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1.0 INTRODUCTION

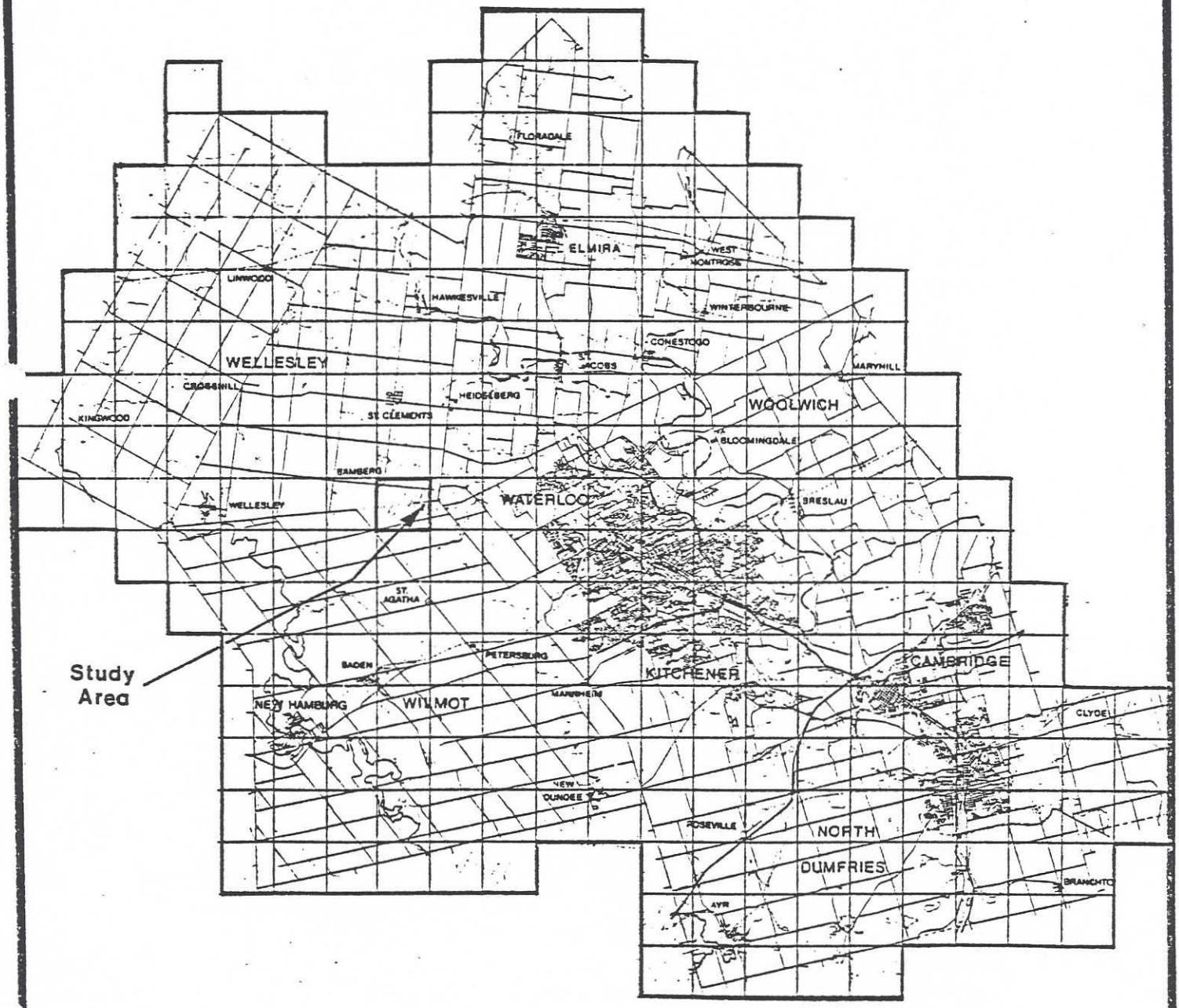
Development and re-development in the Sunfish Lake area has been the subject of discussion between Mr. Jack Hutchison, as the representative of the Sunfish Lake Residents' Association, several individual property owners and the Township of Wilmot for a number of years.

The main objective of the property owners of the Sunfish Lake area is to amend the Official Plan and Zoning By-law 1175 of the Township of Wilmot to permit the existing vacant lots (four in total) to be developed and to provide for the redevelopment of existing properties. The residents are also very clear in their desire to protect the lake from any potential environmental degradation; and to keep the said area as private as possible. A majority of the existing development is summer or seasonal dwellings, but some of them are old and approaching the time when the owners would like to rehabilitate them.

After numerous meetings among the Association, Township, Region of Waterloo Planning Staff and other Governmental agencies, the Township of Wilmot agreed to support the development and redevelopment of the Sunfish Lake Area (Part Lot 2, Concession 3, Block B) for seasonal cottages only. In addition, it was recommended that the items 1 to 9 in the Addendum to P.D. Report 22/80 dated August 19, 1980 be adopted as the basis for resolving the Planning matter relative to this matter. The authorization for the above procedure was given by Planning Committee in their resolution dated May 25, 1981 which was ratified by Council on June 8, 1981. (See Figure 1).

Location Plan

FIGURE 1



Once the Official Plan Amendment is approved by the Township, the municipality intends to implement the policies by means of a zoning by-law amendment for the affected area. The area will also be designated as a Site Plan Control Area in accordance with Section 40 of the Planning Act, and all site development will be regulated by development agreements with each property owner.

Items 6 and 7 of the Addendum P.D. Report 22, 1980 suggested the following:

(6) That the residents at their expense and with professional assistance as required, undertake an Environmental Impact Statement sufficient to satisfy the requirements of the Regional Municipality of Waterloo, and obtain the approval from the Region for this Statement.

(7) When the approved Environmental Impact Statement is available, along with the registered survey plan, the Township would agree to prepare and adopt the appropriate amendment to the Wilmot Township Official Plan.

On August , 1981, Jack Hutchison, spokesperson for the Sunfish Lake Residents Association, authorized Planning Initiatives to proceed with investigations pertinent to the two above mentioned items. In order to clearly ascertain the specific study objectives, we undertook a preliminary analysis including:

Meetings with the Region of Waterloo and Township of Wilmot Planning staff, a visit of the area with Mr. J. Hutchison and meetings with Grand River Conservation Authority and Ministry of Natural Resources.

Based on the above investigations, it was generally agreed that it was not necessary to spend a significant amount of time and money to collect new additional information since there exists sufficient information from which to make proper planning and environmental decisions. The existing data and reports can be assembled and organized to meet the Regional requirements under Policy 31, Chapter 13 of the Regional Official Policies Plan. Secondly, it was agreed to restrict the Environmental Impact Statement to a consideration of those impacts resulting from only those lots (Beynon, Hearn, Guy and Wilson) proposed for development or redevelopment, together with mitigatory measures if required.

The Environmental Impact Statement has been completed in response to the above requirements and is detailed in the following report, which adheres to a five fold breakdown. Section 2 provides a summary of the project description of the existing environment and the sensitive areas are discussed in Section 4. A description of the impacts associated with the development and the practical methods of preventing or effectively minimizing degradation are outlined in Section 5. The final section provides the study conclusions and recommendations.

2.0 PROJECT DESCRIPTION

As stated in the previous section, the Township of Wilmot intends to amend its Official Plan by identifying and designating the Sunfish Lake Area as a settlement area. The boundaries of the settlement area are illustrated on Figures 2 & 3. They include all existing seasonal and permanent residential properties directly fronting on the lake, the four (4) vacant parcels fronting on the lake and Township Road Number 2. The settlement area does not include the two large wooded parcels owned by the Residents' Association on the north end of the lake, nor does it include any land south of Township Road Number 2.

In summary, the Environmental Impact Statement, which is detailed in the following report, will adhere to the following study objectives:

(1) The preparation of an Environmental Impact Statement that will evaluate and assess the specific impacts, if any, of the development of the four lots for seasonal use, and redevelopment of existing cottages of the Sunfish Lake Area will have on the existing lake and surrounding environs.

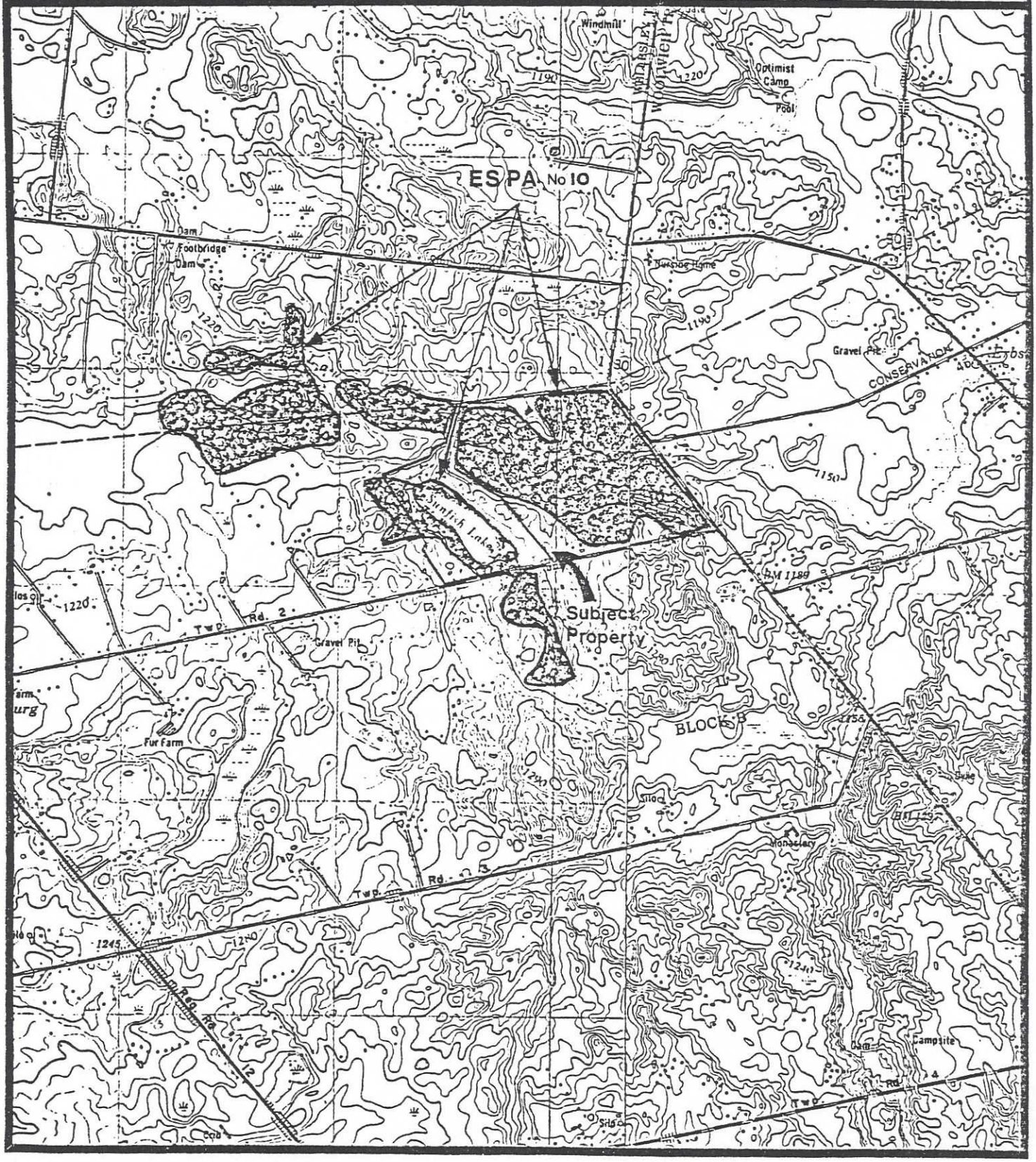
(2) To provide certain mitigatory measures aimed at alleviation or substantial reduction of the anticipated impacts.

(3) To provide certain guidelines or criteria for the development and/or redevelopment of certain properties, that must be adhered to.

Environmentally Sensitive
Policy Area

FIGURE 2

1: 25000



3.0 STUDY METHODOLOGY

The study methodology for the Sunfish Lake Area was undertaken in the following manner:

(1) A September 4th, 1981 meeting with the Region of Waterloo Planning staff in order to obtain their preliminary comments;

(2) A September 9th, 1981 site inspection by J. Hutchison, Paul F. Puopolo, Robert Shaw, P.Eng. to examine access, drainage, location of building, storm water runoff, vegetation and general existing conditions;

(3) A September 14th, 1981 meeting with D. Greer and W. McMillian of Grand River Conservation Authority and R. Taply of Ministry of Natural Resources to obtain comments from these agencies;

(4) A review of existing published and unpublished reports and data to provide background information on the site;

(5) A September 30th, 1981 site visit by J. Hutchison, C. Campbell and C. Cecile to inventory and assess the vegetation cover of these areas which are to be developed or redeveloped;

(6) An October 16th meeting with the Region of Waterloo and Township of Wilmot to discuss the specific details of the environmental study;

(7) A January 13, 1981 meeting with the Ecological & Environmental Advisory Committee to obtain preliminary comments from the committee members prior to completing the report;

(8) An analysis of the existing landscape features;

(9) the identification and recommendations of proposed mitigatory measures to minimize any potential impacts associated with the construction activity on the four lots.

For this project, the study team included:

P.F. Puopolo, Study Co-ordinator Planner; Robert Shaw, P. Eng., of Frances-Nicholas Ltd., who provided information about drainage, sedimentation and septic tank; C. Campbell, Ecological Consultant, who provided input on the plants and wildlife of the site; S. R. Brown, Ph.D., Queen's University, who provided detailed information about the Lake itself and J. Hutchison, and J. Guy, local residents, who provided the background information about the aims of ratepayers.

4.0 EXISTING ENVIRONMENT

4.1 General Site Description

The Sunfish Lake Settlement area occupies approximately 28 ha. in the north eastern corner of the Township of Wilmot. It is bounded by Township Road Number 2 on the south, rolling farmland and part of E.S.P.A. #10 on the west, the high ridge of the kame and rolling pasture land to the east and by a mixture of heavily wooded areas to the north.

The site displays considerable topographic diversity; the most prominent feature is the merimictic kettle nestled between the sandy kames. The eastern kame rises about 18 metres above the existing lake level.

The four lots in question (J. R. Guy, M.M. Hearn, A.F.M. Wilson, M. T. and J. Beynon) are situated in diverse locations about Sunfish Lake. The Guy (2.4 ac) and Hearn (.67 ac) properties are largely in mowed, grassed cover, whereas part of the A. Wilson lot (5+ ac) is partially in conifer plantation and the Beynon lot (3.2 ac) is almost entirely wooded with mature mixed forest.

The Wilson property is situated on an elevated knoll; while the Guy and Hearn lots are also reasonably high above the lake and well-drained. Part of the Beynon property is near lake level.

The location of the said lots and existing condition of the Sunfish Lake Area is clearly illustrated on figure 3.

4.2 ENVIRONMENTALLY SENSITIVE PROTECTION AREA No. 10 -
General Description:

The sensitive area, Sunfish Lake, is described as a deep bog lake surrounded by wetland forest of primarily cedar/tamarack/hemlock association. The entire area is a natural water storage/recharge area and it forms one of the principal headwater sources of Laurel Creek.

Presently, the shoreline of Sunfish Lake is built up, in the main, with seasonal cottage development and supplemented with a few permanent dwellings located along Township Road Number 2. But, there is not as much developed shoreline as at nearby Paradise Lake, which has a remnant of similar wet forest (Montgomery 1945, 227)

Although of great interest and environmental significance regionally, and singled out by the late, noted botanist Prof. F. H. Montgomery (1945) as interesting for its extensive cool, wet woods and certain plants, Sunfish Lake does not appear in A Naturalist's Guide to Ontario (1964), The Physiography of Southern Ontario (1966) or Pleistocene Geology of the Hamilton-Galt Area (1963).

Specifically, the sensitive area meets a number of criteria for establishing Environmentally Sensitive Protection Areas in the Regional Official Policies Plan, and the description of Sunfish Lake and the criteria it meets are identified in Table 1.

TABLE 1

DESCRIPTION OF ENVIRONMENTALLY SENSITIVE POLICY AREA NO. 10

NAME: SUNFISH LAKE

NUMBER: 10

GENERAL DESCRIPTION:

A deep bog lake surrounded by wetland forest, primarily cedar/tamarack/hemlock, which forms one of the principal headwater sources of Laurel Creek. There is some cottage development around the lake.

CRITERIA MET:

Number (a)

Plants: Many orchid species Early Coral-root, (Coral-lorhiza trifida) Moccasin-flower (Cypripedium acaule) and more common species; Stiff Clubmoss (Lycopodium annotinum). Also Adder's Tongue (Ophioglossum vulgatum) and Striped-coral Root (Corallorhiza striata), Very few Regional stations. Large-Leaved Violet (Viola incognita), Dalibarda or Dewdrop (Dalibarda repens).

Birds: Barred Owl (Strix varia) has nested here for some years, its only known breeding site in the Region (along with adjacent Schaefer's Woods) and one of the few left in southern Ontario.

One to two pairs of Red-shouldered Hawks (Buteo lineatus), nest annually, a high density for this Blue-listed bird (AB). A pair of Sharp-shinned Hawks (Accipiter striatus), very rare here, in 1973. Cooper's Hawk - (Accipiter cooperii) Northern Water-

11.18 Thrush (Seiurus novebor acensis) Winter Wren (Troglodytes troglodytes).

Amphibians: The declining Pickerel Frog (Rana palustris) occurs.

Insects: Mustard White (butter-fly) Pieris napi

Number (b)

Unusual merimictic bog condition attracts aquatic biologists from local universities. (Other unusual plants are Selkirk's Violet (Viola selkirkii), Kidney-leaved Violet (Viola renifolia), and a native legume (Astragalus sp.) north of its usual range.

Number (c)

The area is large.

Number (e)

Lake
Trout Streams
Small Pools
Hemlock Forest
Wet Meadow
Swamp Forest
Hilly Topography
Upland Maple-Beech Forest

Number (g)

Natural water storage/recharge area.

Note: The species names are not intended to be exclusive as a reason for an area being identified as significant. Many other species are present and also contribute to the significance of the area and may upon detailed study be specifically named as being rare, endangered and/or unique.

SOURCES: Ian McDonald, M.N.R.
C.A. Campbell
Experience '75
L. Lamb of U. of W.
KWFN

July, 1978

The Boundary of E.S.P.A. No. 10 encompasses about three-quarters of the Sunfish Lake Settlement Area. Its eastern boundary runs from Township Road No. 2 in a northerly direction and then follows the shoreline of the lake. The specific limits of E.S.P.A. No. 10 are illustrated on Figure 3.

4.3 GEOLOGY AND SOILS

Sunfish Lake lies in a small depression surrounded by Sandy Kames over a Salina (Upper Silurian) bedrock of shale, salt and gypsum. The lake itself is about 20m. deep and the bottom is covered by a black sulfide sapropel. It is one of a series of kettles which include Spongy and Hofstetter Lake.

Soils in the area (eg. Waterloo, Brant, Tuscola, Heidelburg and St. Clements Series) have developed on till or laucustrine sediment deposited in depressions. This area is within the Waterloo moraine and is associated with depositions of clay or silty to clay tills. In the low lying areas, particularly to the north west of the lake it appears that organic materials are present.

4.4 HYDROLOGY AND DRAINAGE

Using existing aerial photography the catchment area of Sunfish lake has been determined to be 1.23 sq. km. This is different from the 2.25 sq. km. determined by others probably due to the fact that the northerly water-course no longer enters the lake. This 1.23 sq. km. includes three sub-catchment areas as follows:

Sub-Drainage Area No.	Description		
1	North of Township Road # 2	=	54.4 ha
2	South of Township Road # 2	=	48.4 ha
3	South of Township Road # 2	=	20.2 ha
	TOTAL		123.0 ha

of which the pond has a plan area of 7.7 ha based on current mapping (1978). The above data is illustrated on Figure 4.

For the 100 year return period storm it can be determined that:

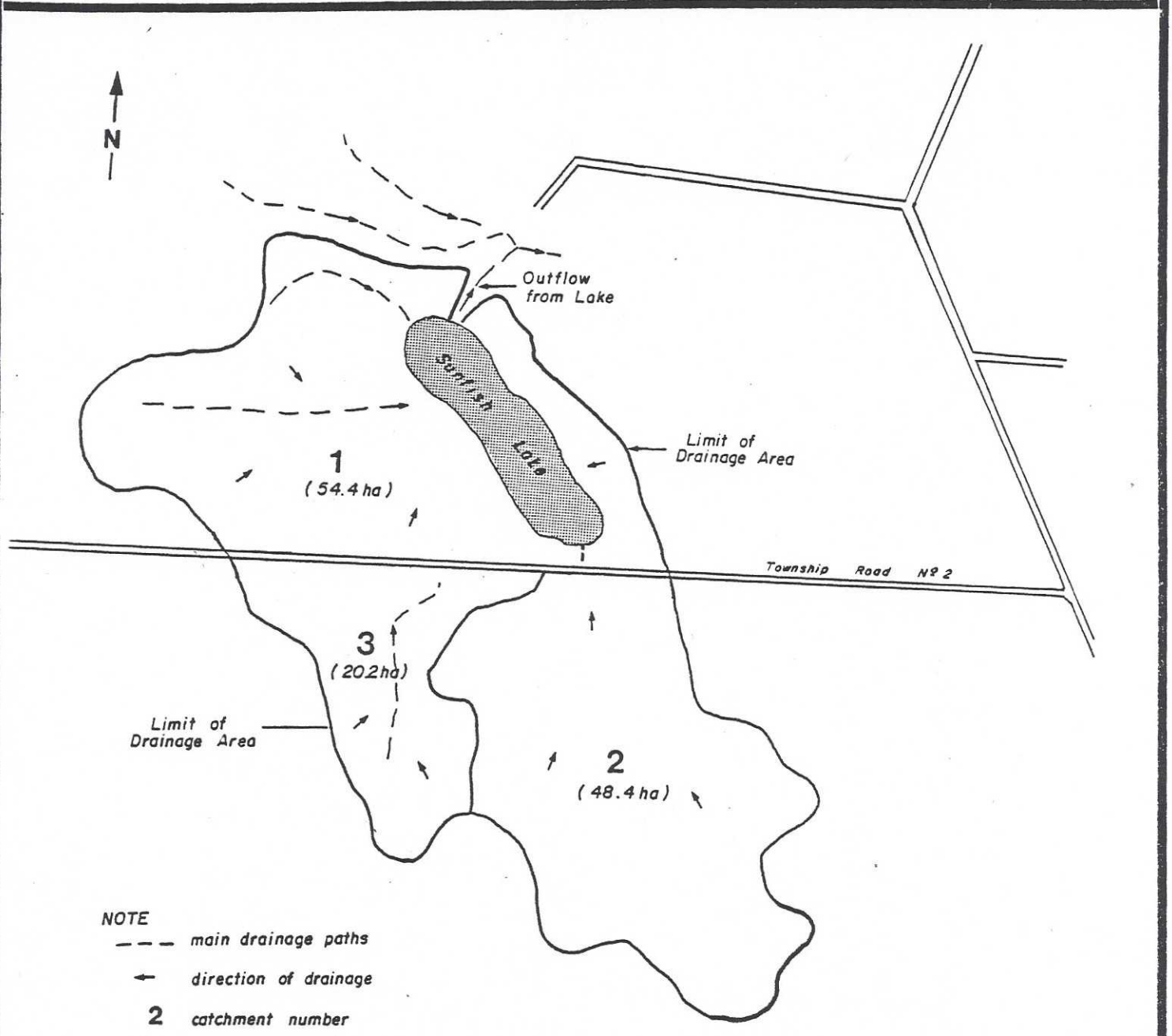
Q(100 year) = 11.3 m3/ sec
Total runoff = 3.23 ha.m

If we assume that no outflow takes place from the pond during this storm, the water level would rise by 0.57m or to an elevation of 31.05m (assumed W.L. existing at time of survey = 30.48 m). However in reality some outflow will take place, and in the absence of routing the storm through the pond, it is sufficient to say that this 31.05 m established as the minimum W.L. governs the minimum ground elevation that any development should be placed on. This elevation in fact co-relates with the existing development which shows all houses at or above this elevation.

With lands to the South and West of the Sunfish Lake in farmlands, it is evident that during periods of rainfall, chemical and biological pollutants can be transported and eventually end up in the lake. Of a total catchment area of 123 ha, about 70-80% of the area lies outside the control of the existing residents of the settlement area.

Existing Drainage

FIGURE 4



Scale 1:12,500

4.5 EXISTING SERVICES

WATER SUPPLY

In August 1980 the Waterloo Regional Health Unit conducted a survey to determine if the quality is acceptable according to drinking water standards. The results of this survey are attached as Appendix A which shows that of the 19 cottages existing around the lake, four using lake water showed an unacceptable level of pollution.

According to water well logs in the area (Stahler and Hemmerich), water was found at approximately 2 and 4 m respectively below ground level for these two properties located on Sunfish Lake. The Stahler well was tested at 22.5 l/s for domestic water comsumption.

SEWAGE DISPOSAL

During the August 1980 study by the Waterloo Regional Health Unit, they also used flourescien dye to determine if there was any sewage pollution discharged into the lake. These test results are attached as Appendix B and indicate that there was no evidence of pollution of the lake.

4.6 PLANTS

4.6.1 COVER TYPES

On September 30, 1981, Craig Campbell and his colleague C. P. Cecile traversed the majority of the Sunfish Lake Settlement Area to investigate the existing vegetation of the site. Particular emphasis was placed on the four subject lots. The compilation of the data occurred just as the autumn die-off of herbaceous vegetation was occurring; the samples of most plants collected could still be identified. Aquatic plant species were sampled only if at the shoreline of the lake. Plant groups which may have been missed on site because of the late season of year might include certain orchids (e.g., small species like Early Coralroot) and grape ferns (some of which have occurred in the area: Data Sheets 1978). Vegetation lists were made in the field and vouchers for some critical plants were collected.

The results of the above field investigation revealed much of the Guy and Hearn properties is currently in lawn, while the A. Wilson lot and area is partly oldfield and conifer plantation. Apart from a narrow shoreline zone of aquatic vegetation along the 165 foot (50.3 m) lake frontage of the Beynon property, this lot is in wet forest. This forest may be classified as belonging to the Great Lakes-St. Lawrence Forest (Floral) Region, the Huron-Ontario Section (Rowe 1972; Scoggan 1978, I, 29-30). Some dominant tree associations in this forest tract are White Cedar, Tamarack, Eastern Hemlock, Yellow Birch. These may all together, or in combination, form a forest association (Fowells, 1965, 680) which may have

relatively shallow rooting and grow much more slowly, especially the cedar, than on upland sites (ibid.). Curtis (1959,542) lists White Cedar and Tamarack as two principal components of the "Northern Lowland Forest" in Wisconsin. As some prevalent species (50% of stands sampled) of ground cover in such forest, he lists Corn-Lily, Bunchberry, Creeping Snowberry, Twinflower, Canada Mayflower, Dwarf Raspberry, Starflower and Velvet-leaf Blueberry, all present on the survey site. These are "boreal" intrusives in a forest which seems to lack spruce and fir, and is more typical of the Great Lakes (mixed) zone. This Sunfish tract is an essentially closed forest, transitional from a more northern to a more southern Great Lakes-St. Lawrence zone. On the one hand, it is related to bog forest, but black spruce and many shrubby heaths are lacking which might be present if the site composition is a good one for native orchids (Curtis, 1959, 232), especially Queen Lady's-slipper.

With the exception of possible high water levels and attendant flooding from Sunfish Lake, this forest cover type should remain stable for "long periods" of time (Curtis, 1959, 237); natural blow-down and tipping of white cedars may also occur (Curtis, 1959, 239).

4.6.2 VEGETATION AFFINITIES

As the accompanying Appendix F shows, many of the floristic affinities of the Beynon property lie with the mixed Great Lakes-St. Lawrence Forest, transitional from conifers to hardwoods. However, by combination of the four authorities consulted, there are a number (17) of boreal elements which are quite significant for this part of Southern Ontario.

4.6.3 RARE AND SIGNIFICANT PLANT SPECIES

The only plant species occurring on-site, on the Beynon Property, that is of any national concern is the Queen or Showy Lady's-slipper. Only seven (7) plants (6 of them fertile) were located in September, 1981, in dense white cedars 30 to 50 feet (9 to 15 meters) east from the western fence line. This orchid has had at least eleven (11) other Waterloo Regional stations from 1891 to 1976 (University of Waterloo Computer printout 1976). Habitat at this site appears ideal (Case, 1964, 46). C. reginae is listed in Appendix II as potentially threatened under the convention on inter-national Trade in Endangered Species of Wild Fauna and Flora (CITES). Judging from Campbell's survey of the site in 1966, there were more of this Lady's - slipper present then.

Only one plant species on-site, Spreading Goldenrod, is listed as rare in Ontario by Argus and White (1977, 45). It is also listed by these authorities as rare in Canada: Pringle (1968, 12), an authority on the goldenrod genus, considers it one of the less common species in Southern Ontario, and limited to swamps and bogs. Scoggan (1979, 4; 1610) records it in wet woods of eight (8) Southern Ontario counties. It behaves essentially as a perennial plant (ibid.). An additional eleven plants as shown on Appendix F may be considered regionally rare or significant. None of these are among the nine species meeting the criteria for E.S.A. # 10. However, the 1978 E.S.A. data sheet states that these species are not intended to be significant exclusively.

4.7 MAMMALS, BIRDS AND AMPHIBIANS

No observations or signs of uncommon mammals were made on-site in September 1981. Beaver, Mink and Snowshoe Hare have occurred around the lake, but apparently not lately (P.C. J. Hutchison, 1981). These are all relatively wide-ranging species.

BIRDS

None of the species listed on the 1978 data sheet for the E.S.A. was noted in September 1981. Barred Owls have a relatively wide territory, and have recently been noted more in the Schaefer's Woods area than at Sunfish Lake. Cooper's, Sharp-shinned and Red-shouldered Hawks have not recently been known to nest close to the lake (Campbell, pers. data). The existing habitat, particularly on the Beynon Property, is suitable for Winter Wren, Northern Waterthrush and certain other northern warblers in summer. These songbirds have recently been found in the general area (1978 Data Sheet).

AMPHIBIANS

No evidence was obtained in September 1981 of the scarce Pickerel Frog or Bullfrog. However, portions of the lakeshore remain suitable for these amphibians. They are both listed as in need of study regarding their status in Canada (Bowman M.S. 1978).

BUTTERFLIES

Three species of butterfly, which may be considered uncommon to rare in the region (Lamb, 1967) and occur about Sunfish Lake are Mustard or Veined White, White Admiral and Northern Pearly Eye. According to Pyle (1981), these are essentially forest species.

4.8 AQUATIC ENVIRONMENT

The major portion of the history and factors affecting Sunfish Lake was prepared by S.R. Brown of the Department of Biology, Queen's University because of his extensive knowledge and background of the area. (see appendix C for report of S.R. Brown).

The following section provides a morphometric data, and the historical evolution of the lake, an identification of research and academic studies and factors affecting the development of Sunfish Lake.

The specific morphometric data of the Lake and surrounding areas:

Total area	=	7.7 ha
Maximum length		577 m
Maximum width		189 m
Maximum depth		20 m
Mean depth		10.4 m
Watershed area		1.23 sq. km.

A fish study was done in 1980 by Katherine E. Wynne-Edwards and was continued in 1981 by Victor Nishi.

The fish population was sampled three times in 1980 using both Seine and Gill nets. The species together with the number caught and their weight as a percentage of the total are:

SPECIES	PERCENT TOTAL WEIGHT	NUMBER
White Sucker	37.3	43
Yellow Perch	24.1	74
Pumpkinseed	13.9	120
Largemouth Bass	10.9	57
Brown Bullhead	6.6	1
Golden Shiner	3.9	22
Rock Bass	2.1	78
Iowa Darter	.6	160
Smallmouth Bass	.4	2
Bluntnose Minnow	.2	19
Brook Stickleback	-	2
Tadpole Madtom	-	1

A carefully integrated series of studies on Sunfish Lake have been conducted under Dr. S. R. Brown's direction over the past five years. They are designed to investigate the current limnological status of the lake as part of a program that explores its paleolimnological development (using sedimentary fossils) since the last Ice Age, 12,000 + years ago. As a result, Dr. Brown has become familiar and cognizant with the entire lake and his report found in the appendix addresses the four subject lots and the Lake as a whole. There are presently ongoning studies being undertaken by university students. Further management studies of the lake are anticipated.

Dr. S. R. Brown's interest in Sunfish Lake was stimulated by the earlier and excellent studies by Dr. Hamish Duthie, his colleagues and students at the University of Waterloo. There is some overlap in the Brown studies with those of the Waterloo group for comparative purposes, but in the main they converge or provide parallels.

Two features of the lake are of unique limnological interest. It is one of the oldest small lakes in Canada, having been formed or uncovered in the early retreat of the Wisconsin Ice Sheet during the last deglaciation. Its history is superbly recorded by fossils in its sediments. This chronological record is of great significance in providing insights into the long-term dynamics of lake ecosystems and the formulation of management policies that protect our water resources. Secondly, the lake is of limnological interest in the mere fact that it continues to exist. Many lakes of this age and size have progressed through trophic stages into oblivion; from mature lakes into stagnant ponds, then marshes, bogs, and finally into wetlands. In fact, this is the classical concept of the developmental history of lakes, although obviously not always correct.

Trophic development of lakes depends largely upon two factors, nutrient loading and the balance between primary and secondary productivity (plant vs. animal life). Nutrient loading, in turn, depends on runoff from the watershed and recycling of nutrients from the lake sediments. Phosphorus and nitrogen compounds are identified primarily, but cannot be regarded exclusively. Runoff is greatly influenced by changes in vegetation within the watershed, erosion, geological substrate, and probably most of all by human impact - itself a feedback cycle. Recyling of nutrients is regulated by the animal

community and very importantly by degradation of organic materials by bacteria both in the water and in the lake sediments. The balance betwen plant and animal life is an enormously complex subject; it should point out that only that in oligotrophic (nutrient-poor) lakes, the relationship appears to be nearly ideally balanced, little waste occurs, and little organic sediment accumulates in the lake basin. As eutrophication proceeds, the balance becomes less and less favourable; an ever-increasing proportion of the primary production (algae) is not utilized as food for the animal populations, consequently is sedimented out of the water to form organic mud in the lake basins. The bacterial processes invoved in degrading and recycling these plant material undergo important changes that relate to the concentration of oxygen and redox conditions in the water and in the sediments.

It should also be noted that nutrient regimes, whether originating in the watershed or in the sediments, are affected by density differences in the water and caused by temperature, chemical solutions, or both. Sunfish Lake is meromictic, one of those lakes in which the water is density stratified, seasonally through changes in temperature, and more permanently by solution gradients. Thus three layers are formed, an epilimnion of warm surface waters, overlying a cold hypolimnion. Mixing of the two upper layers occurs when temperature differences are obliterated, seasonally, but the monimolimnetic waters with their high nutrient content cannot be brought to the surface while chemical stratification persists. Since all algal growth is limited to surface waters by light requirements, it is clear that while meromixis persists, regulation of nutrient input from the watershed is of paramount importance. There is now conclusive evidence

that a tenuous meromixis has existed in Sunfish Lake for nearly a thousand years, although possibly partially broken down on exceptional years. This chemical stability over decades may be rather low, and can be upset by sudden change in nutrient loading from the watershed or by the introduction of fine silts such as arise from erosion or other physical disturbance of the geological substrate.

During the five years of Brown's studies and in comparison with the data from the studies of Dr. Duthie and his collaborators at an earlier time, there is no scientific evidence of serious disturbance or deterioration (within the limits of normal yearly variation) in the lake over that period of time.

5.0 DESCRIPTION OF IMPACTS AND MITIGATORY MEASURES

As indicated previously, the environmentally sensitive area is both contiguous to and included within the Sunfish Lake Settlement Area. The possible impacts that the proposed development on the four lots may have on the sensitive area and associated system without the implementation of proper guidelines, are related to:

1. The direct discharge of sediment-laden run-off from active construction activities into the sensitive area.

2. The removal and disturbance of rare and regionally significant vegetation.

3. The increase of seepage of effuluent from waste disposal facilities.

4. The effect of human activity and nutrient loading on the eutrophication of the lake.

In the ensuing sub sections, these potential impacts will be examined in some detail, and mitigatory measures aimed at alleviation or substantial reduction of the anticipated impacts are suggested.

5.1 SEDIMENTATION

As the settlement area exists today it is unlikely that large amounts of suspended sediment can enter the pond. However, with the possibility of new development (4 lots) and redevelopment on some existing lots, any removal of vegetation, topsoil stripping and stockpiles, site filling etc., may increase the capability of surface water runoff, if proper measures are not taken, to pick up and transport suspended solids into the lake resulting in the following:

1. An increase in turbidity in the lake and a subsequent reduction of light penetration with resultant decrease in photosynthetic activity, a reduction in the rate of photochemical reactions, a reduction in the feeding rate of visual feeders and an overall reduction in the feeding rate of visual feeders and an overall reduction in predation;

2. Increased abrasive action of suspended solids on sensitive organisms;

3. Clogging of filter-feeding apparatus of planktonic and benthic animals;

4. Sediment dispersion and fall-out resulting in smothering of benthic organisms;

5. Changes in water quality due to the release of absorbed chemicals from suspended particles;

6. Overall, accelerated eutrophication of the lake and degradation of the existing environment.

MITIGATORY MEASURES

To prevent sediment laden runoff from stripping and construction operations from entering the lake, it is recommended that a sediment pond be built by contructing an earth berm at the front of the lake to impound runoff by utilizing the natural topographic features of the area. This pond would impound surface runoff, and promote soil infiltration in this area, thus abating any problems associated with sedimentation of the water body. Therefore, the surface drainage from the active construction area would be channelled to this catchment area.

Other methods recommended are:

1. To restrict the extent of area of construction, as much as possible.

2. To erect a snow fence along the sides of the construction area in order to limit further ground disturbance.

3. To seed the area with native stock and existing vegetation (white cedar, white pine, balsam poplar) immediately after construction has been completed.

4. To setback any permanent buildings as far as possible from the water's edge.

5.2 SEWAGE FROM WASTE DISPOSAL FACILITIES

With four (4) lots requiring facilities for waste disposal, it is possible without proper measures being implemented that an inadequately designed system could result in the following:

1. An increase in biological contamination of the lake resulting in a deterioration of water quality.

2. Pollution of wells used for domestic water

3. Improper functioning of associated tile fields resulting in ponding/seepage of effluent on lots and unsanitary conditions generally.

MITIGATORY MEASURES

To prevent pollution of the water table, the lake and lots in general, it is recommended that sewage disposal be provided by:

1. Septic tank and tile field or

2. Aerobic system and tile field

A discussion on these systems is presented in Appendix D. It is also recommended that prior to selection of a method of sewage disposal that an evaluation be carried out by a professional engineer after obtaining information on:

(a) Depth of water table
(b) Soil types above the water table
(c) Percolation tests
(d) Evaluation of the design flows,

and that the requirements of the Regional Health Unit be complied with.

Whilst the Regional Health Unit lay down certain minimum requirements, we would suggest that all tile fields be located to the rear of houses (houses fronting on the lake) to minimize any pollution problems that may occur.

5.3 REMOVAL OF VEGETATION

There appears to be no major problems with the development or change in existing land use on the Guy Hearn and Wilson properties and within certain defined areas of the Beynon lot. No rare or regionally significant plant species were observed on these areas. However development outside of the defined building envelope of the Beynon lot (Figure 5) could have an impact upon the natural vegetation cover, if proper measures are not undertaken.

At present, the Beynon Property is heavily forested and comprises one of the only portions around Sunfish Lake where development is nil. Under the Regional Official Policies Plan, the area is a small but dense and sheltered protected remnant of high quality. It may be considered under criterion B to be of regional significance only. There is no recent evidence that the Winter Wren or Hawk were noted on the site. Within a very small area, the Beynon property fulfils the regional criteria of diversity of habitats, (lakeshore, coniferous forest, and water recharge area). The micro-climate (cool and humid) and variety of habitats have produced a diverse flora. Too little of this type of flora now remains in the region, with the extensive loss of such woods around both Sunfish and Paradise Lakes. As noted, the woods at both lakes were similar (Montgomery 1945). In their priority ranking of E.S.A.'s in the Region of Waterloo, Francis et al. (1979,69), ranked Paradise Lake by several scoring methods as one of the top six E.S.A.'s of fifteen sampled in the region. By the scoring of Sargent et al. (as used by Francis et al.), the raw score and rank of Paradise Lake were the highest.

MITIGATORY MEASURES

No detailed measures are required for the Guy, Hearn and Wilson properties, except that any existing vegetation cover should be preserved and incorporated with the cottage development.

For the Beynon property, it is recommended that development would be confined to the three areas defined in figure 5, namely building envelope, access and septic tile field. If one wishes to build beyond these defined areas, he or she must provide further environmental data to E.E.A.C. to prove that it will not affect the vegetation and/or natural environment.

The site plan for the Beynon lot has been prepared to address the specific concerns outlined in the Report on Sunfish Lake by Planning Initiatives. In particular the concerns were related to :

(i) Location of a building and building envelope

(ii) Site access

(iii) Location of sedimentation areas

(iv) Location of the tile field

Field work was carried out to obtain on site elevations in an area that would be suitable for building purposes. Altogether the survey covered an area of approximately 0.4 ha and reference points were located on site so as to relate this work to a future site visit to be conducted by Craig Campbell. The brief report on this site visit by Craig Campbell is attached as Appendix E and the site plan conforms to the specific requirements outlined therein.

1. LOCATION OF BUILDING AND BUILDING ENVELOPE

The optimum location for a building is on a low knoll where the tree cover on the site is minimal. The building envelope describes the maximum area required for construction of the building. However, it must be recognised that many trees are located in this area and a tree saving plan may be required to determine what trees may be retained.

Based on our study we would recommend that all permanent site works be constructed above elevation 31.00 m and that for this site, the finished floor level be 31.75 m minimum. Finally, it is our recommendation that no major change of grades occur outside of the building envelope and if necessary appropriate tree saving techniques may be required within this area to allow for drainage away from the building.

2. SITE ACCESS

An existing 9± m access right-of-way is located to the south west corner of the site. It is proposed to extend this access along its current alignment and then easterly to the proposed building. At present the proposed access is located in a clearing between the cedar trees and because of their existing condition, some of the trees may be removed on the westerly side if it is necessary to provide for a wider driveway or turnaround.

Construction of this access will require removal of topsoil etc. and shall be carried out in summer. The material obtained here may be used to build the temporary berm required for storm water detention and sedimentation. We would recommend that this access be constructed using granular B and granular A, and the actual thickness to be determined when the soil investigation is carried out.

3. LOCATION OF SEDIMENTATION AREA

With reference to the attached Site Plan of the Beynon Lot, the temporary berm to retain storm water runoff and allow sedimentation is constructed for the main part between two survey bars as this line is relatively clear. Thereafter it would meander between the trees and terminate at an elevation of 31.40 m.

A filtered outlet consisting of straw bales covered with gravel would be located at the lowest point to allow for the area to drain. It is anticipated that in addition to water outletting from this area, that percolation and infiltration would contribute to reducing these outflows.

4. LOCATION OF TILE FIELD

The most appropriate location for the proposed sewage disposal tile field is as shown on the attached drawing. The actual size would be determined after the results of the soil investigation, and domestic waste would be pumped via a force main located in the driveway (depth 1.5 m min.) to a small sewage treatment plant to be located adjacent to the tile field. As an alternate it is possible to locate this plant closer to the building and within the building envelope and pump the effluent to the tile field.

By confining the building activity to the defined area, it is anticipated that it will have minimal effect on the vegetation species (refer to Appendix E).

5.4 CONTROL OF EUTROPHICATION

Three factors that are considered essential to the control of eutrophication in Sunfish Lake are (1) the maintenance of meromixis, (2) the control (preferably reduction) of nutrient loading, and (3) the regulation of human impact.

MITIGATORY MEASURES

Clearly, any disturbance of the mature terrestrial vegetation in the watershed should be avoided in order to prevent erosion and maintain protection from the wind. (Wind provides the energy that brings about mixing of the water strata previously referred to). Only in this way can the delicate meromictic stability be maintained or enhanced. Road building, excavation for new dwellings or any major disturbance of soil substrates could have serious deleterious effects. However, in this case, no new roads are to be constructed and secondly, the

existing private road will not be widened and / or reconstructed to meet the normal municipal standards. The private roads will remain and only driveways from it to new proposed cottages on the four vacant lots would be built.

Nutrient loading requires careful attention and control. Extensive seasonal algal blooms now exist, that include some undesirable species relative to the balance between plant and animal populations (phytoplankton - zooplankton). Nutrient enrichment favours the undesirable species - the limnological weeds, characterized by their remarkable nutrient uptake kinetics - at the same time increasing organic waste because these species are not extensively utilized by the grazing zooplankton. Efficient septic systems are especially important in nutrient control. The harvesting of aquatic macrophytes is a very progressive step in diminishing the recycling of nutrient elements from that source. The meromictic stability can be lost through development of heavy algal blooms such as may result from excessive nutrient availability.

The human impact is slightly more difficult to deal with because of its complexity. Increased human density is probably one of its most obvious features. Certainly the proposal to restrict subdivision of existing lots is most desirable, and the building on three vacant lots (fronting onto the lake) would not seem unreasonable given proper attention to advanced septic systems and careful regard for vegetational losses and erosion through soil disturbance. The balance between environmental and economic advantage is often a thorny problem to assess. In the case of the Cottage-owners' Association, and indeed for the municipality in general, it is an important one. If one oversteps the environmental limits, and these appear to be in critical balance, one stands to lose heavily on the economic and esthetic side. The proposal to encourage only seasonal occupancy would tend to reduce human impact.

6.0 CONCLUSIONS AND RECOMMENDATIONS

It is our contention that development of the four lots or redevlopment of existing lots will not seriously affect or threaten the well being of the environmentally Sensitive Area No. 10 Sunfish Lake. Secondly, the implementation of the mitigatory measures as outlined in this report will ensure the continued vitality of the sensitive area. The following provides a list of the study conclusions:

1. According to studies undertaken by Dr. S. R. Brown during the past five years, he concludes that there is no scientific evidence of serious disturbance or deterioration (within the limits of normal yearly variation) in the lake over that period of time.

2. Dr. S. R. Brown also states in his report on Sunfish Lake that to restrict subdivision of existing lots is most desirable and that the building on these four vacant lots would not seem unreasonable given proper attention to proper septic systems and careful regard for vegetational loss and erosion through soil disturbance.

3. No rare or regionally significant plant species were observed on the Guy, Hearn, and Wilson properties. Provided that the guidelines and measures outlined in this report are followed and implemented, no major problem is envisaged in the construction of a cottage on these lots.

Some significant plant species, located in specific areas, were noted on the Beynon property. Investigations undertaken by C. Campbell and R. Shaw, P. Eng. of Frances-Nicholas Ltd. reveal and confirm that it is possible to locate a cottage that can be sited so that it minimizes the affects on the plant species. A site plan, as prepared by Frances-Nicholas Ltd., illustrates areas where site development (access driveway, cottage, septic tank tile filed) can be permitted. Any development beyond these defined areas would require the applicant to prepare and present additional environmental data to E.E.A.C. for their review and approval.

4. The Sunfish Lake Residents' Association and its administrators made up of well-informed, concerned and responsible populace has through the years implemented certain management practices to protect the quality of the lake. These include the yearly macrophyte harvesting program started in 1979, the banning of motor boats on the lake, the controlling of use of certain fertilizers for the lawns and the controlling of certain pesticides entering the lake. It is anticipated that the residents will continue to use the management policies and practices recommended by this report and Dr. S. R. Brown, in order to maintain the character of the lake.

5. The designation of the Sunfish Lake area as a Site Plan Control Area in accordance with Section 40 of the Planning Act will sufficiently control and regulate the development and/or redevelopment of the four vacant properties and existing lots.

As part of the implementation process, a consistent set of guidelines for development/redevelopment should be implemented and they should include the preparation of site and grade control plans, the investigations related to water, soil and sewage disposal and methods to control sedimentation; and they are detailed as follows:

A. SITE PLAN

The purpose of a site plan is to show the significant features existing on the lot to be developed, the adjacent lots and the development proposals viz;

1. Existing Contours
2. Existing cluster of trees, vegetation, swamps, etc.
3. Borehole/Test pit locations
4. Existing Drainage
5. Location of adjacent houses, tile fields, well, etc.
6. Location of proposed house, tile fields, well, sedimentation areas, berms, etc.
7. Trees to be removed

8. Limit of area to be disturbed by construction. (snowfencing around its perimeter)

B. GRADE CONTROL PLAN

The purpose of the plan is to show how the proposed development will function as it relates to all existing contours, natural features, drainage and proposed ground surface elevations. Specific details showing how tree saving and site filling should be addressed.

1. Existing Contours

2. Proposed site grading and drainage showing ground surface elevations at all charges of grade, embankments, etc.

3. Finished floor levels (ground floor only)

4. Areas to be reseeded with native stock. Reseeding will take place concurrently with the completion of sedimentation pond, berming and general construction activities.

C. SOIL INVESTIGATION REPORT

The purpose of this report is two fold, firstly to evaluate the capability of the soils to support sewage disposal by tile field, and secondly to determine the adequacy of the subsoils as regards supporting the proposed buildings.

1. Soil Types and depths

2. Water Table elevations

3. N-values

4. Percolation tests

5. Design requirements for sewage disposal facilities

6. Foundation design parameters.

D. WATER SUPPLY

An evaluation is necessary to determine the source of water (wells or lake), and its quantity and quality.

E. SEWAGE DISPOSAL

Each site is unique and the method of sewage disposal will to a great extent depend on the results of the soil report.

1. Location of sewage disposal facilities

2. Selection of method/system

3. Determination of size of septic tank

4. Design of tile field

F. SEDIMENTATION POND/AREA

During the site work and building construction activity, mitigative measures are required to minimize potential impacts on the lake and these include:

1. The design of retention/detention storage area,

2. The design of berms,

3. The design of filtered outlet.

appendices

APPENDIX A

SUNFISH LAKE SURVEY

REQUESTED BY: The Sunfish Lake Property Owner's Association
Mr. J. G. Hutchison (885-5323)

DATE CONDUCTED: August 21, 22, 25 & 26, 1980

SURVEY CONDUCTED BY: Deo Nanakdewa (Student P.H.I.)

SURVEY RESULT CHECKED BY: Mr. John Yan, Public Health Inspector
Waterloo Regional Health Unit

PURPOSE OF SURVEY:

1) To determine if there is any sewage pollution discharged into the lake

2) To determine if the water supply to the cottages is acceptable according to the drinking water standard

METHOD OF SURVEY:

1) To record types of sewage disposal systems; to use dye test techniques; to detect any malfunctioning systems

2) To obtain water sample for bacteriological analysis.

FINDINGS:

There were 14 septic tank and tile bed systems, 2 pit privies, 1 humus toilet, 1 electric toilet, 1 Aquarobic system all were teste by flourescein green dye and none of the above showed positive result

The holding tank for Canada Trust Company's cottage was said to be 700 gallons only. If this information is true then this system is undersized and does not meet the M.O.E. requirements.

The 14 septic tank and tile bed systems were installed over 10 years ago; four of them had to use a pump to feed the sewage to the uphill tile bed.

WATER SUPPLY:

There were 19 water samples taken from the cottages (see attach table) Four samples were unsatisfactory for drinking; 14 lake water samples piped into the cottages were satisfactory for drinking except 1 sample which had a coliform count of 10.

.../2

DISCUSSION:

From the result of the water test of lake water and dye test there was no evidence of sewage discharge into the lake and other water courses. Some sewage system such as the holding tank is undersized according to M.O.E. standards, however the cottage owner stated that it will be brought up to standard within the near future. Because of the occasional use of the septic system, no problem has occurred so far. The most recent installation of a Class 4 and a Class 6 system took place 5 years ago.

RECOMMENDATION:

The four cottages which have poor water results should be notified not to drink the water unless it is boiled or chlorinated. These four cottages are Canada Trust, T. Reidel, E. Staebler and I. Weber.

There should be no action taken against the owner of any sewage system at this time until the owner make new application or where there is evidence of sewage malfunctioning.

John Yan

WATER SUPPLY

NAME	Source of Drinking Water	Lake water Used ?	Counts Total	Counts Faecal	Commer
W. Henderson	City	Yes	<2	0	
Canada Trust	City	Yes	14	0	
D. Meyer	Lake-filtered	Yes	<2	0	
T. Pernfuss	Dug Well(filtered	No	<2	0	
T. Reidel	City	Yes	16	10	
L. Hemmerich	Dug Well (filtered	No	<2	0	
C. Winters	Lake-filtered	Yes	<2	0	
N. Lackner	City	Yes			
A. Shields	Lake-filtered	Yes	<2	0	
J. Carlisle	City	Yes	<2	0	
E. Hymmen	City	Yes	<2	0	
A. Vandepol	Dug well	No	<2	0	
E. Playford	Dug well	No	<2	0	
E. Staebler	Dug well	No	160	0	
M. Robinson	Not known		<2	0	
E Dietz	City	Yes	<2	0	
I. Weber	Dug well	No	30	0	
Hudgins	City	Yes	<2	0	
J. Hutchison	Lake-filtered	Yes	<2	0	
			<2	0	

NOTE: Where city water is used as the source of drinking water, the cou
shown are from samples of the lake water pumped into thecottage.

SUMMARY:

DUG WELLS

No. of Dug Wells	Filtered	Unfiltered	Satisfactory	(Unfiltered) Unsatisfactor
6	2	4	4	2

SANITARY SYSTEM

APPENDIX B

NAME	TYPE OF SYSTEM	DYE TEST POS./NEG.	COMMENTS
W. Henderson	Septic Tank	Neg.	
Canada Trust	Holding Tank	Neg.	
D. Meyer	Aquarobic System	Neg.	
T. Pernfuss	Septic Tank	Neg.	
T. Reidel	Septic Tank	Neg.	
L. Hemmerich	Septic Tank	Neg.	
C. Winters	Septic Tank	Neg.	
N. Lackner	Septic Tank	Neg.	
A. Shields	Septic Tank	Neg.	
I. Carlisle	Electric Toilet	-	
E. Hymmen	Septic Tank	Neg.	
A. Vandepol	Septic Tank	Neg.	
E. Playford	Septic Tank	Neg.	
E. Staebler	Septic Tank	Neg.	
M. Robinson	Septic Tank	Neg.	
E. Dietz	Pit Privy	Neg.	
I. Weber	Septic Tank	Neg.	
Hudgins	Humas Toilet/ Pit Privy	Neg.	
J. Hutchison	Septic Tank/Pump	Neg.	

SUMMARY

Septic Tanks	14
Pit Privy	2
Humas Toilet	1
Electric Toilet	1
Aquarobic System	1
Holding Tank	1

APPENDIX C

DEPARTMENT OF BIOLOGY

Queen's University
Kingston, Canada
K7L 3N6

The Sunfish Lake Cottage-owners Association,
Attn: Mr. J. Hutcheson
293 Longfellow Drive,
Waterloo, Ontario

January 13, 1982

Ladies and Gentlemen,

Mr. Hutcheson has asked me to provide a brief statement about our limnological studies on Sunfish Lake and to give a professional opinion on how proposals which you are now considering may relate to the future ecological integrity of the lake.

A carefully integrated series of studies on Sunfish Lake have been conducted under my direction over the past five years. They are designed to investigate the current limnological status of the lake as part of a program that explores its paleolimnological development (using sedimentary fossils) since the last Ice Age, 12,000^{+} years ago. Three B.Sc. theses have been completed and a fourth will be finished in April. 1982. These deal with the current status of phytoplankton, zooplankton, benthic and fish populations, focusing primarily on the balance between primary and secondary productivity. One M.Sc. thesis, to be completed this summer, deals with algal and bacterial changes in relation to inferred water chemistry throughout the entire history of the lake. One Ph.D. thesis, also to be completed this summer, compares the paleolimnology of Sunfish Lake to that of two other lakes in Ontario, emphasizing emphasizing physical, chemical, and biological relationships. We have also presented a number of scientific papers on specific aspects of the biology of Sunfish Lake at international congresses in Canada, the U.S.A., Germany, and Finland.

My initial interest in Sunfish Lake was stimulated by the earlier and excellent studies by Dr. Hamish Duthie, his colleagues and students at the University of Waterloo. There is some overlap in our studies with those of the Waterloo group for comparative purposes, but in the main they diverge or provide parallels.

Two features of the lake are of unique limnological interest. It is one of the oldest small lakes in Canada, having been formed or uncovered in the early retreat of the Wisconsin Ice Sheet during the last deglaciation. Its history is superbly recorded by fossils in its sediments. This chronological record is of great significance in providing insights into the long-tern dynamics of lake ecosystems and the formulation of management policies that protect our water resources. Secondly, the lake is of limnological interest in the mere fact that it continues to exist. Many lakes of this age and size have progressed through trophic stages into

oblivion; from mature lakes into stagnant ponds, then marshes, bogs, and finally into wetlands. In fact, this is the classical concept of the developmental history of lakes, although obviously not always correct. The important questions are what factors have contributed to the maintenance of Sunfish Lake at or near its present trophic state, and what are its future prospects? These questions are central to my scientific interests, and certainly relate to the interests of your Cottagers' Association. They are also basic to any program that considers and concerns the future of Sunfish Lake and its environs.

Trophic development of lakes depends largely upon two factors, nutrient loading and the balance between primary and secondary productivity (plant vs. animal life). Nutrient loading, in turn, depends on runoff from the watershed and recycling of nutrients from the lake sediments. Phosphorus and nitrogen compounds are identified primarily, but cannot be regarded exclusively. Runoff is greatly influenced by changes in vegetation within the watershed, erosion, geological substrate, and probably most of all by human impact - itself a feedback cycle. Recycling of nutrients is regulated by the animal community and very importantly by degradation of organic materials by bacteria both in the water and in the lake sediments. The balance between plant and animal life is an enormously complex subject; so, for the moment, I shall point out only that in oligotrophic (nutrient-poor) lakes the relationship appears to be nearly ideally balanced, little waste occurs, and little organic sediment accumulates in the lake basin. As eutrophication proceeds, the balance becomes less and less favourable; an ever-increasing proportion of the primary production (algae) is not utilized as food for the animal populations, consequently is sedimented out of the water to form organic mud in the lake basins. The bacterial processes involved in degrading and recycling these plant materials undergo important changes that relate to the concentration of oxygen and redox conditions in the water and in the sediments.

It should also be noted that nutrient regimes, whether originating in the watershed or in the sediments, are affected by density differences in the water and caused by temperature, chemical solutions, or both. Sunfish Lake is meromictic, one of those lakes in which the water is density stratified, seasonally through changes in temperature, and more permanently by solution gradients. Thus three layers are formed, an epilimnion of warm surface waters, overlying a cold hypolimnion and beneath which is the chemically stratified monimolimnion. Mixing of the two upper layers occurs when temperature differences are obliterated, seasonally, but the monimolimnetic waters with their high nutrient content cannot be brought to the surface while chemical stratification persists. Since all algal growth is limited to surface waters by light requirements, it is clear that while meromixis persists, regulation of nutrient input from the watershed is of paramount importance. There is now conclusive evidence that a tenuous meromixis has existed in Sunfish Lake for nearly a thousand years, although possibly partially broken down on exceptional years. This chemical stability over decades may be rather low, and can be upset by sudden change in nutrient loading from the watershed or by the introduction of fine silts such as arise from erosion or other physical disturbance of the geological substrate.

With this background I will now comment on your proposals.

(1) Seasonal dwellings
(2) No change in private road system
(3) No further subdivision of lots
(4) Development of three presently vacant lots
(5) Replacement of present cottages by new ones, when required
(6) Macrophyte harvesting for reduction of nutrient input

I have emphasized three factors which I consider essential to the control of eutrophication in Sunfish Lake:

(1) Maintenance of meromixis
(2) Control (preferably reduction) of nutrient loading
(3) Regulation of human impact

Clearly, any disturbance of the mature terrestrial vegetation in the watershed should be avoided in order to prevent erosion and maintain protection from the wind. (Wind provides the energy that brings about mixing of the water strata previously referred to). Only in this way can the delicate meromictic stability be maintained or enhanced. Road building, excavation for new dwellings, or any major disturbance of soil substrates could have serious deleterious effects. Thus your proposals 2 and 3 are exceedingly well taken. If meromixis is lost it is most unlikely that it can be regained under the pressures of human impact that now exist.

Nutrient loading requires careful attention and control. You now have extensive seasonal algal blooms that include some undesirable species relative to the balance between plant and animal populations (phytoplankton - zooplankton). Nutrient enrichment favours the undesirable species - the limnological weeds, characterized by their remarkable nutrient uptake kinetics - at the same time increasing organic waste because these species are not extensively utilized by the grazing zooplankton. Efficient septic systems are especially important in nutrient control. Your harvesting of aquatic macrophytes is a very progressive step in diminishing the recycling of nutrient elements from that source. I shall not elaborate on the subject at this time other than to point out that meromictic stability can be lost through development of heavy algal blooms such as may result from excessive nutrient availability.

The human impact is slightly more difficult to deal with because of its complexity. Increased human density is probably one of its most obvious features. Certainly your proposal to restrict subdivision of existing lots is most desirable, and the building on three vacant lots would not seem unreasonable given proper attention to advanced septic systems and careful regard for vegetational loss and erosion through soil disturbance. The balance between environmental and economic advantage is often a thorny problem to assess. In the case of the Cottage-owners' Association, and indeed for the municipality in general, it is an important one. If you overstep the environmental limits, and these appear to be in critical balance, you stand to lose heavily on the economic and esthetic side. Your proposal to encourage only seasonal occupancy would tend to reduce human impact, but I do not have the expertise to assess its significance.

Two important factors operate in your favour; your community and its administrators is made up of a well-informed, concerned and responsible populace prepared for dispassionate consideration of the factors involved; and the future of the lake, as the focal point of the community, can be assured for decades to come if you institute vigilant and informed management policies. Fortunately I can end this brief report on an encouraging note. During the five years of our studies and in comparison with the data from the studies of Dr. Duthie and his collaborators at an earlier time, there is no scientific evidence of serious disturbance or deterioration (within the limits of normal yearly variation) in the lake over that period of time. Hopefully, when our present studies are completed this coming summer, the data wll confirm this preliminary assessment. In this statement I refer to the final details of our sediment core analyses which, I believe, will provide the most conclusive evidence of our study. We have completed the primary scan of the core, identifying major changes, but at least another two months' work is required to fill in details of oscillations in the populations of photosynthetic bacteria. These appear to play an exceptionally prominent part in the metabolism of Sunfish Lake. This factor has not been recognized in contemporary studies, but the evidence from Sunfish Lake is very convincing, not just to my research colleagues here but to members of the international scientific community with whom we have discussed it.

I would like to express my thanks and that of my students to the various cottagers whose interest in our studies was always a source of encouragement; for helpful co-operation and participation; for the support of the Vandepols through their generous hospitality. We owe an immense debt to the Hutchesons for their genial friendship, their gracious hospitality, and accommodation in every aspect of our needs during the conduct of the field studies.

I wish you well in your deliberations and am confident that your enlightened approach to the management of this sensitive but charming centrepiece of the community will meet with success. It would appear that the Kitchener-Waterloo region is establishing a model that other Canadian communities should emulate.

Yours sincerely,

S. R. Brown
Professor,
Department of Biology

SRB/s.

APPENDIX D

SANITARY SEWAGE DISPOSAL

It is proposed that four (4) seasonal dwellings will eventually be built adjacent to the lake and sewage disposal will be by:

i) Septic Tank and Tile field or

ii) Aerobic type system and Tile field

SEPTIC TANK AND TILE FIELD

The purpose of a septic tank is to seperate the solids that cannot be absorbed by the soil in the field, and whilst some bacterial action takes place by breaking down some of the solid waste, the effluent remains essentially untreated. The septic tank therefore retains all insoluable matter including sludge and scum which must be removed periodically.

The effluent leaving the septic tank is the distributed via open jointed pipes in trenches so that the liquid can infiltrate into the soil where further bacterial action occurs to purify the effluent so that the ground water is not polluted.

AEROBIC TYPE SYSTEMS

There are many situations that occur that may render the previous sewage disposal method unsuitable such as

1) Available land area
2) Soil types and thichness
3) Location of water,ponds and lakes
4) Poor drainage

and in instances such as these, it become necessary to carry

out some treatment of the sewage prior to distribution and absorption into the soil.

These Aerobic type system of which there are a number, aerate the sewage and then provides aerobic micro-organisims with a constant supply of oxygen necessary to support the biological activity which purifies the sewage. The effect of this therefore is to reduce the size of the tile field necessary and produce a much higher quality effluent in a short time frame. Three such systems are reviewed hereunder.

	Reductions				
Trade Name	S.S.	BoD	Tile Field	Overload	Capacity gpd
Rotodisc S.5.	90%-95%	?	67	25-400%	500
Aquarobic M480	84%	91%	67	?	690
N.P.S. C.A.5	85%	85%	67	140%	380

All above systems operate on 110v and additional equipment such as chlorinators are optional.

APPENDIX E

SITE INVESTIGATION - Beynon Property, Sunfish Lake, Wilmot Township, Waterloo Region.

Based on the concerns expressed by the members of the Ecological and Environmental Advisory Committee at their meeting of January 13, 1982 and the summary statement of C. Campbell dated February 12, 1982, a field reconnaissance on March 19, 1982 by Campbell and D. Coulson, and R. Shaw of Frances Nicholas Ltd. indicated the possibility of a building envelope or site on a portion of the aforesaid property.

This site would probably be best situated in terms of ground contours and vegetative cover. The building(s) might be best situated on a low knoll west of flagged point 5 and south-west of flagged points 9 and 10 and south-east of flagged point 6, as delineated by Shaw et al. It was the consensus of Shaw and Campbell that a tile-bed might best be located north-west of this proposed building site, in an existing clearing (approximately 12 x 12 m), lying adjacent to the present path as right-of-way. Access to the building site from this right-of-way might best be achieved by creating a new access veering past the proposed tile-bed toward flag point 9. This route might prove less destructive of existing vegetation than a more southerly route.

At the proposed building site itself, vegetation consists of numerous dead and dying White Cedar (12±m in height; some dead for lower three-quarters of trees, and others leaning or toppled). To the north-west of the proposed building site, the forest becomes more dense and representative of Larch-White Cedar bog with associated rare plants, such as Queen Lady's-Slipper. To the south-east there is good mature growth, of medium density and age, of Yellow Birch, Eastern Hemlock, White Pine and White (Paper) Birch, representative of northern Transitional forest.

With the present proposal, some trimming of one or more rows of White Cedar (most of which are not healthy) will probably be necessary to create the preferred access road. At approximately flag point 18, if a tile bed were sited here, and cutting of healthy dense stands of White Cedar deemed necessary, a planted row(s) of such a tree as Balsam Poplar might mitigate stress to the cedar stand.

In situating any building(s) at the proposed location, the destruction of excellent specimen trees of White Pine and aspen(sp.) would have to be carefully considered, along with any damage to vigorous young White Cedar growth. During the spring and summer growing season, a reconnaissance for any rare ground plants should be undertaken before building commences. These could then be relocated.

APPENDIX F

FLORAL/FLORISTIC AFFINITIES OF VEGETATION ON BEYNON PROPERTY: September, 1981

fide Montgomery(1945) Transcontinental	fide Scoggan(1966;1978-79) Great Lakes - St. Lawrence (section Huron-Ontario)	fide McKay & Catling(1979) Mixed
Creeping Snowberry	Alder-leaved Buckthorn	Bunchberry
Goldthread	Canada Yew	Canada Mayflower
Larch	Chokecherry	Canada Yew
Kidney-leaved Violet	Eastern Hemlock	Chokecherry
Trembling Aspen	Red Maple	Common Elder
Twinflower	White Ash	Eastern Hemlock
	White Cedar	Mountain Maple
Transitional	Wild Raisin	Red Maple
Canada Yew	Yellow Birch	Starflower
Eastern Hemlock		Trembling Aspen
Red Maple	Boreal	Twinflower
White Ash	Bunchberry	White Ash
White Pine	Canada Mayflower	White Cedar
Yellow Birch	Corn-lily or Bluebead	White Pine
	Creeping Snowberry	Yellow Birch
fide Montgomery(1944)	Goldthread	
Glacial Bog Flora	Larch	Boreal
	Liver-leaf Pyrola	Corn-lily or Bluebead
Marsh Fern	Mountain Maple	Goldthread
Naked Miterwort	Naked Miterwort	Kidney-leaved Violet
Red-osier Dogwood	Pinesap	Liver-leaf Pyrola
Starflower	Red-osier Dogwood	Naked Miterwort
White Cedar	Trembling Aspen	Velvet-leaf Blueberry
	Twinflower	
	Velvet-leaf Blueberry	
	Water-hemlock	

RARE/SIGNIFICANT PLANTS ON BEYNON PROPERTY: September 1981

5 STATIONS OR FEWER IN REGIONAL MUNICIPALITY OF WATERLOO (University of Waterloo Computer Listing, 1976)

Aster puniceus	
Chrysosplenium americanum	
Cicuta bulbifera	
Cypripedium reginae	(in Appendix 2 of CITES, 1978)*
Gaultheria hispidula	
Geum macrophyllum	(2)**
Linnaea borealis	
Pyrola asarifolia	
Solidago patula	(2)** (listed by Argus & White, 1977)***
Solidago rugosa	(2)**
Vaccinium myrtilloides	(2)**
Viburnum cassinoides	
Monotropa hypopithys	(some on Wilson Property)

Total of 12 (13) species

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*Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) - Appendix II includes (a) all species which, although not necessarily now threatened with extinction, may become so unless trade in specimens of such species is subject to strict regulation and (b) other species which must be subject to regulation in order that trade in specimens of certain species referred to in (a) may be brought under effective control

**refers to the number of known stations within the region

***listed as a rare vascular plant in Ontario

Although suitable habitat in many cases exists on the sites, no evidence of nine species recorded in the Regional Data Sheets (1978) was found. These species are:

Astragalus sp.	milk-vetch
Corallorhiza striata Chatelin	Striped Coral-root
Corallorhiza trifida Lindl.	Early Coral-root
Cypripedium acaule Ait.	Stemless Lady's-slipper or Moccasin Flower
Dalibarda repens L.	False Violet
Lycopodium annotinum L.	Stiff or Bristly Clubmoss
Ophioglossum vulgatum L.	(formerly) Common Adders-tongue
Viola incognita Brainerd	White Violet
Viola selkirkii Pursh	Selkirk's Violet