increase the rate and amount of run-off and increase downstream flooding.

6. Wooded Areas

Dry woodland and dry scrub, to some extent, reduce volumes and rates of run-off. The snowmelt run-off from open country usually precedes that from adjacent wooded areas. Thus a watershed of bush cover intermixed with cleared land usually has a longer run-off period and lower run-off rates than a watershed that is either entirely cleared or entirely wooded. The areas of dry scrub, dry woodland, wet scrub and swamp are summarized in the following table. For more detail on woody cover the forestry report section should be consulted.

TABLE 5

AREAS OF WOODY VEGETATION

TWELVE-MILE CREEK WATERSHED

Type of Woody Growth	Square Miles	Percentage of Watershed (119.9 Sq.Mi.)
Dry Woodland	27.02	22.5
Dry Scrub	3.76	3.1
Total of dry areas	30.78	25.6
Swamp	11.90	9.9
Wet Scrub	3.41	2.9
Total of wet areas	15.31	12.8
Total dry and wet areas	46.09	38.4

In addition to reducing spring run-off peaks as pointed out above, run-off for the majority of rainfalls is much less from wooded and well vegetated areas than from cultivated areas. However, when the less frequent high precipitation volume storms occur, the soil, even in well vegetated areas, may become saturated and unable to absorb further rainfall. Thus run-off may be as great from vegetated as from cultivated areas during the latter part of such storms. Vegetation helps protect the watershed against erosion and flooding from minor storms but is not sufficient to prevent a stream from overflowing its banks when the large volume, high intensity storms occur.

7. Lakes

Lakes function as retardation basins during flood periods. The topographical sheets show eight very small lakes or "kettle ponds" within the watershed, five in zone A and three in B. These lakes reduce the run-off rates in the immediate tributary but their effect on peaks in the main streams is not appreciable. However lakes have additional values for community

uses as will be described later. Crawford Lake, the only lake named on the topographic sheets is privately owned. It and others are used for recreation.

8. Flood Flow Estimates

Fortunately flood damage along Twelve-Mile Creek has been minor in the past. However, there are flood-vulnerable areas along the creek and its tributaries. One of the best means of reducing the burden on public resources caused by flooding is to prevent build-up of damageable facilities in flood-vulnerable areas. It is a tribute to the people of this valley that the number of dwellings in flood plains is still small. However, with increasing population in the area there is greater pressure to build on the lower ground. In order to delimit or provide structural protection for the flood hazard areas flood flow rates must be determined.

Where river control structures are concerned, it is not the normal or average discharges of a stream but the unusual or exceptional flows that have occurred in the past or may reasonably be expected to occur in the future that are significant. These flows provide the basic design criteria for all water control structures, particularly major ones where failure could result in loss of life and destruction of property.

It is necessary, therefore, in the analysis of the available data to consider probable maximum conditions in relation to the human and economic factors involved.

In the absence of discharge records it is necessary to resort to empirical means to ascertain within reasonable limits the flows which may occur under various conditions.

Of the number of methods available for this type of calculation, that of Snyder* was chosen as being best suited and applicable in respect to the data available for this area.

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* Franklin F. Snyder, Hydrologic and Hydraulic analyses, Corps of Engineers, U.S. Army Engineering Manual, Part CXIV, Chapter 5, March 1948.

To give an indication of the flows that may be expected with varying degrees of probability, calculations based on the Snyder method were made for two locations in the watershed. The locations chosen were the hamlet of Zimmerman above which there is a drainage area of 110.3 square miles and at Cedar Springs above which there is a drainage area of 68.1 square miles. Cedar Springs was chosen since the flow at this location originates above the escarpment and the flood plain is well defined from Cedar Springs downstream. Zimmerman was chosen because it is at the upstream end of the 7¾-mile-long neck which forms the lower portion of the watershed. Only 9.5 square miles drain into the Twelve-Mile Creek below Zimmerman. With the drainage area above Zimmerman being 92.3 per cent of the total, the flows at Zimmerman will be representative of what can be expected through the lower 7¾ miles of the creek. Further, a main stream dam and reservoir site near Zimmerman was investigated at the time of field survey as described later. The results of calculations for flows at these two location are summarized in the following tabulation:

TABLE 6

ESTIMATED DISCHARGES OF VARIOUS PROBABILITIES AT ZIMMERMAN AND CEDAR SPRINGS

Average Probability of Occurrence of Discharges Greater than shown	Discharge Estimates			
	Zimmerman (Drainage 110.3 Sq.Mi.)		Cedar Springs (Drainage 68.1 Sq.Mi.)	
	c.f.s.	c.s.m.	c.f.s.	c.s.m.
Once in 25 years	8,300	75	6,000	88
Once in 50 years	9,600	87	6,900	101
Once in 100 years	9,900	90	7,200	105
Probable Maximum	38,000	345	29,000	423

In the above table the Probable Maximum discharge was deduced from the 6-hour "Probable Maximum Thunderstorm"*, with a run-off co-efficient of 75 per cent.

The 25- 50- and 100-year "return period" discharges are directly related to the rainfall intensity-duration-frequency curves for Toronto.

The creek discharge rates in the above tabulation are intended as a preliminary guide only. As major water control projects are undertaken the flow estimates should be rechecked in the light of any discharge measurements which may become available in the meantime. Even for flood line mapping to delimit accurately the flood-vulnerable regions it would be most valuable to have a few years' flow records. It is, therefore, recommended that the Authority establish recording stream gauge stations near Zimmerman, Carlisle and Mountsberg.

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* Preliminary Estimates of Probable Maximum Precipitation over Southern Ontario - J.P. Bruce, Eng. Journal, July 1957.

CHAPTER 3

WATER PROBLEMS

1. In Generalized Terms

The physical processes affecting water within or along the boundaries of a watershed give rise to problems which are, or may become, of interest to the Conservation Authority. In extreme generalization it might be stated that these problems are due to non-moderation of use or supply. During times of excessive supply, flood and erosion losses occur. In low-supply periods pollution effects are more serious, irrigation may be required; wells and reservoirs may be unable to meet the demand and water may have to be imported. Flood damages are generally due to man's use of areas which the river occasionally needs. Where population pressure has not already become too great, the best means of reducing flood damage is to re-adjust man's use of the lands subject to flooding. Where civilization has encroached with expensive developments on the lands occasionally needed by the river it may be more economical and necessary to adjust the river than to re-adjust man's use of the land.

Flood and low-flow problems may often be relieved by the modification of the river's regime. Water that goes to waste during flood periods may be conserved for use during periods of drought to the benefit of the development within the watershed.

2. Limiting Flood Plain Occupancy

As can be seen from Table 1 in Chapter 1 the population both within the boundaries of the Authority and within the municipalities which make up the Authority has increased rapidly in the last decade. The total population in the municipalities represented on the Authority was 29,320 in 1950, 83,783 in 1959 and 92,019 in 1960. Thus the population increased 314 per cent from 1950 to 1960, and 11 per cent from

1959 to 1960. While much of this increase was in the municipalities fronting on Lake Ontario the intensification can be expected to continue inlandward with a tendency for housing and industry to encroach upon the flood plains. As yet the Twelve-Mile Creek Conservation Authority is in the enviable position of having jurisdiction over a watershed which to date has suffered only minor flood damage in a few localities.

Much distress can be obviated by delimiting the flood-vulnerable areas now and promoting uses of these areas which do not involve a flood damage hazard. It is better to prevent building in the flood plains than to require extensive flood protection structures after the build-up has occurred.

If building in the flood plains of Metropolitan Toronto and Region had been prevented during the past century the damages and deaths during hurricane "Hazel" would have been considerably less, and the Metropolitan Toronto and Region Conservation Authority would not now have to undertake such a costly flood control program. The build-up within the Twelve-Mile Creek Watershed is currently at a stage similar to the Toronto region 70 years ago and the Authority should act now to save the people of this watershed the expense of the Metropolitan Toronto experience.

During the survey of the Twelve-Mile Creek Watershed it was not possible to carry out the full detailed work necessary to delimit precisely the flood-vulnerable areas. This might be done by the Authority through a program of flood-line mapping. However, while the limits of flood-vulnerable lands were not established during the conservation survey, some of the low-lying and likely vulnerable areas were observed. These will be pointed out as brief examples only. It may be well to picture these areas in the light of the following definition of flood plains:

> "Flood Plains, the low-lying areas adjoining the streams and rivers that are subject to flooding during the high water periods, are an integral part of the river or stream, just as much as the

main channel of the river. As such they should be so classified and used."*

The map of the Twelve-Mile Creek Watershed enclosed at the back of this report shows only Morriston as subject to flooding. Parts of the village of Morriston suffer from continuously saturated conditions with frequent flooding and a proposal for relief of this condition is presented later in this chapter.

In addition to Morriston, however, there are many flood-plain areas which would be subject to considerable flood damage if built upon. Along the Twelve-Mile Creek from Highway 6, through Carlisle, to the brink of the escarpment the flood plain is broad. The spring freshets frequently rise to the edge of the first garage north of the creek along the Waterdown Road at Carlisle.

At Cedar Springs the flood plain is relatively narrow, but already several dwellings are practically upon the creek. It is to be expected that these will be damaged by flood waters from time to time.

From Lowville to Zimmerman the flood plain is quite broad and accessible by township roads. There are some farmsteads in this reach of the valley which appear to be close to the flood limit. Further build-up in this reach should be discouraged.

From Zimmerman to the Queen Elizabeth Way there is no significant build-up within the flood plain yet. Through this zone it can reasonably be expected that flood waters will occasionally stretch over the complete valley floor.

At Bronte there is marina development which suffers occasionally from flood-water buffetting. Here troubles may arise either from lake or creek. Debris which is dumped on the flood plain upstream may be swept down to Bronte in high water times to damage boats at their moorings.

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* Journal of Soil and Water Conservation July 1960.

The above descriptions have pointed only to localities along the main stream. Buildings should also be kept prudently back from the tributary waters. Subdividers and local residents need to know just where the building limit is. To provide this information complete floodline maps of the Twelve-Mile Creek and its tributaries need to be prepared.

3. The Flood Problem at Morriston

Morriston lies astride and near the headwaters of tributary "J" of the Twelve-Mile Creek. Periodically for years water has ponded along this reach of the tributary causing considerable inconvenience and distress. The drainage is poor and the ground remains in a saturated condition. Then when heavy rains or rapid snowmelts occur the water spreads out over the yards fouling gardens and septic tanks and backing up into some basements.

In an attempt to relieve this situation for Morriston and the farms in the five downstream lots in Concessions VII and VIII of Puslinch Township, the channel capacity of tributary "J" was increased by the digging of the "Penrice Drain" in 1917. Unfortunately, the results of this channelization work were not as satisfactory at Morriston as for the downstream farms. Except for periodic localized silting and ponding adjacent to the Highway 6 culvert the channel is in good condition from Highway 6 downstream to its south-easterly limit at the sideroad between Lots 35 and 36. The adequacy of this part of the drainage channel is indicated by the profile and typical sections shown on the accompanying plan. However, as illustrated by the accompanying photographs the channel is not in good condition through Morriston.

The lack of effectiveness of the channelization in Morriston, as compared to the downstream farms, is due primarily to a difference in soil characteristics. The soil along the channel through Morriston is silt part of the way and the remainder is muck. Neither of these soil types, as found

Tributary "J" of Twelve-Mile Creek, south from Badenock Street, Morriston. May 9, 1960.

Tributary "J" of Twelve-Mile Creek, looking upstream from Morriston Hall. May 9, 1960.

Tributary "J" Twelve-Mile Creek, east from Highway 6 in Morriston. May 9, 1960.

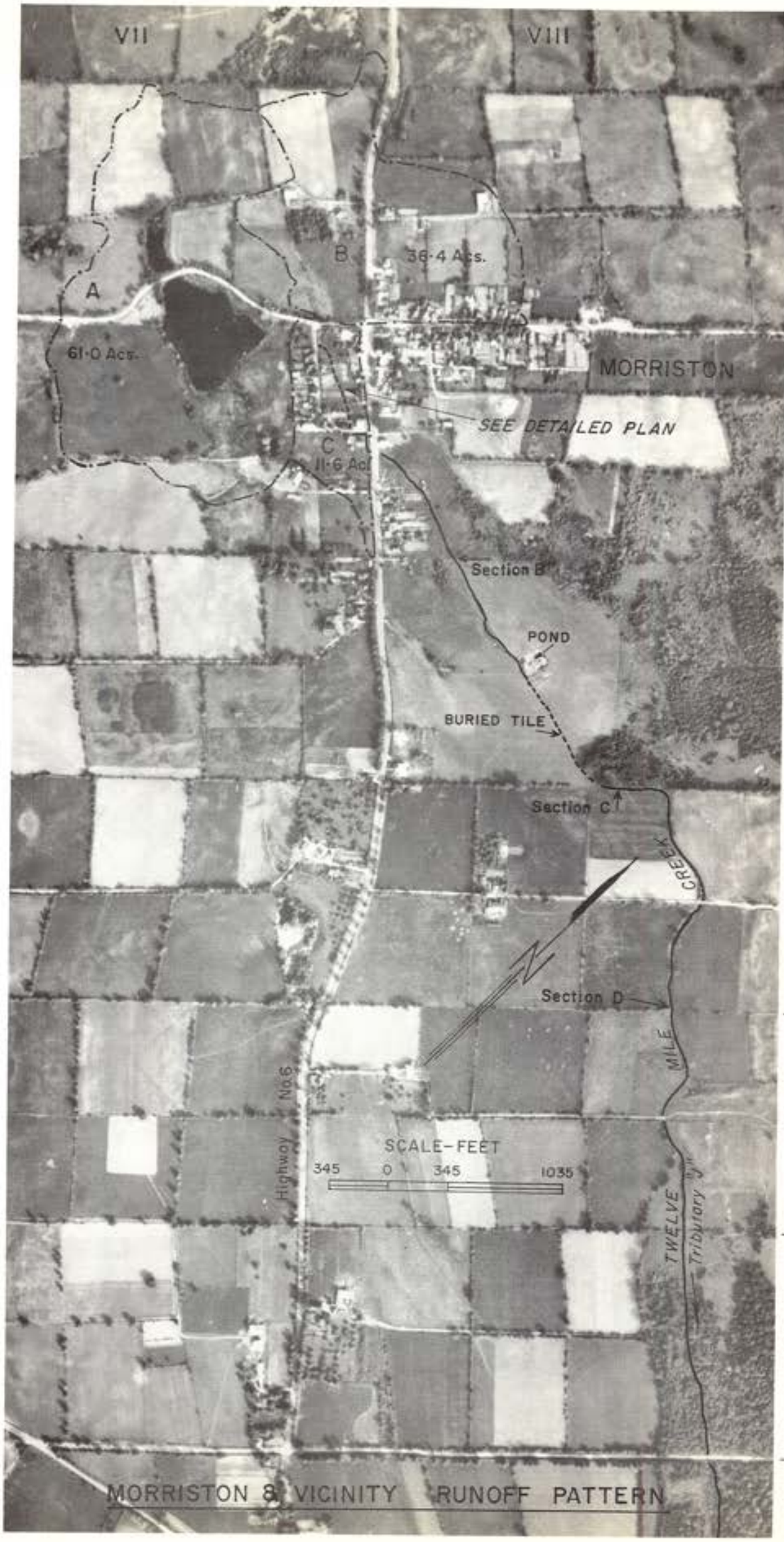
in the 1960 summer survey, possess sufficient shear strength to maintain the side slopes required by an open channel. To be satisfactory through soils such as these in a built-up area a channel must be lined.

In addition to carrying off the excess surface water it would be desirable if any flood-control channel through such a built-up headwater region also provided underdrainage to relieve the saturated condition of the soil. It is desirable also to construct the channel in a way which minimizes debris jamming. The use of large-diameter field tile appears to best meet the above requirements.

But, what size of tile should be used? To answer this the watershed characteristics must be determined. The watershed above Morriston is outlined on the accompanying aerial photograph. This photograph also gives some impression of the vegetal cover of the watershed. Watershed slopes were determined from the national topographic series maps. Computations of run-off rates indicate that a 42"-diameter tile would be required through Morriston to carry along the present route a run-off which can reasonably be expected to be exceeded once in 50 years. Such a tile would be expensive to install.

Fortunately on the west boundary of Morriston there is a 10.9-acre lake with an elevation low enough that the run-off from area "B" above Badenock Street may be diverted into it before being routed downstream through Morriston. This lake can then serve as a flood-control reservoir to retard the run-off and reduce the size of tile needed through Morriston.

A run-off equal to or greater than 2.3 inches from areas "A" and "B" or 2.3 x(36.4 + 61.0) = 224 acre-inches, can reasonably be expected to be exceeded once in 50 years from a storm of 6 hours or less duration. To store this volume of water would require provision for only a $\frac{224}{10.9 \times 12}$ = 1.7 foot flood surcharge on the 10.9-acre lake. This flood surcharge could drain off in 3 days through a 14-inch field tile with the gradient available through Morriston.



MORRISTON & VICINITY RUNOFF PATTERN

Run-offs greater than 2.3 inches could be expected from storms of durations greater than 6 hours or from snowmelt. However, discharge would be occurring through the outlet tile during the run-off period, and the surcharge on the lake would seldom exceed 1.7 feet. The flow in the outlet tile during a 6-hour storm would be largely made up from run-off from the 11.6 acres in area "C" within Morriston. The "once-in-50-years" flood flow is used for design purposes as being consistent with the lifetime of the channel components.

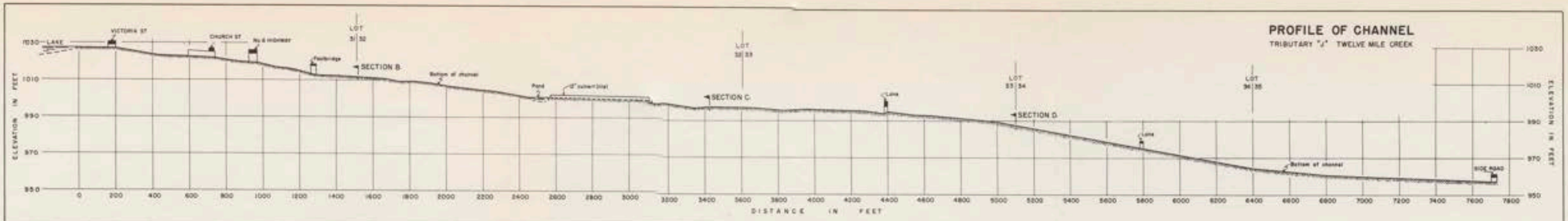
Further details for the proposed flood-control measures for Morriston are included on the accompanying plan which shows that the run-off from area "B" would be diverted under Badenock Street through a 36-inch corrugated iron pipe and thence into the lake through an open cut. Outflow from the lake would proceed slowly through the drop inlet and the 14-inch-diameter tile. Laterals of 6-inch, 8-inch and 12-inch diameters would pick up local run-off from area "C" within Morriston and introduce it into the 14-inch tile at manholes. The 14-inch tile would empty into the existing 21-inch tile behind the Morriston Hall. The tile trench should be backfilled with gravel at selected locations to allow local pondings to drain away. Excepting for the drop inlet at the lake end and the manhole at the juncture with the 21-inch tile, which would be square, the manholes could be made from 36-inch diameter well tiles. The manholes should extend 18 inches below the tile lines to form a silt trap. Solid covers should be fitted to the manholes for safety reasons.

Sediment from the watershed above Highway 6 would mostly settle out above Badenock Street and in the open cut upstream of the drop inlet.

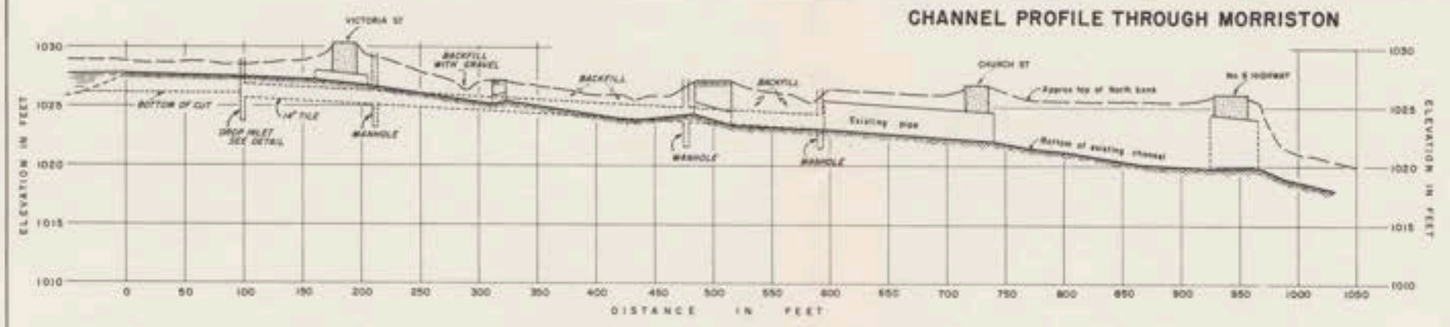
The use of the lake as a flood-control reservoir will improve the performance of the channel through the farms below Morriston. The run-off from above Morriston will be largely delayed until after the peak of downstream run-off has

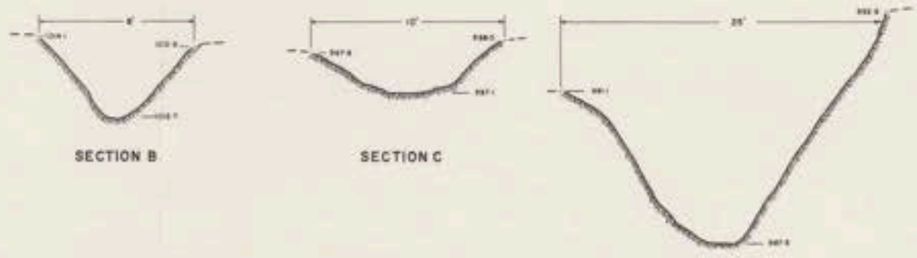
PROFILE OF CHANNEL

TRIBUTARY "J" TWELVE MILE CREEK



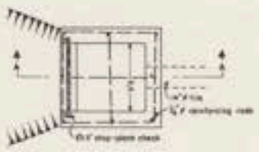
CHANNEL PROFILE THROUGH MORRISTON



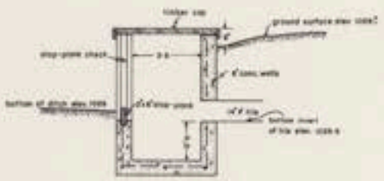


TYPICAL CHANNEL SECTIONS

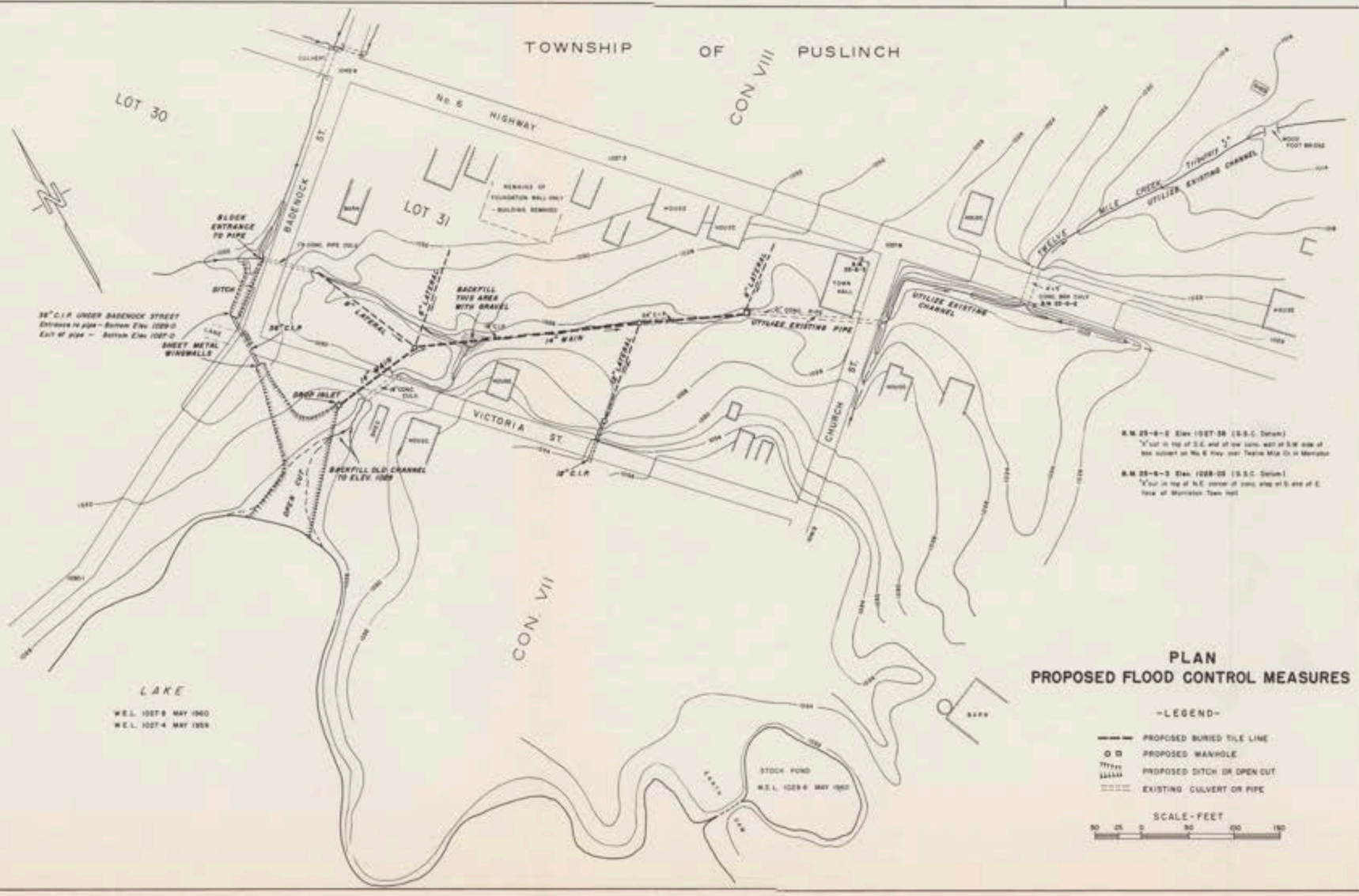
NOT TO SCALE



PLAN OF DROP INLET
NOT TO SCALE



SECTION AA – DROP INLET
NOT TO SCALE



PLAN
PROPOSED FLOOD CONTROL MEASURES

-LEGEND-

- PROPOSED BURIED TILE LINE
- PROPOSED MANHOLE
- PROPOSED DITCH OR OPEN CUT
- EXISTING CULVERT OR PIPE

SCALE-FEET

50 25 0 50 100 150

MORRISTON
FLOOD CONTROL PROJECT

SCALES AS SHOWN

D.F.O. CONSERVATION BRANCH Mar. M. 1960

passed. Even then the flow from Morriston will be meted out gradually and will be well below the channel capacity downstream.

In addition to its function as a flood-control reservoir the lake at Morriston could well be developed more completely as a community pond. More will be said about this in Chapter 5.

4. Water Erosion Control

Precious soil is eroded off our watersheds in tremendous quantities annually, only to fill up and annihilate some downstream lake. Soil may be lost insidiously by sheet erosion or dramatically by gullying.

No attempt will be made here to describe in detail the processes of erosion, as many treatises exist on this topic. More to the point are a few examples from the Twelve-Mile Creek Watershed where the Authority could assist the worthy cause of erosion control.

In the illustrations overleaf are examples of three types of erosion of soil by water. Firstly, consider the raw, rilled, bank along Appleby line. This is typical of many of the roadway cuts and fills in the watershed. Tremendous quantities of soil are moved downward from these bare banks with each rainstorm. Not only is the soil lost from its structural position but it settles out in flatter areas to fill culverts and pools, cover crops and pollute streams. The erosion on many of these banks could be significantly reduced by inexpensive vegetative means. Often the vegetation needs but a little encouragement in the form of seed, fertilizer, surface scarification and attendant interest. From the standpoint even of short-term economics it will often be less expensive to vegetate a bank than to haul in replacement structural fill, or clear out and replace culverts.

The Conservation Authority could perhaps co-operate with the Works Departments of the municipalities to carry out road bank erosion control.

Flood plain of Twelve-Mile Creek, one half mile west of Zimmerman. July 7, 1958.

Erosion rills on a bank along Appleby Line near Zimmerman exemplify a prevalent source of soil loss and sediment load to the stream. Aug. 8, 1960.

Erosion is accelerating on the north bank of the Twelve-Mile Creek ravine where the gas pipeline was installed in 1957, just south of the Upper Midle Road in Trafalgar Twp. Aug. 8, 1960.

Secondly, consider the bald, rapidly eroding bank where the gas pipeline crosses the Twelve-Mile Creek ravine 150 feet south of the Upper Middle Road projection. Here again the ravine wall could be restored to vegetative productivity. Indeed the Authority might take steps to require those who slash rights-of-way over well vegetated hillsides to establish vegetation to minimize erosion of the scarred earth.

Gully erosion is occurring at many places throughout the watershed. One startling gully is to be found in the north part of Lot 33, Concession II S.D.S. of Trafalgar Township. This gully has been named "Inglehart Gully" for convenience and is illustrated in the three accompanying views.

This gully represents the outcome of a drainage diversion that appeared harmless a generation ago. As can be seen in the upper illustration the original watercourse was at a higher level and the flow was toward the left of the photograph. The water from the 460 acres drained by this watercourse flowed into the Palermo Creek originally but a previous landowner, in order to reduce the flow in the watercourse near his buildings, had a small ditch about 150 feet long dug to divert the watercourse to the brink of the Twelve-Mile Creek ravine. The accelerating water did the rest of the excavating. It is estimated that 4,000 cubic yards of soil have been eroded from this one gully in the last generation.

This gully could be controlled by constructing a dam across it to guidethe flow back into its original watercourse. The dam could be so designed that in times of extreme high flows some of the water spills through the gully, so that the present landowner who has adjusted his crop program to the reduced flow might receive some flood relief. There is also a good location on this watercourse to construct a dam to form an irrigation pond wherein some of the excess from freshets might be stored for later use. The Authority should consider carrying out a gully-control demonstration on such a gully as this.

Inglehart Gully, Lot 33, Con. II, S.D.S. Trafalgar, Note arrow and broken line indicating original watercourse and diversion as dug. April, 1960.

Inglehart Gully near brink of Twelve-Mile Creek ravine. Note broken line indicating approximate position of diversion as dug. Aug. 8, 1960.

Looking up through Inglehart Gully from ravine floor. Note broken line indicating approximate position or original ravine wall. Aug. 8, 1960.

CHAPTER 4

CONSERVATION STORAGE

1. Why Consider Storage on the Creeks?

The water problems described above are not an exhaustive listing for the Twelve-Mile Creek Watershed. Other problems such as water shortage can be expected to occur frequently as population increases. Indeed, many localities including the Palermo and Ash vicinities already find supplies insufficient. Annual precipitation is more than ample for the needs but the time distribution does not always meet the requirements.

People look at the vast volume of water in the Great Lakes and think that all future needs can be taken from these lakes. But massive pipelines and pumps and expenditures of energy would be required to bring back from the lakes the water that flowed down past their doors in the freshets. If some of the excess from the freshets could be stored in reservoirs water would not have to be pumped upstream from the Great Lakes.

Since acquisition costs may become prohibitive if houses and other developments exist in a desired reservoir area, it is well to inspect a watershed for reservoir sites before it becomes densely populated.

Before embarking on the conservation field survey the national topographic series maps of the region were scanned for promising reservoir sites. Five sites were selected for more detailed field investigation. The location of these sites is indicated on the watershed map included after Chapter 5. The sites are described below. The sites considered were those which had potential for large volumes of storage which might meet requirements for flood control as well as water supply. It should not be construed that these are the only places where storage could be effected. There are undoubtedly many locations where smaller reservoirs, which would supply a few farms, could be established.

Besides the purchase of the land, the costs involved in impounding reservoirs are numerous and varied. The major expense is the dam itself, the cost of which varies with the height, length and spillway capacity required to pass the peak flows without endangering the structure. The spillway section usually requires costly reinforced concrete walls and steel sluice-gates. Other costs are the re-routing and raising of roads, replacement of bridges, clearing and fencing the reservoir area.

2. Brief Description of Reservoir Sites Investigated

(a) Ash

Located in Concessions VI and VII, Lots 4 to 7, Burlington, a reservoir with a capacity of approximately 1,280 acre feet could be established by a dam about 20 feet high and 700 feet long. The drainage area above the reservoir site is about 7.9 square miles. Unfortunately half a mile of town road would have to be raised or re-routed.

(b) Zimmerman

At this site a 2,080-acre-foot reservoir could be created by a dam 30 feet high and 800 feet long. The drainage area above this site is 108 square miles which, as can be seen from the flow estimates given in Chapter 2, would require an extensive spillway. This site would flood about one mile of town road. The size of reservoir at this location could be much increased by building a higher dam. However, due to the steep gradient of the creek and the extensive spillway required, a reservoir here would be very expensive and hardly justified from a flood-control point of view, since much of the area to be protected lies upstream.

(c) Strabane

A dam about 10 feet high and 400 feet long at this location would create a reservoir of about 294 acre feet capacity. The reservoir would be relatively shallow with much of the 140-acre area less than 5 feet deep. A reservoir here would be able

to store most of the excess spring run-off from the 2.56-square-mile drainage area. The portion of outflow from the Beverly Swamp which reaches the Twelve-Mile Creek passes through this site and a reservoir here would effect a control on that outflow.

While a reservoir at this site would be shallow, the water would be relatively warm, and should vegetable crops be grown more intensively in this region the Strabane reservoir could be constructed to provide irrigation water.

(d) Freelton

A reservoir of about 120 acre feet capacity could be established at this location by raising the county road and installing a spillway at the road bridge. Again the lake created would be shallow with much of its 57 acres less than 5 feet deep. Marshy vegetation would likely become established around the shores. Such a lake would increase wildlife habitat in the area.

A 120-acre-foot reservoir here could reduce the peaks of the freshets somewhat but would not be large enough to significantly reduce major flood peaks. Should irrigation demands increase a reservoir here would be able to provide irrigation water for about 350 acres.

The reservoir site is growing only wet scrub at present. The region around this reservoir was recommended in the Forestry Report as suitable for reforestation. If purchased by the Authority, the area above the maximum reservoir level could be reforested first. The irrigation demand could then be re-assessed before reforesting the pondable land. The reservoir, if constructed, would be an asset for fire protection of adjacent forest.

(e) Mountsberg

By building a dam 10 feet above the stream bed and 310 feet long at this site a reservoir of about 1,380 acre feet capacity could be established. The maximum reservoir elevation is governed by the C.P.R. embankment which skirts the south edge of the reservoir site.

The existence of limestone bedrock about 2 feet below the surface at this site favours a gravity type concrete dam which could be so constructed as to permit water to be spilled along the whole length of the dam. This arrangement would obviate the need for extensive spillway gates. Such a concrete dam could be constructed to provide a maximum storage pool level of 974.5 feet (G.S.C. datum) for a cost of about $37,000. In flood time the reservoir could be raised to a level of 975.5 feet. The reservoir area has been estimated, from the 975-foot contour on the national topographic series maps, to be 345 acres. This area should be confirmed by locating the 975 contour on the ground before a dam is constructed. Again much of the reservoir would be shallower than 5 feet and marshy vegetation could be expected along the shorline in the upper reaches of the reservoir. The northerly half of the site is at present growing wet scrub with some sizeable timber. The zone around this site was also recommended in the Forestry Report as suitable for reforestation. If acquired by the Authority for reforestation purposes the water requirements in the vicinity should be re-assessed before reforesting below the maximum reservoir level.

Access to this site is quite good and a reservoir here could be blended with a recreation development, as well as providing fire protection.

3. Summary

Significant acreages near Carlisle are already being irrigated. As the demand for further irrigation develops some upstream storage will be required to replenish the creeks. Of the sites investigated, Mountsberg is the most promising, though Strabane and Freelton could be used to advantage. It is recommended that the Authority acquire the lands for these three sites and allow for reservoir construction at a later date as the needs develop.

CHAPTER 5

COMMUNITY PONDS

1. Community Pond Criteria

The benefits derived from community ponds are becoming increasingly appreciated throughout Ontario, especially in heavily populated regions. Flooded gravel pits and quarries, old mill ponds and newly constructed ponds are attracting an increasing number of people each year. Many are also using the more attractive stretches of river as "swimming holes" and picnic spots. Since many existing community ponds are already overcrowded, it is suggested that the Authority prepare a program for community pond development.

Besides providing recreational facilities, the community pond, has a number of other advantages. Since these ponds are generally located close to a community they provide a certain degree of fire protection. Many small hamlets do not have an adequate water system to cope with a major fire, and the water from community ponds has been used for this purpose on quite a number of occasions in Southern Ontario. This protection does not only apply to buildings but also to valuable woodlots which might be located nearby.

Other advantages of these ponds are their water conservation features. When urban development supplants rural use of land, run-off rates during periods of precipitation or during the spring "break-up" are increased. The construction of extensive drainage systems and the surfacing of many acres of land with roadways and rooftops, reduces infiltration opportunity. Much of the run-off just goes to waste down the creeks and rivers, and it is therefore desirable to store excess run-off whenever possible. Community ponds, along with farm-ponds, large water-storage reservoirs and, of course, good agricultural practices, play a considerable part in this program to conserve a portion of the annual precipitation. Not only does this provide a supply of water

for a variety of later uses, but it also helps to ensure a more reliable stream flow during the dry months.

Suitable locations of community ponds are often within the flood plain. Community pond development without damagable property build-up is one of the desirable uses for flood plain land. Such use will help to reduce the hazardous encroachment of buildings on flood plains.

A further asset of the community pond is its ability to provide a habitat for various forms of wildlife. It can be stocked with fish and, providing conditions are favourable, wildfowl, muskrats and other forms of life can be encouraged to inhabit its waters. Besides these material benefits, community ponds have aesthetic value which cannot easily be measured in dollars and cents.

In view of these advantages as well as the need for new recreational areas it is recommended that the Authority proceed with a program for the acquisition of suitable community pond sites. This program should include the few remaining millponds in the watershed. At one time there were several millponds in the Twelve-Mile Creek. A changing economy, however, put the mills out of business and resulted in the dams being allowed to deteriorate and wash away.

Gravel pits and quarries also have a potential as community ponds. These enterprises eventually close down as the supply of suitable material runs out and the sites are abandoned. Many worked-out pits have filled with water from springs and are being used by picnickers and swimmers.

Other community ponds can be created by constructing a dam at a suitable location on a stream. This is best done by erecting a temporary dam which consists of a concrete sill laid across the stream bed and concrete buttresses set into the banks. Wooden flashboards supported by steel posts placed in sockets in the sill are put in after the spring freshets have

passed. Such a dam can create a good-sized pond if the site is carefully chosen. A community pond could be established by this method at site P2 shown on the watershed map at the end of this chapter.

Several factors should be considered when a community pond site is being selected. Easy access and good entrance roads are essential. The facilities should be able to accommodate adequately the expected size of crowd. Where one site is likely to become overcrowded as its popularity increases, the Authority should plan to expand its facilities or search for other suitable sites in the area. The water feeding the pond should be free from pollution, warm enough for comfortable swimming, and should have a reliable flow. Where the water is very cold in a pond created by a dam, the discharge should be from the bottom of the pond rather than from the surface. This removes the cold water and provides more comfortable swimming. The site should provide adequate parking facilities to prevent the blockage of the main roadways. There should be sufficient picnic areas and, where possible, an open area for ball-playing should be provided. Care should be taken to insure that adequate toilet and garbage collection facilities will be available. The construction of change rooms and refreshment booths is necessary at larger sites. The area should be free of hazards such as old wells, submerged tree stumps, dangerous ruins and other objects, which might endanger the lives of those using the area for swimming, boating, fishing, skating or other recreation. Finally, where a dam is to be constructed, the site should be chosen to provide as much pond surface area as possible, and a depth of water of at least five feet.

Other points could be raised, especially as each site is examined for its own merits. The factors outlined above, however, are considered to be basic for any site. Helpful information about stream conditions for community pond sites in addition to those outlined below can be found on the "Biological Conditions of Streams" map in the Wildlife Report.

2. Description of Recommended Community Pond Sites

The locations of the sites described below in relation to the watershed can be seen on the Watershed plan following this chapter.

Site E1

Located on the west side of the village of Morriston is a 10-acre lake which could be developed as a community pond by the Authority, as mentioned in Chapter 3 above. The lake already meets many of the criteria outlined above and in some respects it already serves as a community pond. It is used as a source of water for stock and fire protection. Amateur hockey players and skaters glide over the winter surface of the lake. Undoubtedly, the level of the lake has a bearing on the water levels of the local shallow wells.

The lake, which is illustrated overleaf, was sculptured by the glacier in the recent ice age. The glacier has also conveniently laid down sands and gravels on part of the shoreline, which could be used to establish a beach at one section of the lake where public entry could be provided.

The lake can also serve admirably to relieve the flood problems as outlined in Chapter 3 above, and it is recommended that the Authority proceed with developing this lake for community purposes in conjunction with flood control work for the village of Morriston.

Site P2

About 1 mile south-east of Freelton the Twelve-Mile Creek takes a slow meander to the west. A low flashboard type dam, as outlined above, could be constructed here to establish a community pond. While not as immediately promising as sites E1 and P3, this site fulfils many of the criteria described at the outset of this chapter. The access is good for local residents from highway and township roads and the village of Freelton is close by.

Mountsberg reservoir site from the west end of the damline. Aug. 8, 1960.

Carlisle community pond site viewed from the county road. Aug. 8. 1960.

Lake at Morriston from the southeast shore. July 7, 1958.

The water at this site is of good quality though cooler than at Carlisle or Lowville. Located in a flood plain zone hazardous to buildings, it is recommended that the Authority consider the establishment of a community pond at this site.

Site P3

The flood plain of the Twelve-Mile Creek is quite wide through the reach near the village of Carlisle. The most suitable, and recommended, location for a community pond in this reach is immediately east of the Carlisle-Waterdown Road. Local residents currently use the swimming hole scoured out by the creek downstream of the bridge.

A view of the creek at this swimming hole taken during the 1960 summer season is shown in the accompanying photograph.

A proposed plan for construction of a community pond at this site is presented on the following page. Since the creek has a mild gradient through this reach and the flood plain is very close to summer creek level a dam would not create a satisfactory pond here. It is proposed instead that the creek be enlarged by excavation. The first meander below the bridge could be cut off leaving an island in the middle which would provide extra shoreline and easy supervision of the swimming area. The excavation could be tapered out to form a wading area downstream of the meander. The excavation as outlined on the accompanying plan could be carried out for about $1,800.

The flood plain flats bounding the proposed pond are flooded over every spring and are not suitable for buildings. Gracious maples and elms shade the creek east of the county road and give a relaxing atmosphere to this site.

The pond diversions may be changed somewhat by scouring during flood flows but it is anticipated that maintenance would be no more expensive than for a pond formed by damming.

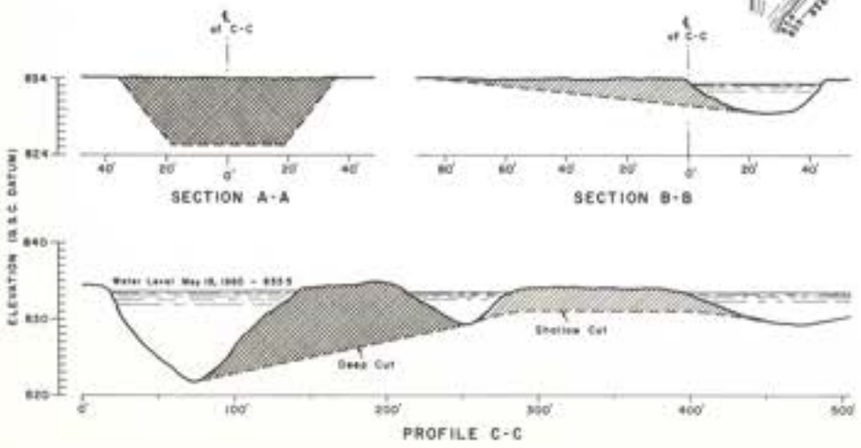
PLAN OF
CARLISLE COMMUNITY POND SITE
Lot 7, Con. VIII, Township of E. Flamborough
SHOWING SUGGESTED EXCAVATION

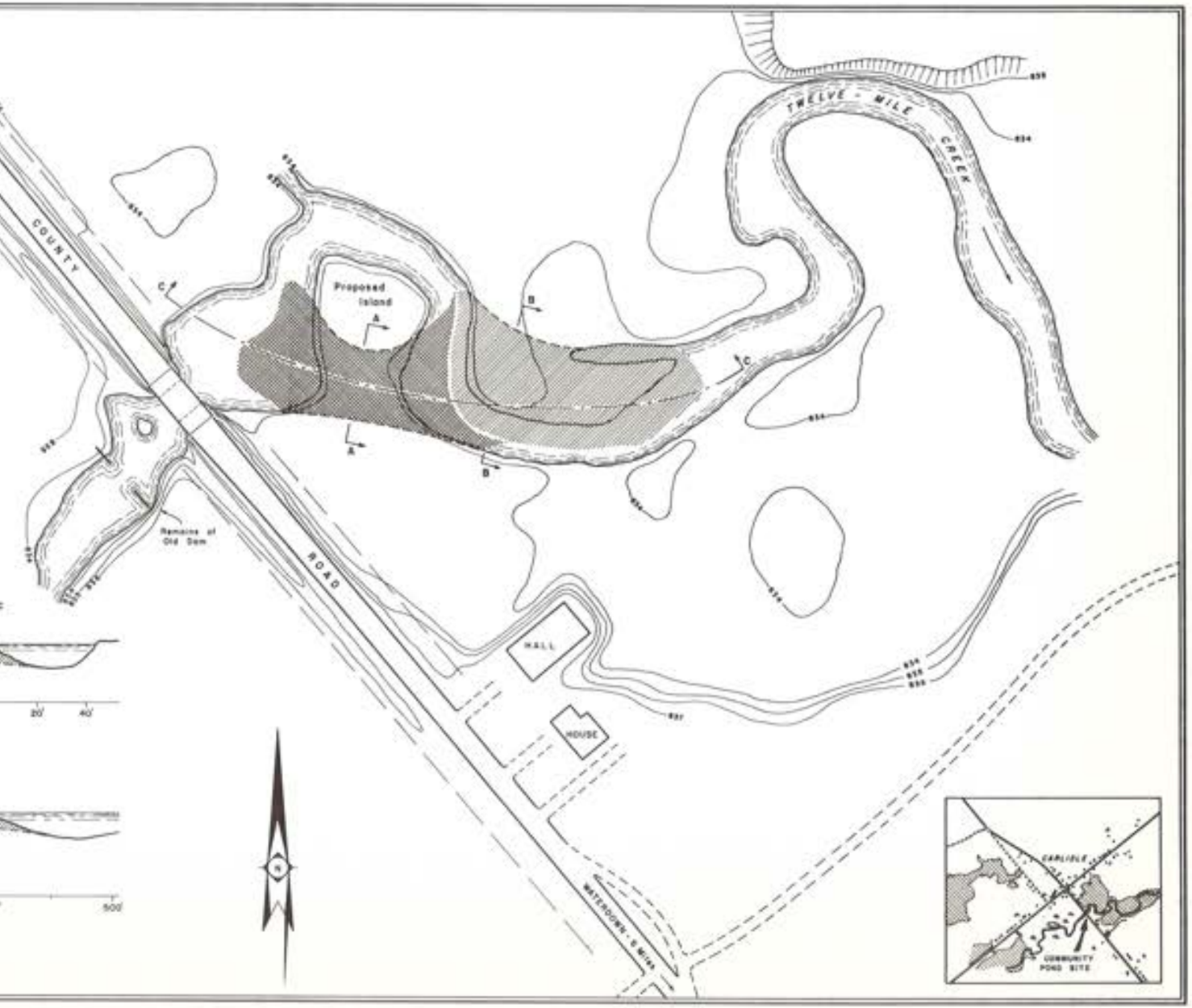
Deep excavation for enlarged pond

Shallow excavation for wading area

SCALE - FEET
0 25 50 100 150 200

ONTARIO DEPARTMENT OF PLANNING AND DEVELOPMENT
CONSERVATION BRANCH SEPT, 1960, W.G.M.





Site E4

In Lowville the Twelve-Mile Creek has been dammed to create a reservoir and head of water to operate the local mill. This mill pond is a long established feature of Lowville geography. The mill dam forms a barrier above which the devastating sea lamprey has not been able to penetrate. Many fishermen and sports enthusiasts appreciate that fact and frequent this reach of the creek.

Over the past century this pond has been partly filled with silt and some dredging may be necessary to make a good swimming area. Access to the pond is not as good as for the community ponds described above, but the water is warm and of good quality. It is recommended that the Authority take steps to preserve this pond.

PLAN OF

TWELVE MILE CREEK WATERSHED

SHOWING

RESERVOIR AND COMMUNITY POND SITES

LEGEND

- RESERVOIR SITES INVESTIGATED
- AREA SUBJECT TO FLOODING
- (E) EXISTING POND SITES
- (P) POSSIBLE POND SITES

SCALE MILES

1 ½ 0 1 2 3

O.F.& D. CONSERVATION DR. E.E.M. 1960

TWELVE MILE CREEK WATERSHED AREA	119·8 Sq. Mi.
AUTHORITY AREA	124·0 Sq. Mi.

DARBYVILLE
MOFFAT
C.P.R.
NASSAGAWEYA TP
PUSLINCH TP
CAMPBELLVILLE
MILTON
1967 401 UNDER CONSTRUCTION
E1
MORRISTON
TRIBUTARY "A"
MOUNTSBERG
C.P.R.
EAST FLAMBOROUGH TP
PUSLINCH TP
TRIBUTARY "C"
NASSAGAWEYA TP
TOWN OF BURLINGTON
CRAWFORD LAKE
TRAFALGAR TP
C.N.R.
ASH
FREELTON
TRIBUTARY "D"
TRIBUTARY "E"
E4
LOWVILLE
TRIBUTARY "B"
KILBRIDE
ZIMMERMAN
FREELTON
EAST FLAMBOROUGH TP
WEST FLAMBOROUGH TP
TOWN OF BURLINGTON
TRAFALGAR TP
BEVERLY
SWAMP
VIII STRABANE
P2
TWELVE TR
CARLISLE
P3
MILE
TWELVE MILE CREEK
C.N.R.
BRONTE
ONTARIO
LAKE

ABBREVIATIONS, EQUIVALENTS AND DEFINITIONS

Abbreviations

ac. ft.	is the abbreviation for acre foot which is the equivalent to 43,560 cubic feet and is the quantity of water required to cover one acre to a depth of one foot.
B.O.D.	is the abbreviation for Biochemical Oxygen Demand and is a measure of the oxygen that will be demanded by the material in the course of its complete oxidation biochemically. It is determined by the availability of the material as a bacterial food and by the amount of oxygen used by the bacteria during its oxidation.
c.s.m.	is the abbreviation for cubic feet per second per square mile and is the average number of cubic feet of water flowing per second from each square mile of drainage area.
c.f.s.	is the abbreviation for cubic feet per second and is the unit generally used to express discharge or the rate of flow.
G.S.C.	is the abbreviation for Geodetic Survey of Canada which refers to the official datum of elevations above mean sea level as established by the Geodetic Survey of Canada.
M.P.N. or m.p.n.	most probable number
ML or ml.	millilitre
P.P.B. or p.p.b.	parts per billion
P.P.M. or p.p.m.	parts per million
PH or ph	value measure of acidity or alkalinity

Equivalents

1 c.f.s.	= 6.25 imperial gallons per second
1 c.f.s. for 1 day	= 1.98347 acre feet or approximately 2 acre feet
1 c.f.s. for 1 year	= 724 acre feet
1 ac. ft.	= 271,472 Imperial gallons

1,000,000 Imperial gallons per day = 1.86 c.f.s.= 3.6836 ac.ft.

Definitions

AQUIFER is a water-bearing structure or formation

BASE FLOW is that portion of the stream flow which originates from the ground water storage.

BOOST STORAGE is the storage required to increase the head of water over the discharge tubes in order that they may be able to discharge the required flow.

CAREX - sedges - grass-like plants common to wetlands.

CHANNEL CAPACITY or "IN BANK" FLOW is the maximum flow which is contained within the river banks and does not overflow the adjacent low lands.

CHANNEL CAPACITY STORAGE is the volume of water that must be impounded in order that the stream flow will not exceed the channel capacity flow or stage.

DAM is a structure in and across a river valley to impound, control and otherwise regulate the river flow.

DEAD STORAGE is the amount of water kept in a reservoir at all times for the purpose of protecting the artificial and natural water seals at the base of the dam.

DISCHARGE TUBE OR CONDUIT is an opening through the base of the spillway to provide means for discharging water when the water level of the reservoir is below the spillway level.

DRUMLINS are oval shaped hills laid down by glaciers. They usually all point in the same direction.

FLOOD is an overflow or inundation coming from a river or other body of water.

FLOOD CONTROL is the prevention of flooding by controlling the high water stages by means of storage reservoirs, dikes, diversions or channel improvements such as widening, deepening and straightening.

FLOOD CONTROL STORAGE is the total volume of water that must be impounded during a given flood in order that the stream flow will not exceed the channel capacity flow or stage and is equal to the sum of the channel capacity, dead, boost and operational storages.

FLOOD CREST is the maximum height or stage that the flood waters reach during any one flood period.

FLOOD HYDROGRAPH is a hydrograph which covers only the flood period or time interval during which the river flow is above the flood stage.

FLOOD RATIO is the ratio of peak flow to the average flow for the flood period.

FLOOD STAGE is an arbitrary flow stage which varies from place to place and from season to season and is that flow or water level at which the water threatens to do damage.

FREEBOARD is the vertical distance between the maximum permissible water level and the top of the dam or dikes.

GROUND WATER is the portion of the subterranean water which occurs in the zone of saturation.

GROUND WATER STORAGE or RESERVOIR is a term used interchangeably with aquifer.

HORIZONS are the layers of soil i.e., topsoil, subsoil, etc.

HYDRAULICS as applied to conservation deals with the measurement and control of run-off from river drainage basins.

HYDROGRAPH is a plot of flow against time and is a correct expression of the detailed run-off of a stream resulting from all the varying physical conditions which have occurred on the drainage area above the gauging station previous to the time which it represents.

HYDROLOGY is the science which deals with the occurrence and distribution of water in its various forms over and within the earth's surface. As applied to conservation it deals more specifically with that portion of the hydrologic cycle from precipitation to re-evaporation or return of the water to the seas and embodies the meteorological phenomena which influence the behaviour of the waters during this phase of the cycle.

MORAINE is a ridge of sand or clay material deposited at the edge of, or between, lobes of a glacier.

OPERATIONAL STORAGE is additional storage that is required to provide a safety factor to enable the controller to regulate the discharge from a dam so as not to exceed the channel capacity flow or stage.

PHYSIOGRAPHY is the description of the surface features of a landscape.

RATE OF RUN-OFF is the rate at which water drains from an area. Usually expressed in cubic feet per second (c.f.s.).

RATE OF RUN-OFF PER SQUARE MILE is the average number of cubic feet per second of water flowing from each square mile of area drained (c.f.s./sq.mi. or c.s.m.).

RESERVOIR is the body of water created by the construction of a dam.

RESERVOIR CAPACITY is the maximum amount of water that may be contained within the reservoir without exceeding the maximum permissible water level. Usually expressed in acre feet.

RUN-OFF is the amount of water which reaches the open stream channels and may be broadly defined as the excess of precipitation over evaporation, transpiration and deep-seepage.

RUN-OFF DEPTH IN INCHES is the depth to which the area would be covered if all the water flowing from it were conserved and uniformly distributed over the surface.

SPILLWAY is that part of a dam over or through which the water is discharged.

SPILLWAY CAPACITY is the maximum amount of water that may be discharged over the spillway without exceeding the maximum permissible water level in the reservoir.

STREAM GAUGE is a measuring device used to determine the elevation of the water surface at selected points - usually a graduated rod fixed in an upright position and set to a known elevation from which the gauge readings are obtained by direct observation. An automatic type gauge is a mechanically operated recording instrument which gives a continuous record of water surface elevations.

SUMMER FLOW STORAGE is that volume of water remaining in a reservoir which may be used to augment the low flows and is equivalent to the maximum storage capacity of the reservoir less the dead storage, evaporation and ice losses and the space reserved for flash floods.

TILL is an heterogeneous mixture of clay, sand and stone material deposited by glaciers.

WATER or CLIMATIC YEAR is a 12-month period from October 1 to September 30. The water year was found to be a more convenient form than the calendar year for the purpose of stream flow studies as it groups together those months in which the water losses due to evaporation and vegetation demands are at a minimum (October - March) and those during which the losses are high (April - September).

WATER TABLE is the upper surface of the zone of saturation.

ZONE OF SATURATION is the portion of the earth which is saturated with water.

WILDLIFE

CHAPTER 1

INTRODUCTION

The wildlife of the Twelve-Mile Creek Watershed is a self-sustaining natural resource of considerable value to both residents and visitors. The watershed not only includes a part of the Niagara escarpment or cliff but also a large area of rough land with a high percentage of woodlands and a series of excellent springs above and below the escarpment, which provide water of good temperature for brook trout fishing.

The part of the watershed along the edge of the Niagara escarpment is extremely spectacular and lies almost midway between Toronto and Hamilton. The north-western part of the watershed is therefore visited by considerable numbers of people, including hunters looking for upland game, fishermen seeking fish, and a growing army of naturalists interested in the opportunities to see and enjoy the fine views and the varied forms of animal and plant life.

The watershed also has considerable rich agricultural land and a very deeply carved river valley with wooded slopes stretching almost to Bronte.

In the north-western part of the watershed, with careful handling of the wildlife habitat and with good management of their numbers, it should be possible to manage wildlife populations with no adverse effect on most good land use practices. Here the best farm husbandry and the best methods of handling mixed woodlands go hand in hand with good conditions for most species of wildlife. The porcupine, the white-tailed deer, the beaver and the meadow mouse (with occasional aid from other mice) seem to be the only species which come into serious conflict with man's interests.

On the exceptionally rich lands of the Peel Plain it is more difficult to justify the production of wildlife other than those insects needed for pollination and some birds which

eat weed seeds or destructive insects. In such areas those who wish to have wildlife on their land have usually to sacrifice some of the land's produce or productivity.

Planning for wildlife in Ontario is already the full-time occupation of an entire division of the provincial Department of Lands and Forests. The District Biologist at Hespeler and a group of Conservation Officers strategically placed through the country provide advice to the average citizen. The present report, based on a short-term examination, deals only with the conditions of the streams for fish, the birds and mammals that may be found in the watershed, and the general problem of improving farms for wildlife, for those persons who happen to be interested in doing so.

CHAPTER 2

FORMER AND PRESENT SPECIES

At least seven species of mammals which probably were found in the Twelve-Mile Creek Watershed at the time of settlement no longer occur in it. These are the marten, fisher, wolverine, timber wolf, Canada lynx, wapiti or American elk, and the cougar. The cougar was formerly called the catamount. Those who doubt that the cougar ever was present in this general region would do well to ponder the following by-law which was passed by the council of the Township of Nassagaweya about 1870. The by-law reads as follows: "Any party claiming bounty for killing a bear, catamount, lynx or wildcat is required to produce witness that such an animal was killed within the township." It is most unlikely that such a by-law would have been passed if the cougar was unknown in this general region.

The bobcat or bay lynx may still occur rarely in the northern forested part of the watershed. Among the birds which were permanent residents at the time of settlement the wild turkey may have been found in the watershed. Its former range in Ontario extended north and east to Lake Simcoe. The bobwhite was listed by Brooks in 1906 as "occasional only". The passenger pigeon, whose vast flocks surprised the early settlers, is extinct. The Twelve-Mile Creek Watershed lay almost in the centre of the Ontario nesting area. The numbers of these birds are considered to have fluctuated widely, but it is well known that they were present in very large numbers in the adjoining Sixteen-Mile Creek Watershed about 1860. Passenger pigeons used to gather at a salt lick in Bridgeman's Bush near Zimmerman in the watershed. The last large flights in Halton County are reported to have been in 1869 to 1870. The numbers of passenger pigeons then declined rapidly. It is now generally considered that the final decline was caused as much by the reduction of the natural habitat and food (the hardwood forest beech mast which the pigeons needed) as by the intensive shooting and trapping.

The high, wooded bluffs in the northern sections and the sides of the deeply-carved valley lower down the river provide cover and food for many species. The shoreline of Lake Ontario attracts many waterfowl and shorebirds and is also on the migration route of many species of hawks.

1. Present Mammals

The following list includes those mammals which have been recently collected or observed in or near the watershed and other species which, from their general range, are considered to be certainly present. The arrangement and terminology of the list follow those of "A Provisional Check-List of the Mammals of Ontario"*. The survey is indebted to Dr. R. L. Peterson, Curator of Mammals, Royal Ontario Museum, for assistance in the preparation of this list.

MAMMALS OF THE WATERSHED

	COMMON NAME	SCIENTIFIC NAME	REMARKS
	Cinereous Shrew	Sorex cinereus	Trapped 1958
Y	Smoky Shrew	Sorex fumeus	At Rattlesnake Point
Y	Water Shrew	Sorex palustris	At Freelton
	Pigmy Shrew	Microsorex hoyi	
Y	Mole Shrew	Blarina brevicauda	Common 1958
Y	Hairy-tailed Mole	Parascalops breweri	From Norval
X	Star-nosed Mole	Condylura cristata	
	Little Brown Bat	Myotis lucifugus	Common
	Long-eared Brown Bat	Myotis keenii	
Y	Least Brown Bat	Myotis subulatus	From Terra Cotta
Y	Silver-haired Bat	Lasionycteris noctivagans	From Port Nelson
X	Pipistrelle	Pipistrellus subflavus	
X	Big Brown Bat	Eptesicus fuscus	Common
X	Red Bat	Lasiurus borealis	
Y	Hoary Bat	Lasiurus cinereus	From Brindale
X	European Hare	Lepus europaeus	Common 1958
	Varying Hare	Lepus americanus	
Y	Cottontail	Sylvilagus floridanus	Common 1958
X	Black or Gray Squirrel	Sciurus carolinensis	Abundant 1958
X	Red Squirrel	Tamiasciurus hudsonicus	Common 1958
X	Woodchuck or Groundhog	Marmota monax	Common 1958
	Eastern Chipmunk	Tamias striatus	Common 1958
	Eastern Flying Squirrel	Glaucomys volans	

* Downing, S.C., "A Provisional Check-List of the Mammals of Ontario", Royal Ontario Museum 1948.

Mammals of the Watershed (continued)

	COMMON NAME	SCIENTIFIC NAME	REMARKS
X	Northern Flying Squirrel	Glaucomys sabrinus	
	Beaver	Castor canadensis	
	Deer Mouse	Peromyscus manicul-atus	Common 1958
X	White-footed Mouse	Peromyscus leucopus	Common 1958
X	Bog Lemming	Synaptomys cooperi	
	Muskrat	Ondatra zibethica	Common 1958
X	Meadow Mouse	Microtus pennsyl-vanicus	Very common at times
X	House Rat	Rattus norvegicus	
	House Mouse	Mus musculus	
X	Meadow Jumping Mouse	Zapus hudsonius	
Y	Woodland Jumping Mouse	Napaeozapus insignis	At Freelton
	Porcupine	Erethizon dorsatum	Several seen in 1958
	Brush Wolf	Canis latrans	
	Red Fox	Vulpes fulva	Several seen in 1958
	Raccoon	Procyon lotor	Common in 1958
	Ermine	Mustela erminea	
	Long-tailed Weasel	Mustela frenata	
	Mink	Mustela vison	
	Skunk	Mephitis mephitis	Very common
	White-tailed Deer	Odocoileus virgin-ianus	Several seen in 1958

X Specimens from the watershed are in the collections of the Department of Mammalogy, Division of Zoology & Palaeontology, Royal Ontario Museum, Toronto.

Y Museum specimens from nearby (cited) areas are in the above museum's collections.

2. Birds

At least 220 species of birds either breed in, migrate through, or visit the watershed. Almost without exception these would be the same species which have already been listed in published reports concerning adjacent or nearby watersheds. It is therefore considered that a more useful list would include only those species which are known to spend the summer in the watershed, to visit it in winter, or to be permanent residents. All birds which merely pass over the area in migration are therefore excluded from the following list, which is based on records made by Dr. George Peck, of Oakville and Hubert Moore, formerly of Nassagaweya Township, with assistance from James L. Baillie, Curatorial Assistant, Department of Birds, Life Sciences Division, Royal Ontario Museum.

The arrangement and names are from the American Ornithologists Union Check-List (5th edition, 1957).

A guide to the list follows:

PR = Permanent Resident
SR = Summer Resident
WV = Winter Resident or Winter Visitor
* = Breeding records available

SUMMER AND WINTER BIRDS OF THE WATERSHED

WV Horned Grebe
* Pied-billed Grebe
SR Great Blue Heron
* Green Heron
* Least Bittern
* American Bittern
* Mallard
* Black Duck
Green-winged Teal
* Wood Duck
WV Canvasback
WV Greater Scaup
WV Barrow's Goldeneye
WV Common Goldeneye
WV Bufflehead
WV Oldsquaw
WV King Eider
WV White-winged Scoter
WV Common Scoter
WV Common Merganser
WV Red-breasted Merganser
* Turkey Vulture
Goshawk
* Sharp-shinned Hawk
* Cooper's Hawk
*PR Red-tailed Hawk
Red-shouldered Hawk
Broad-winged Hawk
Rough-legged Hawk
Marsh Hawk
*PR Sparrow Hawk
*PR Ruffed Grouse
*PR Ring-necked Pheasant
SR Virginia Rail
* Common Gallinule
* Killdeer
American Woodcock
* Spotted Sandpiper
WV Glaucous Gull
WV Iceland Gull
WV Great Black-backed Gull
WV Herring Gull
WV Ring-billed Gull
* Black Tern
* Rock Dove
* Mourning Dove
Yellow-billed Cuckoo
* Black-billed Cuckoo
* Screech Owl
* Great Horned Owl
WV Saw-whet Owl
Whip-poor-will
* Common Nighthawk
* Chimney Swift
* Ruby-throated Hummingbird
* Belted Kingfisher
* Yellow-shafted Flicker
*PR Pileated Woodpecker
* Red-headed Woodpecker
* Yellow-bellied Sapsucker
* Hairy Woodpecker
* Downy Woodpecker
WV Black-backed Three-toed Woodpecker
* Eastern Kingbird
* Great Crested Flycatcher
* Eastern Phoebe
Traill's Flycatcher
* Eastern Wood Pewee
*WV Horned Lark
* Tree Swallow
* Bank Swallow
* Rough-winged Swallow
* Barn Swallow
* Cliff Swallow
* Purple Martin
*PR Blue Jay
*WV Common Crow
*PR Black-capped Chickadee
PR White-breasted Nuthatch
*PR Red-breasted Nuthatch
Brown Creeper
* House Wren
*PR Winter Wren
* Long-billed Marsh Wren
* Catbird
* Brown Thrasher
*WV Robin
* Wood Thrush
WV Hermit Thrush
* Veery
* Eastern Bluebird
WV Golden-crowned Kinglet
* Cedar Waxwing
WV Northern Shrike
Loggerhead Shrike
*PR Starling
Yellow-throated Vireo
* Red-eyed Vireo
Warbling Vireo
* Black-and-white Warbler
* Golden-winged Warbler
* Blue-winged Warbler
Nashville Warbler
* Yellow Warbler
WV Myrtle Warbler

Black-throated Green Warbler
* Cerulean Warbler
* Blackburnian Warbler
* Chestnut-sided Warbler
* Pine Warbler
* Ovenbird
* Northern Waterthrush
Mourning Warbler
* Yellowthroat
Yellow-breasted Chat
Hooded Warbler
* Canada Warbler
* American Redstart
* House Sparrow
Bobolink
* Eastern Meadowlark
Yellow-headed Blackbird
* Redwinged Blackbird
* Baltimore Oriole
* Common Grackle
* Brown-headed Cowbird
Scarlet Tanager
*PR Cardinal
Rose-breasted Grosbeak
* Indigo Bunting
WV Evening Grosbeak
WV Purple Finch
WV Pine Grosbeak
WV Hoary Redpoll
WV Common Redpoll
WV Pine Siskin
* American Goldfinch
WV Red Crossbill
WV White-winged Crossbill
* Rufous-sided Towhee
* Savannah Sparrow
Grasshopper Sparrow
* Henslow's Sparrow
* Vesper Sparrow
*PR Slate-colored Junco
WV Tree Sparrow
* Chipping Sparrow
Clay-colored Sparrow
* Field Sparrow
White-throated Sparrow
Swamp Sparrow
* Song Sparrow
WV Snow Bunting

3. Amphibians and Reptiles

The watershed probably contains at least 24 species of amphibians and reptiles. Many people have an unreasoning fear of frogs, toads and salamanders, although they are harmless and useful to the gardener and farmer. Of the salamanders, the mud-puppy appears revolting to most people, but remains near the bottom of rivers and is seldom seen. The adults of the other salamanders are occasionally encountered under logs and detritus in forested land.

The Eastern garter snake is probably the commonest snake. The northern water snake is found only around ponds or near streams. The watershed is not within the known range of any venomous snake. It is extremely unlikely that any rattlesnake remains in the area.

The following list includes all those species known to occur in the nearby Credit Watershed. Most of the species have already been reported from the Twelve-Mile Creek area also. The writer is indebted to E. B. S. Logier, Associate Curator of Ichthyology and Herpetology, Division of Zoology, Royal Ontario Museum, for the list.

Salamanders

Mudpuppy	Necturus maculosus maculosus Rafinesque
Jefferson's sala mander	Ambystoma jeffersonianum Green
Spotted salamander	Ambystoma maculatum Shaw
Newt	Diemictylus viridescens viridescens Rafinesque
Red-backed salamander	Plethodon cinereus cinereus Green

Frogs and Toads

American toad	Bufo terrestris americanus Holbrook
Spring peeper	Hyla crucifer crucifer Wied.
Tree toad	Hyla versicolor versicolor LeConte
Swamp tree frog	Pseudacris nigrita triseriata Wied.
Bullfrog	Rana catesbeiana Shaw
Green frog	Rana clamitans Latreille
Wood frog	Rana sylvatica LeConte
Leopard frog	Rana pipiens Schreber
Pickerel frog	Rana palustris LeConte

Turtles

Snapping turtle	Chelydra serpentina serpentina Linnaeus
*Wood turtle	Clemmys insculpta LeConte
Central painted turtle	Chrysemys picta marginata Agassiz

Snakes

Northern water snake	Natrix sipedon sipedon Linnaeus
De Kay's brown snake	Storeria dekayi dekayi Holbrook
Red-bellied snake	Storeria occipitomaculata occipitomaculata Storer
Eastern ribbon snake	Thamnophis suaritus suaritus Linnaeus
Eastern garter snake	Thamnophis sirtalis sirtalis Linnaeus
Eastern ring-necked snake	Diadophis punctatus edwardsi Merrem
Eastern smooth green snake	Opheodrys vernalis vernalis Harlan
Eastern milk snake	Lampropeltis doliata triangulum Lacépède

4. Status of Game and Fur Species

The status of the chief game species and fur bearers is as follows:

European Hare	Introduced, generally distributed and widely hunted.
Varying Hare	Probably found only in the upper part of the valley and in the woodlands above the escarpment.

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* Reported from near Bronte.

Cottontail	Common wherever brushy cover and scattered agricultural land are both found.
Beaver	Abundant in the past and referred to in the records of several surveyors. One or two pairs may have re-established themselves in the watershed.
Muskrat	A common inhabitant of most of the marshy areas.
Red Fox	This species has been very common in recent years.
Raccoon	Common and a nuisance to farmers and all others whose houses are near a water-course.
Mink	Tracks are commonly seen along the permanent streams
Skunk	Common throughout the watershed.
White-tailed Deer	A common species in the woodlands and along the main valley.
Ring-necked Pheasant	The good habitat for these birds lies close to Lake Ontario where the snow does not remain deep for more than a few days at most. However many pheasants have been planted in all of the townships in the watershed. It is probable that in winters of high snowfall no pheasants can survive in the northern part of the watershed without extra food supplied by man.
Hungarian Partridge	None were reported during the course of the survey, and it is presumed that none are in the watershed in the wild state. If it could be established, this species might do better than the pheasant.
Waterfowl	Although there are scattered records of Mallards, Black Ducks and Wood Ducks breeding in this watershed, the area does not provide any important large marshes, and there are relatively few small ones. Naturally a few of these ducks, along with several of the species listed as winter visitors - which actually are migratory species - can be shot in the watershed and along the shore of Lake Ontario. Waterfowl are not an important part of the fauna of this area.

CHAPTER 3

IMPROVING THE LAND FOR WILDLIFE

The many varied types of land in the Twelve-Mile Creek Watershed have already been mentioned. Water is one essential requirement for almost all species. This matter is discussed later in this chapter. The requirements of food and cover vary greatly for different species of wildlife. The recommendations listed here are therefore those which can be most generally applied by the landowner. It may be assumed that few farmers who work the exceptionally rich and almost flat lands of the Peel Plain will wish to improve their land for wildlife. But even in this land where erosion is not a serious problem, there are, of course, drainage channels including the deeply carved valley of the lower section of Twelve-Mile Creek. Many farmers use, and others perhaps should use, windbreaks. These features tend to increase the potential of land for wildlife. The following remarks, therefore, apply to those whose lands include a part of the escarpment or the rough land along or above it, and to others who wish to improve the carrying capacity of the land for wildlife. There may be small areas of land in the southern part of the watershed which are lying idle, being held for possible future subdivision for residential or industrial use. This type of land with its weedy patches, is probably now providing good habitat for upland game such as pheasants. In winters of deep snow these will need additional food in order to survive.

1. Woodlands

More than 20 per cent of the land is now in woodlots, many of which are grazed. The elimination of grazing of these woodlots would be the most useful single measure in improving the wildlife environment. In plantations

up to about the tenth year from planting, the entire planted area is valuable for wildlife. But large blocks of coniferous trees will, at least after about the twelfth year from planting, have little or no undergrowth and will, apart from their edges or fire-breaks in them, be comparatively sterile as far as upland game and most forms of wildlife are concerned. The chief improvements to be expected will therefore come from good management of the farm woodlot. Selective cutting, at least in mixedwoods, is both sound forestry practice and good planning for wildlife. Landowners who have woodlots in which the crown canopy has closed over considerable areas, and who wish to produce a proper environment for wildlife, will find that release cuttings, slashings to stimulate sprout growth, thinnings and felling timber for sale will improve rather than retard the carrying capacity for wildlife. Construction of brush piles from cuttings is recommended where cottontail rabbits are desired, two or three such brush piles per acre being the normal spacing.

2. Cultivation Practices

All good farming practices which make a more luxuriant vegetation will improve the farm environment for wildlife. A few special practices will give more specific benefits. Strip-cropping is of particular value, since by this means no extensive area is denuded of cover at one time by harvesting. In the less flat parts of the agricultural section of the watershed grassed waterways, intended for erosion control, will provide travel lanes and nesting cover for wildlife. Cover crops such as the clovers and hairy vetch provide a habitat and food for wildlife in areas that would otherwise be barren during the winter months.

The elimination of brushy fencerows is now becoming more common in the Twelve-Mile Creek Watershed. Those who are interested in wildlife improvement will find that the inclusion of a few field boundary hedges on the farm will reduce

the effect of winds on crops, serve as travel lanes and cover for wildlife and harbour large numbers of songbirds which may help to control insect pests. Inevitably the presence of boundary hedges on a farm tends to encourage the growth of weeds. This is the price that must be paid for improved wildlife conditions.

The following are a few species of plants which are of particular value as food or cover for wildlife. Those marked with a star can usually be found growing on some part of every farm.

Multiflora Rose -
This plant is an excellent hedge-forming shrub. It has a tendency, in Southern Ontario, to die back in winter but rapidly forms a dense hedge, which is reported to be proof against cattle and hogs. It provides both cover and food and does not exhaust the nearby cultivated ground. However, in view of the questionable hardiness of some varieties the stock used should be known to be hardy in Southern Ontario.

* Wild Grape -
This plant provides excellent wildlife food and cover, but it forms such a dense tangle over fences and young trees that it should only be planted where it can be carefully watched and controlled.

Hairy Vetch -
This plant can be grown on poor, sandy soil, and overwinters well. Cottontails and the European hare use it for food and cover. The seeds are eaten by a great many of the ground-feeding birds.

European Millet -
This plant fruits profusely and the seed attracts vast numbers of birds. It is grown commercially for bird seed.

* Elderberry -
A great many species of birds feed on the small black juicy berries, and there are not often many of the fruits left in winter. However, the birds, once attracted will return to feed on other fruits.

Corn -
A few rows of uncut corn standing in a field or garden will provide excellent cover and a continual supply of food for the larger birds, including the Ring-necked Pheasant and the Hungarian Partridge. Cracked corn is useful for smaller birds. Corn left near streams will almost certainly be removed and eaten by raccoons. At present there are no Hungarian Partridges reported in the watershed, although they thrive both east and west of it in various parts of Ontario. The Authority might urge an experimental introduction of the species, when the present population in other areas of the Province reaches a high level.

Buckwheat -
This common crop plant is chiefly grown for its abundant seed which is mixed in with other seeds in feed mixtures. The seeds have a high fat content, while the rest of the plant is commonly ploughed under particularly to increase the soil nitrogen.

Much of the seed drops off into the stubble, and buckwheat stubble is a favoured feeding ground for the Hungarian Partridge and many other birds.

Highbush Cranberry
This shrub is strongly recommended, and grows as a native species in this area.

There are many other plants which could be recommended for use as cover, food or nesting sites in gardens. The best general reference book on this subject, for birds of this area, is "Planting Your Garden for Wild Birds" by James R. MacKintosh, published by the Audubon Society of Canada, 181 Jarvis Street, Toronto, Ontario.

3. Field Corners

Field Corners are frequently barren of crops, and the ground cannot be ploughed to the corner. Therefore a fence crossing which embraces the corners of four fields may be made into a haven for ground-nesting species by planting a few trees and shrubs and protecting them. It is important to rid such areas of useless weeds by crowding them out with the normal climax type of open vegetation, such as Bleugrass, (Poa pratensis L.).

4. Ponds and Streams

The importance of water to wildlife is often forgotten. Many farms have at least one low spot where a small amount of work with a scoop will create a dam and a pond to provide nesting and feeding sites for water and marsh birds. If possible, ponds for wildlife should be separate from those intended for cattle or for fish. Willow cuttings, preferably shrub species rather than tree species, can be pushed in the ground around such a hollow, and will rapidly provide wildlife cover. New water areas are usually very rapidly invaded by aquatic plants, but additional species may have to be introduced.

No extensive duck food studies have been made in Southern Ontario. Wild rice may be introduced, but since

it is not well adapted to wide variations in water levels during its growing season, being often sterile in fluctuating waters, it cannot be considered as certain to succeed. The seed must be kept wet from the time it is harvested until it is sown (or broadcast) on the water surface. The idea has long been current, and fostered by many sportsmen's organizations, that the growing of wild rice is the answer to the problem of how to attract ducks to any area. Wild rice is actually of little significance to ducks in Canada except in the fall, and does not provide good cover or nesting sites.

The following species, which may be easily obtained, are recommended as certain to be valuable duck foods. If none of them occur in ponds or shallows with good cover for ducks, they can be introduced. All of them are hardy in Southern Ontario.

Sago Pondweed	Potamogeton pectinatus L.
Red-Head Pondweed	Potamogeton Richardsonii (Ar. Benn.) Rydb.
Wild Millet	Echinochloa crusgalli (L) Beauv.
Japanese Millet	Echinochloa frumentacea (Roxb) Link
Wild Celery	Vallisneria americana Michx.
Knotweed	Polygonum pensylvanicum L.
Water-Smartweed	Polygonum coccineum Muhl.
Three-square	Scirpus americanus Pers.
Great Bulrush	Scirpus validus Vahl., var. creber Fern
Duckweed	Spirodela sp. and Lemma sp.

Those who are interested in farm ponds for wildlife will find very useful details of the various types of pond and methods for constructing each type in a booklet, "Farm Ponds", which is available from the Provincial Department of Agriculture.* Farm ponds differ from those intended for wildlife in that care is usually taken to prevent the growth of aquatic vegetation in a farm pond intended only for watering stock or fire protection purposes. Otherwise, the

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* Applications may be made to the nearest Provincial Agricultural Representative or to the Department of Agriculture, Parliament Buildings, Toronto.

construction and details of ponds for wildlife should follow one of the types there described.

Algae in ponds are often only present for a short time and will disappear in a month or so. A concentration of 0.5 p.p.m. of copper sulphate will destroy them temporarily at least. The larger aquatic vegetation, if too abundant, cannot be removed except by cutting(a heavy chain is useful), by draining the pond or by the use of 2,4-D for emergent vegetation or poisonous compounds such as sodium arsenite for submerged plants. These compounds will of course kill fish also, and the use of this method requires permission from the provincial Department of Lands and Forests and the Water Resources Commission of Ontario if the treated water flows into any other privately owned or public waters.

CHAPTER 4

FISH

The purpose of this survey was to classify the waters of the Twelve-Mile Creek and its tributaries, and to make recommendations for their improvement.

1. Methods

The procedure here adopted followed closely that used in other surveys made by the Department of Planning and Development in other river systems. The various streams were visited at 54 different stations, varying from half a mile to three miles on each stream course. At every station the topography, erosion, vegetation, volume of flow, turbidity, temperature and bottom type were listed. At most of the stations collections of fish were made. At all suitable stations collections of the aquatic insects and other invertebrates were made. The collections were later examined and classified and were used in zoning the various sections of the river, as shown on the accompanying map.

Certain insects are particularly useful for this purpose since they are reliable indicators of what the stream conditions will be at the critical time of year for fish survival. Some species are confined to waters which remain cold and usually clear in summer, such as brook trout waters. Other species are indicators of permanent flow or of polluted water or of high maximum summer temperatures of the water. The fish collections and the records of maximum-minimum and continuous recording thermometers substantiated these findings at their particular stations.

Since the procedure here used follows that of previous river surveys it allows close comparisons of the characteristics of many rivers. The present methods were developed from more intensive research carried out by

Dr. F. P. Ide*, University of Toronto, and others, on many streams in Ontario.

Four maximum-minimum thermometers were installed in branches of Twelve-Mile Creek for six weeks in 1958. A continuous recording thermometer was also placed in the main stream at Lowville.

2. Permanence of Flow and Temperature Conditions

Almost all of the branches of Twelve-Mile Creek that have permanent flow are fed from the lands above the escarpment or from springs along the base of the cliffs. The permanence of flow of the river and its tributaries is shown on the accompanying map "Biological Conditions of Streams". The permanence was based partly on local reports, but chiefly on the presence or absence of certain insect larvae which are not found except where there is permanent flow. The genus used was Hydropsyche, one of the Caddisflies. The conditions shown are applicable in any year of relatively normal precipitation and temperature. Very exceptional weather conditions would of course change the stream condition. The damming of any stream to form a reservoir for these purposes would of course also alter the temperature of the outgoing water unless the effluent was taken from the bottom of the ponded area.

The summer temperature conditions affecting the distribution of fish are also shown on the accompanying map. Adult brook trout should thrive best in the lower parts of the sections coloured blue. The greatest daily fluctuations in

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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, 1935.

Sprules, W. M. An Ecological Investigation of Stream Insects in Algonquin Park, Ontario. University of Toronto Studies 56, Ontario Fisheries Research Laboratory. 1947.

TWELVE MILE CREEK WATERSHED

DEPARTMENT OF PLANNING & DEVELOPMENT SURVEY 1958

SHOWING

BIOLOGICAL CONDITIONS OF STREAMS

(COMMON SUMMER CONDITIONS)

— LEGEND —

- PERMANENT FLOW COLD — Temperatures not above 75° F favourable for brook trout
- PERMANENT FLOW WITH INTERMEDIATE TEMPERATURES — Brook trout water in spring, but summer temperatures often unfavourable
- PERMANENT FLOW WARM — Suitable for centrarchids, such as rock bass and associated species
- DRIES TO STANDING POOLS (in most summers)
- DRIES COMPLETELY (in most summers)
- STREAM COURSES NOT EXAMINED
- MM MAXIMUM - MINIMUM THERMOMETERS
- R CONTINUOUS RECORDING THERMOMETER

LOCATIONS OF FOUR FISH SPECIES COLLECTED 1958

- BROWN TROUT
- BROOK TROUT
- ROCK BASS
- SMALLMOUTH BASS

SCALE : MILES

½ 0 1 2 3 4 5

DEPARTMENT OF PLANNING & DEVELOPMENT — CONSERVATION BRANCH — 1958 C.D.V.

W. FLAMBOROUGH

E. FLAMBOROUGH

PUSLINCH

NASSAGAWEYA

TOWN of BURLINGTON

TRAFALGAR

MORRISTON

FREELTON

MOFFAT

DARBYVILLE

KILBRIDE

ZIMMERMAN

BRONTE

LAKE ONTARIO

HWY No. 97

HWY No. 6

HWY No. 401

HWY No. 2

C.P.R.

C.N.R.

Escarpment

Q.E. WAY

Near the mouth of Bronte Creek there is good smallmouth bass water and an excellent marsh for wildfowl.

Twelve-Mile Creek one mile east of Kilbride. The rocks would provide good cover if the stream could be deepened at least six inches.

temperature are found in the sections coloured green. Brook trout may inhabit some of the green sections, particularly the upper parts, in early summer or in the fall or winter, but in the lower green sections will move out or be killed in the warm days of warm summers. Brown trout appear to adapt themselves better to the higher temperatures in these sections, i.e., they thrive in slightly warmer water than the optimum water for brook trout, but both species are subject to approximately the same lethal or killing temperature (depending on the temperature range to which they have recently been acclimatized).

The only change which is likely to affect the general conditions shown on the map is the removal of large quantities of water from any stream course for irrigation or industrial use. Irrigation is already carried on extensively from Twelve-Mile Creek east and west of Carlisle.

3. Fish Distribution

The following 27 species of fish were found in the rivers and streams of the watershed during the survey of 1958.

LIST OF FISHES OF THE TWELVE-MILE CREEK WATERSHED
(From the 1958 collections)

Family and Species	No. of Stations at which the species was collected in 1958
Petromyzonidae - lampreys	
* Sea lamprey	2
Salmonidae - salmons and trouts	
* Brown trout	3
* Brook trout	16
Umbridae - mudminnows	
Central mudminnow	7

Family and Species	No. of Stations at which the species was collected in 1958
Catostomidae - suckers	
Hog sucker	16
* White sucker	17
Cyprinidae - minnows	
* Creek chub	30
Northern pearl dace	17
Redside dace	17
Northern redbelly dace	17
Finescale dace	1
River chub	6
Blacknose dace	34
Longnose dace	3
Rosyface shiner	5
Common shiner	18
Brassy minnow	3
Bluntnose minnow	14
Fathead minnow	7
Ameiuridae - catfishes	
* Brown bullhead	1
Anguillidae - freshwater eels	
* American eel	1
Centrarchidae - sunfishes	
* Smallmouth bass	2
* Rock bass	6
Percidae - perches	
Johnny darter	9
Rainbow darter	10
Fantail darter	6
Gasterosteidae - sticklebacks	
Brook stickleback	24

* Species which may be familiar to the angler are starred.

The order and names in this list follow the common names of "A Checklist of the Freshwater Fishes of Canada and Alaska" by W. B. Scott, Curator of Fishes, Department of Life Sciences, Royal Ontario Museum, Toronto.

Bank erosion on Twelve-Mile Creek half a mile west of Zimmerman. In as steep a location as this it can best be controlled by the planting of willow, poplar and locust trees. The poplars and locusts should be planted on the sites with the best drainage.

The mill-dam at Lowville which marks the lower limit of the best trout water. In the gravel below this dam sea lampreys spawn. They were not observed above the dam, which appears to block their progress.

The records of fish in a river system depend of course not only on the numbers actually present, but also on the method and skill of capture. Several species are also likely to be missing from a list because of the season during which the survey was made. For example, the smelt and the alewife could certainly be found in the river near its mouth in season. The northern pike and the carp are two other species which are probably present but were not found during this survey.

The mill dam at Lowville appears to be a key spot on the main stream. Above this dam brook trout were found at many stations. Below this dam none were found, although a few may pass over the dam or through the turbine at times and there are reports of catches of individual brown trout below the dam. There have been extensive introductions of brown trout above the dam and these seem to be well established from Carlisle to Lowville.

Lowville is also the uppermost location on the river at which rock bass were found. It is also the lowest place on the main stream at which the redside dace (a common minnow of the upper waters) was found, and it is the highest place which can be reached by the sea lamprey. In a very rapid examination of this area 5 adult sea lampreys (two males and three females) were caught. Spawning beds of the lamprey could be seen a few yards below the dam, and there were many spawning beds within two hundred yards. There were occasional sites which looked like spawning beds in the neighbourhood of Zimmerman and also near No. 5 Highway and the crossing of the Queen Elizabeth Way, but no lampreys were found at these locations. At Bronte about 20 spawning beds were found and three sea lampreys were destroyed. Twelve-Mile Creek below Lowville is obviously an important stream for lampreys. There are also many suitable sites for the development of young (larval) lampreys.

Smallmouth bass are probably common in the river below Lowville although only two were collected.

There are of course a few species of fish which are exceptionally tolerant of different conditions and which are found almost throughout the watershed. The more important of these are the creek chub, the white sucker, the hog sucker and the common shiner. The other species named on the fish list are chiefly small "minnows", darters and other fish of little interest to the angler except as forage fish.

4. Pollution

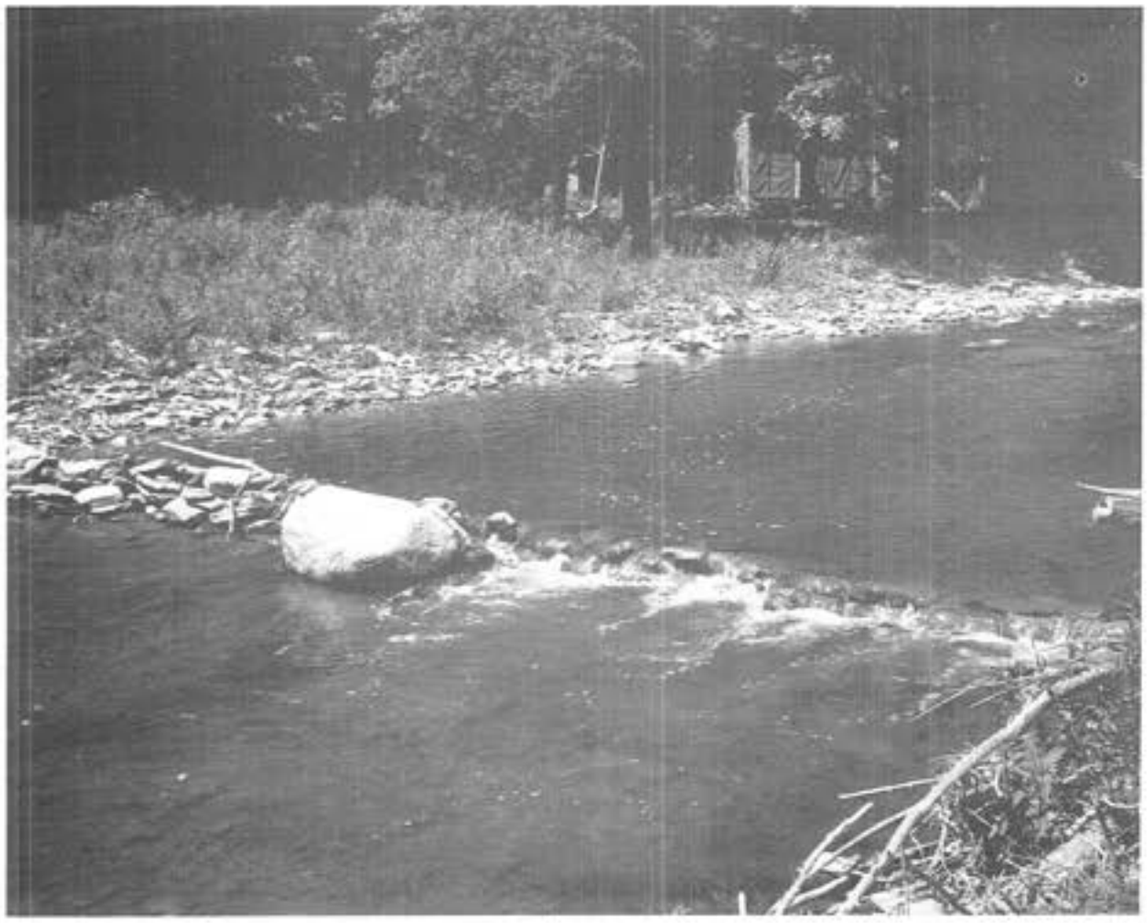
As there are few towns and villages lying along the course of Twelve-Mile Creek and its tributaries, especially in their upper reaches, there is virtually no pollution of the creek affecting fish life except that caused by cattle. Pollution by cattle is not usually a serious problem concerning fish life unless there is a large herd of cattle using a stream which has little or no flow. Where a farmer fences a stream from cattle or allows a fishing club to do so, restricting the watering place to a particular spot where, by placing stones or other material in the stream, cattle do not silt the stream, he could be and should be recompensed by fishermen for his time and material and for the loss of pasture involved. There are several places in Ontario where such an arrangement is made, and a great many in the States of Michigan and New York. If a Conservation Authority wishes to make a demonstration of stream improvement for the conservation of the natural resource of clean and productive water, the same practices should be carried out.

5. Stream Improvement

There are possible locations for stream improvements at or near the following locations:

(a) The first major tributary of Twelve-Mile Creek at the crossing half a mile north-west of Carlisle, at Lot 8, Concession IX, East Flamborough Township.

(b) The main stream of Twelve-Mile Creek a quarter mile west of Carlisle, at Lot 9, Concession VIII, East Flamborough Township.



Most streams have been so changed by the running of logs down them that they no longer have much cover for fish. An attempt has been made at this point, one mile north-west of Bronte, to improve Twelve-Mile Creek. The depth has been increased and the falling water increases its oxygen content. However this improvement would be washed out by high water.

Here at Cedar Springs the temperature of the water is excellent for trout, but there is a shortage of deep pools. Log or stone deflectors would much improve the stream for trout.

(c) The main stream between Carlisle and Flamborough, at Lot 5, Concession VIII, East Flamborough Township.

(d) The main stream from the above point to Cedar Springs, Lot 7, Concession I, Town of Burlington.

(e) The tributary south-west of Rattlesnake Point, at Lots 10 and 11, Concession IV, of the Town of Burlington.

There are no doubt many additional suitable locations for stream improvements between the actual stations visited.

Almost all of the water of Twelve-Mile Creek is shallow and there is relatively little first-class fish habitat. This should include alternating stretches of rapids and deep pools with scattered aquatic vegetation, and logs and boulders supplying suitable cover and abundant insects for food. Gravel beds (preferably with spring water seeping up through them) provide spawning beds, but shifting sands are virtually sterile and provide little fish food. The coldest spring-fed streams are by no means ideal for brook or brown trout, which both thrive best in water with temperatures ranging from 55°-67°F.. Digger logs (well anchored in the banks), small dams and deflectors can all be made to produce deep water with occasional rapids.

Provincial Highway No. 401 (now under construction) crosses two branches of Twelve-Mile Creek, one permanently flowing tributary on the Puslinch-Nassagaweya Township boundary, the other the main stream of the creek, a trout stream, three miles south of Moffat. The Conservation Authority would therefore do well to see that no unnecessary amounts of silt, oil, or other pollutants are deposited in these streams and that the flow of the streams is not stopped for any purpose. This matter could be negotiated with the provincial Department of Highways.

If land which contains a permanently flowing stream is acquired by the Conservation Authority for reforestation or other conservation purposes, the Authority might make a demonstration of stream improvement by one or other of the devices previously mentioned.

6. Crawford Lake

The only lake in the watershed is Crawford Lake which lies on the high land near the edge of the escarpment in Concession IV of the town of Burlington. The surface area is approximately 5 acres. The water was examined both with conventional methods and with the aid of an aqua-lung. The lake is a deep pocket in the limestone, and the shores are chiefly limestone bedrock or talus with an almost continuous fringe of debris from trees including many large logs underwater.

In spite of its small area this lake is very deep, the depths increasing to more than 50 feet within 100 feet of the shore on both sides. On one side there is a level stretch of bottom from 50-60 feet down, but on the other side the bottom falls off rapidly to a depth of 70 feet and there is a large hole 80 feet wide which has depths greater than 70 feet. The maximum depth found was 78 feet.

The upper waters of the lake were extremely clear when examined, with secchi disc readings varying from 25 to 27 feet in the centre. The light intensity drops off rapidly at depths from 35 feet to 45 feet, and there is little visible light at a depth of 50 feet. A dipterous larva (Corethra sp.) was abundant at depths from 35 feet to 40 feet.

Water temperatures in this lake on June 12, 1958, were as follows:

Depth	Temperature F.
Surface	65°
10'	62°
20'	52°
30'	46°
50'	40°
60'	40°
70'	40°

The lake bottom is a layer, several feet thick, of black ooze, muck, and detritus.

As the lake is privately owned and managed no fish collections were made in it, but when it was visited several thousand smallmouth bass fry were being guarded by male bass on artificial spawning beds of gravel in boxes.

7. Farm Fish Ponds

There is ample room for improvement of this type of fishing. The chief research on management of farm fish ponds has been carried on in southern and warmer climates, and therefore the findings cannot be applied without qualification to an area having the climate of Southern Ontario, but some definite recommendations may be made. Suitable methods for the construction of six types of farm pond are given in a bulletin, "Farm Ponds", which may be obtained from the Ontario Department of Agriculture.

From the fisherman's point of view, farm ponds are of two main kinds:

(a) Trout Ponds

The first is the cool pond with continuous inflowing water and maximum temperatures at the surface of about 75°F. with cooler bottom. Ponds of this type are adapted to the production of speckled or brown trout. They are usually placed near the headwaters and may range in size from about an acre to 8 or 10 acres. Depth should be 10 feet or more in the deepest part. Spring flow of as low as half a cubic foot per second will maintain a pond of one acre.

The outlet of each dam should be a pipe (with a screened inlet at the bottom of the pond) rising close to the normal surface level and there passing through the dam, so that cold water is drained from the bottom and the warmed surface water is not allowed to flow over the dam. The surface water in the pond serves as an insulating layer, and the water below the pond has scarcely been heated by its passage through the pond. The pipe should be of such a size as to discharge the minimum summer flow. In time of flood the additional flow would pour over the dam at a suitable outlet, or be carried around it by a grassed spillway.

The by-pass type of pond has two particular advantages for the production of either speckled or brown trout. A pond of this class is built close to but not on a permanent stream and gets its name from the fact that the water supply is by-passed through a pipe from the stream to the pond. The first advantage is that there is no danger of the pond filling up with silt, because any excessive run-off goes down the permanent stream channel and not through the pond. The other advantage is that by controlling the amount of cold water entering the pond the temperature of the pond may be adjusted to give the maximum growth rate in the fish kept there.

However, trout ponds do not normally have spawning beds for trout and, therefore, must be managed on a put-and-take basis, i.e., stocked artificially.

(b) Warm-Water Ponds

The second and commoner type of farm pond is the warm-water pond. Most farms have at least one low spot suitable for a fish pond. It is frequently good practice to have separate ponds devoted to wildlife and fish and to control the aquatic plants in the 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) It is often necessary to control existing aquatic vegetation. There are both mechanical and chemical methods available.*

(4) 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 (Micropterus salmoides) and one of the forage fish species. The most suitable forage fish for farm ponds in the Twelve-Mile Creek Watershed would probably be the fathead minnow (Pimephales promelas).

If it is found necessary to control the numbers of young largemouth bass, a pure race of the bluegill might be used instead of the minnows, but these would probably have to be imported from the United States, as those found here commonly include hybrids with the pumpkinseed. Those importing fish should have the arrangement approved by the provincial Department of Lands and Forests.

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 fertilizing ponds should apply to the local District Biologist at Hespeler for advice.

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* Speirs, J. Murray. Summary of Literature on Aquatic Weed Control. Canadian Fish Culturist, 3:(4); August 1948. (Many other chemical compounds have been developed for this purpose since the publication of the above summary).

RECREATION

CHAPTER 1

INTRODUCTION

1. The Need and Urgency of Recreation Planning

There is perhaps no other part of Canada where the need for recreation facilities is as great as in Southern Ontario. This is because the population of this part of the country has grown extremely rapidly during the last fifty years and as a result of this increase alone, open and wild space adjacent to what were small towns half a century ago has now been appropriated by ever-expanding industries - roads and residences sprawling over the suburbs. These developments are an index of the economic potential as well as the prosperity of the people who work in or are attracted to these areas. However, paradoxically enough they also have consumed areas which would otherwise have been used for the recreation of the very population of the growing urban nodes. This could have been avoided if the small cities and towns had grown vertically as is the case in the old European and large American metropolitan centres. On the contrary the expansion in Ontario took place horizontally because increasing prosperity and lack of foresight on the part of planners permitted, nay even encouraged, the tendency for acquisition of single family surburban dwellings in preference to multiple dwellings within, or closer to, the heart of urban centres. We thus have the phenomenon of an artificial mirage wherein the young prosperous couples, able to, and desirous of, living away from the dirt and grime of the crowded city move to the countryside, only to find that the countryside has receded that much farther.

Even though this is a vicious, and perhaps unavoidable circle, the situation would not be as bad if the expansion had been planned. Unfortunately, the expansion occurred without any co-ordination or organization and was almost entirely exploited by individual land prospectors and sub-dividers who had neither the desire nor the ability to assess

the proper functional values of the land. Prosperous orchards and dairy farms, useless swamps, wooded or eroded hillsides and river-flats subject to flooding, all became sites for uniform-type houses which now dot the bulk of the suburban areas. Even areas primarily designated and suitable for recreation did not escape the land prospector's invasion, cases in point being Lake Simcoe and Wasaga Beach where cottage densities and beach crowding in the open season are perhaps even more severe than the homes and crowds within many towns and cities, thus defeating the very purpose and meaning of recreation.

All these ills are particularly pronounced in a five to fifteen-mile belt which skirts the western sections of Lake Ontario and which geographers and planners are already calling an embryo Megalopolis, or the great conurbation of the Mississaga. This region has three centres, Toronto, Hamilton and the Niagara Peninsula which still may "be regarded as individual nuclei but the indications are that in the near future they will grow together to form a conurbation and an industrial area of enormous size and complexity".* This present and future economic core which contains the lakeward sections of ten counties (Welland, Lincoln, Wentworth, Halton, Brant, Waterloo, Wellington, Peel, York and Ontario) is growing in population almost twice as rapidly as the average for the country as a whole. It contains about the highest birth-rate, proportionately the largest influx of immigrants, and the most pronounced degree of urbanization in the country.

2. Urban Expansion

Expansion of urban growth has been particularly rapid around three main centres, Metropolitan Toronto, the Hamilton-Burlington node, and the Niagara Peninsula. Between

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* Mississaga - Dr. D.F. Putnam, Head of the Dept. of Geography at University of Toronto. Community Planning Review, Volume IV-1954, p.94.

1951 and 1955, a peak period in urban expansion, the Metropolitan Toronto Region (including the counties of Halton, Ontario, Peel and York) increased in population from 1.4 million to 1.7 million and acquired nearly 70,000 new dwellings of which all but 6,000 were located in suburban areas. Similarly the Hamilton-Niagara Region inclusive of parts of Brant, Wentworth, Haldimand, Lincoln and Welland Counties increased in population from 575,677 to 681,643, adding 22,650 new homes of which 90 per cent were again in the suburbs.

At even the most modest estimates it seems that suburban development uses one acre of land for each 4.5 additional dwellers. Census statistics at the same time indicate that the population of the entire region in question has nearly trebled during the last 50 years and at the present time stands at about 2.5 million. If these rates continue it should reach the 5-million mark by about 1980, namely a gain of 2.5 million. In other words new homes required for this additional land would use up another 800,000 acres in the next thirty years.

It is obvious that this additional land must then be lost to what is now open space. Unfortunately this situation is fraught with the indispensable irony that the greater the loss of available open space, the greater the demand for more open space to satisfy the recreational needs of the additional urban populace. This dilemma can be resolved only by rational planning and prompt action.

It is the purpose of this report to recommend for immediate action areas which should be saved <u>from</u> indiscriminate urban expansion but saved <u>for</u> the needs of the same urban population settling elsewhere. This can be most appropriately done by Conservation Authorities who have both the power and the ability to institute and enlarge a province-wide recreation program which they spearheaded a few years ago. The Conservation Authorities Act, Section 15(gg) empowers them to use portions of their land for recreation purposes and the popularity of

Conservation Areas which various Authorities have already developed, is a clear proof of their ability to foresee and satisfy the recreational demands of the public. The crowds at Elora Gorge Park, the Fanshawe Dam and the Heart Lake are ideal examples of the success of such projects. For the Metropolitan Toronto and Region and Grand Valley Conservation Authorities the Conservation Areas have been so popular this summer that visitors have been turned away because of overcrowding.

This watershed lies in the middle of the great urban belt and therefore lends itself logically and naturally for the development of such Conservation Areas.

As proper decisions regarding future recreation areas cannot be made without an understanding of the recreational habits and recreational potential available in regard to these habits, a brief description under each of these headings is given here.

(a) Recreational Habits

Apart from formal games and sports which are restricted to people of certain age groups, the major recreation needs of the bulk of Ontario's population are, in large part, determined by what people can afford and what is most easily available. The rising standard of living, rapid increase in the number of automobiles and motorable roads, shorter working hours, more frequent long week-ends and the growing span of holidays, necessitate as well as facilitate the urbanite's one prime desire - "an escape from the city". Economic ability, and indeed even social pressure, further necessitate short or long-term release from the stale urban atmosphere of one's neighbourhood. The summer cottage has already become a well-established institution, but as mentioned earlier the crowding of cottages in resort areas is tending to decrease whatever charm the cottage might have had in the past. Furthermore, cottage space is available to only a small proportion of the urban population. The majority must still find other forms of

recreation. The most popular of these are swimming (an attraction particularly impelling in the short summer season peculiar to Canada), skiing - a sport which is rapidly gaining ground and which can be enjoyed over a longer period and to a smaller extent, driving, picnicking, fishing, over-night camping, hunting and hiking in more or less descending order of popularity.

Swimming, of course, requires good beaches, and water of reasonably mild temperatures, neither of which is available to any great extent on the shores of Lake Ontario. Smaller inland lakes farther north have become the major haunt of the swimmers. Skiing requires plenty of snow (which is available throughout Ontario), but also appropriate access and desirable slopes which are found mainly in the region of the Niagara escarpment. The major skiing areas of the province still happen to be in the northern sections of the escarpment close to Georgian Bay, but in view of the difficult winter driving necessitate more than a day's visit if the visit is not to be a tiring one. In other words, the development of ski areas on slopes closer to the great urban belt of Southern Ontario is both desirable and necessary. It is fortunate that the Niagara escarpment dips down almost into the urban belt thus enabling future development of ski slopes on a large scale.

Fishing is also a most popular sport. Open water fishing in Lake Ontario is restricted but river fishing is extremely popular with the urbanites. A day's outing with rod and tackle is itself enjoyable enough even if no catch is made at the end. There are many small and sizeable streams close to the urban region and they are always popular haunts of the amateur fisherman. So far there does not seem to be a concerted large-scale program for making more fish available, yet beginnings of such a program can be seen in the establishment of a fish hatchery on the Twelve-Mile Creek underneath the Queen Elizabeth Highway and the periodic stocking of the larger streams like the Etobicoke, Twelve-Mile and Spencer Creeks.

Southern Ontario's climate is such as to produce a varied and luxuriant natural vegetation. Considerable variations in altitude, slope and aspect accentuate the variety. Natural woods of coniferous and deciduous trees; the dark sombre green of cedars and pines stands in sharp contrast to the gold and amber of the maple and the striking white of the birch. Man himself has contributed greatly by providing and nurturing the multi-coloured spring bloom of the fruit trees which is surpassed only by the golden spectacle spread by nature in the autumn. All this is available in Southern Ontario. Thanks to the changing slopes of the escarpment and the sinuous secluded cuts across it, one is still able to enjoy the beauty of trees in all their glory. The narrow clefts and gorges made by sprightly streams such as the Bronte and Spencer Creeks, and the wide natural valleys such as the Dundas Valley, are a delight for the driver and hiker alike. It will be most tragic if such sites as these, few as they are, cannot be saved from the creeping avalanche of steel and concrete which comes in the wake of urban expansion.

(b) The Chief Factors of Recreational Potential

(1) Climate

Climate is a most important factor determining recreational potential, both because it influences the recreational needs and habits of a people as well as providing the framework for satisfying those needs. To take one example, winter sports like skating and skiing in Canada are almost foregone choices of a people living in an area of pronounced winters, which in turn provide ample opportunities for such sports. Summer, however brief, is also a season most eagerly awaited by these people who do their best to enjoy it while it lasts and in the manner facilitated by the climate. Abundant sunshine, sufficiently warm waters of lakes and rivers, considerable shady cover, all are directly or indirectly related to the summer climate when swimming, fishing, boating and hiking

become the most popular recreation.

The part of Ontario which we are studying in this report has about the most desirable climate in Canada from the viewpoints of both human activity and plant growth and of course year-round but highly varied recreation. An average winter in these parts lasts for about four months (December to February) but it is not overly severe - the average monthly temperature for even the most severe month seldom falling below 25°F. On the other hand snowfall is considerable - 50 to 60 inches per winter and more than 18 inches of skiable snow cover remains generally for over 10 weeks in areas of higher altitude such as the Niagara escarpment.

Similarly, the summers are quite warm with the July temperature averaging 70°F, bringing shade and water in much demand for the holidayer. Spring and autumn are particularly pleasant and even if sports like skiing or swimming are not possible during these periods, the scenic aspect is at its best during both.

(2) Physiography and Topography

Physiographic and topographic conditions often determine, to a large degree, the recreational potential of a given area. From the recreational viewpoint the area under study contains three prominent features. These are:-

a Lake Ontario

b The Niagara escarpment

c The area between the lake and the escarpment which may be called the Foreland

a Lake Ontario

The most obvious recreational feature in this part of Ontario is Lake Ontario itself but both by nature and human incursion its recreational capacity is rather limited. Apart from the short duration of the summer season the water temperatures on the lake even during the warmest month are low - seldom exceeding 65° or 70°F. The shoreline is frequently

polluted by outlets of residential and industrial sewage which render offshore swimming undesirable and even hazardous. Further, most of the beach and shoreline is already privately owned restricting public access to the lake. Cherry Beach in Toronto and very narrow strips of public beaches in satellite towns are the only recreational sites now available and they are over-crowded for the better part of the summer even though they are used mainly for "sunning" and picnicking. The only significant addition to public beach is the strip of land in the Sunnyside-Exhibition Park section of Toronto which is being developed as a ribbon park. A similar but smaller development is planned at the mouth of the Etobicoke Creek. The more appropriate and increasingly popular recreation on the lake is boating - a tendency demonstrated by the brisk business and rapid increase in the size and number of the yacht and boating clubs appearing in many parts of the shore between Toronto and Hamilton.

b The Niagara Escarpment

The Niagara escarpment is one of the most important features of the province both geologically and topographically. It is a sinuous imposing formation, mainly of dolomite limestone with the shallow slope merging into the inland surface and the steep slope facing the lake. In many places it is blanketed by undulating moraine and other glacial burden which introduces considerable topographic variety. In the main the escarpment varies in altitude from the base elevation of 300 to 350 feet, and the top elevation of 600 to 1,000 feet. Both structural and erosional breaks across the escarpment have produced distinct mesas or plateau-like blocks skirted often by attractive streams, such as Bronte Creek near Kilbride, and occasionally precipitous drops which offer magnificent vistas such as Mount Nemo and Rattlesnake Point, and picturesque water-falls such as Webster's Falls. In many places the favourable slopes of the escarpment with their fertile loam have lent themselves to fruit cultivation. Orchards of peaches, grapes

pears and apples clothe many wide stretches with their variegated blossoms during springtime and further enhance the beauteous nature of the escarpment. Even bare slopes, despite the naked appearance during summer, can be and most probably will be developed as ski-runs as the popularity of this sport grows.

In the main, however, the escarpment is still a wild area with agricultural prospects being rather limited. The only other important uses which would conflict with public recreation are the increasing demand on limestone, owing to its low silica content as chemical rock for blast furnaces, particularly of Hamilton. Large firms have located their quarries in areas where the dolomite is more or less in solid and large formations - in other words, the very areas which are most picturesque and most easily accessible. At a rough estimate based on one hour counts at the three quarries one concludes that the rock is being removed at the rate of 140 trucks per hour from the three quarries. A more modest but impressive way of saying it is that the rock face is being removed by more than 1,000 truck loads per day, 25,000 truck loads per month, or over 300,000 truck loads per year.

Besides limestone, the escarpment is rich in shale which is excellently suited for brick and tile-making. One of the oldest (75 years old) brick manufactories of the province affords a good example of the mass removal and large-scale gouging of the escarpment face. There are three other large companies with well-established businesses in bricks and tiles mining away the slope face in other parts of the escarpment.

Even more dangerous is the removal of sand, sandstone and gravel, which is to be found mainly in the old glacial valleys and spillways. In most cases this material is removed without re-correction of drainage and slope thus upsetting the natural balance of water flow and accentuating both sheet and gully erosion.

Almost all of these mining and quarrying operations result in removal of, or damage to, vegetation cover which increases erosion and seriously jeopardizes the scenic potential of the escarpment. There can, of course, be no objection to the removal of these economic materials which are indispensable for urban development, but certainly adequate protective measures must be adopted to stop indiscriminate destruction of the irreplacable scenic beauty of the escarpment. Few such measures exist at present. The best way would be to exclude appropriate areas whose scenic value has hitherto escaped the ravages and to specify other parts from which - but from nowhere else - quarrying should be allowed.

Even more insidious and less controllable is the tendency of expensive homes occupying aesthetically strategic sites on the escarpment slopes. Growth of fairly extensive residential subdivisions atop the crest and along the slopes of the escarpment in the suburbs of Hamilton, Webster's Falls, Burlington and Dundas are the examples of large-scale appropriation. Small-scale appropriation is however widespread and usually takes the form of expensive summer or all-year-round homes appearing on individual hilltops. The completion or near completion, of Highway 401 in the vicinity of the escarpment country (in Halton County) has enabled many a private owner to purchase home sites and build homes in what otherwise were beatiful villages recessed in the seclusion and surrounded by the wooded clefts and bewitching valleys within the meandering escarpment. Cedar Springs, Kilbride, Campbellville and Lowville have suddenly become preferred home sites for the workers in Malton and Hamilton as well as the well-to-do of the metropolitan belt as a whole. If steps are not taken promptly, there is every likelihood that the public in general will be excluded even from access to parts of the escarpment for "NO TRESPASS" signs are steadily increasing in number.

c The Foreland

Between the lake and the escarpment lie the terraced lower slopes and the shore areas which collectively may be called the Foreland. With minor exceptions this zone has been and is being occupied so rapidly and intensively by residential and industrial buildings that it has little recreational potential. Even steeper slopes, as between Waterdown and Burlington, have been almost completely subdivided into private properties. The valley mouths and lower reaches of streams (and the land adjoining them) as they traverse the foreland are not excluded from the invasion of residential and industrial development. This is understandable in the case of Spencer Creek which has been so completely hemmed in by the town of Dundas and reaches the lake via a rather unattractive swamp. There it was impossible to earmark areas for public recreation. Bronte, or Twelve Mile Creek, on the other hand had an incised, picturesque valley near its mouth and almost skirted the village of Bronte. This part of the creek could have been developed into a most appropriate public park but during the last five years the land on the east bank has become a hotbed of competition between subdividers, and the land on the west bank has been sold to an oil refinery. On the whole the Foreland area is becoming so completely urbanized that any attempt to provide recreational land here would be an extremely expensive undertaking.

3. The Importance of Location

It should be obvious from the foregoing remarks that there is both abundant need and considerable potential for recreation in the Mississaga Region. The most positive conclusion is that there is hardly another place in Ontario where such suitable features as the escarpment, the lake and the streams lie in such close proximity to each other and to the great urban population. This watershed occupies an almost central location between two great population nodes, the Toronto region and the Hamilton region.

4. A Departure from the Conventional Method

The recommendations in this report are the combined result of air-photo interpretation, map and municipal data study, three and a half months of field observation, and many interviews and discussions with appropriate persons. Consideration of the locational and recreational aspects of our watersheds, and of the slow but definite change in the recreational tendencies of the urban population involved, must be simultaneously kept in view when determining the type of recommendations. For instance this watershed, owing to its location in the midst of a rapid urban growth and owing to the absence of any large expanse of warm water suitable for swimming, affords neither the relief from urban environment nor the facilities which attract summer cottages and cabins. The few summer cottage sites already in the area are completely occupied and many cottages have been converted into permanent residences. Similarly, the cabins have lost their recreational value and are already serving as commercial accommodation. Besides these, such items as wayside tables, rest areas, etc., which also formed part of recommendations in previous recreation studies of other Conservation Authorities are also and perhaps more appropriately managed by the Department of Highways. Similarly, no attempt is made or advantage lost by excluding exhaustive consideration of existing recreational facilities. There are only a few of these to begin with, and reference is best made to them in the context of the proposals. For all these reasons the report in hand excludes consideration of the above-mentioned features and concentrates principally on proposals for "Conservation Areas". This departure from convention is both rational and appropriate.

CHAPTER 2

LOCATION SIZE AND DESCRIPTION

Twelve-Mile Creek and its watershed lie almost half-way between Toronto and Hamilton and are accessible from each of these urban centres by a number of highways and motorable roads, the more noteworthy of which are No. 5, No. 6, No. 25, the Queen Elizabeth Highway and the proposed Highway 401. As the name of the creek indicates, it has a small watershed of 124 square miles. The bulk of the watershed, namely, two of the eastern tributaries and part of the middle reaches, lie within the limits of the expanded town of Burlington. The main or eastern stream begins just south of Darbyville in Nassagaweya Township, cuts across the south-east corner of Puslinch and flows through East Flamborough Township before turning due east through the town of Burlington and the township of Trafalgar to Bronte. The westerly tributary flows parallel to and about a mile west of the main stream.

In its upper and middle reaches the stream and its branches flow through the escarpment country, sometimes incising across the escarpment via picturesque gorges, sometimes weaving past them and skirting the edges of escarpment blocks. Almost all the drainage is accumulated before the stream leaves the escarpment zone to enter the foreland which is much wider here than it is farther west.

The most interesting and picturesque part of the creek lies in the region of Campbellville, Kilbride and Lowville, where the upper streams are deeply incised into notches within the escarpment.

The entire watershed is largely rural. The largest settlement is Bronte at the mouth of the creek, which has a population of 2,100. Other hamlets are Morriston, Freelton, Kilbride, Lowville and Zimmerman, with even smaller populations. Most of these settlements have or will soon have, easy access to the 401 Highway, and are capitalizing on the

advantage by offering scenic home sites to urbanites of both the Toronto and Hamilton Regions with the result that their population can be expected to increase rapidly.

The proximity of the new highway to the escarpment is also likely to encourage the expansion of quarrying and brick building industries which could then reach the markets with greater ease.

Thus although the recreation demands of the local population itself may be unimportant, the hazard of arbitrary appropriation of land for commercial and residential purposes, and the recreation facilities which this watershed can offer to the metropolitan populations adjacent to it, points to the urgency of reserving appropriate parts as Conservation Areas to be developed into recreation areas as and when necessary.

Existing Recreation Areas

The present recreational use of the Twelve-Mile Creek is rather limited - limited to a small but perhaps the most picturesque section of the creek. This is the region in and around Cedar Springs where the major stream has eroded its way through what is most probably a structural notch between two escarpment blocks. Almost in the middle of the notch the stream is met at right angles by two youthful tributaries, one from the north flowing past Kilbride, and another following the same orientation but from the opposite direction which most likely taps Lake Medad and the ribbon swamp extending northward from it.

1. Cedar Springs

Each of the three streams flows through well wooded strips, is fed intermittently by springs and surface moisture and has clear water. Valley banks in each case are quite steep and the drop is most pronounced at the tri-junction in the vicinity of Cedar Springs where it varies between 125 and 150 feet. The valley of the combined streams is quite wide, in

some places more than 200 yards. It is in this widest part that a group of prosperous businessmen from Toronto and Hamilton established a resort for their mutual benefit about 40 years ago. The resort consists of all sorts of recreational facilities, the most important of which are summer cottages, golf, swimming, fishing, skiing and skating.

There are 81 summer cottages all built with cedar logs procured mainly from the local trees and each with a solid and distinctive design and facade. The cottages lie in two tiers, those which lie in the valley on either side of the streams and those which lie up on the terraces of the valley, about 35 to 40 feet higher than the valley cottages. Each cottage has ample open space and treed area and by mutual agreement the owner is not permitted to remove or cut the trees. All of them are supplied with electricity, interior heating and indoor plumbing. According to mutually agreed specifications each cottage should have comfortable accommodation for at least six persons. The number of guests and sub-letting to non-owners are kept at a minimum and for short periods only. From the very beginning the convention of keeping the establishments clean has been rigorously observed. In many respects the Cedar Springs may be considered as a model cottage area.

Apart from the cottages, the group as a whole has established many corporate recreation amenities. There is first of all, at the very entrance of the property, a community building which contains a store for sundry provisions, a soft drink bar, a community hall used for meetings, dances, indoor sports and group banquets. A swimming area has also been provided by damming the creek with wooden blocks thus enabling the waters to spread and be contained in a wider area upstream from the dam. There is a maximum swimming depth of 6½ feet close to the dam but for the better part the water is only 3 or 4 feet deep and if stirred up for more than a couple of hours

at a stretch tends to become turbid. Generally the pool is used for wading.

Part of a terrace on the west bank of the creek has been developed into a nine-hole golf course which is for the exclusive use of the members and their guests (if accompanied by the member). Similarly part of the valley flats contain half a dozen tennis and badminton courts which, like the golf course, are kept fairly busy during the season.

For the most part the stream provides meagre fishing, perhaps mainly because there are too few fish and too many fisherman. Stocking is done almost each year but the supplies are fished out within the initial part of the open season. Although hunting seems to be very popular, especially with the boys of 'teenage', there do not appear to be either birds or animals in sufficient quantities to assure a satisfactory bag.

The owners are members of an association which does not plan to expand its membership. Even transfer or sale of properties by members has to be approved by the association executive, approval being given only after careful scrutiny of the qualifications and credentials of the prospective buyer. For all purposes this development is closed to the public.

2. The Cedar Springs Ski Club

More recently a Hamilton group has started a ski development on the escarpment slope just outside and across the road from the Cedar Springs cottages. At the present time there is one fully operating ski-lift and one temporary make-shift arrangement but the place has become popular so quickly that early expansion of facilities is a certainty. During the last two seasons the number of skiers has averaged over 5,000, a small portion of whom are steady week to week visitors. Unlike the Cedar Springs cottages, the ski development is a commercial enterprise and open to the public in general. Two-thirds of the visitors were reported to be from the Hamilton-Burlington area, the balance being from the Toronto region.

Some skating is also done mainly in the frozen-over swimming pond within the Cedar Springs area.

3. Mount Nemo Scout Camp

The only other significant recreation development in the watershed is the Mount Nemo Scout Camp which lies east of and across the road from Mount Nemo. The camp was started about 15 years ago by the Hamilton group and is now a part of the Province wide scout camp system. For the better part, the land occupies the terrace and western slopes of the Bronte Creek which is now an almost full-fledged stream. The bulk of the land is wooded though not densely. The camp is reportedly quite popular in summer and is used even during the winter months for occasional rallies and group meets. A few buildings and considerable space for tents are available even for extended membership. Recreation in the camp consists of the usual scout activities.

4. Other Areas

No other areas in the watershed have been developed for recreation although some land is being secured by private individuals and groups for future use, similarly the municipalities involved have zoned parts of the valley for recreation, but no measures have been taken to develop recreational facilities. Reference to both such areas i.e., under private ownership and municipal jurisdiction is made subsequently in connection with the proposed Conservation Areas.

CHAPTER 3

PROPOSED CONSERVATION AREAS

1. Rattlesnake Point Conservation Area

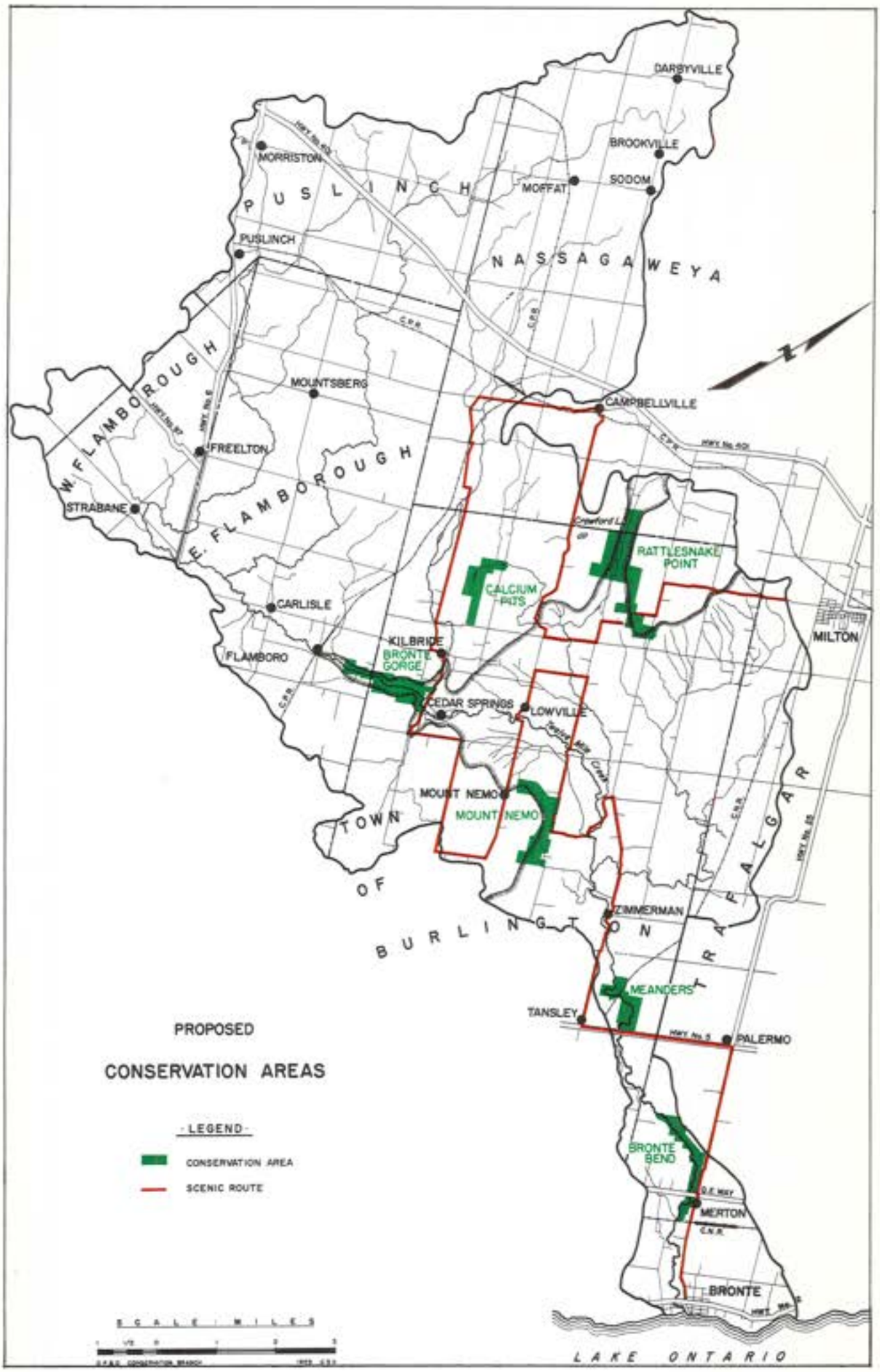
The proposed Area occupies about 240 acres in Lots 1 and 2, Concessions IV and V of Nassagaweya and Lots 11 to 15, Concessions IV and V of Burlington. It combines the two main recreational features of the watershed, i.e., the most impressive sections of the escarpment and one of the most attractive sections of the Bronte river system.

(a) The Mesas

The upper or northern section of the area contains two mesas separated from each other by a narrow trench. The drop towards the trench is both imposing and steep varying in depth between 100 and 250 feet, and exposing massive but cracked limestone blocks on both the western and eastern sides. The latter is the more spectacular and better known. This is Rattlesnake Point which is easily accessible by a motorable road and a well-worn trail from the town of Milton. The brow of the Point unfolds an unbroken vista of neatly carved, gently rolling agricultural land intersected frequently by old hamlets and new homes adjusting themselves to the grid pattern of the roads. An added attraction is the view of the glow and glitter of Metropolitan Toronto's skyline on many a clear evening. The lip and the face of the escarpment here contain many solution hollows, lateral cracks and coves which even now provide considerable enjoyment to exploring teen-agers and which can be developed commercially for the benefit of the tourists.

The land behind the escarpment face is well wooded with scrub and a mixture of hardwoods which have of late replaced what might have been a magnificent pine forest. Evidence of pines can still be seen in the decaying stumps and limbs which lie hidden under the new growth.

The western face of the escarpment stretches over a longer distance, exposing nearly two miles of bare limestone


DARBYVILLE
BROOKVILLE
MORRISTON
MOFFAT
SODOM
PUSLINCH
NASSAGAWEYA
PUSLINCH
C.P.R.
C.P.R.
MOUNTSBERG
CAMPBELLVILLE
W. FLAMBOROUGH
E. FLAMBOROUGH
FREELTON
STRABANE
HWY. No. 401
CALCIUM PITS
RATTLESNAKE POINT
CARLISLE
MILTON
KILBRIDE
BRONTE GORGE
FLAMBORO
C.P.R.
CEDAR SPRINGS
LOWVILLE
MOUNT NEMO
MOUNT NEMO
TOWN OF BURLINGTON
ZIMMERMAN
TRAFALGAR
C.N.R.
HWY. No. 25
MEANDERS
TANSLEY
HWY. No. 5
PALERMO
BRONTE BEND
QE. WAY
MERTON
C.N.R.
BRONTE
HWY. No. 2
LAKE ONTARIO
PROPOSED
CONSERVATION AREAS
- LEGEND -
CONSERVATION AREA
SCENIC ROUTE
SCALE - MILES

but the rise, only about 75 feet, is less imposing. The vegetation atop the escarpment is denser and the surface is rendered quite undulating by the morainic deposits. One of the few glacial lakes of the watershed lies within a mile of the escarpment brow. This is Crawford Lake which by virtue of its seclusion, scenery and water, could have made an excellent resort but is privately owned.

(b) The Canyon

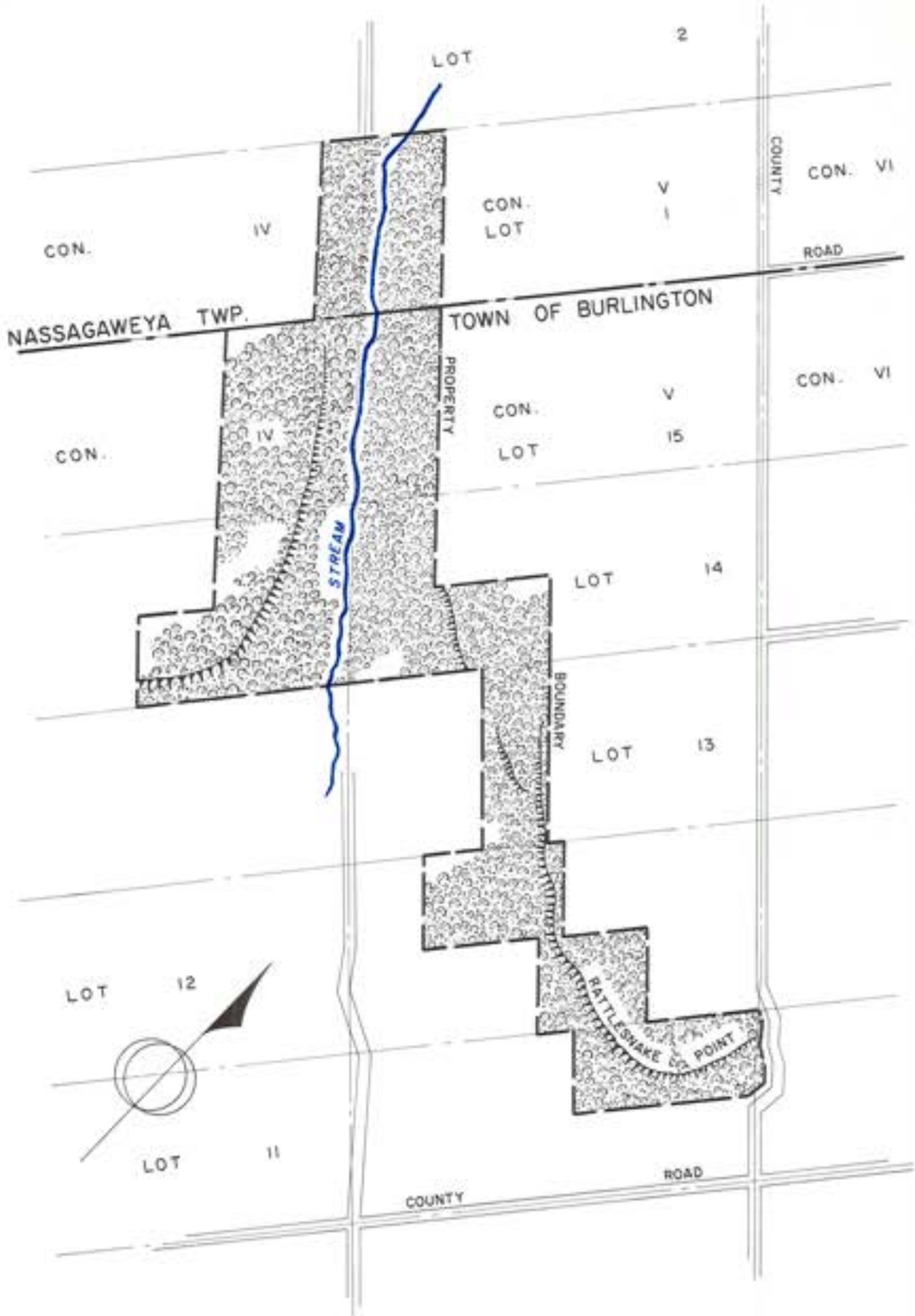
The trench between the two valleys is a pre-glacial valley now occupied by a chain of rills and springs that mark the birth of an eastern tributary of Twelve-Mile Creek. The stream itself occupies a narrow central strip of the valley. The ribbon valley flats on either side of the stream receiving the waters off the steep slopes have developed swampy vegetation which includes many unusual ferns and considerable strips of elm and cedar. Some varieties of ferns are either little known or almost extinct, making this section extremely interesting to the amateur as well as the professional botanist.

The dark hue of the vegetation in the valley is accentuated by the darkness induced by the steep face of bare, but frequently discoloured and graying limestone which forms its precipitous walls. The entire atmosphere of this part is that of a small canyon which produces an illusion of seclusion and remoteness although it lies so close to the population sprawl of Southern Ontario.

(c) Wildlife

Seclusion appears to have preserved considerable wildlife in the area. Rabbit, squirrel, skunk and muskrat are plentiful and deer are quite common. Pheasant and partridge are also found, and there are some birds and insects not generally found elsewhere in Ontario.

Water is neither abundant nor warm enough for any large growth of fish but a proper re-organization of drainage into channels and pools, and rational introduction especially of trout could improve the situation in this regard.



PROPOSED

RATTLESNAKE POINT CONSERVATION AREA

—LEGEND—

ESCARPMENT

WOODLAND

SCALE 1320 660 0 1320 2640 3960 FEET

D.P.B.D. CONSERVATION BRANCH B.A.E.

1959

Similarly there is no suitable place available for swimming but provision can be made for swimming areas. This may be achieved by damming the creek just before it comes out of the trench i.e., by creating a headstream reservoir which by virtue of its locale and nature will contain cool, clear water. The bottom now covered with rather swampy vegetation will have to be cleaned before the dam is constructed. At a rough estimate a dam 150 yards long and jutting 8 feet above the surface of the stream, with lateral protective abutments extending for 50 yards upstream on each side would provide a swimming area of about fifty to sixty acres in size with summer water depth between 4 and 8 feet. The spring waters having been strained through swamp are reasonably clean although it may be found necessary subsequently to eliminate insects.

In resumé, the area is excellently suited for all sorts of outdoor recreation. Geology, vegetation and wildlife should be of considerable value and interest to amateur and the scientist alike. Few areas offer such magnificient nature trails and pleasure hikes as this part of the Twelve-Mile Creek which is so beautifully recessed in the only really wild area of the escarpment which has so far escaped invasion by the urbanite. The potential is there, it only remains to be improved to make it more accessible to the public.

At the moment a road track traverses the valley which is motorable only up to the edges of the proposed area but fortunately is not motorable within the valley itself. This could serve as the main trail - the spine from which other trails will branch out into the escarpment.

Steps should also be taken to preserve and improve the wildlife by prohibiting hunting within the area. There are few things more pleasing to the hiker and particularly the younger hiker, than the sight of wild animals at close quarters.

(d) Access

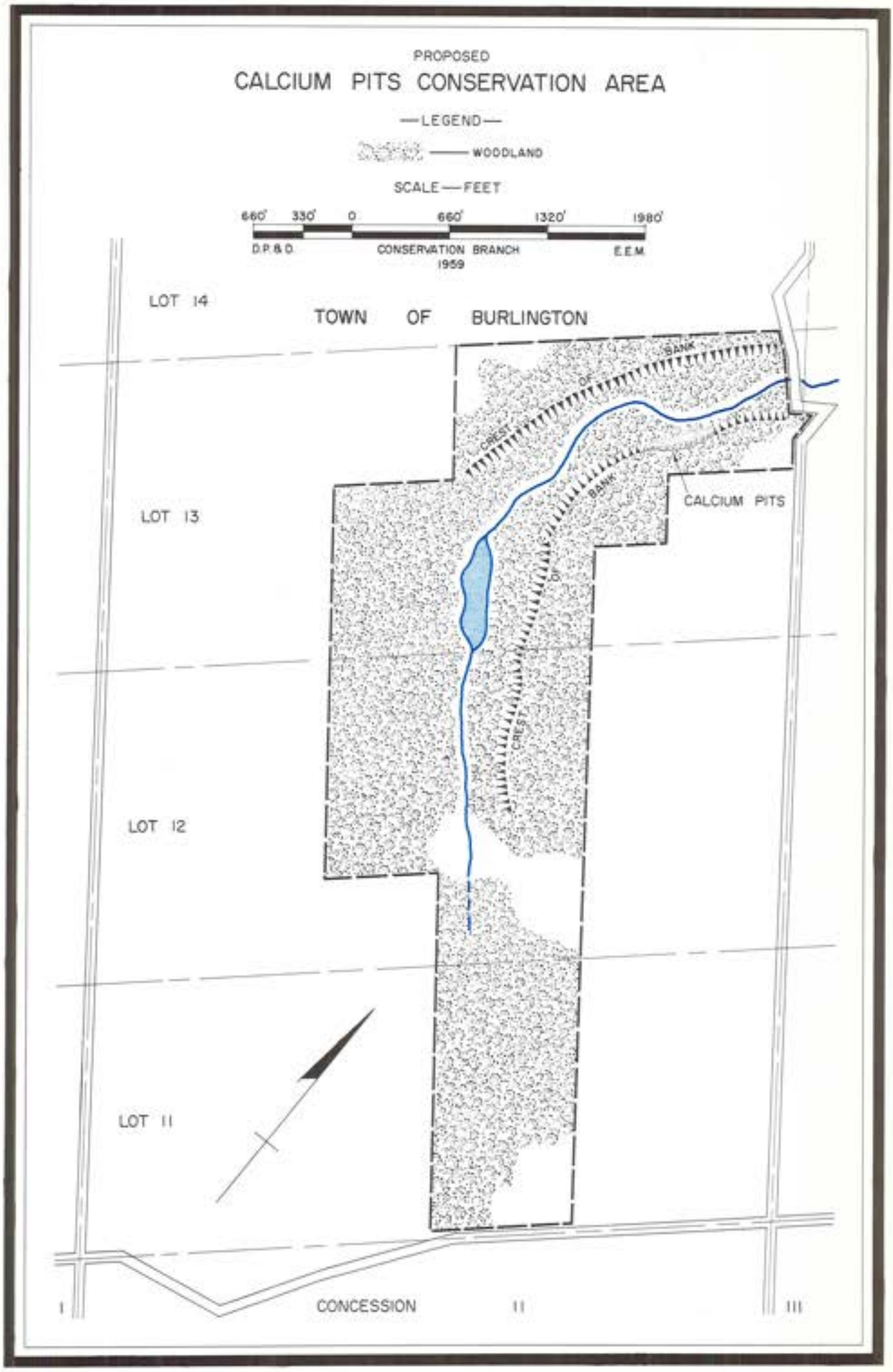
The area is fairly well off the heavy traffic routes yet also easily accessible from them. The easiest access is of course, through Milton which is easily reached by No. 5, No. 25 and No. 401 Highways, and which is less than an hour's drive from both Hamilton and Toronto. To some extent the channelling of future tourist traffic will also be to the benefit of Milton.

(e) Property Acquisition

The land within the proposed area is privately owned. Most of it is very poor agriculturally and consists mainly of areas of either bad or inadequate drainage. All but a fraction of the area is in woods and nearly a third of it in wooded swamp. Land prices in the region vary from $100 to $200 per acre for land without agricultural occupancy. Mention has already been made of the two farms within the proposed area. Special mention may be made of another property containing about 30 acres and occuping a section of the slope on the northern side of the valley. This tract is owned by The Rattlesnake Syndicate, a group of naturalists from Toronto who make occasional visits to the area. They do not plan to change the existing complexion of the area and are likely to favour any scheme which would further conservation aims either adjacent to or even inclusive of their property. (Note - the exclusion of Crawford Lake from the proposed area is most notable but had to be accepted in view of the high price of that property. If and when possible, that property can be easily added).

2. Calcium Pits Conservation Area

This area lies about 2 miles west of the above-mentioned Conservation Area, and is quite similar to the latter in many respects both geologically and floristically. It occupies the brow, the slope and the skirt of a small, low, detached mesa whose south-western face exposes a number of bare, disjointed and prominent vertical limestone columns.


PROPOSED
CALCIUM PITS CONSERVATION AREA
—LEGEND—
WOODLAND
SCALE—FEET
660' 330' 0 660' 1320' 1980'
D.P.&O. CONSERVATION BRANCH E.E.M.
1959
LOT 14
TOWN OF BURLINGTON
BANK
CREST OF
BANK
CALCIUM PITS
LOT 13
CREST OF
LOT 12
LOT 11
I
CONCESSION
II
III

Solution and vertical erosion have accentuated their outlines and locally the formation is called Calcium Pits. The face is highly impressive and photogenic.

A natural trench rings the foot of the escarpment and contains a chain of surface and sub-surface springs which are not large enough to provide a continuous or permanent channel of surface water but are of sufficient size to induce swampiness throughout the trench. The slope throughout the trench is rather indeterminate. Most likely the trench is the source area of a small creek which curves around the northern edge of the mesa and subsequently joins that branch of Twelve-Mile Creek mentioned in the foregoing section.

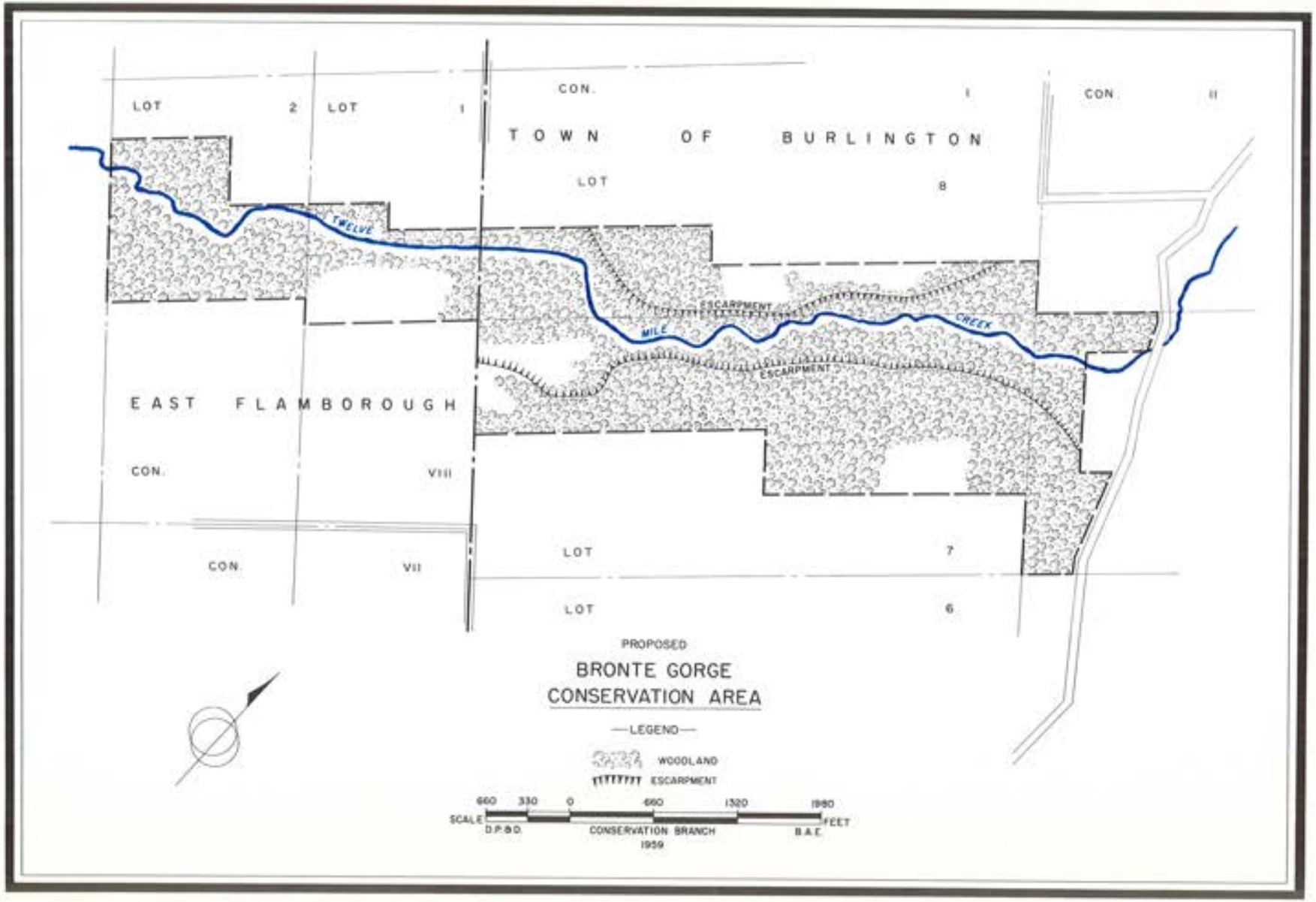
The lowest part of the trench is usually filled with water producing a small though quite muddy lake which could be improved by proper drainage. Vegetation which is very messy at the present could also be made more attractive by proper care and cleaning. The entire property could thus be converted into a neat and desirable Conservation Area.

Property Disposition

All land in the area is privately owned and the bulk of it is ill-drained and agriculturally poor. Even the woodland needs care and improvement and it will be necessary to introduce an appropriate program. Land values range between $80 and $120 an acre. The total approximate area is 90 acres located in Lots 11 to 13, Concession II of Burlington.

3. Bronte Gorge Conservation Area

This area occupies about 130 acres covering parts of Lots 7 and 8, Concessions I and II of Burlington and Lots I and 2, Concession VIII of East Flamborough. In many respects this area resembles the Cedar Springs. Here Twelve-Mile Creek cuts its way by a deep and long incision across a notch in the escarpment. The steep slopes on either side are densely wooded, the banks rising to about 150 feet on the west and 200 feet on the east, permitting neither a bridge across the creek,


LOT 2
LOT 1
CON. I
CON. II
TOWN OF BURLINGTON
LOT 8
TWELVE MILE CREEK
ESCARPMENT
ESCARPMENT
EAST FLAMBOROUGH
CON. VIII
CON. VII
LOT 7
LOT 6
PROPOSED
BRONTE GORGE
CONSERVATION AREA
—LEGEND—
WOODLAND
ESCARPMENT
660 330 0 660 1320 1980
SCALE FEET
D.P.&D. CONSERVATION BRANCH B.A.E.
1959

nor even an access road into the valley. The wild and difficult aspect of the area has hitherto saved it from outside incursion and thus preserved its scenic beauty. Considering that well-to-do people in Southern Ontario are extremely eager to find exclusive and scenic sites for permanent or holiday homes it will not be long before this area is discovered and parcelled away.

The area has a dense growth of medium-sized hardwood, an excellent supply of cool-to-mild water in a swiftly flowing channel which is ideal for trout, and a considerable population of birds. The deer and rabbit area is truly an outdoor enthusiast's paradise.

Thus both for preventive and protective reasons it is recommended that it be brought under the protection and control of the Conservation Authority as soon as possible. It is also suggested that the Authority permit no improvement of access into the area apart from providing a few trails so that the area will be used mainly by those who are really admirers of natural beauty which is becoming so scarce in this part of the province.

Property Acquisition

Owing to the absence of access, difficult terrain dense vegetation, and lack of any attraction for agricultural and industrial uses, the property should be easy and inexpensive to acquire.

4. Mount Nemo Conservation Area

The proposed area is a narrow strip of land, 262 acres in size and occupying parts of Lots 1 to 4, Concession IV in the town of Burlington.

The area covers the eastern edge and slope of the mesa, the highest point of which with an elevation approximately 1000 feet is known as Mount Nemo. Mount Nemo, like Rattlesnake Point, in fact refers more truly to the entire face which drops precipitously eastward by nearly 300 feet. The

PROPOSED

MOUNT NEMO CONSERVATION AREA

—LEGEND—

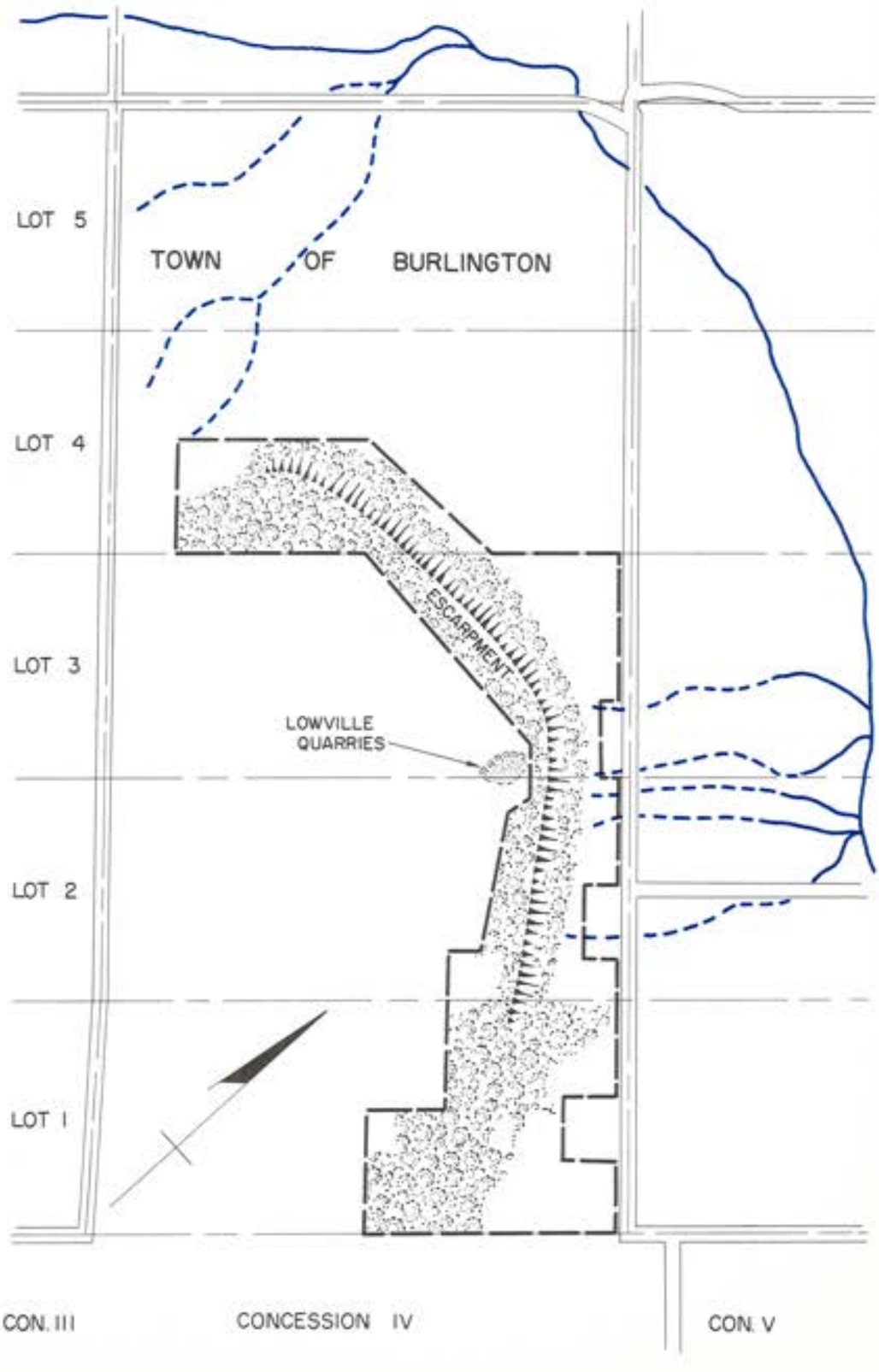
WOODLAND

ESCARPMENT

SCALE 1320' 660' 0 1320' 2640' FEET

D.P. & D. CONSERVATION BRANCH E.E.M.

1959



eastern facade and the lowland which stretches beyond it make it a landmark which can be seen from miles around. Large sections in the upper half of the slope contain massive blocks of bare limestone and the whole is extremely impressive in the morning when the rays of the rising sun accentuate its prominence.

Lying at the very margin of the watershed in an area where eastward drainage is rather insignificant, there is a deficiency of streams and lakes, but wildlife is quite plentiful. The main virtue of the area lies essentially in its being a landmark and offering a wide vista of the countryside.

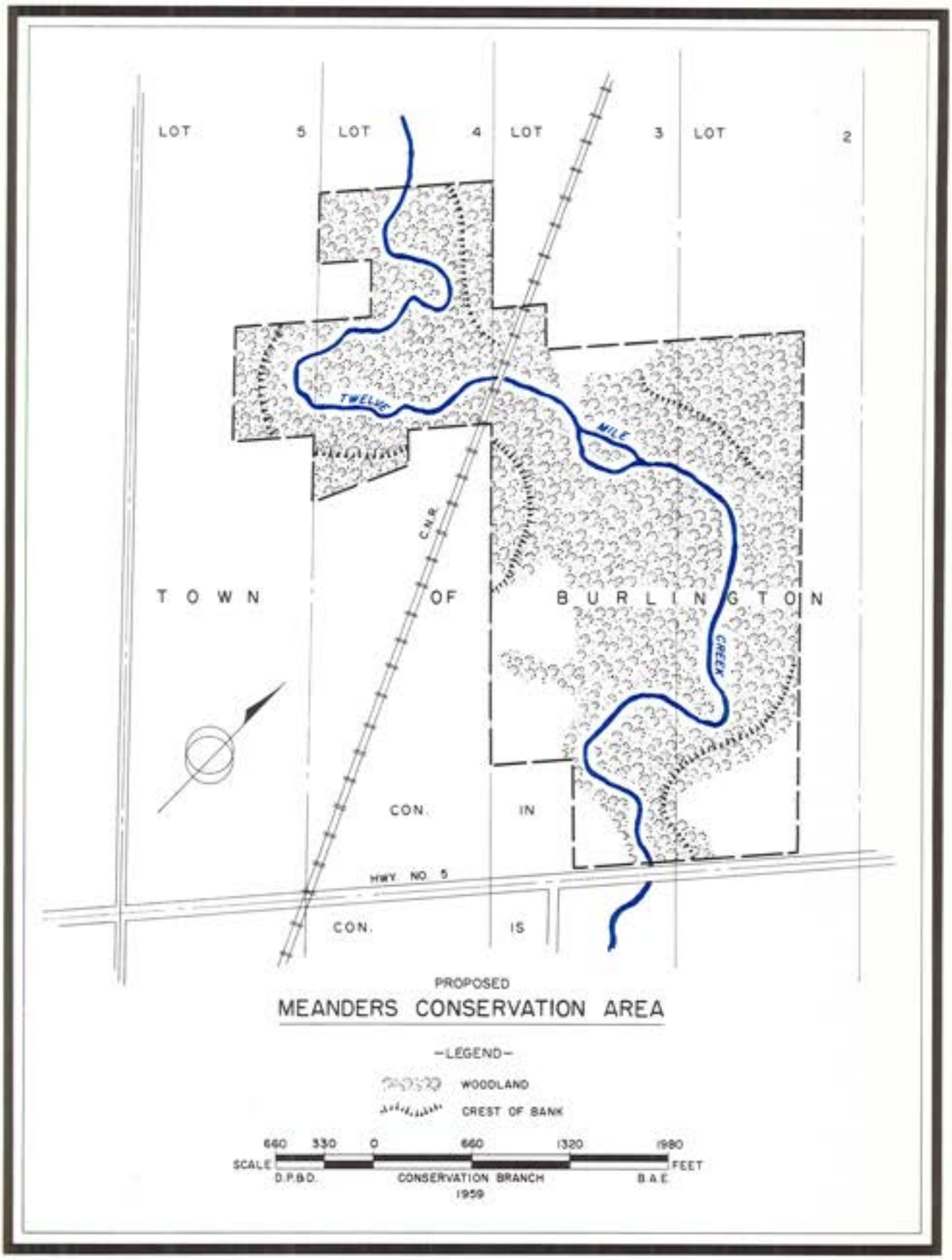
A township road runs close to the edge of the escarpment and trails to reach the top can be provided at both the northern and the southern end. An added feature is its proximity and direct connection to Highway No. 5 which runs only 2 miles south of this area. Proper advertisement and improvement measures could easily make Mount Nemo a popular tourist attraction. Conscious of these considerations the Twelve-Mile Creek Conservation Authority has already taken steps to acquire this property for recreation purposes.

Property Acquisition

As usual the land is privately owned. The escarpment land is agriculturally useless, but as it contains a very visible and valuable stock of low-silica limestone, it has attracted construction interests and quarrying is in progress. Evidence of some excavation in the past can be seen atop the escarpment. This factor is therefore likely to raise the cost of land somewhat. Even more likely is the rapid rise in the price of land fronting on the township road below, which provides most likely home sites for future suburbanites who will have such easy access to the improved No. 5 Highway. It is suggested that any steps to acquire this property should be initiated before the area becomes a market for homes.

5. Meanders Conservation Area

This area covers 95 acres in Lots 2, 3 and 4, Concession I, N.D.S., of the town of Burlington. It encompasses



PROPOSED

MEANDERS CONSERVATION AREA

-LEGEND-

WOODLAND

CREST OF BANK

660 330 0 660 1320 1980

SCALE FEET

D.P.B.D. CONSERVATION BRANCH B.A.E.

1959

a mile-long stretch of Twelve-Mile Creek just north of Highway No. 5. The stream is now mature and has begun to meander over narrow valley flats contained between deeply incised banks rising about a hundred feet on each side. There are two quite pronounced and rather spectacular meander bends, one at the northern and another at the southern edge of the proposed area. Although the banks and slopes are heavily clothed with scrub and trees there are signs of erosion, especially around the convex bends where the pressure of the flow is more pronounced. It may be wise to look after these sections before the damage becomes too severe.

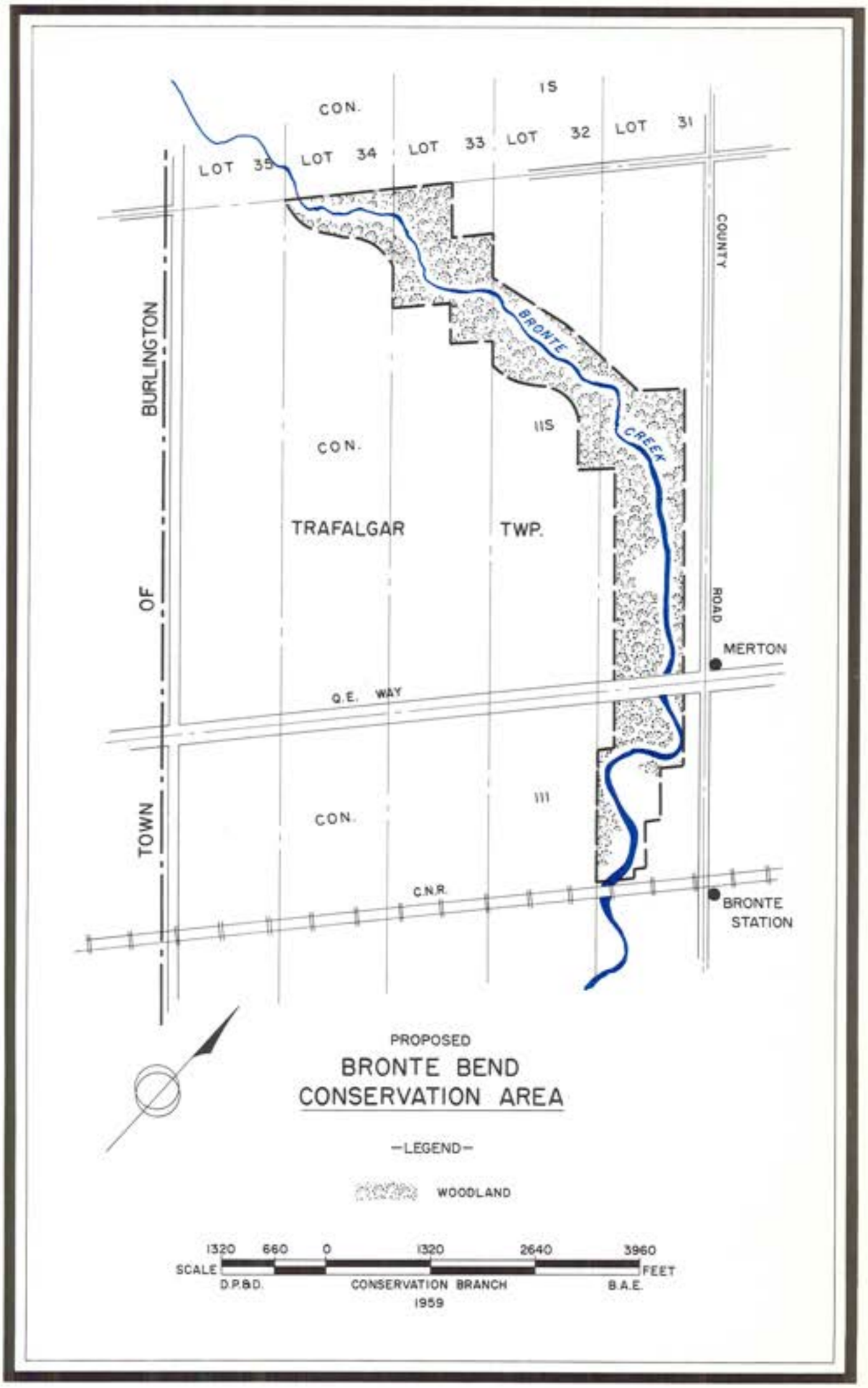
Apart from the scenic quality produced by the stream winding through the green of the woods, the area possesses other recreational attributes. The bed and water of the stream are reasonably clear, in places almost 6 feet deep; trout fishing is becoming more and more popular and hiking along the valley and across the slopes is most pleasant.

The best feature perhaps is the ease with which the drivers on the No. 5 Highway can take time off for a short and pleasant rest before resuming their trip. In view of the growing popularity and inadequate number of way-side tables on this highway, the proposed area would serve as an ideal resting place which would accommodate a fair numberof visitors. Facilities for wading and swimming by the children could also be easily improved. Once the area is opened it will become both necessary and possible to take better care of the erosion which may otherwise go un-noticed.

The acquisition of this area may also forestall the possibility of its appropriation by land subdividers on the banks in the near future.

6. Bronte Bend Conservation Area

A sister way-side area but larger in size (115 acres) lies a mile southwards and comprises the valley in Concessions II and III S.D.S., Lots 31 to 34 of Trafalgar Township.


CON.
15
LOT 35
LOT 34
LOT 33
LOT 32
LOT 31
COUNTY
ROAD
BURLINGTON
OF
TOWN
BRONTE
CREEK
11S
CON.
TRAFALGAR
TWP.
MERTON
Q.E. WAY
111
CON.
C.N.R.
BRONTE
STATION
PROPOSED
BRONTE BEND
CONSERVATION AREA
—LEGEND—
WOODLAND
1320 660 0 1320 2640 3960
SCALE
FEET
D.P.&D.
CONSERVATION BRANCH
B.A.E.
1959

The hinge point of this area is the bridge over which the Queen Elizabeth Highway crosses the creek. A hundred feet below the bridge the creek flows picturesquely in a wide meandering channel both on the up and down-stream side. The banks are as steep and impressive as in the vicinity of Tansley, but the valley is wider, the channel broader and consequently the water shallower. The stream tends to become slightly deeper before approaching the opposite face of a meander. One such example being the wide, rather bare face of the meander on the south side of and facing the Queen Elizabeth Highway. This section has been put to good use by being developed as a fish nursery, and the only one on the Twelve-Mile Creek. The Creek has a straighter channel north of the bridge and parts of it can easily be developed into swimming areas.

For the most part the banks are steep and well wooded and the erosion hazard is quite low. To the south of the proposed area a large parcel of land on the west bank has been acquired by an oil company which has established storing tanks and refining and pumping equipment. The land on the eastern bank appears to be in increasing demand for expensive homes. These tendencies are bound to spread northwards, and if prompt steps are not taken both banks will have been lost to the public. The proposed area is at present zoned as recreation land by the local township.

The area is easily accessible to the drivers on the Queen Elizabeth Way and would make an excellent picnic and recreation site. A rather novel feature of the site is the view the tourist below has of the traffic rushing along the busy highway. The view is both interesting and psychologically satisfying in the sense that one is right below the traffic without actually being in it. On the whole the acquisition of this area would fill a much needed demand by providing large scale picnicking facilities which are only barely met by the existing wayside tables along this highway.

Part of the land is already owned by the Government - the Department of Highways owning right of use for a future widening of the bridge and the Department of Lands and Forests owning part of the valley. The remainder, i.e., the bulk of the land, is however privately owned and owing to its location close to major traffic arteries is rather expensive.

CHAPTER 4

SCENIC DRIVES, VISTAS AND TRAILS

1. Need

Apart from the yearly vacation which most people spend or attempt to spend in non-urban surroundings, one must also take into account the normal and long week-ends which collectively amount to more than four times an average annual vacation. Thanks to the spread of the automobile, and the highway network, drives to the countryside have become an ideal and most popular type of short-term recreation. It is quite normal for most car-owning families to put in a 100 miles of pleasure driving on a week-end of good weather. The majority of such people are unfortunately ignorant of the great beauty that lies within an hour's drive and therefore do no more than pleasure-cruise around the city. The Conservation Authority would serve an important purpose if it were to launch a national information program whose main duty would be to bring the natural beauty of the rural neighbourhood to the attention of the population and thereby put its own Conservation Areas to fuller use.

We have already seen how closely the proposed Conservation Areas are integrated with either the escarpment or the streams - the two most attractive recreational features of the watershed. It only remains to integrate the proposed areas by a route which would be as rewarding of pleasure as the areas themselves. This can easily be done by the provision of a scenic driveway.

Dr. D.F. Putnam* of the Department of Geography, University of Toronto, was perhaps the first person to propose the establishment of a "Cuesta Parkway" to run between Oshawa and Hamilton, thus incorporating the morainic heights in the east as well as the escarpment country in the west for the benefit of what is one of the most urbanized regions in the

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* Putnam, D.F. The Regional Green Belt and the Rural Park Areas - Toronto City Planning Board Report - 1943.

country. This was in 1943, a time when the proposal could have been implemented most easily, but also the time when its immediate need was not as great and the proposal therefore appeared too radical. Since that time, of course, urbanization has increased so rapidly as to interfere with the implementation of the original proposal in full. However, it is still not too late to salvage whatever still remains possible from the original plan.

The best thing, of course, would be the creation of an altogether new route to follow the crest areas of the escarpment and designed exclusively for recreational driving. In view of the competing claims of other development expenditures, the more realistic, although the next best alternative is the designation and improvment of existing township roads as a scenic route which may not fully meet the requirements of an exclusive parkway but still contain many of the latter's functions - such a route is shown on the map.

Although hiking is not too popular in Canada, there is a substantial section of the populace, mainly of European immigrant stock, in Ontario who find it the least expensive and most enjoyable form of outdoor recreation. Even in other groups there is a distinctly growing attraction for it. In fact only trails provide the feel of the beauty, driving in comparison affording a rather indirect appreciation of natural beauty. Accordingly, it was considered desirable to make provision for a number of trails linked to the scenic drive. Reference is also made to points which offer particularly wide vistas of the surrounding landscape.

2. Scenic Drive, Vistas and Trails

The concession roads in the Twelve-Mile Creek Watershed run northwest-southeast and the side roads run at right angles to these, namely, northeast-southwest. Many have short deviations in them to get round the irregular topographic features of the area and, as it is these features which produce

the most spectacular scenery, the scenic drive has been laid out along the best roads in this somewhat rugged country. The route is difficult to describe in detail but is clearly shown on the accompanying map.

The scenic drive starts at Milton on Highway 25 and ends at Bronte, or it may be travelled in the reverse direction. From the centre of Milton it proceeds south-west along the paved road, climbs the east face of the mesa and crosses the proposed Conservation Area No. 1, which includes spectacular lookouts at Rattlesnake Point and similar views from a point a mile farther north. After descending the southern slope of the mesa by a rather difficult and therefore most interesting road, the route offers a glimpse of the dark, green, narrow valley where the eastern branch of the Twelve-Mile Creek takes birth. From here the visitor can take a most attractive trail winding to the top of the escarpment where another vista site offers a wide view of the countryside to the south-east.

From here the route turns north-west on the county road to Campbellville, then turns south-west crossing the C.P.R. at Guelph Junction. At the next cross-road it swings south-east down the township road to Kilbride and descends from there into the valley of Twelve-Mile Creek at Cedar Springs.

This is a most spectacular section of the main stream part of which has developed into an area of exclusive cottages (Cedar Springs), but part a mile farther west is still an area of striking but untouched beauty. It can be visited by taking a trail which first leads to a strategic prominence on the bank, from where a beautiful view of the valley can be enjoyed, and subsequently descends the bank to take the more enthusiastic visitor to the valley itself where fishing, wading, and even swimming can be enjoyed. This valley is the proposed Conservation Area No. 3.

After crossing Twelve-Mile Creek the route turns north-east on the township road, then south-east, then north-east

on the county road and north-west to bring one down over the escarpment at Mount Nemo through Lowville.

North-west of Lowville the drive turns north-east on the county road and south-east at the next intersection to follow the township road which skirts the north-eastern side of Mount Nemo. A trail from the drive will bring the visitor to the highest point of the mesa which unfolds another breath-taking vista of the countryside in the proposed Conservation Area No. 4.

Opposite Mount Nemo the route turns sharp left, crosses Twelve-Mile Creek and at the next cross-roads turns sharply right on the road to Zimmerman. A mile south of Zimmerman a trail would bring one back to a most acute and high meander bank of the creek from which one gets a beautiful view of the green ribbon-like valley both up and down-stream. This is the proposed Conservation Area No. 5.

The route joins Highway No. 5 at Tansley and proceeds along it to Palermo where it turns south-east along the county road for another two and a half miles before crossing the Queen Elizabeth Highway. Another trail along the western bank of the creek leads one into the Conservation Area No. 6. The more enthusiastic members of the party might take this trail which goes beneath the Queen Elizabeth bridge and rejoin the driver south of the bridge.

The drive ends at Bronte, the picturesque village on the shores of Lake Ontario named for Lord Nelson, Earl of Bronte.